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Aeronautical and Aerospace Sciences (*No Abstracts Submitted*)

Agriculture, Forestry and Aquaculture Science

EFFECT OF VARIATION IN MILKING METHOD, TEAT MEASUREMENTS, AND DAY OF LACTATION ON SOW MILK COMPOSITION AND YIELD. C. H. Aardema, B. L. Williams*, A. S. Garst* and F. C. Gwazdauskas. Dept. Dairy Sci., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061-0315. Milking methods were investigated to determine effects on porcine milk composition and yield. Sows were induced to letdown milk with exogenous oxytocin and milked by machine with: pulsation rates of 60 (50:50 milk:rest) and 150 (23:78) pulses/min, teat cup sizes of 12, 14, and 15 mm i.d., teat cups weights of 45, 70, 95, and 120 g, and piglet removal of 60 min or no removal prior to milking throughout lactation. Oxytocin resulted in a somatic cell count of 3.48×10^6 /ml milk for i.v. administration and 7.53×10^6 for i.m. injection. Protein increased from d 10 (3.5%) to d 40 (6.3%) and was highest for the first milking of the day (6.2%). A pulsation rate of 150 resulted in 29.5 ml milk per teat per milking, whereas 60 per min yielded 24.3 ml milk per teat per milking. A teat cup size of 15 mm led to the peak milk yield (28.9 ml). Teat cup weight affected milk yield with the highest yield from the 95 g cup (31.7 ml) while 45, 70, and 120 g cups yielded less (20.7, 26.6, and 28.6 ml). Yield was increased with removal of piglets for 1 h (31.5 ml) compared to no piglet removal (22.3 ml). Route of oxytocin administration affected milk yield with a higher yield for i.v. (34.4 ml per teat per milking) than for i.m. injection (19.4 ml). These results show that milk yield can be optimized by milking machine modifications and piglet removal.

SUSTAINABLE MANAGEMENT OF FOREST ECOSYSTEMS USING SYSTEM DYNAMICS MODELING. Samuel H. Austin, Forest Hydrologist, Virginia Department of Forestry, P.O. Box 3758, Charlottesville, Va. 22903. The forests of the earth are solar collectors. Energy from the sun is delayed by forests and transformed into richly diverse states of plant and animal (ecosystem) organization. No one has absolute knowledge of all forest processes. System dynamics modeling aids sustainable management of forest ecosystems by tracing the links, delays and feedback associations in these dynamic, non-linear, feedback systems. Embedded in the systems paradigm is the notion that complex, non-linear, dynamic systems may be effectively managed using relatively few controls. A model is presented that maps the future consequences of forest management decisions made using three silvicultural controls: rate of timber harvest, size of harvest opening, and choice of regenerated tree species. The model shows that forest management decisions are temporally and spatially interrelated, and that complex forest ecosystems may be effectively managed and sustained, or harmed, using various combinations of just three types of intervention.

BREED DIFFERENCES IN BREEDING SOUNDNESS EXAMINATION TESTS IN MEAT-TYPE MALE GOATS. Kori S. Baker and S. Wildeus, Agricultural Res. Station, Va. State Univ., Petersburg, Va. 23806. Breeding soundness examination standards, although common for bulls and rams, have not been well defined for the goat. This project evaluated scrotal circumference (SC), reaction time and ejaculate characteristics in bucks of the Myotonic (M), Nubian (N), Pygmy (P) and Spanish (S) breeds (n=5/breed). Reaction time was measured as the period bucks required to mount one of two estrus-induced ovariectomized does following entry into a test pen. Semen was collected via electroejaculation. Ejaculate volume, wave motion and individual motility were recorded and samples were stained (live/dead) and fixed (concentration/morphology) for further analysis. Data were analyzed using analysis of variance with breed as variable and age as covariate. Body weight (WT) and SC differed ($P < 0.05$) between breeds, ranging from 45.0 kg and 22.7 cm in S to 22.9 kg and 20.1 cm in P, respectively. In contrast, SC:WT ratio was higher ($P < 0.01$) in P (0.406) than in the other breeds (0.232-0.272). Reaction time was similar in M, P and S (20-26 sec), but N failed ($P < 0.01$) to mount within the allotted test time (5 min). There were no breed differences for % motile, live and normal spermatozoa and wave motion score. Breeds differed ($P < 0.05$) in ejaculate volume (0.74-1.10 ml), but not sperm concentration (0.43-1.37x10⁹/ml) and total sperm in ejaculate (0.48-1.53x10⁹). Age affected ($P < 0.05$) WT, SC, SC:WT, sperm concentration and total sperm in ejaculate. There were significant ($P < 0.05$) breed x age interactions for SC, ejaculate volume, sperm concentration and total sperm in ejaculate. These data indicate that the smaller mature body size of P was not associated with a proportionally smaller scrotal circumference measurement. Furthermore, breed and age effects need to be taken into consideration when developing breeding soundness examination standards for goats.

KENAF PRODUCTION IN VIRGINIA. Harbans L. Bhardwaj and M. Rangappa, Agricultural Research Station, Virginia State University, Petersburg, VA 23806 & C.L. Webber, III, USDA-ARS, Lane, OK 74555.

The United States imports two-third of its newsprint at an annual cost of about \$4.5 billion. Kenaf (*Hibiscus cannabinus* L.), a relative of cotton, okra, and hollyhock, can be turned into pulp for newsprint with lower energy and bleaching requirements than those for pine trees. The objective of kenaf research under the new crops program of Virginia State University is to evaluate feasibility of kenaf production in Virginia, determine yield potential, and develop alternative uses to sustain the crop until its use as a domestic source of pulp becomes established. The dry matter yields of 7 kenaf varieties during 1992, 1993, and 1994 varied from about 6 to 12 metric tons per hectare, respectively at 70 and 126 days after planting. This yield level compares favorably with yields reported from Mississippi, Texas and other Southern states. Possibility of multiple-harvests, desirable nutritional quality (crude protein content of about 15% at 70 days after planting), and satisfactory consumption of chopped kenaf plants by goats indicate suitability of kenaf as a forage for livestock. These results indicate that kenaf can be easily produced in Virginia. The use of kenaf as a summer forage for livestock also has considerable potential.

BROOMRAPE (OROBANCHE SPP.): BOTANICAL CURIOSITY OR THREAT TO VIRGINIA. Chester L. Foy, Dept. of Plant Pathol., Physiol. & Weed Sci., Va. Polytech. Inst. & State Univ., Blacksburg, VA 24061. Broomrapes are phanerogamic holoparasites which attack the roots of numerous broadleaved host plants, including major crops in the Solanaceae, Fabaceae, Compositae, and Umbelliferae families. Some species of broomrape produce showy flowers; others are less conspicuous. In northern and western Europe, *Orobanchae* spp. occur sparsely and are preserved as botanical curiosities. However, the genus is a devastating noxious weed in semi-arid and some temperate regions of the world. Three species, *O. ramosa*, *O. minor*, and *O. ludoviciana*, exist in the USA. Three of the most devastating species in the world, *O. aegyptiaca*, *O. ramosa*, and *O. crenata* have the potential to parasitize and cause severe yield loss in tomato, tobacco, peanut, alfalfa, and soybean. All means of control used against broomrape have limitations either in terms of effectiveness or expense. A four-year US AID trilateral (Egypt-Israel-USA) project titled Multipronged Approaches to Eliminating Crop Devastation by Parasitic Weeds is now in its second year. The project is divided into three approaches, agronomic, biocontrol, and biotechnological. Research at VPI & SU involves: testing nitrogen fertilizers and germination stimulants; analyzing enzymes, amino acids, and proteins in host plants and broomrapes; studying germination, haustorium formation, attachment, and early development of broomrape on various host and trap crops; and DNA fingerprinting of *O. minor* from Virginia, the Carolinas, and Georgia. Representative research highlights will be presented.

TRENDS IN RED MEAT SLAUGHTER IN THE US. T.A. Gipson, Agricultural Res. Station, Va. State Univ., Petersburg, VA 23806 and S. R. Rein, Dept. of Math. Sci., Va. Commonwealth Univ., Richmond, VA 23284-2014. Weekly slaughter data on cattle, hogs, sheep, goats and horses were obtained from the USDA National Agricultural Statistical Service and analyzed for time trends. The dataset covered the 15-year period of 1980 through 1994 and only for the aforementioned species slaughtered at federally inspected plants. Trends for the number of cattle, hogs, sheep and horses slaughtered at federally inspected slaughter facilities tend to be cyclical. In recent years, cattle and hog numbers seem to be increasing; however, sheep and horse numbers seem to be decreasing. The trend for the number of goats slaughtered at federally inspected slaughter facilities tends to be linear and increasing over this time period.

RESULTS OF A SURVEY OF VIRGINIA GOAT PRODUCERS. T.A. Gipson, Agricultural Res. Station, Va. State Univ., Petersburg, VA 23806. A survey was developed and distributed to goat producers in the commonwealth to establish a profile of the management practices of the different goat operations. A total of 66 goat producers responded to the survey. The number of producers owning a single breed of goats versus those who owned two or more breeds were nearly equal (52% vs. 48%, respectively). Nubians were the most popular breed with 45% of the respondents stating that they owned that breed. Second popular were Pygmies with 24% of the respondents owning this breed which is kept as pets and not for production purposes. The average herd size is small with 55% of the respondents owning fewer than 15 animals. Twenty-three percent (23%) owned 16 to 30 animals, 11% owned 31 to 50 animals, 3% owned 51-100 animals and 8% had more than 100 animals in their herd. Goat producers are long on experience with 37% responding that they have owned goats for more than ten years. Twenty-three percent (24%) have owned goats for between six and ten years, 21% owned goats for between three and five years and 18% had owned goats less than three years. The vast majority (76%) of goat producers are not full-time farmers and keep goats or other livestock as a sideline. Twenty-six percent (26%) of the respondents stated that they only kept goats. Among those that kept other livestock besides goats, poultry was the most popular with 35% of the respondents. Cattle were second at 27%. Twenty-three percent (23%) of the respondents also raised horses or sheep and 5% raised rabbits or swine. Of the goat producer that did raise other livestock, 74% co-grazed their goats with the other livestock. Woven wire fencing was the most popular type of fencing used by goat producers with 62% of the respondents using it. Second was high tensile electric or simpler electric fencing used (38%). Barbed wire was used by only 8% of the producers. Goat producers in the commonwealth utilize many different management practices.

PERIPARTURIENT RISE IN FECAL EGG COUNTS IN GOATS. T.A. Gipson, Agricultural Res. Station, Va. State Univ., Petersburg, VA 23806 and A. M. Zajac*, VA-MD Regional Col. of Veterinary Medicine, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Increased pasture contamination by parasitic nematode eggs associated with parturition is an important management consideration in the control of gastrointestinal parasites in sheep. It has not been well established if goats also have a corresponding rise in nematode egg output at or near kidding, especially in meat goats in the Mid-Atlantic region. The objective of this study was to monitor pregnant and non-pregnant does for any rise in nematode egg output. Fecal samples were taken weekly from twenty-two pregnant and fifteen non-pregnant Spanish meat goats from approximately six weeks prepartum to four weeks post-partum. Fecal samples were analyzed using the Modified McMaster technique to determine levels of trichostrongyle eggs and coccidia oocysts per gram of feces. Counts were transformed using a $\log(\text{count}+1)$ transformation and analyzed as repeated measures using a split-plot design. The linear and quadratic effects of time were evaluated using covariate analysis. For trichostrongyles and for coccidia, there was no significant ($p<.05$) difference in fecal egg counts of pregnant versus non-pregnant does. The linear and quadratic effects of time were significant ($p<.05$); indicating an increase and then a resulting decrease of fecal egg counts over the time period of this study. Fecal egg counts of pregnant does were statistically analyzed for time effects about time of parturition. For trichostrongyles, a significant linear and quadratic effect exists; however, none were observed for coccidia. This study suggests that a rise in fecal egg counts does exist in goats; however, it was not associated with parturition. Previous studies in this area have shown a definite pregnancy status by nutritional status interaction. The does in this study were maintained on improved natural pasture and supplemented with grain. Additional studies are needed to investigate the periparturient rise phenomenon in meat goats further.

CAN TRAP CROPS PREVENT HARLEQUIN BUG DAMAGE IN CRUCIFEROUS CROPS? Scott W. Ludwig & Loke T. Kok*, Dept. of Entomology, Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061. The harlequin bug, *Murgantia histrionica* Hahn, is an exotic pest of cruciferous crops in the southern regions of the United States. It sucks juices from the stems and leaves of plants and was considered the most destructive insect pest of cabbage and related crops before the advent of synthetic insecticides. Our hypothesis is that trap crops can be used to prevent the harlequin bug from building up destructive populations on broccoli when insecticides are not used to suppress them. The use of trap crops in preventing harlequin bug damage has not been field tested. Thus, we planted broccoli, mustard and rape as trap crops of broccoli during 1994. In both the spring and fall plantings, almost 100% of the harlequin bugs were on the trap crops which prevented infestation of broccoli. This shows that trap crops can prevent harlequin bug damage of broccoli. The study will be repeated in 1995 to see whether this will be confirmed.

EFFECTS OF FOOD PROCESSING ON THE NUTRITIONAL QUALITY OF LEGUMES. III. LENTIL (*lens esculantum*). Ali I. Mohamed, Agricultural Research Station, Virginia State University, Petersburg, Va 23806. Lentil (*Lens esculantum*) is one of the oldest legume crops. The preparation of lentil soup is depicted in a fresco of the time of Rameses III (1200 B.C.). Lentil is a staple source of protein, calories, and minerals of vegetarian diets in many countries and holds promise as a future food for the Western world. In this study, effects of dry dehulling processes, soaking, and cooking on the nutritional quality of lentil were investigated. There were no significant changes in amino acids by dry dehulling. Dehulling was associated with a significant increase in total protein and total hydrolyzable carbohydrates (26 to 28% and 62 to 69% respectively), phytic acid (172 to 212), and reducing and non-reducing sugars. Highly significant reductions in crude fiber (4.0% to 0.9%), tannins (117 to 85), and total phenols were observed. Protein and carbohydrate digestibility were significantly increased by dehulling, from 74 to 77%, and 45 to 47%, respectively. Soaking and cooking decreased protein and hydrolyzable carbohydrates due to leaching. Cooking and soaking in 0.05N NaOH resulted in a significant increase in digestibility of protein and carbohydrates from 74 to 95 and 21 to 86% respectively. It appears that anti-nutritional factors other than tannins and phenolics are present in lentil and were reduced by dehulling, soaking, and cooking.

A NEW METHOD TO LABEL CHOLESTEROL AND ITS APPLICATION TO STUDY CHOLESTEROL ABSORPTION IN NORMAL AND HYPERCHOLESTEROLEMIC ANIMALS. Ali I. Mohamed, Agricultural Research, Virginia State University, Petersburg, VA 23806. Iodocholesterol was prepared using iodine monochloride tagged with Iodine¹³¹. The iodo¹³¹ cholesterol was used to study the absorption and distribution of cholesterol in various tissues of hypercholesterolemic and normal rats. A single dose of this compound was administered orally to normal and treated rats and the specific activity in the different tissues was measured after 24, 48, and 168 hr after administration of the dose. The data showed that hypercholesterolemia resulted in a significant alteration in the absorption and distribution of radiolabeled cholesterol in various tissues of the normal and diseased rats. Aorta had the highest specific activity in through the study in the diseased rats than other organs. Thyroid gland accumulated less iodinated cholesterol in hypercholesterolemic animals which may reflect a hyperthyroidism state due to the presence of methylthiouracil in atherogenic solution. The distribution of radioactivity in tissues after oral administration of iodocholesterol was used to evaluate the potential use of this compound as photoscanning agents. The distribution ratios of radioactivity in aorta : lung and aorta : liver were considered low for possible use as a photoscanning agent for aorta. However, this compound could be tested for photoscanning for other diseases such as cancer.

EARLY PREGNANCY DETERMINATION IN MEAT-TYPE GOATS USING TRANSRECTAL AND ABDOMINAL ULTRASONOGRAPHY. G.A. Moore^{1*} and S. Wildeus², ¹College of Vet. Medicine, Virginia Tech, Blacksburg, VA 24061 and ²Agricultural Res. Station, Va. State Univ., Petersburg, Va. 23806. The use of pregnancy diagnosis by real-time ultrasound has become a useful tool in livestock management. The current project evaluated the efficacy of transrectal (TR) and transabdominal (TA) ultrasonography using a 5 MHz linear array probe (Pie Medical, model 480) for the detection of pregnancy at three stages post mating in three breeds of meat goats of varying mature size (Myotonic, Pygmy, Spanish). Does (n=60) used in the study were either bred to a synchronized estrus or the subsequent cycle following synchronization. Pregnancy diagnosis was performed at 25-30 (PD1), 50 (PD2) and 75 (PD3) days post mating. Animals were scanned standing for both modes of diagnosing, using a custom handle for probe manipulation transrectally. Does were classified as pregnant, open or 'no diagnosis' and variables were analyzed using a categorical models procedures. The overall frequency of 'no diagnosis' was 6.1% and tended to be affected by mode (P=0.12) and time (P=0.11) of scanning, but not by breed, age or body weight. A differential diagnosis between TR and TA was obtained in 23.0% of cases. Differential diagnosis was affected by breed (P<0.05), ranging from 4.5% in Pygmy to 32.7% in Spanish does. There was a tendency (P=0.11) for differential diagnosis to be affected by time of scanning and at PD1 this was associated exclusively with underestimating the number of pregnant does using TA, whereas at PD3 TR always underestimated the number of pregnant does. These data demonstrate that pregnancy diagnosis using linear array ultrasound can be affected by breed in meat-type goats and that transrectal diagnosis is possible as early as 25 to 30 days post mating.

GERMINATION RESPONSE OF BROOMRAPE (*OROBANCHE* SPP.) TO MOISTURE STRESS AND NUTRIENTS. Vijay K. Nandula and Chester L. Foy, Dept. of Plant Pathology, Physiology, and Weed Science, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Broomrapes, belonging to the family Orobanchaceae are phanerogamic holo-parasites lacking chlorophyll. An experiment was conducted in vitro to evaluate the effect of various forms of nitrogen fertilizer on germination and radicle length of four broomrape species (*O. aegyptiaca*, *O. cernua*, *O. crenata*, and *O. ramosa*). Nitrogen in the form of NO₃⁻, NH₄⁺, and urea was applied to seeds of broomrape in presence of a germination stimulant. Germination of most of the species tested was significantly less with urea and NH₄⁺ compared to NO₃⁻. In the same study, the influence of cations like Na⁺, Ca²⁺, and K⁺ had a positive influence on NO₃⁻ in enhancing the germination of *O. aegyptiaca*, whereas NH₄⁺ gave a lower response. A different experiment was conducted to study the effect of moisture stress, induced with polyethylene glycol, on germination of the four broomrape species mentioned earlier. In general, germination percentage was highest at lower osmotic potentials and gradually declined with all the species except *O. crenata* recording negligible results at -8 bars. Presence of nitrogen and cations, osmotic potential of soil, and presence of a suitable host root, all collectively determine the potential for broomrape attack.

AN OVERVIEW OF THE RAINBOW TROUT INDUSTRY IN VIRGINIA. Scott H. Newton, Virginia State University, Petersburg, VA 23806, Jimmy A. Lawson, Virginia Agriculture Statistics Service, Richmond, VA 23209, and Bryan P. Plemmons, Castaline Trout Farms, Goshen, VA 24439. Rainbow trout (*Oncorhynchus mykiss*) culture is the oldest and most established freshwater aquaculture industry in Virginia and in the United States. Since the early 1950s, trouts have been cultured in the mountains of Virginia using existing springs and streams. Since 1990, they also have been reared in cages and farm ponds in the Piedmont and Coastal regions, from fall to spring when water temperatures are suitable for their survival and growth. Rainbow trout is the major species of freshwater fish grown in Virginia. Brook (*Salvelinus fontinalis*), brown (*Salmo trutta*), and golden trout (a genetic color variation of the rainbow trout), are the other species being reared in the State. Nationally, Virginia ranks sixth in total pounds produced and is the third largest trout producing state on the East coast. Since 1988, annual sales have been slightly over \$2 million for approximately one million pounds of fish. While most regional trout markets are nearly saturated, niche markets are available for specialty products and stocking live trout in recreational fee fishing ponds.

RESPONSE OF THREE MEAT-TYPE BREEDS OF GOATS TO TWO METHODS OF ESTRUS SYNCHRONIZATION. S. Wildeus¹ and G.A. Moore^{2*}, ¹Agricultural Res. Station, Va. State Univ., Petersburg, Va. 23806 and ²College of Vet. Medicine, Virginia Tech, Blacksburg, VA 24061. Estrus synchronization in small ruminants is a valuable reproductive technique to control the mating season and facilitate out-of-season breeding, artificial insemination and embryo transfer. However, no synchronization systems are currently commercially available for sheep and goats in the U.S. This experiment evaluated the estrus and conception rate in 3 meat-type goat breeds (Spanish - S, n=31; Myotonic - M, n=29; and Pygmy - P, n=13) using either 2 mg norgestomet (1/3 Synchro-Mate-B[®] cattle ear implant - NOR) or 500 mg progesterone (custom-made vaginal pessary - PRO) without gonadotropin co-treatment. Average doe age (2.8 yrs) was similar for all breeds, with body weights ranging from 16.5 kg in P to 28.3 and 26.2 kg in S and M, respectively. Does were implanted for a 12 d period at the end of the natural breeding season (December/January). Following implant removal does were observed for estrus for 5 days and hand mated to different sires of like breeds. At 35 and 50 d post implant removal conception was determined via ultrasonography. Retention of NOR implants was higher than of PRO pessaries (100% vs. 94.1%; P=0.097), caused specifically by the loss of PRO pessaries in P (33%). The estrus response and time from implant removal to estrus was similar for NOR (79.5%, 50.3 hrs) and PRO (78.1%, 54.9 hrs), regardless of breed. Overall conception rate to the synchronized estrus was 57.1%, but was lower (P<0.05) in P-PRO (0%) compared to S-PRO (72.7%) and M-PRO (70.0%). These data suggest that 1) a third of a Synchro-Mate-B[®] implant is sufficient for estrus synchronization in meat-type goats and 2) vaginal pessaries perform unsatisfactory in Pygmy does.

Archaeology

"OBSERVATION, PARTICIPATION, EDUCATION:" WORKING TO EXPAND THE RELEVANCE OF AFRICAN AMERICAN SITES. Anna S. Agbe-Davies, Dept. of Archaeological Res., The Colonial Williamsburg Fndn., Williamsburg, VA 23185. As archaeologists, we are responsible not only for the excavation of sites and the curation of artifacts, but the dissemination of findings to our colleagues and to the general public. Conferences such as this one help us fulfill our obligation to one another, but how do we share our discoveries with the public? This paper describes public involvement at several African American archaeological sites and discusses possibilities for future cooperation, both among professionals, and between archaeologists and their lay audience.

PREHISTORIC ARCHAEOLOGY AT THE MULBERRY ISLAND SITE, RICHMOND COUNTY, VIRGINIA. Courtney Anderson, Dept. of Historic Preservation, Mary Washington College, Fredericksburg, Va. 22401. The Mulberry Island Site (44RD81) was identified by surface collection during the 1993 cultural resource assessment survey of Richmond County, Va. by Mary Washington College. A second phase of investigation, conducted by the 1994 Mary Washington College- Stratford Hall Field School, consisted of four operations of surface collections, two transects of shovel test pits and one test unit. The resultant assemblage consists of approximately 950 prehistoric ceramic and lithic artifacts. The ceramic assemblage ranges from the Early Woodland period to the Contact period. A hearth feature within the test unit and the lithic assemblage reveal prehistoric exchange from beyond the Northern Neck and the dominance of expedient manufacture at this site. Statistical analysis of the artifact assemblage evidences 44RD81 as an ephemeral site inhabited in order to exploit marshlands from the Late Archaic period to the Contact period. (Supported by undergraduate research grant awarded by Mary Washington College.)

ANALYSIS OF RECOVERED FAUNAL REMAINS FROM THE AFRICAN-AMERICAN OWNED BURRELL PHARMACY SITE (44RN256), CITY OF ROANOKE, VIRGINIA. Michael B. Barber, Preservation Technologies, Inc., P.O. Box 921, Salem, Va. 24153. The analysis of 2,722 animal bones recovered from the midden deposit associated with the 1897 - 1917/18 Burrell Pharmacy lend insight into the foodways of an African-American population of the turn-of-the-century, urban South. The recovered fauna emphasized Bos taurus (cattle), Sus scrofa (pig), and Gallus gallus (chicken). Cuts of beef were characterized as sawn, highly regularized, and of moderate to lesser and low quality. A high frequency of teeth and cranial elements suggested either nearby butchery or the consumption of head soup/stew. Pork cuts were also of low quality including jowl and headcuts and pigs' feet. Chickens were consumed as a unit and may have been raised in the neighborhood. Few wild animals were eaten and Rattus sp. (rat) was noted as a nuisance species. On the whole, the vertebrate faunal assemblage depicts a community of low economic scale, consuming primarily lesser and low quality meats.

THE ISAAC D. BURRELL PHARMACY SITE (44RN256): AN AFRICAN-AMERICAN DRUGSTORE 1897-1917/18, CITY OF ROANOKE, VIRGINIA. Michael F. Barber and Michael B. Barber, Preservation Technologies, Inc., P.O. Box 921, Salem, VA 24153. The Burrell Pharmacy site represents a window on the day-to-day activities and lifestyles of the black community in Roanoke at the turn-of-the-century. The excavations sampled a city block of the historic Gainsboro Community on which the Davis Hotel was situated. A number of businesses shared the building throughout the late 19th and early 20th century including groceries, restaurants, and the Burrell Pharmacy. The cultural remains investigated consisted of the pharmacy foundations and a sample of an extensive trash midden deposit. Over 27,000 artifacts were recovered with a large number relating to the drugstore era. The implications of the cultural remains are examined with an eye on the community, regional and national perspectives.

EVOLUTION, USES AND CULTURAL IMPLICATIONS OF GLASSWARE AT THE DR. ISAAC D. BURRELL PHARMACY (44RN256), AN AFRICAN-AMERICAN TURN-OF-THE-CENTURY DRUG STORE EXCAVATED IN ROANOKE, VIRGINIA. Eugene B. Barfield and Joel Hardison, Heritage Resources, George Washington and Jefferson National Forests, Roanoke, VA 24019. In 1893, upon receiving his Medical degree Dr. Isaac D. Burrell traveled to Roanoke, Virginia to start his practice. He also established a pharmacy hailed by a Richmond newspaper as "the largest and best stocked drugstore in the state owned by a colored man." Within the real but unrecognized social strata of the black community the doctor and his wife were admired and respected. Recognition from whites came only when there was trouble. Dr. Burrell's drugstore operated from 1897 until 1914 when he became gravely ill. Unable to enter local white hospitals the doctor traveled to Washington, D.C. where he died. A planned widening of one of the main streets in Gainsboro (the black community) initiated the Section 106 process leading to Phase III mitigation of the long since razed drugstore. Pharmaceutical glassware artifacts and drugs for types of illnesses are discussed as well as the lack of turn-of-the-century apothecary excavations available for comparative analysis.

A SKELETAL COMPARISON OF HUMAN REMAINS FROM TWO LATE WOODLAND SITES IN SMYTH COUNTY, VIRGINIA. Cliff Boyd and Donna Boyd, Dept. of Sociology and Anthropology, Radford Univ., Radford, VA 24142. Recent limited archaeological excavations at the Fox Site (44SM6) resulted in the recovery of the remains of seven Native American individuals. The age, sex, preservation, and incidence of pathologies for these individuals are described and are compared to the 35 individuals previously excavated from the nearby Bonham Site (44SM7). Both sites represent components of MacCord's Intermediate Culture dating to the latter portion of the Late Woodland period (ca. A.D. 1000-1600). In addition to the skeletal comparison, discussions of previous work at the Fox Site and the mortuary patterns for both Fox and Bonham are presented.

"ONE CAN NOT CALL THEM BY THE NAME OF HOUSES": THE SEARCH FOR GEORGE WASHINGTON'S UNION FARM SLAVE QUARTER. S. Curtis Breckenridge, Mount Vernon Ladies' Association, Mount Vernon, Va. 22121. In 1991 archaeologists with the Mount Vernon Ladies' Association surveyed to locate the site of buildings at George Washington's Union Farm. An outlying quarter, part of Washington's 8000 acre Mount Vernon plantation, Union Farm contained dwellings housing both African-American slaves and a White overseer. The survey was designed to yield evidence of the quarter in order to provide a comparative assemblage of African-American associated artifacts. This paper will present the results of the survey and subsequent work.

THE INDIAN ARK: ARCHAEOLOGY RESOURCE KIT. Keith T. Egloff, Dept. of Historic Resources, 221 Governor Street, Richmond, Va. 23219. The ARK brings to teacher's classroom an exciting, multidisciplinary, multisensory approach to learning about Virginia's first people. It is designed to make the job of teaching local and state history easier and more enjoyable. The kit give students a variety of ways to explore Virginia's earliest cultures through archaeology--books, drawings, maps, videos, artifact replicas, and a computer game. The enclosed Teacher's Guide presents discussion questions and projects that will deepen student's awareness of people, places, and events of the past that still influence us today. The kit can help teachers meet Standards of Learning Objectives for Social Studies, Language Arts, and Science for grades K-12. Twenty Indian ARKs are being assembled. Soon they will be available through the mail to school teachers across Virginia.

PREHISTORIC SUN CIRCLES, CEREMONIES, AND ROCKART. Wm Jack Hranicky, Archeonic Systems of Virginia, P.O. Box 11256, Alexandria, VA 22312. This paper discusses Virginia's rockart sites, namely Little Mountain (44NZ13) and Paint Lick Mountain (44TZ13), as prehistoric solar observatories. The hand and concentric ring glyphs analyzed and contrasted to other Mississippian glyphs with an emphasis on their being a symbolic priestly sign for a solar festival. The use of red ocher as a priest-associated color is discussed. The paper presents a distributional history of the ring glyph with arguments that it is a solar glyph symbol which is directly associated with solar observatories and village celebrations of the winter and summer solstices. Mesoamerican examples are discussed for origins and incorporation into the Mississippian culture. Also, the implications of post-marked sun circle or ceremonial areas on eastern village sites are discussed. The paper uses White's 1585 circle-dance drawing for reference on solar ceremonies and solar observatories.

SETTLEMENT AND SUBSISTENCE IN THE VIRGINIA PIEDMONT AND FALL ZONE: SURVEY RESULTS FROM TWO MILITARY BASES. Clifton A. Husted, William and Mary Center for Archaeological Research, Williamsburg, VA 23187. Preliminary archaeological surveys of Quantico Marine Corps Base in the Northern Fall Zone and Fort Pickett in the Southern Fall Zone of Virginia have indicated substantial differences in settlement patterning for the poorly known Woodland period between these two areas. Although physiographically very similar, the two study areas have produced widely differing temporal/functional archaeological assemblages. It is inferred that the populations of these areas responded to similar needs by the utilization of very different subsistence and settlement strategies. This also suggests differing levels of socio-political complexity and interaction with the neighboring areas.

FOLK ART, ARCHITECTURE, AND ARTIFACT: TOWARD A MATERIAL UNDERSTANDING OF ACCULTURATION IN GERMAN SETTLEMENT IN THE SHENANDOAH VALLEY OF VIRGINIA. Donald W. Linebaugh, Dept. of Anthro., College of William and Mary, Williamsburg, Va. 23185. This paper will use Pennsylvania German folk artist Lewis Miller's work as evidence for approaching problems central to understanding life in the 18th- and 19th-century American backcountry, particularly acculturation in German settlement. From a cultural history perspective, Miller's drawings provide an opportunity to glimpse brief moments in time across the landscapes of Pennsylvania and Virginia. His drawings contain highly detailed depictions of people and places throughout the Shenandoah Valley, particularly landscapes and architectural subjects. The drawings provide new evidence to test assumptions about the acculturation of Germans in Virginia, particularly when used with architectural, archaeological, and other cultural material data from the period. Because they are contemporary depictions of the architecture and landscape and were produced by and among members of an acculturative group, they offer a slightly different perspective from the previous architectural studies that utilize surviving structures in a modern post-acculturative setting.

THE ROLE OF ARCHEOLOGY IN VIRGINIA'S NATURAL HISTORY. Howard A. MacCord, Sr., 562 Rossmore Road, Richmond, VA. 23225. Archeological research probes human history and adaptations over the past ten millennia. The information recovered included geologic, botanic, and zoologic evidence, including microscopic and chemical data. Several contributions to Botany and Zoology are cited from the current or recent archeological literature. Archeologists are urged to continue to seek such data in future work.

CHEMICAL CHARACTERIZATION AS A MEANS OF EXPLORING THE PRODUCTION AND DISTRIBUTION OF CERAMIC ROOFING TILES IN WILLIAMSBURG, VIRGINIA. John D. Metz, Dept. of Archaeological Research, Colonial Williamsburg Foundation, Williamsburg, Va. 23187. Williamsburg and Jamestown are unique in that they appear to have been the sole loci of brick and tile production using an older, more medieval technology in North America. Analysis of the production and distribution of roofing tiles is difficult due to the absence of decoration and the highly standardized form. Specific production sites may be differentiated, however, through a unique chemical signature in ceramic paste resulting from differences in clay source and production techniques. Acid extraction analysis offers an affordable method of determining the compositional make-up of ceramics such as roofing tiles. This method produces highly precise results capable of intra-regional discrimination of production loci. Unlike other, more expensive techniques such as neutron activation analysis (NAA) and x-ray fluorescence (XRF), acid extraction does not require the total digestion of the artifact. Moreover, the technique provides reliable compositional data using conventional equipment.

AFRICAN AMERICAN FOODWAYS DURING THE 19TH CENTURY AT THE OCTAGON. Elizabeth A. Moore and Rebecca Hess, 4600 43rd Place, NW, Washington, DC 20016. During the early 19th century The Octagon was the Washington, D.C. residence of John Tayloe, wealthy Virginia plantation owner, his wife Ann Ogle Tayloe, and their 13 children. In 1993, excavations of the servant's hall and housekeeper's room in the basement of the Octagon revealed six historic features and activity areas. An undisturbed deposit in the servant's hall yielded a zooarchaeological sample of almost 500 faunal specimens, most of which were found in a single cluster, interpreted as a food processing activity area. In addition to the zooarchaeological data, historic data gathered from extensive files of records, documents, and research reports were examined for references to both private and public foodways. Various models have been developed by researchers for the historic utilization of fauna for the East Coast in general, and, more specifically, the Chesapeake area. In an examination of these models, a better understanding of the lifeways of the servants, their access to faunal resources, and their participation in the local economy will be developed.

SETTLEMENT AND CRM: PREHISTORIC LAND USE IN VIRGINIA'S POWELL VALLEY. Stevan Pullins and Jane Peterson, Ctr. for Archaeological Res., Col. of William and Mary, P.O. Box 8795, Williamsburg, VA 23187-8795. The College of William and Mary Center for Archaeological Research conducted a series of Phase II investigations on eight archaeological sites in Lee County, Virginia, in the vicinity of the towns of Pennington Gap and Dryden. Sites were temporally and functionally diverse, dating from the Early Archaic through late Woodland periods and consisting of small temporary camps, upland farmsteads, lithic procurement sites, and larger villages. The results of these investigations were used in conjunction with previous survey results, soil and physiographic data, and patterns of material culture to lay the groundwork for a diachronic model of prehistoric settlement in the Powell Valley.

TALES OF THE ORDINARY: EARLY TAVERNS OF ROCKBRIDGE COUNTY, VA. Kurt C. Russ and John-Paul Lunn, Lab. of Anthropol., Washington and Lee Univ., Lexington, VA 24450. An historical and archaeological survey of taverns in Rockbridge County, Virginia was initiated by the staff of Washington and Lee's Laboratory of Anthropology in the Fall of 1994. A research design was formulated which outlined general project goals as well as specific research questions and hypotheses. The goals ranged from identifying and locating county taverns to developing an historic context for understanding the data base to testing selected tavern sites archaeologically. Research questions focus generally on commerce in Rockbridge County and include a consideration of factors affecting the distribution of taverns across space and through time, the evolution in tavern function, their organization, self-sufficiency, and the nature of the labor force utilized, the lifeways of the taverners and their compliance with governmental regulations, and the impact of taverns on the local economy. The vast majority of the 17 taverns identified were situated along major corridors of travel especially the "Great Road" and to a much lesser extent the Lexington-Covington turnpike. Specific clustering of sites related to developing communities along this route including one cluster in the vicinity of Fairfield/Brownsburg and another in Lexington as well as a third in the southern portion of the county adjacent to Natural Bridge. Archaeological testing at two of the sites, Mackey's Tavern and Barclay's Tavern, provide for explication of material culture patterning at two late-18th-through early-19th-century Rockbridge taverns.

RELOCATING THE FOUNDATIONS OF JENNIE DEAN'S VISION: ARCHAEOLOGICAL INVESTIGATIONS AT THE MANASSAS INDUSTRIAL SCHOOL, 44PW505. John H. Sprinkle, Jr., Louis Berger & Associates, Inc., Washington, DC 20006. In October 1993, Louis Berger & Associates, Inc. (LBA) conducted field investigations at the Manassas Industrial School (44PW505) in Manassas, Virginia. Established during the late nineteenth century by an former slave, Jennie Dean, the Manassas School was the only vocational school for black youth located in Northern Virginia. Dedicated by Frederick Douglass in 1894 and partially funded by Andrew Carnegie during the early twentieth century, the school operated as a private, residential, and co-educational institution until the late 1930s when it was taken over by the Prince William County School system. LBA's study was designed to locate the foundations of three academic structures that had been demolished in the early 1960s. Methodology included the use of historic maps, limited machine trenching and supplementary shovel testing to identify the outlines of Hackley and Howland Halls, and the Carnegie Building. In addition, LBA prepared a National Register of Historic Places nomination for the property. This paper discusses the methodology and results of the archeological investigations at the Manassas Industrial School. (Sponsored by The Manassas Museum and the City of Manassas)

HITTING THE NAIL ON THE HEAD: NAILS AND THEIR MEANING ON A SLAVE SITE. Michael A. Strutt, Dept. of Archeology, Jefferson's Poplar Forest, Forest, Va. 24551. Nails are found in abundance at many slave cabin sites across Virginia. Archeologists have for the most part only categorized them into sizes and manufacturing technique when cataloguing these ubiquitous artifacts. The author will suggest that it may be possible to tease more information out of a collection by looking at the way nails are dispersed on a site and the state of the nails, ie used/unused, clinched, pulled etc. By doing this and looking at the relative percentages of nails to other artifacts it may be possible to understand more than the architecture of the missing cabins. Comparing data from an excavated slave cabin at Poplar Forest to other excavated sites an expanded interpretation of our sites may be possible.

HISTORICAL DEVELOPMENT AND USE OF WOODEN WATER PIPE AND THE RECOVERY OF A TWENTIETH-CENTURY EXAMPLE FROM HOPEWELL, VIRGINIA. Kenneth E. Stuck, William and Mary Center for Archaeological Research, P. O. Box 8795, Williamsburg, Va. 23187. Wooden water pipelines are no longer in use today, but not that long ago wooden water pipe was considered to be a valid choice, technologically and economically, for utility companies and municipalities. As late as the first quarter of this century, water companies serving urban areas like Norfolk, Virginia were installing complete or partial wooden pipelines, above and below ground, to carry water from reservoirs to pumping stations. Some areas also used wooden pipe as part of the regular water distribution network that connected the company to its customers. This paper will examine the development of wooden water pipe technology and the advantages and disadvantages of wood pipe, and then focus on an attempt to archaeologically recover a portion of one of these pipes in Hopewell, Virginia.

THE LONG MOUNTAIN COMMUNITY: BLACK AND WHITE RELATIONS IN THE LATE NINETEENTH/EARLY TWENTIETH CENTURY. George A. Tolley and Mark Martin, George Washington and Jefferson National Forests, 5162 Valleypointe Parkway, Roanoke, VA 24019. In this paper, the authors discuss the relationships between black and white residents within the Long Mountain Community of Amherst County, Virginia. The authors utilize Forest Service acquisition records, abstracts from land sales, Census Records, field observations, and the transcript from an interview with an African American native of Long Mountain to relate history and land settlement patterns for this area. Following the Civil War, land settlement patterns changes as economic conditions forced the sale of large estates and freed slaves needed to find housing and jobs. By the beginning of the Twentieth Century, African Americans owned the majority of the land within the community. Euro and African American land owners and share croppers lived as neighbors as they struggled to bring stability to their lives during the depressed economic conditions of the late Nineteenth Century.

FURTHER ANALYSIS OF THE POPE SITE: AN EIGHTEENTH CENTURY FARMSTEAD IN SOUTHAMPTON COUNTY, VIRGINIA. Esther C. White, Mount Vernon Ladies' Association, Mount Vernon, Va. 22121. Originally excavated by the College of William and Mary, the Pope Site is an eighteenth century farmstead. Located in Southampton County, Virginia, the site consisted of a main structure and three outbuildings interpreted as a kitchen, smokehouse, and slave quarter. This interpretation will be explored through an examination of the artifacts found at each structure. The ceramic vessels, especially the colonoware, a locally produced coarse earthenware often associated with slave quarters, will be an integral part of the analysis.

Astronomy, Mathematics and Physics

PHOTOMULTIPLIER TUBE CALIBRATION. Robert Atkins, Dr. Kevin Giovanetti, Department of Physics, James Madison University, Harrisonburg, Va. 22807. Photomultiplier tubes (pmt's) for the CEBAF Large Acceptance Spectrometer's (CLAS) Forward Electromagnetic Calorimeter (EMC) are currently being tested at JMU. Measurements of dark current and linearity are made to access the pmt's characteristics and make a first step towards understanding the response of the EMC detector. An overview of pmt's, the testing setup, and the current results of the tests will be presented.

DATA COMPRESSION USING WAVELETS AND WAVELET PACKETS, Brian Bradie, Dept. of Mathematics, Christopher Newport Univ., Newport News, VA 23606-2998. Fundamentally, data compression involves detecting and removing redundancies from a given data set. Techniques for data compression typically fall into one of two categories: (1) direct techniques, which process the data samples in the original representation in which they were recorded; and (2) transform techniques, which attempt to isolate the underlying features contained in the data by first expressing the data in terms of a different representational basis. Wavelets and wavelet packets are recently developed tools in applied mathematics which fall into the latter category of compression methods. In this survey, a brief introduction to the philosophy of wavelets and wavelet packets, to the efficient computation of each transform and to the concept of a best wavelet packet basis is provided. A variety of procedures for using wavelet and wavelet packet transform coefficients to obtain data compression are then described. The fast approximate factor analysis algorithm of Coifman and Wickerhauser (1992) is included in the presentation. The compression of single lead electrocardiogram data is used for illustrative purposes.

ENERGETICS AND SPECTROSCOPY OF FORMING GROUP 2 DIHALIDES.

Thomas C. DeVore, Dept. of Chemistry, James Madison University, Harrisonburg, VA 22807 and J. L. Gole*, School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332 The M (Ca, Sr, Ba) + X₂ (Cl₂, Br₂) reaction encounters produce unstructured visible chemiluminescence under single collision conditions. The second order dependence of the emission intensity suggests that this emission results from MX₂ molecules rather than the MX molecules more typically found during this type of reaction. A combination of multiple collision chemiluminescent studies and laser induced fluorescence spectroscopy has been used to demonstrate the highly efficient collisional stabilization of these electronically excited Group 2 dihalide collisional complexes. The first discrete emission spectra for each of these complexes have been obtained and analyzed. Discrepancies between the bond strengths determined by mass spectroscopy and from chemiluminescence measurements will also be discussed.

NEW CCD PHOTOMETRY OF FAINT CEPHEID VARIABLE STARS. David L.

DuPuy and Robert W. Youngren*. Department of Physics and Astronomy, Virginia Military Institute, Lexington, VA 24450. New observations of faint Cepheid variable stars have been obtained, using the VMI 0.5m telescope and electronic imaging. Cepheids are important links in the chain of distance measurements leading ultimately to the Hubble constant. We observed stars which had not been observed during the past 40 or more years, to look for changes in light curves or pulsation periods, and to obtain detailed light curves. In our sample of 15 stars, we found two with dramatically altered pulsation, and we obtained improved periods for several other stars. A brief discussion of the procedure and errors in CCD photometry will also be presented.

DESIGN AND IMPLEMENTATION OF A CONTROL SYSTEM FOR CEBAF DETECTORS.

Darren Ellis, Dr. Kevin Giovanetti, Department of Physics, James Madison University, Harrisonburg, Va. 22807. The CEBAF large acceptance spectrometer's forward electromagnetic calorimeter will require routine calibration. Development of a calibration system to perform this operation is currently underway at JMU. Once development is complete, the calibration system will be integrated into the existing framework set forth by the data acquisition and slow controls being developed for the CLAS detector. An overview of the design and implementation aspects of this project will be presented.

ATM ACCESS STRATEGIES FOR CEBAF CLAS DETECTOR SYSTEMS. David E.

Game, Lisa P. Mitchell* and David C. Doughy, Dept. of Physics and Computer Science, Christopher Newport University, Newport News, Va. 23606. The data acquisition systems for particle physics have employed a number of strategies, primarily employing customized equipment. Here we present the results of a study which involves using simulation to analyze access strategies for a design which employs an ATM switch as the primary means of data transfer from read out controllers to the the analysis farm and subsequently to the permanent storage medium. Given the non-deterministic nature of the ATM switch, the study focuses on strategies which attempt to assure delivery by avoiding congestion on a single output port.

CONFIRMATION AND CLARIFICATION OF THE ORBITAL ACCELERATIONS OF JUPITER'S GALILEAN SATELLITES. Kenneth C. Jacobs, Dept. of Physics, Hollins Col., Roanoke, Va. 24020, & Samuel J. Goldstein, Jr., Dept. of Astronomy, Univ. of Va., Charlottesville, Va. 22903. Early in 1995 we heard from Fred Franklin of Harvard College Observatory that their 20-year project with the Galilean moons had revealed an orbital acceleration for Io of order $2 \times 10^{-10} \text{yr}^{-1}$. This independent support for our 1986 result of $4.6 \times 10^{-10} \text{yr}^{-1}$ led us to re-examine both our 1986 work and our published errata of 1987. [There is also a new value for the total heat flow power from Io (between 1983 and 1993): $10.5 \times 10^{13} \text{W}$.] We have now corrected all algebraic errors, and have confirmed our 1986 results anew: Io is accelerating at $\dot{n}_1/n_1 = 5 \times 10^{-10} \text{yr}^{-1}$, Europa is accelerating at $\dot{n}_2/n_2 = 2 \times 10^{-10} \text{yr}^{-1}$, and Ganymede seems to be decelerating at $\dot{n}_3/n_3 = -4 \times 10^{-10} \text{yr}^{-1}$. This talk will clarify our many new findings. (Supported in part by a Faculty Travel Grant from Hollins College.)

NUCLEON RESONANCE ELECTROPRODUCTION AT LARGE MOMENTUM TRANSFERS Cynthia Keppel Virginia Union University, Richmond, VA. The description of hadrons (protons, neutrons, mesons) and their excitations in terms of elementary quark and gluon constituents is one of the fundamental challenges in physics today. Bloom-Gilman Duality is an observed phenomenon in electron scattering which suggests a common origin for both deep inelastic scattering (scattering from pointlike quarks in the nucleon) and nucleon resonance excitation. Nucleon resonance electroproduction data obtained at the Stanford Linear Accelerator Center (SLAC) and proposed for the Continuous Electron Beam Accelerator Facility (CEBAF) will be presented. These data, obtained from scattering high energy electrons (up to 6 GeV proposed at CEBAF and up to 20 GeV at SLAC) from hydrogen targets, will be discussed in light of Bloom-Gilman duality.

COUPLING BETWEEN ELECTRONS AND ACOUSTIC PHONONS IN QUANTUM DOTS AND OTHER NANOSTRUCTURES. Peter A. Knipp, Dept. of Physics and Comp. Sci., Christopher Newport Univ., Newport News, VA 23606, & Thomas L. Reinecke, Naval Research Lab, Washington, DC 20375. We show that the coupling between electrons and acoustic phonons in semiconductor confined structures occurs via a novel interaction, which we call the "ripple" mechanism, in addition to the usual deformation potential coupling. The ripple mechanism coupling arises from the perturbation of electron wavefunctions by the motion of interfaces. Detailed expressions for this coupling are derived here which are valid for all nanostructure systems, including those with quasi-zero, one and two dimensional geometries. Calculations of the electron scattering rates due to acoustic phonons have been made for semiconductor quantum dots in the shapes of spheres, cubes and rectangular parallelepipeds. It is found that scattering due to the ripple mechanism dominates that from the deformation potential for dot sizes less than several hundred angstroms and that it can be much larger for small dot sizes. (Supported in part by the U. S. Office of Naval Research and by the Office of International Studies at Christopher Newport University.)

TIME DECAY OF THE LOCAL ENERGY FOR A TWO-DIMENSIONAL DISPERSIVE WAVE. J.E. Lin, Dept. of Mathematical Sciences, George Mason University, Fairfax, Va. 22030. It has been known that solitons can emerge from initial pulses of arbitrary shape and amplitude whose central frequencies are at the zero-dispersion point of a single model fiber. In this paper, we consider a weak perturbation of it in another direction and show that the local energy of this two-dimensional wave decays in time.

The equation of this study is $u_t - u_x + u_{xxx} + i|u|^2 u = -w_y$, where $i = \sqrt{-1}$, $w_x = u_y$.

OPERATION AND DESIGN OF THE CLAS FORWARD ELECTROMAGNETIC CALORIMETER. Dustin E. McNulty, Dr. Kevin Giovanetti, Department of Physics, James Madison University, Harrisonburg, Va. 22807. Electromagnetic calorimeters (EMC's) are an important tool in determining the properties of particles resulting in high energy collisions. Specifically, the CEBAF Large Acceptance Spectrometer's (CLAS) Forward EMC will be used to help distinguish electrons from pions and measure photon and neutron energies. The CLAS EMC is a total absorption shower calorimeter that employs lead sheets (to induce showering), and plastic scintillators together with photomultiplier tubes to fractionally sample the total energy deposited. An overview of this detector will be presented in conjunction with work being done on the calibration of this detector ongoing at JMU.

"CCD'S, IMAGE-PROCESSING, AND ORBITS--SUMMER SKIES AT JMU OBSERVATORY". Joseph W. Rudmin and Geoffrey Williams, Physics Dept., James Madison Univ., Harrisonburg, VA, 22807. During the summer of 1994, the authors implemented image acquisition at the Stokesville Observatory using a Celestron Compustar 14 telescope, and a Linx ST-4 Charge Coupled Device (CCD), with a Macintosh interface. Elements of the project included learning to use the Linx hardware and software, construction of a cabinet for transport and testing of the CCD, acquisition of images, and preliminary development of programs to convert data to IBM-PC formats, to process the images using Fourier decomposition, and to begin orbit computational techniques with a goal of determining the orbits of asteroids. A significant development was to implement a new technique of calculating orbits using a variation on the Picard Iteration, developed by James Sochacki and G. Edgar Parker of the JMU Mathematics Department. Results will be presented.

Biology

EFFECTS OF TEMPERATURE AND TERMITE HOST STARVATION ON FEEDING BY PROTOZOAN SYMBIONTS IN RETICULITERMES FLAVIPES (ISOPTERA; RHINOTERMITIDAE). Lisa A. Belitz & Deborah A. Waller, Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529. Termites rely on cellulolytic intestinal protozoan symbionts to digest their cellulosic foods. We examined food acquisition in termite hindgut protozoans by following phagocytosis of red paper fed to the termite host. Protozoans in termites maintained at 32°C and 26°C acquired red paper sooner than in those held at 22°C. Two protozoan species, Pyrsonympha and Dinenympha, disappeared after 72 hours at 32°C, but other protozoan species were unaffected by temperature. Protozoans in termites starved for 24 hours incorporated red paper faster than those in termites with continuous access to food.

AGGREGATION OF DOPAMINE-BOUND HAEMOLYMPH PROTEINS BY THE AMERICAN COCKROACH. Daniel E. Buyas, W.D. Bailey*, R.R. Mills and T.D. Kimbrough, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284-2012. Newly ecdysed American cockroaches, Periplaneta americana, greater than 600 mg were injected with ³H-dopamine or ¹⁴C-dopamine. Haemolymph was collected after 30 minutes. Size exclusion chromatography showed that 3 different molecular weight dopamine-bound proteins were present. Injection of each radiolabelled protein fraction into freshly ecdysed cockroaches resulted in their incorporation into the cuticular matrix. Reinjection of the smallest haemolymph components resulted in *in vivo* protein aggregation with the radiolabel bound to higher molecular weight proteins.

EFFECTS OF HIGHER AND LOWER THAN NORMAL INCUBATION TEMPERATURES ON CHICK EMBRYO DEVELOPMENT. Karen L. Calfee & Carolyn M. Conway, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va., 23284-2012. The teratogenic effects of hyperthermia and hypothermia on embryonic development were investigated using chick embryos (Gallus domesticus). Following incubation *in ovo* for 27 hours, embryos were removed from the yolk and cultured *in vitro* using the Spratt technique. While control embryos were cultured at 37.5 °C (normal incubation temperature), experimental embryos were cultured for 4 hours at either 40 °C or 35 °C and then returned to 37.5 °C for further incubation. All embryos were evaluated after 36 and 51 hours of total incubation using a morphological scoring system. Structures examined at 36 hours included the forming neural tube, notochord, somites, anterior intestinal portal, blood islands, Hensen's node, and primitive groove. Structures examined at 51 hours included the developing neural tube, eye primordia, heart primordium, somites, anterior intestinal portal, and blood islands. Mean embryo length, number of somite pairs and total morphological score of hyperthermic and hypothermic embryos were significantly decreased relative to that of control embryos. Developmental retardation was noted especially in the anterior neural tube (brain primordium), eye primordia, and heart primordium. These results were consistent with our hypothesis that hyperthermia and hypothermia would be teratogenic during the critical stages of development when organ primordia are being established. (Supported by the Undergraduate Research Grant Program at VCU)

MACROPHAGE AND GRANULOCYTE POPULATIONS AROUND NORMAL AND LIPOPOLYSACCHARIDE-INDUCED RESORBING EMBRYOS IN CD-1 MICE. E. M. Conors and A. F. Conway, Dept. of Biol., Randolph-Macon Col., and C. M. Conway, Dept. of Biol., Va. Commonwealth U. Lipopolysaccharide-induced pregnancy loss (resorption) in CD-1 mice was studied by injecting pregnant CD-1 mice intravenously with 0.05 ml of 0.1 mg/ml E. coli lipopolysaccharide (LPS, Sigma) on day 9 of gestation. Females were sacrificed by excess etherization at 6, 18, 24, or 30 hours after treatment. Mature macrophages were identified by peroxidase-labeled antibody staining for the F4/80 antigen. Granulocytes were identified by staining for endogenous peroxidase resistant to inactivation by methanol+peroxide (resistant peroxidase). Cells stained for F4/80 were primarily large cells with extended processes, with a minority of smaller rounded cells near blood vessels. Resistant peroxidase positive cells were small spherical cells containing either bi- or three to five-lobed nuclei. Both F4/80⁺ and resistant peroxidase⁺ cells were primarily localized in the mesometrial myometrium and were rare at the maternal-embryonic interface. Both cell populations were increased in LPS-treated females, with increases being statistically significant for resistant peroxidase⁺ cells. Because of their locations, neither of these cell populations are likely to participate directly in destruction of embryonic tissues during lipopolysaccharide-induced pregnancy loss.

THE EFFECTS OF TAMOXIFEN ON HEPATOMA CELLS. Robert M. Covington and Rosemary Barra, Department of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Tamoxifen is a drug currently used for the treatment of women with estrogen positive breast cancer. Recent evidence indicates that a side effect of the tamoxifen treatment may be the induction of liver carcinomas. In this study, experiments were performed to determine the effects of tamoxifen on cultured Morris Hepatoma 7777 cells. These cells were incubated for four days with concentrations of tamoxifen from 0 to 100 nM. Trypan blue exclusion was used as an indicator of cell viability and the results showed that incubation with 100 nM Tamoxifen resulted in a 62.5% toxicity. The results of experiments that measured H³-thymidine incorporation into DNA indicate that tamoxifen inhibited incorporation up to 25%.

LOW OXYGEN EFFECTS ON NITROGEN FIXATION RATES IN TERMITES (ISOPTERA: RHINOTERMITIDAE). Anthony D. Curtis and Deborah A. Waller, Department of Biological Sciences, Old Dominion Univ., Norfolk, VA 23529. Termite hindguts harbor bacteria that are able to fix atmospheric nitrogen. We examined nitrogen fixation rates in *Reticulitermes* workers under low oxygen conditions which may occur in subterranean galleries. We also examined the effect of elevated CO₂ on nitrogen fixation. We generated 16.55% oxygen atmospheres by the addition of CO₂, argon, or N₂ gases; termite nitrogen fixation rates were higher in 16.55% O₂ atmospheres than in 18.55% O₂ atmospheres. There was no difference in nitrogen fixation rates between termites exposed to normal atmospheric concentrations of CO₂ and atmospheres containing 300 times atmospheric CO₂. However, when termites were exposed to 90% and 95% CO₂, nitrogen fixation rates decreased due to CO₂ narcosis. These results show that nitrogen fixation in termites is oxygen sensitive and is not affected by CO₂ levels below the point of narcosis.

ECTOPARASITES OF WHARF RATS IN NEW ORLEANS. Ralph P. Eckerlin, Harry F. Painter, Northern VA Comnty. Col., Annandale, VA 22003, Lance A. Durden, Institute of Arthropodology and Parasitology, Georgia Southern Univ. Statesboro, GA 30460, and Maurice D. Little, Dept. of Tropical Medicine, Tulane Univ. Medical Center, 1501 Canal St., New Orleans, LA 70112. Between November 1988 and March 1990, 93 Rattus norvegicus and 89 Rattus rattus were trapped near wharves along the Mississippi River in New Orleans, LA and examined for external and internal parasites. Because animals were pooled, no prevalence or intensity of infection data are available. However, total numbers of ectoparasites found are as follows: ACARI - Laelaps (Echinolaelaps) echidnina 1 nymph, 125 females, 2 males; Laelaps (Laelaps) nuttalli 19 females; Ornithonyssus bacoti 2 nymphs, 8 females. ANOPLURA - Polyplax spinulosa 1 nymph, 1 female; Hoplopleura pacifica 1 nymph, 1 male. SIPHONAPTERA - Xenopsylla cheopis 17 males, 27 females; Ctenocephalides felis 5 females; Nosopsyllus fasciatus 1 female. The "plague flea", X. cheopis, was the most abundant flea collected. In light of the recent epidemic of human plague that occurred in India, and the speed of modern travel, we suggest that rat control measures and periodic monitoring of rat ectoparasite populations in port cities such as New Orleans, be continued.

NOT ALL AQUATIC ASTIGMATID MITES WALK! SWIMMING BEHAVIOR IN THE GENUS CREUTZERIA (ACARINA : HISTIOSTOMATIDAE). Norman J. Fashing, Dept. of Biol., Col. of William and Mary, Williamsburg, Va. 23187. Heretofore swimming in the Acarina (mites) has been considered a trait of so called "water-mites" (Hydracharina), suborder Prostigmata; whereas the literature on other suborders including the Astigmata, a diverse assemblage with over 785 genera in 69 families, contains no mention of natatory behavior. While fully aquatic species are not common in the Astigmata as a whole, they are not unusual for the families Acaridae, Alghagidae, Hyadesiidae, and Histiostomatidae. The literature would indicate, nonetheless, that these mites are ambulatory, clinging to the substrate when walking. Members of the histiostomatid genus Creutzeria, inhabitants of the fluid-filled pitchers of plants of the family Nepenthaceae, are an exception - adults and instars other than the deutonymph are so modified that they are unable to walk and must swim. Morphological adaptations for swimming include a spherical body with a thin, smooth integument, as well as the shape, orientation and location of the legs and leg setae.

PROBLEMS IN USING BIOTINYLATED ANTIBODIES FOR ELISA MEASUREMENT OF TUMOR NECROSIS ALPHA CONCENTRATIONS AROUND NORMAL AND LIPOPOLYSACCHARIDE-INDUCED RESORBING EMBRYOS IN CD-1 MICE. W. A. Fritz, C. P. Toomey, and A. F. Conway, Dept. of Biol., Randolph-Macon Col., and C. M. Conway, Dept. of Biol., Va. Commonwealth U. When higher than expected values were observed in ELISA measurements of homogenates of samples punched from thick frozen sections of mouse implantation sites, a series of control experiments revealed that high values were obtained from many samples when the biotinylated primary antibody was omitted from the sequence. Our experience indicates that a control in which the biotinylated antibody is omitted but which is treated with the streptavidin-peroxidase or avidin-peroxidase reagent in the normal fashion should be run for each sample when analyzing homogenates in ELISA techniques using biotinylated antibody technology.

POSSIBLE EVIDENCE OF NON-RANDOM MATING IN COTTON STAINER INSECTS FROM ST. THOMAS, USVI. Harold J. Grau, Dept. of BCES, Christopher Newport Univ., Newport News, Va.23606. The Insect genus *Dysdercus* (Pyrrhocoridae; Heteroptera) is known collectively as the cotton stainers because many of its species have feeding habits that include the transfer of a fiber-staining fungus to the cotton bolls they feed on. Other food sources include various Malvaceous plants. One New World species, *D. andreae*, inhabits most of the islands of the West Indies. On St. Thomas, US Virgin Islands, the species is found exclusively in association with *Thespesia populnea* trees, feeding on its seeds. Among the behaviors exhibited by these bugs is prolonged copulation, in which mated pairs remain *in copula* for extended periods of time. It is not clear if mating in these insects is random. In random mating, one would expect to find that, if variation in body size exists among adults, there should be no correlation among body sizes of mated adult males and females within a pair. Also, in a random mating system, there should be no difference in body sizes between unmated and mated adults. To examine whether the mating system of these insects is random, body sizes of mated and unmated adult *D. andreae* were measured from several populations on St. Thomas, USVI. Three indicators of body size were used: pronotum width, wing length, and thorax-abdomen length. There was no significant difference found in the body sizes of mated and unmated adults. However, statistically significant correlations were found among the measured body size indices of mated males and females, that is, larger males tended to be mated with larger females. These results suggest that mating in this insect is not random, but based in part on size selection within a pair.

INTERACTIONS BETWEEN LIPOPOLYSACCHARIDE-COATED LATEX MICROSPHERES AND IMPLANTATION SITES IN CD-1 MICE. H. A. Harden and A. F. Conway, Dept. of Biol., Randolph-Macon Col., and C. M. Conway, Dept. of Biol., Va. Commonwealth U. In an attempt to produce a probe visible by fluorescent microscopy and which could be used to follow the distribution of injected lipopolysaccharide during lipopolysaccharide-induced pregnancy loss (resorption) in CD-1 mice, pregnant CD-1 mice were injected with 1 micrometer diameter fluorescent latex microspheres (Polysciences) coated with *E. coli* lipopolysaccharide (LPS, Sigma) or with control preparations on day 9 of gestation. All females were sacrificed by excess etherization on day 12 of gestation. Overnight incubation of microspheres in 2 mg/ml LPS in phosphate buffered saline produced preparations which contained in excess of 3 micrograms of LPS (as measured by competition ELISA) per 0.05 ml injection and which caused marginally significant body weight losses when injected intravenously or subcutaneously in the tail, but which caused no increase in the frequency of resorption. Microspheres incubated with 5 mg/ml concanavalin A followed by incubation with 2 mg/ml LPS caused statistically significant body weight loss and statistically marginal increases in the frequency of resorption. These results suggest that the polysaccharide part of LPS is important in body weight loss but that the lipid A part is important in inducing pregnancy loss.

DISTRIBUTION OF APOPTOTIC CELLS AND FRAGMENTED DNA AROUND NORMAL AND LIPOPOLYSACCHARIDE-INDUCED RESORBING EMBRYOS IN CD-1 MICE. S. L. Harris and A. F. Conway, Dept. of Biol., Randolph-Macon Col., and C. M. Conway, Dept. of Biol., Va. Commonwealth U. Involvement of apoptosis in lipopolysaccharide-induced pregnancy loss (resorption) in CD-1 mice was studied by intravenously injecting pregnant CD-1 mice with 0.05 ml of 0.1 mg/ml *E. coli* lipopolysaccharide (LPS, Sigma, control = 0.05 ml phosphate-buffered saline) on day 9 of gestation. Females were sacrificed by excess etherization at 6, 24, or 48 hours after treatment and apoptotic nuclei were detected in transverse frozen sections of implantation sites by staining for fragmented DNA (Oncor kit). Control samples contained scattered apoptotic nuclei in decidual tissues and exhibited a diffusely stained region at the maternal-embryonic interface. Treatment with LPS resulted in loss of most apoptotic nuclei from decidual tissues and extensive expansion of the diffusely stained interface zone by 24 hours after treatment. These results are incompatible with typical apoptosis as a major mechanism of cell loss at the normal maternal-embryonic interface or during pregnancy loss induced by LPS treatment.

COEVOLUTIONARY IMPLICATIONS OF BREEDING CESSATION IN CUTEREBRA-INFESTED PEROMYSCUS POPULATIONS. Michael S. Hensley, Department of Biology, Bridgewater College, Bridgewater, VA 22812. The phenomenon of botfly (*C. fontinella*) parasitism of white-footed mice (*P. leucopus*) has been studied for 23 years on three insular woodlots in the Shenandoah Valley. Botfly prevalence, host demography, and bot-induced biology are presented for 6,240 mice on the woodlots. Data suggest increased longevity and reduced fertility as a result of moderated infections. Such mice show greater winter survival and, subsequently, increased fertility during the spring breeding upsurge. Evidence for coevolved population ecology is strong on insular woodlots, but scant or lacking in expansive forests. Differences are attributed to the more intimate contact of two small, static gene pools in the insular woodlot environment.

INFESTATION RATES AND BIOMASSES OF A STOMACH ASCARID IN A POPULATION OF SIGMODON HISPIDUS, THE HISPID COTTON RAT, OF SOUTHEASTERN VIRGINIA. Barbara Hiller and Robert K. Rose, Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529. A population of hispid cotton rats, *Sigmodon hispidus*, from southeastern Virginia infested with stomach worms was studied for its patterns of reproduction from 1987 to 1990. The hispid cotton rat is a cricetine rodent found in grass-dominated habitats and has an omnivorous diet consisting mainly of grasses and insects. Animals were collected using Fitch and Sherman live traps baited with birdseed from an old field in Portsmouth, Virginia. Animals over 50 grams were brought back into the laboratory and sacrificed using chloroform. Necropsies were performed in which stomachs were extracted and examined for internal parasites. The rats become infested by swallowing insects carrying encapsulated eggs. Approximately 23% of all animals collected were found to have loads of an ascarid worm, which were removed and stored in 70% alcohol. Parasite sex and biomasses were recorded. One-third of those animals infested were found to have parasite loads containing only one sex. The original study site was revisited in the Spring of 1995 and additional sampling showed that the population continued to be infested.

CYTOTOXICITY OF LAK CELLS AGAINST ME-180 CELLS. Rodney L. Madagan and Rosemary Barra, Department of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Lymphokine activated killer (LAK) cells are clearly an important component in the immune systems arsenal against cancer cells. The proliferation of these cells is known to be dependent upon the action of cytokines, and studies are being performed to evaluate the role of various factors in the differentiation and proliferation of this specific cell type. The aim of this project is the evaluation of the effects of two major cytokines, IL-2 and interferon gamma, to determine if they act synergistically on LAK cell cytotoxicity against cancer cells. Freshly isolated lymphocytes were initially stimulated for 24 hours with 500 units of IL-2. The cells were then harvested and plated in 12 well culture plates and incubated with 1000 units of IL-2 and 1000 units of INF- for an additional 24 hours. At the end of this incubation period, the cells were transferred to well plates containing ME-180 cervical carcinoma cells and their cytotoxic effects were determined. The results of these experiments indicate that this treatment protocol resulted in 42% cytotoxicity which represents a 15% increase over treatment with IL-2 alone. The presence of LAK cells was confirmed by the binding of anti-CD16.

THE POPULATION DYNAMICS OF *Oryzomys palustris*, THE MARSH RICE RAT, FROM EASTERN SHORE TIDAL MARSHES. John A. March Jr.* and Dr. Robert K. Rose, Dept. of Biol., Old Dominion Univ., Norfolk Va. 23508. A year-long mark-and-recapture study was conducted on two grids located in coastal tidal marshes on the Eastern Shore of Virginia. Population densities of *Oryzomys palustris* were greatest in late summer and early winter. *Microtus pennsylvanicus* cohabited the study areas with *O. palustris*, and was present in greater numbers from May to July. Previously, few studies on the relationship of microtine rodents with other small mammals have been conducted.

THE IMPORTANCE OF PLANT SECONDARY COMPOUNDS TO HIGHER TROPHIC LEVELS: EFFECTS OF SINIGRIN ON THE CABBAGE BUTTERFLY, *PIERIS RAPAE* AND ITS HYMENOPTERAN PARASITOID, *COTESIA GLOMERATA*. Julie A. McNichol & D.N. Karowe, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. The effects of the plant secondary compound sinigrin, on the small white cabbage butterfly, *Pieris rapae*, and its hymenopteran parasitoid, *Cotesia glomerata*, were investigated. When fed diets containing sinigrin, *P. rapae* displayed increased relative consumption rate and relative growth rate, and decreased fifth instar duration. In contrast, average adult male wasp weight and host-parasitoid complex weight were both significantly lower when the caterpillars were fed a diet high in sinigrin. Neither wasp larval nor pupal mortality was affected by sinigrin. Hypotheses for the method of wasp exposure to and a general mode of action for sinigrin are presented. (Supported by a grant from the Undergraduate Research Program of Va. Commonwealth Univ.)

EFFECTS OF SALT-TREATED WOOD ON FEEDING AND SURVIVORSHIP IN TERMITES (RHINOTERMITIDAE; RETICULITERMES) FROM COASTAL AND INLAND FORESTS. Susan E. Morlino & Deborah A. Waller, Dept. of Biol. Sci., Old Dominion Univ., Norfolk, Va. 23529. Logs containing termites in a tidal wetland forest on the Eastern Shore of Virginia are frequently submerged under brackish water during high tides. We used choice and no-choice feeding tests to examine termite response to filter paper and wood blocks treated with solutions of differing salt concentrations. We compared termite feeding and survivorship responses to different salt treatments for termites from coastal tidal forests and from inland forests. Salt concentration had a significant effect on termite response, but there were no differences in response among termites from coastal versus inland habitats.

RESCUING ENDANGERED SPECIES: PARTULA ON MOOREA. James Murray, Dept. of Biol., Univ. of Va., Charlottesville, VA 22903, & Bryan Clarke*, Dept. of Genetics, Univ. of Nottingham, NG7 2UH, England. The land snails of the genus Partula have been studied as a model of evolutionary processes for more than 100 years. Unfortunately, an ill-considered introduction of the predatory snail Euglandina rosea, intended as a biological control for the Giant African Snail Achatina fulica, has resulted in the complete extirpation of the native snails. With the help of a number of zoos we have maintained breeding colonies of several of the Moorean species in captivity, and we hope eventually to be able to restore them to the wild. As a pilot project we have built an enclosure on Moorea housing three of the species, protected behind physical, chemical, and electrical barriers. The species in the enclosure have survived for six months and have begun to produce offspring. The enclosure experiment is designed to provide us with information about the interaction of the species with one another. (Supported by a grant from the University of California, Berkeley, through their Richard B. Gump South Pacific Biological Research Station.)

THE EFFECTS OF CHEMOTHERAPEUTIC AGENTS ON ME-180 CELLS AND p53 PRODUCTION. Katharine W. Nowell, Gary L. Brown and Rosemary Barra, Department of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. The p53 gene is an important regulatory gene for cell division. Recent studies indicate that the p53 protein functions as a transcription factor, binding upstream response elements to inhibit cell cycle progression. The mutated form of p53 is associated with the majority of human cancers and thus normal p53 is considered a suppressor protein.

The goal of this study was to determine the level of expression of p53 in ME-180 cells and to determine if doxorubicin treatment increases p53 expression. The p53 protein was isolated from ME-180 cells using immunoprecipitation and immunoblot procedures. The results indicate that low level p53 production is present in ME-180 cells and that the level is increased by the DNA damage associated with doxorubicin treatment.

BROWN-HEADED COWBIRD (MOLOTHRUS ATER) RANGE EXPANSION INTO THE SOUTHEAST: EFFECTS ON POULATIONS OF SELECTED PASSERINES. Elizabeth A. Pruitt and Robert K. Rose, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. The Brown-headed Cowbird is an obligate brood parasite and host generalist. Because it is able to exploit a number of hosts, it is not limited by the density of a single species and can rapidly increase its numbers when expanding into new regions, threatening individual species. The objectives of this study are to determine the current breeding range of the Brown-headed Cowbird in the southeast, to document how densities within this range have changed over the study period and to determine how this invasion has affected several species of warblers and vireos which are potential hosts. The data used in this analysis was collected by the North American Breeding Bird Survey from 1966 through 1992 in Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama and Tennessee.

PATTERNS OF REPRODUCTION IN THREE SPECIES OF RODENTS IN NATURAL AND IRRIGATED FIELDS IN NORTHERN NIGERIA. Safianu Rabi and Robert K. Rose, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529-0266. We studied the breeding patterns of Arvicanthis niloticus, Mastomys natalensis and Tatera valida in natural and irrigated fields near Kano, Nigeria, from July 1990 to June 1992. In the natural fields all species showed strict seasonal breeding in the rainy months (May-October), with Arvicanthis starting at the same time as the onset of the rains but a month or two ahead of Mastomys and Tatera. The peak of breeding activity for all species was in J u l y - September. Mean number of 8.61 embryos was highest in Mastomys, followed by 5.30 and 3.41 embryos in Arvicanthis and Tatera, respectively. In contrast to reproduction in the natural fields, the breeding seasons in Arvicanthis and Mastomys in the irrigated fields were continuous. However, significantly larger reproductive organs and marginally larger mean litter sizes were observed during the rains compared to the dry months. These changes in gonadal sizes were influenced by seasonal changes that were unrelated to larger animals having larger gonads. Surprisingly, Tatera was completely absent from the irrigated fields. Thus, the responses to the application of irrigation water differed among the species.

EXTRACELLULAR CALCIUM REGULATES DIFFERENTIATION IN CULTURED EMBRYONIC CHICK DUODENA. J. Orion Rogers, Dept. of Biol., Radford Univ., Radford, VA. 24142.

This work ascertains the influence of extracellular calcium (Ca^{2+}) concentration in the absence and presence of the hormones thyroxine (T_4) and hydrocortisone (HC) on the development of the microvillar enzymes alkaline phosphatase (ALP) and the disaccharidases maltase (M) and sucrase (S). Duodena from 14-day-old chick embryos were cultured at 38° C for 48 h in Medium 199 containing either 0.7, 0.9, 1.3 or 2.8 mM Ca^{2+} in the absence or presence of hormones. In the absence of exogenous hormones, tissue ALP activity increases by 92% ($P < 0.005$) as extracellular Ca^{2+} is increased from 0.7 to 2.8 mM, but the activities of disaccharidases are not influenced by altering Ca^{2+} . In 1 nM T_4 -treated cultures tissue ALP activity increases by 138% ($P < 0.0005$) as Ca^{2+} is increased from 0.7 to 2.8 mM, but M activity of T_4 -treated tissue is not influenced by increasing Ca^{2+} . In 1 μM HC-treated cultures, tissue ALP activity increases by 80% as Ca^{2+} is increased from 0.7 to 0.9 mM, but further increases in Ca^{2+} do not influence ALP activity. HC stimulation of disaccharidase activity is unaffected by altering the extracellular Ca^{2+} . These data infer a role for Ca^{2+} in T_4 and HC mechanism of action.

THE SMALL MAMMAL COMMUNITY IN FORESTED WETLANDS OF SOUTHEASTERN VIRGINIA AS REVEALED BY PITFALL TRAPPING STUDIES. Robert K. Rose and Daryl H. Thomas, Dept of Biological Sciences, Old Dominion University, Norfolk, VA 23529.

Small mammals were studied using pitfall traps in forested wetland habitats in Chesapeake, Virginia. In all, 39 0.25 ha study grids were placed at 21 sites along Route 17; each square grid had 25 pitfall traps (#10 tin cans sunk into the ground) placed at 12.5 m intervals. The southeastern shrew was the most common mammal taken during 29,250 nights of pitfall trapping, occurring on 19 of 21 study sites and comprising 61% of the 267 small mammals caught. Eleven other species were taken, with short-tailed shrews (Blarina brevicauda, N=65) and white-footed mice (Peromyscus leucopus, N=11) the only ones in double digits.

NATURAL KILLER CELLS ARE NOT ESSENTIAL FOR LIPOPOLYSACCHARIDE-INDUCED EMBRYO LOSS IN CD-1 MICE. S. M. Schlager, E. M. Conors and A. F. Conway, Dept. of Biol., Randolph-Macon Col., and C. M. Conway, Dept. of Biol., Va. Commonwealth U. Involvement of natural killer cells in lipopolysaccharide-induced pregnancy loss (resorption) in CD-1 mice was studied by injecting pregnant CD-1 mice with either 0.2 ml of rabbit anti-asialo GM1 (Wako, control = 0.2 ml normal rabbit serum) intraperitoneally on day 7 (vaginal plug = day 1) of gestation or 0.05 ml of rabbit anti-asialo GM1 (Wako, control = 0.05 ml normal rabbit gamma globulin) intravenously on day 8 of gestation, both followed by intravenous injection of 0.05 ml of 0.1 mg/ml E. coli lipopolysaccharide (LPS, Sigma, control = 0.05 ml phosphate-buffered saline) on day 9 of gestation. All females were sacrificed by excess etherization on day 12 of gestation. Females treated with anti-asialo GM1 on day 7 or 8 followed by LPS on day 9 exhibited frequencies of pregnancy loss equal to or higher than the frequencies of pregnancy loss observed in females who received control treatments on day 7 or 8 followed by LPS on day 9 of gestation. Since the anti-asialo GM1 treatments were in excess of those needed to totally eliminate detectable natural killer cell populations, these results indicate that natural killer cells are not essential to the process of pregnancy loss by resorption induced by bacterial lipopolysaccharide.

HABITUATION OF AGGRESSIVE BEHAVIOR IN BETTA SPLENDENS. Jennifer Schuchert, Elsa Q. Falls, and Arthur F. Conway, Department of Biology, Randolph-Macon College, Ashland, VA 23005. Previous investigations have shown that aggressive behavior in fish is a reaction to the presentation of many kinds of external stimuli, including other fish, and that the behavior can be habituated under certain conditions. In this study the process of aggressive behavior habituation in Betta splendens males was investigated. The experiment compared the waning of aggressive behavior when males were exposed to one or two different stimulus fish of the same species every day over a period of twenty-one days. On day twenty-two, each experimental bettas was presented with a new fish. Results indicated that the habituation of aggressive behavior did occur over the twenty-one day period in both groups but at significantly different rates. The presentation of a new stimulus on day twenty-two did not produce significantly different aggressive behavior compared to day twenty-one.

AN INVESTIGATION IN SMALL MAMMAL HORMONE LEVELS:

RELEASE RATES OF TESTOSTERONE IMPLANTS. Erica A. Serabian, Department of Biology, Virginia Polytechnic Institute, 24061. Research supporting the use of testosterone implants as tools to increase aggressive behavior, along with the hypothesis that crowding effects the endocrine system; affecting reproductive condition leading to subsequent decline in population density, allows combination of these two ideas for application to field research. This investigation aimed to determine the average level of testosterone of mice treated with 1.0 and 1.5 mg testosterone implants. Six mice were injected with empty 10 mm Silastic tubing capsules (shams), seven mice were injected with 1.0 mg implants, and six mice were injected with 1.5 mg implants. Blood samples were taken on days 4, 7, and 14 by the orbital sinus bleeding method. Plasma was extracted; then analyzed by radioimmunoassay. There were significant differences found among treatments; the mean levels of testosterone differed among treatment groups ($P=0.001$). The effect of day was not significant ($P=0.28$), suggesting that effects of the implants were maintained throughout the investigation period. Group 1 (shams) consistently had higher and more variable testosterone levels than groups 2 and 3 (implants of methyl testosterone). Although the investigation did not accurately determine the release rates of the implants, it did show that controls and shams were not different. Implants filled with methyl testosterone suppressed natural testosterone and variation among individual testosterone levels. This supports the hypothesis that hormone implants are useful tools for research, as they can reduce individual variation and control testosterone levels.

IMPACT OF COPPER ON BENTHIC MACROINVERTEBRATES IN AN APPALACHIAN HEADWATER STREAM: A PRELIMINARY ASSESSMENT OF A RESTORATION SITE. Alicia Slater, M. Sanchez, A. C. Hendricks, Dept. of Biol., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. Contamination by acid mine drainage has resulted in copper levels in East Prong Creek ranging from 16 to 23 ppb. The purpose of this study was to examine the effects of copper on benthic macroinvertebrate community structure and function prior to construction of a treatment wetland. Decreases in taxa richness ($\bar{n}=42$ at the reference site, $\bar{n}=26$ at the impacted sites) and abundance ($\bar{N}=768$ at the reference site, $\bar{N}=140$ at the impacted sites) were accompanied by a shift in community composition. Mayflies (Ephemeroptera) were the dominant taxa at the reference site, while true flies (Diptera) were dominant at the impacted sites. Decomposition rates of red maple (*Acer rubrum*) leaves were measured to determine the effects of copper on macroinvertebrate community function. Red maple leaves decomposed faster at the reference site ($k=0.048$) than at the impacted sites ($k=0.020$).

DISTRIBUTION OF MARSH RICE RATS (*ORYZOMYS PALUSTRIS*) AND MEADOW VOLES (*MICROTUS PENNSYLVANICUS*) IN A TIDAL MARSH ON THE EASTERN SHORE OF VIRGINIA. Allison L. Sowell * and Robert K. Rose, Dept. of Biol., Old Dominion Univ., Norfolk, VA. 23529. Relationships can frequently be seen between habitat structure and habitat use by small mammal species. Distribution patterns are influenced by seasonal changes in habitat structure. Although rice rats and meadow voles are both found in Eastern Shore marshes and show extensive overlap of their ranges, each species has specific habitat and niche preferences that prevent competition to the exclusion of the other species. Seasonal comparisons between species and their associated habitats show which elements of habitat structure are most important to each species. Live trapping with mark and recapture allowed for month by month examination of the movements of individual animals for as long as they remained active on the trap grids. (Supported by a grant from the Nature Conservancy)

CHEMICAL BASIS FOR THE ATTRACTION OF THE BLACK SWALLOWTAIL BUTTERFLY TO FENNEL. Leena M. Sumitra & Richard R. Mills, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284-2012. Methanol-water extraction of fennel and subsequent removal of hydrophobic components with chloroform yielded a preparation containing polar compounds. Column chromatography on silica gel resulted in the separation of five different compounds that absorbed at 280 nm. Scans from 200 nm to 800 nm revealed spectra that matched two furanocoumarins, bergapten and xanthotoxin. We have concluded that furanocoumarins are present in fennel and they may be responsible for the chemical basis of host plant selection by the Black Swallowtail butterfly. (Supported by the Va. Commonwealth Univ. Undergraduate Research Grant Program)

NEST BOX USE BY WILD POPULATIONS OF WHITE-FOOTED MICE (*PEROMYSCUS LEUCOPUS NOVEBORACENSIS*) IN EASTERN VIRGINIA. C. Richard Terman, Laboratory of Endocrinology and Population Ecology, Department of Biology, College of William and Mary, Williamsburg, VA 23185. A population of white-footed mice on an 11-ha area was studied monthly during 1983-1989 with 600 live-traps and 254 wooden nest boxes attached to trees at 20 m intervals. Location, sex, age, body weight, and reproductive condition of individual animals were recorded. Data from nest boxes were consistent with those obtained via trapping, but rarely did more than 40% of the population occur in the nest boxes. Nest box use declined to less than 10% of the population during the summer (May-September). Nest box occupancy was inversely related to environmental temperature, i.e., less than 20% of the population occurred in nest boxes when the monthly minimum temperature rose above 8 C.. Other nest box techniques, perhaps subterranean nest boxes, appear to be required to study white-footed mice during the critical mid-summer breeding hiatus.

CONSEQUENCES OF TAIL AUTOTOMY ON *ANOLIS CAROLINENSIS*. Lowell W. Whitney and Werner Wieland, Department of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Effects of caudal autotomy on the running speed and activity level in *Anolis carolinensis* were investigated. Tailed and autotomized lizards were chased down a track to measure running speed. The number of movements tailed and autotomized lizards made in an activity chamber were used as a measure of activity level. Tailed individuals were 50% faster ($p = 0.0006$) and showed a 24% higher activity level ($p = 0.04$) than did individuals that suffered a loss of their tail. This pattern is not, however, found in all lizards reported to exhibit caudal autotomy. Two patterns concerning the effects of caudal autotomy on running speed in lizards were observed. A decrease or increase in running speed after autotomy may be consistent within a family or infraorder. Also, the effect of autotomy on running speed and perhaps activity level may be correlated with tail size in lizards. Results from this study are consistent with both of these observations. Many species which undergo caudal autotomy have not been examined with regard to its effects on running speed or activity level. Additional studies should also examine the relationship between tail size and running speed in autotomized lizards.

THYROID HORMONES IN THE YOLK OF JAPANESE QUAIL EGGS. C. Morgan Wilson. Dept. of Biol., Va. Polytechnic Inst. and State Univ., Blacksburg, Va. 24061. Maternal thyroid hormones (THs) in egg yolk may be important in early avian development prior to the function of the embryonic thyroid gland. To evaluate this idea, I first developed methods for altering thyroid status of laying hens and for the extraction and measurement of THs in avian egg yolk. To develop a protocol for making hens hyperthyroid, laying hens were given a single oral dose of thyroxine (T4) of 3X-6X thyroid secretion rate (TSR: 2.8ng T4/100g body wt.). All doses significantly increased plasma T4; from < 14ng T4/ml to sustained concentrations of ≥ 80 ng T4/ml for hrs 3-6 after dosing; by 12 hrs, plasma T4 levels had dropped considerably. These data indicate twice daily dosing of hens is necessary for sustained elevation of plasma THs. To determine the number of days of T4 administration likely to produce eggs with elevated T4, I administered two lipid soluble dyes orally on alternate days for 8 days. Results showed 5 alternating colored rings (i.e. days) of yolk deposition per egg. To verify a methanol/chloroform extraction procedure for extraction of yolk T4 and the use of extracts in a TH radioimmunoassay, I demonstrated consistent recoveries of THs and accurate measurement of THs in extracts spiked with hormone. Based on the above methods, laying hens were dosed twice daily at 3X TSR to address the ability of hyperthyroid hens to transfer increased concentrations of T4 to their eggs. Currently, I am analyzing TH yolk extracts from the eggs of hens that received 3X T4 twice daily. (Supported by grants from Sigma Xi and the Graduate Research Development Project (Graduate Student Assembly of Va. Tech.))

THE DIET OF *Oryzomys palustris* BASED ON STOMACH CONTENT ANALYSIS. Shannon L. Wright*, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529 & Robert K. Rose, Dept. of Biol., Old Dominion Univ., Norfolk, VA 23529. The purpose of this study is to analyze the diet of *Oryzomys palustris*, the marsh rice rat, which is unusual in that it is one of two carnivorous mammals in the Family Muridae in North America. This is being accomplished by taking the animals from two study areas located in tidal marshes on the Eastern Shore of Virginia for a period of one year. Once caught, the animals are being sacrificed and their stomach contents examined. The contents are being identified to the lowest taxonomic level possible. This study will provide important information about the role of the rice rat as a consumer in its communities, and especially in tidal marshes on the Eastern Shore of Virginia.

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Botany

PATTERNS OF FOREST COMMUNITY COMPOSITION ON THE FERNOW EXPERIMENTAL FOREST AND ADJACENT PORTIONS OF OTTER CREEK WILDERNESS AREA. H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422, S. L. Stephenson, Dept. of Biology, Fairmont State College, Fairmont, WV 26554, R. Muzika*, USDA For. Serv., 180 Canfield St., Morgantown, WV 26505, D. M. Lawrence, Tree-Ring Lab., Lamont-Doherty Earth Obs. of Columbia Univ., Palisades, NY 10964, and G. W. Miller*, USDA For. Serv., Timber and Watershed Lab., Parsons, WV 26287. During the 1994 field season, quantitative data on composition and structure of the tree stratum (stems ≥ 10 cm DBH) were obtained from 105 twenty by fifty meter (0.1 ha) quadrats in the Fernow Experimental Forest and adjacent portions of the Otter Creek Wilderness Area in Tucker County, West Virginia. The study area is within the Allegheny Mountain section of the unglaciated Allegheny Plateau. Fifteen different species occurred as leading dominant in at least one quadrat. The most common examples were northern red oak (25 quadrats), yellow-poplar (22), sugar maple (15), and red maple (11). Positions of tree species along the first axis of a Detrended Correspondence Analysis (DCA) ordination derived using species importance values (one-half the sum of relative density and relative basal area) seemed to be most closely related to a moisture complex-gradient, whereas positions along the second axis appeared to correspond to an elevation complex-gradient. TWINSpan analysis of the 105 quadrats delineated eight forest types, which were named on the basis of their leading dominants. Forest types represented by the greatest number of quadrats were northern red oak/sugar maple (39), yellow-poplar/sugar maple (27), northern red oak/red maple (15), and chestnut oak/red maple (14). (Supported in part by funds provided by the USDA Forest Service.)

SHORT-TERM DYNAMICS OF RED SPRUCE/HARDWOOD ECOTONES IN THE CENTRAL APPALACHIANS OF VIRGINIA AND WEST VIRGINIA. H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422, S. L. Stephenson, Dept. of Biology, Fairmont State College, Fairmont, WV 26554, M. B. Adams*, USDA For. Serv., Timber and Watershed Lab., Parsons, WV 26287, D. M. Lawrence, Tree-Ring Lab., Lamont-Doherty Earth Obs. of Columbia Univ., Palisades, NY 10964, and J. D. Eisenback, Dept. of Plt. Path., Phys., and Weed Sci., Va. Poly. Inst. and St. Univ., Blacksburg, VA 24061. We are investigating patterns of species composition and distribution, ecologically important population processes, and microenvironmental gradients along ten permanent transects (each consisting of a series of contiguous 10 X 10 m quadrats) established across the typically abrupt and narrow spruce/hardwood ecotone at seven localities in the mountains of eastern central West Virginia and western Virginia. Data obtained for three growing seasons along five transects show that densities and basal areas of trees have exhibited no definite directional shift in position of the ecotone. Densities of hardwood and conifer saplings have displayed slight increases at opposing ends of the transects. Seedling densities, though episodic, evidenced decline for both hardwoods and conifers in the most recent tally. Herbaceous cover has tended to decrease in all segments of the transects. Bryophyte cover has decreased in the hardwood and ecotone segments, but increased somewhat in the conifer segment. Our data at least suggest that red spruce communities in the central Appalachians presently exist in static equilibrium with respect to surrounding hardwoods and exhibit, at some localities, some evidence of advance regeneration into the hardwood communities. (Supported in part by funds provided by the USDA Forest Service.)

CREEPING BENTGRASS AND ANNUAL BLUEGRASS GERMINATION RESPONSE TO PROPICONAZOLE. Bigelow, C. A., R. J. Stipes and D. R. Chalmers, Virginia Tech, Blacksburg, VA 24061-0331.

Creeping bentgrass (*Agrostis stolonifera* var. *palustris* (Huds.) Farw.) and annual bluegrass (*Poa annua* var. *annua* L.) seeds were tested for their germination response to propiconazole formulations under laboratory conditions. Seeds of both species were germinated in petri dishes at log concns. (0, 1, 10, 100, 1000 ppm) of two propiconazole formulations: a water-based formulation (Alamo) and an organic solvent-based formulation (Banner). At concentrations greater than 100 ppm, both species had significantly less germination percentages than the untreated control or the 1 and 10 ppm solutions of both formulations. At 100 ppm propiconazole there was significantly less germination of seed treated with Alamo compared to those treated with Banner. At concns. of 1000 ppm seed germination of both species was almost inhibited. These tests illustrate that the Alamo formulation seems to be more effective in penetrating seed coats; this might be attributed to a wetting agent or other additives. Propiconazole is an important fungicide in the maintenance of fine quality turfgrass and of ornamental plants and trees. These tests suggest possible explanations of how turfgrass seed germination might be affected when overseeding is done of established turf treated with propiconazole.

VEGETATION OF HIGH-ELEVATION NORTHERN RED OAK (*QUERCUS RUBRA*) FORESTS OF THE CENTRAL VIRGINIA BLUE RIDGE. Philip P. Coulling, Dept. of Biol., Univ. of N.C. at Chapel Hill, Chapel Hill, NC. 27599-3280. Forty-one 0.1-ha vegetation plots in *Quercus rubra* stands \geq 915 m elevation were sampled as part of an ongoing study of the impact of defoliation by gypsy moth on forest understory dynamics. Stands were located in the central Blue Ridge Mountains of Virginia, between the James River and Rockfish Gap, and were distributed over three types of parent material: volcanic (Catoctin metabasalt), plutonic (charnockite), and metasedimentary (Chilhowee Group). In each plot presence and cover estimates of all vascular plant species were recorded in a series of nested quadrats, and diameters of all woody stems \geq 1.3 m in height were measured. Species richness of both trees and herbs was highest on metabasalt sites; herb richness and cover were lowest on metasedimentary sites. A general gradient of decreasing soil fertility occurs from metabasalt to charnockite to metasedimentary rock, although this pattern is not consistent across all sites. Nearly half of the stands on charnockite had herb layers heavily dominated by *Dennstaedtia punctilobula*; charnockite sites with coarser substrate had lower *Dennstaedtia* and total herb cover and higher abundance of composites and deciduous ericads. Contrary to some previous studies in the region, no stands had high importance of *Q. alba*; on flat high-elevation sites *Setula lenta*, *Carya glabra* or *C. ovata* was often secondary in importance to *Q. rubra*. Size distributions typically show a single peak of *Q. rubra* density at 15-30 cm dbh, although a few stands exhibit bimodal size distributions, with a secondary peak at 2.5-5 cm.

DELIVERY OF MACROMOLECULES INTO INTACT PLANT CELLS VIA PLASMOLYSIS FOLLOWED BY ELECTROPORATION. Carla E. Hegeman & F.S. Wu, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. Plant cells can be genetically transformed by electroporation, provided that foreign DNA is in direct contact with the cell membrane. *Glycine max* suspension culture cells were plasmolyzed in various concentrations of sucrose containing plasmid DNA harboring a reporter gene. As the cell membrane pulled away from the cell wall, DNA in the solution was pulled through the pores in the cell wall and accumulated in the void space. This allowed for DNA to contact the cell membrane without removal of the cell wall. Electroporation was then performed to form temporary pores in the cell membrane to allow passage of DNA into the cell. Enzyme assays for the expression of the reporter gene were performed. Higher enzyme activity was detected in cells that received a 0.2 M sucrose pretreatment.

REPRODUCTIVE BIOLOGY OF ARCHAEOPTERID PROGYNMOSPERMS.

Stewart A. Hill and Stephen E. Scheckler, Dept. of Biology, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. The progymnosperms, an extinct group of free-sporing, homosporous or heterosporous plants with gymnospermous secondary tissues from the Middle Devonian to Lower Carboniferous, are considered probable ancestors of seed plants. Recent comparisons of progymnosperms (including Archaeopteridales, Aneurophytales, and Protopytales) to seed plants have been based mainly on vegetative structure. A preliminary assessment will be presented based on reproductive characters of evolutionary hypotheses that specifically link archaeopterid progymnosperms to various seed plant groups. New information pertinent to this question includes general sporangium design, fertile branch construction, spore size distribution, and confirmation that archaeopterids are ancestrally heterosporous.

PHYTOPLANKTON COMPOSITION IN CHESAPEAKE BAY. H.G. Marshall, Dept.

Biological Sciences, Old Dominion Univ., Norfolk, Va. 23529-0266. Based on collections taken over three decades in the Chesapeake Bay, the author has identified 708 phytoplankton taxa. These include 360 Bacillariophyceae, 125 Dinophyceae, 87 Chlorophyceae, 38 Cyanophyceae, 24 Haptophyceae, 22 Euglenophyceae, 22 Chrysophyceae, 17 Cryptophyceae, 9 Prasinophyceae, and 4 Xanthophyceae. Abundance and productivity maxima (3) occurred during late winter-early spring, summer, and early fall through a sequence of successional stages. Greater concentrations and higher productivity is generally associated with the western Bay. The flora is dominated by diatoms throughout the year, being supplemented by phytoflagellates during spring, summer and fall, and by cyanobacteria in summer. Sporadic bloom events have been associated mainly with dinoflagellates during summer and early fall. Eleven toxin producing species were also identified. Supported in part by the Virginia Dept. of Environmental Quality and EPA.

USE OF MULTIMEDIA INSTRUCTION IN BOTANICAL EDUCATION. Michael H.

Renfroe, Dept. of Biology, James Madison University, Harrisonburg, VA 22807. The development and availability of multimedia authoring programs is facilitating the presentation of traditional, factual information in the botanical sciences. Multimedia presentations allow incorporation of photographs, audio tracks and video clips. Programs can create instructional modules that can be used as tutorial guides to introduce concepts, methods, and materials prior to students conducting laboratory exercises. Instructional programs can be designed to train students in anatomy and morphology in an interactive fashion. Programs also can operate in a test mode in which students are quizzed, yet have the ability to reveal answers and check their responses. Advantages of multimedia authoring programs include the ability to present information from disparate sources such as microscopic and macroscopic specimens. Specimens can be viewed on different scales and perspectives without having to have various pieces of equipment available to the students. Finally, students may view the programs at their own convenience and as often as they need to master the concepts. Other applications, advantages and disadvantages of multimedia instructional modules will be discussed.

APPRAISING THE SPECIES COMPOSITION OF THE DIATOMGENUS PSEUDONITZSCHIA IN THE SOUTHERN CHESAPEAKE BAY. Stephanie Roback and H.G. Marshall, Dept. Biological Sciences, Old Dominion University, Norfolk, Va. 23529-0266.

Pseudonitzschia (Nitzschia) pungens multiseriis, a producer of the toxin domoic acid, was reported in the Chesapeake Bay three decades ago by Hasle (1965). The distinction between this species and other members of this genus can only be determined with electron microscopy so separating this species from others in this genus would be unlikely with light microscopy. Using archived water samples from the Chesapeake Bay that go back 20 years, a search was undertaken to determine if this species was still in the Bay. The results indicated three Pseudonitzschia species present in the Bay, but Pseudonitzschia pungens multiseriis was not found. Pseudonitzschia pungens pungens has the dominant form over these past two decades, with Pseudonitzschia seriata noted infrequently during the colder months. However, Pseudonitzschia pseudodelicatissima, a newly reported species for the Bay, is in samples dating to the late 1980's and preliminary results indicate this species is becoming more dominant in the lower Bay, with P. pungens pungens decreasing in comparison. Of note, is that P. pseudodelicatissima has also been reported as a potential domoic acid producer, so it is important to follow any increasing occurrence of this species as a potential toxin producer and nuisance species. Supported in part by the Old Dominion University Research Foundation.

LONG TERM TRENDS OF PHYTOPLANKTON POPULATIONS IN THE SOUTHERN CHESAPEAKE BAY. David Seaborn, M. Weinstein, S. Olek, B. Hiller H.G. Marshall, and R.W. Alden. Dept. Biological Sciences, Old Dominion Univ. Norfolk, Va. 23529-0266.

This study represents one component of the lower Chesapeake Bay Phytoplankton monitoring program in which trend analysis statistics were applied to the data set between 1985-1992. The results indicated twenty-three significant ($p < 0.01$) trends. These included a decrease across the entire lower Chesapeake Bay in phytoplankton abundance above and below the pycnocline. There were also trends of decreasing number of taxa, above and below the pycnocline, at all stations during each month from March through October. There were monthly differences in the trends (negative:spring and positive:winter) for diatom abundance below the pycnocline over this time period. Supported by the Virginia Dept. of Environmental Quality and EPA.

THE VIRGINIA PITCHER PLANT BOGS. PART THREE. IS THERE INBREEDING OR OUTBREEDING DEPRESSION IN THE YELLOW PITCHER PLANT SARRACENIA FLAVA L. IN VIRGINIA? Philip M. Sheridan and David Karowe, Dept. of Biol., Va. Commonwealth Univ., Richmond, Va. 23284. The Yellow Pitcher Plant, Sarracenia flava L., is an insectivorous plant restricted to fire maintained wetland ecosystems in southeastern Virginia. Only six scattered sites remain in the state with an average population of thirty-six clumps covering a quarter of an acre each. One site each from Dinwiddie, Prince George and Nansemond Counties was tested for the effect of self-pollination (inbreeding), intra-site and inter-site outcrossing on total seed number, total seed weight and average seed weight. In all sites, self-pollination resulted in significantly lower total seed number and total seed weight. Means for self-pollinated capsules were approximately one-fourth the yield of outcrossed capsules; this suggests strong inbreeding depression in all 3 sites. For Dinwiddie plants however, total seed number was significantly lower for inter- than for intra-site outcrossed capsules but the reverse was observed for Nansemond plants and there was no difference among the Prince George plants. Such a pattern might arise if S. flava populations differed in the extent of adaptation to local site conditions.

"A TREE GROWS IN VIRGINIA." R. Jay Stipes and H. L. Witt, Dept. Plant Pathol., Physiol. and Weed Sci., Virginia Tech, Blacksburg, VA 24061-0331. This paper is a take-off on Betty Smith's 1943 novel, "A Tree Grows in Brooklyn," in which the tree was Ailanthus altissima or "Tree of Heaven." This tree was introduced in 1784, and has since become naturalized, invasive and harmfully competitive with the native tree flora. We conducted a "windshield survey" along roadsides and medians from Christiansburg, VA on Interstate 81 up to Staunton, VA, and thence on Interstate 64 to Richmond. We found it along 33% of the 102 miles of I81, and 27% of the 90 miles of I64. We counted from 9 up to 152 stems per "clump" or "grove" in 10 of them on I81. There is a decline in this dioecious species which may be due to climatological and/or pathogenic stress such as *Verticillium* wilt, yet to be studied and documented. However, it seems to thrive along these highways because of its "preference" for neutral or alkaline soils, and also because of its seed dissemination by the very heavy vehicular traffic. Because this tree is an invasive exotic, there is concern of its potential to out-compete desirable tree flora, and therefore contribute to the loss of indigenous biodiversity and/or merchantable lumber in the Appalachians.

VASCULAR FLORA OF THE CORROTOMAN RIVER WATERSHED, LANCASTER COUNTY, VIRGINIA. Troy W. Weldy and Donna M. E. Ware. College of William and Mary, Department of Biology, Williamsburg, VA 23187.

A study of the vascular flora of the Corrotoman River watershed, Lancaster County, Virginia has provided a number of additional records to the county's flora. Located at the southeastern tip of the Northern Neck, the study area of 229 square kilometers, is entirely within the inner coastal plain physiographic region. As of May 22nd, 1995, a total of 733 different species have been identified, including 183 county, 39 peninsula, and 1 coastal plain record. Among these, the Virginia Heritage has listed the following as rare within the Commonwealth: *Fleischmannia incarnata* (S2), *Habenaria peramoena* (S2/3C), *Lechea villosa* (S3), *Quercus margaretta* (S3), *Sabatia dodecandra* (S3), *Stewartia ovata* (S2), and *Triglochin striatum* (S3). The *Stewartia ovata* population is the "lost" population originally discovered by Winfred Harvey and J.T. Baldwin. The study also includes vegetational analysis of representative forest stands using the Bitterlich-circular-quadrat sampling method and phytogeographic analysis of all documented species.

Chemistry

SYNTHESIS AND SPECTROSCOPIC STUDIES OF LIGAND BINDING ON THE PHOTOPHYSICAL PROPERTIES OF A RHENIUM COMPLEX. Siyoung Ahn*, D. S. Amenta, B. A. DeGraff, Dept. of Chemistry, James Madison Univ., Harrisonburg, VA 22807 and J. A. Mosbo, College of Natural Sciences & Mathematics, Univ. of Central Arkansas, Conway, AR 72035-0001. Preliminary evidence indicates that the photophysical properties of transition metals whose ligands contain crown ethers change upon addition of simple cations. The object of this research was to synthesize, characterize, and study the spectroscopic characteristics of rhenium complexes whose ligands contained a crown ether or a crown model. The substituting ligands were either 4'-isocyanobenzo-15-crown-5 or 3,4-dimethoxyisocyanobenzene. The resulting products were then characterized by NMR, IR, UV/VIS, and emission spectroscopy. The object was to determine what effect the cation binding would have on the luminescence of the rhenium crown ether complexes.

SIMULATION OF DISTANCE DISTRIBUTIONS IN PEPTIDES USING MOLECULAR DYNAMICS. David R. Bevan, Dept. of Biochemistry, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. It is important when applying molecular modeling techniques to validate the computer simulation methods by comparing the results with experimental data. We are using molecular dynamics to study the motional properties of peptides, for which corresponding data are available from fluorescence resonance energy transfer experiments. Using molecular dynamics simulations, we computed the distance distribution between a naphthalene fluorescence energy donor and a dansyl acceptor bound to a peptide consisting of N^5 -(2-hydroxyethyl)-L-glutamyl repeating units. These data were fit to a Gaussian distribution which, under some simulation conditions, is in reasonable agreement with that determined by energy transfer. From these computations, we can begin to determine the simulation conditions under which molecular dynamics will reproduce experimental results. Moreover, the computational methods may provide additional insight into molecular events that occur on a timescale that is not readily accessible experimentally.

SYNTHESES AND SPECTROMETRIC PROPERTIES OF TRIKETONES, PYRIDONES, AND PYRONES. Sandra Boatman and Ellen K. James, Dept. of Chemistry, Hollins College, Roanoke, VA 24020. This research compares the absorption and fluorescence spectra of several 1,3,5-triketones and the 4-(1*H*)-pyridones and 4*H*-pyran-4-ones derived from them. The IR spectra of all three kinds of compounds displayed C=O stretch absorbances: triketones, free and intramolecularly H-bonded, and pyridones and pyrones, α - β unsaturated. The UV spectra displayed absorbances typical of $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions. Fluorescence (weak) was observed only for triketones with *p*-methoxyphenyl and 2-naphthyl groups. Pyrones also fluoresced only weakly. Pyridones fluoresced strongly to give single emission maxima when excited at all absorbance maxima for the particular compound.

THE ADSORPTION OF N,N' -DISALICYLIDENE-1,2-PROPANEDIAMINE ON 304 STAINLESS STEEL. C.C. Chusuei, Chemistry Dept., George Mason Univ., Fairfax, VA 22030 and Geocenters Inc., Ft. Washington, MD 20744, J.A. Schreifels*, Chemistry Dept., George Mason Univ., Fairfax, VA 22030 and R.E. Morris*, Chemistry Div., Naval Research Lab., Washington, D.C. 20375-5000. N,N' -disalicylidene-1,2-propanediamine is a jet fuel additive that has been shown to reduce the formation of insoluble gums in fuel tanks and on fuel injector nozzles. X-ray photoelectron spectroscopy (XPS) and temperature programmed desorption (TPD) were used to study the interaction of the additive on oxide and oxide-free 304 stainless steel surfaces. These experiments were undertaken to gain an understanding of how the additive reduces insoluble gum formation on nozzles of jet engines. The temperature of the substrate was varied to simulate operating conditions of an aeroengine. Shifts in the XPS binding energy denoted thermal decomposition. TPD data showed that the molecule decomposed/converted to other species. Redhead activation energies were calculated for the chemisorbed state and the mechanism of its adsorption was studied.

THE SYNTHESIS AND STUDIES OF $(\eta^5\text{-C}_5\text{H}_5)\text{M}(\text{CO})_x(\text{CH}_2\text{C}_6\text{H}_3\text{-15-Crown-5})$. Andrew M. Dattelbaum, D. S. Amenta, Dept. of Chemistry, James Madison Univ., Harrisonburg, VA 22807 and J. A. Mosbo, College of Natural Sciences & Mathematics, Univ. of Central Arkansas, Conway, AR 72035-0001. The purpose of this research was to synthesize, characterize and study the reactivity of transition metal complexes whose ligands contain crown ethers. One of the target molecules, $(\eta^5\text{-C}_5\text{H}_5)(\text{CO})_3\text{Mo}(\text{CH}_2\text{C}_6\text{H}_3\text{-15-crown-5})$ (1), was prepared from $[(\eta^5\text{-C}_5\text{H}_5)(\text{CO})_3\text{Mo}]^+$ and $\text{ClCH}_2\text{C}_6\text{H}_3\text{-15-crown-5}$ (2). The synthesis of 2 was accomplished from the reaction of 3,4-dihydroxybenzaldehyde with the dichloride of tetraethylene glycol, followed by NaBH_4 reduction of the resulting aldehyde to yield 4'-HOCH₂-benzo-15-crown-5. Treatment of this alcohol with thionyl chloride gave the desired 2. All intermediate products have been characterized by NMR spectroscopy. The rate of conversion of 1 into an acyl complex has been studied, in the presence and absence of added Na^+ , using external phosphine ligands.

SYNTHESIS, CHARACTERIZATION, AND REACTIVITY OF THE COMPLEXES $\text{Re}_2(\mu\text{-O}_2\text{C-}n\text{-C}_3\text{H}_4\text{N})_2\text{X}_2(\mu\text{-dppm})_2$ ($n = 3, 4$; X = Cl, Br; dppm = $\text{Ph}_2\text{PCH}_2\text{PPh}_2$). Anjana Mitra,* Ying-Qing Yu,* Kimberly R. Kongkasuwan,* and Daniel R. Derringer,* Dept. of Chem., Hollins Col., Roanoke, Va. 24020 and Kenton H. Whitmire,* Dept. of Chem., Rice Univ., Houston, Tx 77251. Reactions of $\text{Re}_2\text{X}_4(\text{dppm})_2$ (X = Cl, Br; dppm = $\text{Ph}_2\text{PCH}_2\text{PPh}_2$) with $\text{HO}_2\text{C-}n\text{-C}_3\text{H}_4\text{N}$ ($n = 3, 4$) in refluxing ethanol afford complexes of the type $\text{Re}_2(\mu\text{-O}_2\text{C-}n\text{-C}_3\text{H}_4\text{N})_2\text{X}_2(\mu\text{-dppm})_2$. Relatively short reaction times (≤ 30 min) yield *trans*- $\text{Re}_2(\mu\text{-O}_2\text{C-}n\text{-C}_3\text{H}_4\text{N})_2\text{X}_2(\mu\text{-dppm})_2$ while longer reaction times (several hours to several days) produce *cis*- $\text{Re}_2(\mu\text{-O}_2\text{C-}n\text{-C}_3\text{H}_4\text{N})_2\text{X}_2(\mu\text{-dppm})_2$. The *trans* species react rapidly with $(\text{C}_7\text{H}_7)\text{PF}_6$ in CH_2Cl_2 at room temperature to produce *trans*- $[\text{Re}_2(\mu\text{-O}_2\text{C-}n\text{-C}_3\text{H}_4\text{N})_2\text{X}_2(\mu\text{-dppm})_2]\text{PF}_6$. All of the complexes were characterized by infrared and electronic absorption spectroscopy and cyclic voltammetry, and the diamagnetic complexes, *viz.*, *trans*- $\text{Re}_2(\mu\text{-O}_2\text{C-}n\text{-C}_3\text{H}_4\text{N})_2\text{X}_2(\mu\text{-dppm})_2$ and *cis*- $\text{Re}_2(\mu\text{-O}_2\text{C-}n\text{-C}_3\text{H}_4\text{N})_2\text{X}_2(\mu\text{-dppm})_2$ were further characterized by ^1H and $^{31}\text{P}\{^1\text{H}\}$ NMR spectroscopy. One of the complexes, *viz.*, *trans*- $\text{Re}_2(\mu\text{-O}_2\text{C-}4\text{-C}_3\text{H}_4\text{N})_2\text{X}_2(\mu\text{-dppm})_2$ was characterized structurally by X-ray crystallography. (Supported by the Camille and Henry Dreyfus Foundation and the W. M. Keck Foundation.)

DISTANCE GEOMETRY APPROACHES TO THE MOLECULAR CONFORMATION PROBLEM. Steven G. Desjardins, Dept. of Chem., Washington and Lee Univ., Lexington VA 24450. The methods of distance geometry, as discussed by Havel and Crippen, are presented as a way to solve the molecular conformation problem. In these methods, molecules are treated as collections of points and lines subject to a set of geometric constraints, e.g., bond lengths and angles, torsional angles, and non-bonded distances, for which only certain solutions are available. Four points to consider are 1) the number of geometric constraints that are needed to solve for a unique molecular geometry, 2) the inclusion of chirality, 3) the use of empirical geometric information with limited precision, and 4) incorporation of this scheme into an energy minimization algorithm. These points will be discussed in connection with the EMBED algorithm of Havel and Crippen.

METAL OXIDE ASSISTED FLAMELESS COMBUSTION OF METHANOL. Jennifer A. Condon* and Thomas C. DeVore, Dept. of Chemistry, James Madison University, Harrisonburg, VA 22807 Interest in the reaction mechanisms that occur during Chemical Vapor Deposition (CVD) processes has increased during the past decade. Evolved Gas Analysis- Fourier Transform Spectroscopy has been used to investigate the chemical reactions that occur as metal films are generated during the thermal decomposition of metal 2,4-pentanedionato complexes (Metal = Ni, Cu, Zn). Reduction of the metal oxide formed during the initial decomposition by the organic ligand is a main reaction in the production of the metal film. The reduction of nickel oxide films by methanol under CVD conditions indicated that this reaction is 0.5 order in methanol and has an apparent activation energy of $490 \pm 10 \text{ kJ mol}^{-1}$. A reaction mechanism that accounts for the reaction order in methanol and this very large activation energy has been developed. The rate limiting step in the mechanism is the thermal decomposition of the metal oxide to form oxygen atoms. The oxygen atoms then rapidly react with organic radicals adsorbed on the surface.

EMPIRICAL MOLECULAR INTERACTION MODEL BASED ON SMALL MOLECULE HYDROPHOBICITY. Glen E. Kellogg & Donald J. Abraham, Dept. Of Med. Chem., VA Commonwealth Univ., Richmond, VA 23298-0540

For several years we have been developing a unique model for bimolecular interactions based on the simple experimental results from water/1-octanal solvent partitioning (Log P). The premise is that the solvent environment in which a molecule (or molecular fragment) is most soluble, when given a choice between polar and non-polar solvents, is not dissimilar from the binding environment that said molecule (or fragment) would seek in a protein receptor. Our model is designed to apply the experimental interaction and thermodynamic information content encoded in Log P to significant and complex problems such as drug binding, intermolecular protein - protein interactions, protein-DNA interactions and protein folding. The presentation will be illustrated by results from recent investigations of hemoglobin subunit interactions and DNA/interactors interactions.

SOLID PHASE MICROEXTRACTION (SPME) DETERMINATIONS OF AROMATIC HYDROCARBONS IN WATER. Emily K. Knick, Thomas N. Gallaher* and James J. Leary, James Madison University, Department of Chemistry, Harrisonburg, VA 22807. Currently the Environmental Protection Agency's (EPA) approved method (524.5) for the determination of volatile organic compounds in water requires the use of purge and trap techniques. The instrumentation for this method is expensive and the analyses are time consuming. For semivolatiles compounds, the EPA approved method (625) requires elaborate preconcentration by liquid-liquid extractions using methylene chloride as a solvent. This is a lengthy procedure which generates considerable waste. The EPA and other regulatory agencies are trying to find new methods which minimize the use of solvents and simultaneously yield: lower detection limits, faster analysis times and greater reproducibility. Solid phase microextraction (SPME) is a new solventless technique for sample extraction and concentration which may provide an alternative to some of the current methods. The application of this new technique for determination of benzene, toluene, ethylbenzene and xylenes (BTEX) is presented. Preliminary emphasis has been placed on optimization of the extraction and instrumental parameters.

THE SPECIATION OF HEAVY METALS IN SOILS, SEDIMENTS, AND SLUDGES BY USING D.C. PLASMA ATOMIC EMISSION SPECTROMETRY COUPLED WITH ION CHROMATOGRAPHY. Stephen F. Macha and I.T. Urasa, Department of Chemistry, Hampton University, Hampton, Virginia 23668. There are several drawbacks associated with the successive extraction protocol commonly used in the determination of trace metals in soils, sediments, and sludges. The work described in this paper is an attempt to overcome these shortcomings by applying modern chromatographic and spectroscopic technology to the determination of trace metals in environmental samples. The research is based on the employment of direct current atomic emission spectrometry used in combination with ion chromatography (DCPAES-IC) to provide analytical information on the different forms of metal present in the various steps of the successive extraction protocol. The DCPAES-IC approach provides an additional dimension to the analytical procedure, providing speciation data and allowing the determination of the equilibrium concentrations and kinetics of the extraction process.

THE SYNTHESIS AND STUDIES OF AN ISOCYANO-ETHYL-SUBSTITUTED CROWN ETHER AND ITS TRANSITION METAL COMPLEX. Jill M. McFadden*, D. S. Amenta, Dept. of Chemistry, James Madison Univ., Harrisonburg, VA 22807 and J. A. Mosbo, College of Natural Sciences & Mathematics, Univ. of Central Arkansas, Conway, AR 72035-0001. When crown ethers are bound to a transition metal, the addition of a metal cation, such as Na^+ or K^+ , may substantially affect the catalytic properties of the complexes. In order to study these effects, crown ethers must first be synthesized which have groups such as the isocyanide function that can ligate to the transitional metal. Synthesis of the target ligand 4'-(2-isocyanoethyl)-benzo-15-crown-5 was undertaken from the corresponding formamide. The latter compound was obtained from the hydrogen bromide of dopamine. Synthesis of a transition metal complex was accomplished. All compounds have been characterized by IR and NMR spectroscopy.

SYNTHESIS AND CHARACTERIZATION OF POLYIMIDES PREPARED VIA DIELS-ALDER REACTION BETWEEN 3,3'-(OXYDI-*p*-PHENYLENE)BIS(2,4,5-TRIPHENYL-CYCLOPENTADIENONE) AND VARIOUS BISACETYLENES. Rooma M. Mehta and R.G. Bass, Dept. of Chemistry, Box 842006, Virginia Commonwealth Univ., Richmond, VA 23284-2006. As part of a program to develop high performance/high temperature polymers for potential use as composites and adhesives in various aerospace applications, a series of polyimides were prepared via the Diels-Alder reaction between 3,3'-(oxydi-*p*-phenylene)bis(2,4,5-triphenylcyclopentadienone) and various bisacetylenes having preformed imide units. This process of polymerization does not require the formation of a polyamic acid, thereby eliminating the processing disadvantages associated with the state of the art polyimides. In addition, the reaction yields phenylated benzene units along the polymer backbone, thus imparting solubility to these polymers. Polyimides of medium to high molecular weight were prepared as evidenced by inherent viscosities ranging from 0.43 - 1.08 dL/g, obtained on 0.5% (w/v) solutions in chloroform at 25 °C. The polymers prepared were soluble in a number of common organic solvents including chloroform, toluene, dimethylsulfoxide, 1-methyl-2-pyrrolidinone and dimethylacetamide. Yellow fingernail creasable films of these polymers can be cast from chloroform solutions. These polymers exhibited glass transition temperatures ranging from 260 - 334 °C. The thermal stability of these polymers was excellent as evidenced by 10% weight loss in air at temperatures >499 °C and in helium at temperatures >523 °C.

MESSENGER RNA CAP ANALOGS AS SUBSTRATES FOR THE GUANINE-7-METHYLTRANSFERASE. Jason Napodano, D. M. Sinagra, and T. O. Sitz, Dept. of Biochem., Virginia Tech, Blacksburg, VA 24061. Guanine-7-methyltransferase that methylates the cap structure in mRNA, can use the symmetric cap analog GpppG as a substrate. Earlier work in our laboratory demonstrated that another cap analog, GpppA, was not a substrate. Recently, by HPLC analysis, we found that this material was not GpppA but some other nucleotide, which explains why it was not a substrate for our enzyme. This analog was not a substrate for *in vitro* transcription. Another lot number of GpppA was resistant to alkaline phosphatase digestion and had a characteristic elution profile on HPLC. This new lot of GpppA was a substrate for the guanine-7-methyltransferase, however its K_m was 14-fold higher than the K_m for GpppG. This GpppA was incorporated into RNA made in a T7 RNA polymerase *in vitro* transcription system. Currently we are characterizing the ability of these transcripts to serve as substrates for the cap methyltransferase.

DEVELOPMENT OF A SWIPE TEST FOR DETECTING ILLICIT DRUGS ON SURFACES. Grazyna E. Orzechowska, Edward J. Poziomek, and Julie C. Patrick Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. Achieving efficiency in sampling and avoiding losses in sample handling are integral to the operation of field detection and analytical systems. We have been designing sampling procedures as part of the development and evaluation of a prototype sensor system for cocaine hydrochloride. The present paper focuses on development of a swipe test for cocaine hydrochloride, though the same procedure should be applicable to heroin hydrochloride, other illicit drugs, and contaminants in scenarios other than those related to drug interdiction. A variety of swipe materials were used to study efficiency of transfer from several types of surfaces. We also examined effects of transfer from swipe gloves to sensor sample tickets. Tests were designed to simulate the surface targets typically encountered in the field. Metal surfaces, of different composition and surface roughness, were contaminated with illicit-drug simulants and sampled using dry and wet swipes. On the basis of the results to date, it was concluded that Teflon is the most versatile material as both a swipe fabric and as a sensor ticket matrix. However, there are trade-offs. These will be discussed. The authors gratefully acknowledge support from the Advanced Research Projects Agency through a subcontract from Battelle, and review by James A. Petrousky, Office of Special Technology, Fort Washington, MD.

SYNTHESIS AND CHARACTERIZATION OF $[\text{Re}(\text{dppm})_3]^+$. John Overacker,* Kimberly R. Kongkasuwan,* and Daniel R. Derringer,* Dept. of Chem., Hollins Col., Roanoke, Va. 24020 and Kenton H. Whitmire,* Dept. of Chem., Rice Univ., Houston, Tx 77251. Complexes of rhenium(I) are relatively rare, and homoleptic complexes containing three chelating bis(diphenylphosphino)methane (dppm) ligands are almost nonexistent. Here we report two compounds, $[\text{Re}(\text{dppm})_2]\text{ReO}_4$ and $[\text{Re}(\text{dppm})_3]\text{PF}_6$, both of which contain the new tris[bis(diphenylphosphino)methane]rhenium(I) cation. The perrhenate salt was synthesized from $\text{Re}_2\text{Br}_4(\text{dppm})_2$ unintentionally, while $[\text{Re}(\text{dppm})_3]\text{PF}_6$ was prepared by reacting $\text{ReCl}(\text{N}_2)(\text{dppm})_2$ with dppm and KPF_6 in methylene chloride at room temperature. Both of the new compounds were characterized by infrared and electronic absorption spectroscopy, and $[\text{Re}(\text{dppm})_2]\text{ReO}_4$ was characterized structurally by X-ray crystallography. (Supported by the Camille and Henry Dreyfus Foundation and the W. M. Keck Foundation.)

STUDIES ON SIMULANTS FOR ILLICIT DRUG INVESTIGATIONS. Julie C. Patrick, Edward J. Poziomek, and Grazyna E. Orzechowska. Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, VA 23529-0126. Technological challenges in development and testing of field analytical methods for illicit drugs such as cocaine hydrochloride (HCl) and heroin-HCl, include assuring safety of researchers and operations personnel from exposure to the drugs, assessing the efficiency of sampling and sample handling in a simple but quantitative manner, checking for artifacts introduced by field procedures, and identifying a spike other than the target drug for quality control/quality assurance purposes. Methylene blue was chosen as a simulant for *both* cocaine-HCl and heroin-HCl to help meet these challenges. The similarities include molecular weights over 300, melting points between 200 and 300°C, solubility in water, alcohol, and chloroform, and insolubility in ether. Also, all three of the compounds are chloride salts. The major difference is that methylene blue is highly colored whereas cocaine-HCl and heroin-HCl are colorless. It is estimated that as little as 10^{-8} moles (3.1 µg) of the dye covering a surface of 10-30 cm² can be seen under ideal conditions. This will be very useful in the visual assessment of sampling efficiency and in operator training. The authors gratefully acknowledge support from the Advanced Research Projects Agency through a subcontract from Battelle, and review by James A. Petrousky, Office of Special Technology, Fort Washington, MD.

THE CHARACTERIZATION OF DENSE CERAMIC MEMBRANES FOR THE PARTIAL OXYGENATION OF METHANE TO SYNGAS. Michelle L. Radloff, Dept. of Chem., Mary Baldwin Col., Staunton, VA. There are large reserves of natural gas, consisting primarily of methane, which can be useful when a ceramic membrane is used to convert the methane to syngas. This ceramic membrane allows only oxygen to permeate into the core, where it can react with methane and oxidize the methane to syngas (CO and H₂). My research attempts to find a material which exhibits the maximized properties that are desired for a ceramic membrane, such as high strength and high oxygen selectivity. Several materials, including SFC-2, a Strontium-Iron-Cobalt-Oxide, and a Sr-Fe-Ox powder with cobalt added as a metal, were tested. The sample preparation factors that were varied were the pressure at which the bars were pressed, the firing temperature, and the firing atmosphere. Both bars and tubes of these materials were tested and the results were compared. Although the ideal material and conditions have still not been discovered, much progress has been made towards the discovery of a strong, yet oxygen-specific permeable membrane.

AB INITIO STUDY OF THE TRANSITION STATE OF THE UNIMOLECULAR DECAY OF CHLOROFORMIC ACID. Christopher B. Schultz and D. D. Shillady, Dept. of Chemistry, Va. Commonwealth Univ., Richmond, Va. 23298
The GAMESS *ab initio* electronic structure program has been used to carry out a study of the transition state of the unimolecular decomposition of trans-chloroformic acid to HCl and CO₂. Saddle-point optimization of the transition state with a 6-31G** basis set indicates an activation energy of 6.98 Kcal/mole. Graphs are presented showing the energy of the molecule as a function of the rotation of the C-O-H plane from trans- to cis- where Pimentel has documented the formation of HCl and CO₂.

ANALYSIS OF ALKALINE STABLE RNA STRUCTURES ISOLATED FROM THE ARCHAEABACTERIUM *SULFOLOBUS SOLFATARIUS*. D. M. Sinagra, K. A. Oxenrider, and T. O. Sitz, Dept. of Biochem., Virginia Tech, Blacksburg, VA 24061. Messenger RNAs (mRNA) from archaeobacteria do not have a classical "Shine-Dalgarno Sequence" (-AGGAGGU-) which is complementary to the 3'-end of 16S rRNA. The archaeobacteria *Sulfolobus solfataricus* may be closely related to eucaryotes (eocytes). The examination of 30 *Sulfolobus* mRNA sequences in Gene Bank did not find any consensus sequence complementary to the 3'-end of 16S rRNA or any other consensus sequence. It is not clear how ribosomes bind to mRNA in *Sulfolobus*. Are the "cap" structures found in eucaryotes also found in *Sulfolobus* mRNA? Whole cell RNA from *Sulfolobus solfataricus* was digested with 0.3N NaOH. Alkaline resistant fragments were isolated and then digested with alkaline phosphatase and apyrase for 30 min. at 37°C. This digest was applied to a Gen-Pak FAX column on HPLC and a single undigested peak was observed. The undigested peak material was digested with venom phosphodiesterase and apyrase and analyzed with a Hamilton PRP-X100 Anion exchange column on HPLC; again, only a single peak was found. The significance of these digestion data will be discussed.

REFLECTIVE POLYIMIDE FILMS VIA *IN SITU* METALLIZATION. Robin E. Southward, D. Scott Thompson, D. W. Thompson, Maggie L. Caplan and A. K. St. Clair, Department of Chemistry and Applied Science Program, College of William and Mary, Williamsburg, VA 23187 and Langley Research Center, National Aeronautics and Space Administration, Hampton, VA 23665-5225. Optically reflective mirrors with polymeric rather than glass supports can reduce weight and fragility. Silver has a high reflectivity coefficient in the visible region of the EM spectrum. We report studies on a single stage (*in situ*) metallization of BTDA/4,4'-ODA films using (1,1,1,5,5,5-hexafluoro-2,4-pentadionato)silver(I) as the source of metallic silver. This complex is formed *in situ* by the reaction of silver acetate or fluoride with the parent beta-diketone. In thermal curing of silver(I)-containing BTDA/4,4'-ODA poly(amic acid) films silver is reduced to the metallic state and migrates to the air side surface of the polyimide. The silvered surfaces have excellent reflectivity and mechanical properties and acceptable thermal stability. The adhesion of silver to the polymer is excellent and appears to be due to both mechanical interlocking and the formation of silver-carboxylate interactions. Several other solubilizing ligands and additional soluble silver(I) compounds were investigated which also gave reflective metallized surfaces and some surface conductive films.

SYNTHESIS AND PYROLYSIS OF ALKYL PYRIDINES AND QUINOLINES. Wayne M. Stalick, Joseph Murray, Nazdandeh Zahadat and Nazi Abousaeedi*, Dept. of Chemistry, George Mason University, Fairfax, VA, 22030. Fuel instability studies have implicated short alkyl chain substituted heterocycles as major reactants. Two types of instability have been studied: short-term high temperature (oxidative instability) and long-term low temperature (storage instability). Nitrogen containing heterocycles have been implicated in both types of instability. The variation in types of heterocycles and concentration in different fuels makes model compound studies attractive. Precursors to these short chain compounds are branched and long chain alkyl substituted cyclic or aromatic compounds that are degraded during thermal refining. Two classes of compounds were synthesized and then pyrolyzed: 2, 3, and 4-pentadecyl pyridine; and 2 and 4-undecyl quinoline. The syntheses were all performed in liquid ammonia using a modified Brown and Murphy procedure, a reaction which didn't work to produce 3-undecyl quinoline. The purified alkylaromatics were pyrolyzed at temperature and pressure conditions similar to delayed coking. Free radical attack at the alpha and gamma positions in the side chain was favored; however, an interesting aryl-alkyl bond cleavage occurred in the quinoline series which had not been noted in our previous pyrolysis studies.

CONTROL OF THERMAL EXPANSION COEFFICIENTS IN POLYIMIDE FILMS. Anne K. St. Clair, Robin E. Southward, and David W. Thompson (NASA Langley Research Center, Hampton, VA 23681. The addition of lanthanide compounds to the 2,2-bis(3,4-dicarboxyphenyl)hexafluoropropane dianhydride/1,3-bis(aminophenoxy)-benzene polymer (6FDA/APB) in DMAc (both in the amic acid and imide forms) to achieve a homogeneous and optically transparent distribution of Ln(III) ions throughout the polymer has been studied. The Ln elements are unique in giving a series of ions with a trivalent oxidation state and a uniform variation in +3 radii from 117 to 84 pm. Lanthanide(III) acetates solubilized and coordinated with the dibenzoylmethane, hexafluoroacetylacetone, trifluoroacetylacetone, and trifluoroacetic acid have been incorporated into transparent 6FDA/APB films. X-ray and TEM data are consistent with particle sizes for the lanthanide ion containing species which are in the nanometer range. The effect of various Ln additives on T_g , thermal stability, the coefficient of thermal expansion, and mechanical properties will be discussed. In selected cases the CTE was lowered by as much as 25 percent while the thermal and mechanical properties of the films remained intact.

EFFECTS OF SURFACTANTS ON COLORIMETRIC DETERMINATION OF NICKEL AND COBALT. Michael J. Tutor, Daniel Y. Pharr and Frank A. Settle, Jr., Department of Chemistry, Virginia Military Institute, Lexington, VA 24450-0304. In an attempt to automate the spectrophotometric determination of cobalt and nickel the nonionic surfactant Triton-X 100 was used to catalyze the complex formation of cobalt and nickel with 4-(2-pyridylazo)resorcinol. Triton-X 100 was successful in catalyzing the reaction and eliminating heating and waiting periods that would not allow the use of Flow Injection Analysis as a method of determination.

MAGNETIC CIRCULAR DICHROISM AND AB INITIO STUDY OF MELATONIN Anthony Viol, Charles Castevens and D. D. Shillady, Dept. of Chemistry, Va. Commonwealth University, Richmond, Va. 23298

Melatonin is a female hormone whose function has been implicated as abnormally effected by 60 Hz EMF leading to breast cancer in female electrical workers by Loomis at Duke University. Magnetic circular dichroism spectroscopy indicates melatonin has a large magnetic transition at about 300 nm similar to the 290 nm MCD peak of serotonin previously studied in this laboratory. The GAMESS ab initio electronic structure program has been used to optimize the geometry of melatonin at the STO4G basis level and CNDO/2-D excited states have been used to assign the magnetic transition moment.

THE WETTABILITY OF ROUGH SUBSTRATES BY VISCOUS POLYMER MELTS. S. A. Tschetter, N. E. Shephard & J. P. Wightman, Dept. of Chemistry, Va. Tech., Blacksburg, Va. 24061. Wetting has long been recognized as a necessary but insufficient criterion for good adhesion, but little work has been reported on quantitative studies of wetting by neat polymers. Preliminary studies have demonstrated the feasibility of using model porous substrates to study, the flow of neat polymers into capillaries. In this study, the substrate and polymer were allowed to equilibrate at the test temperature before coming in contact with each other. The extent of polymer flow into the capillaries was assessed by dissolving the porous substrate and measuring the length of the resultant polymer fibrils from scanning electron photomicrographs. The polymer flow experiments were made as a function of time and temperature using polystyrene of various molecular weights including some above and below its chain entanglement length. [Research supported by Center for Adhesive and Sealant Science]

A COMPUTER INTERFACE TO PREDICT AND COMPARE INFRARED SPECTRA

Robert H. Williams and (Frank A. Palocsay), Department of Chemistry, James Madison University, Harrisonburg, VA 22807. The goal of this project was to develop a user friendly interface that would allow students and instructors to compare the peak heights and locations of two infrared spectra. This interface program was written in *Visual BASIC for Windows* a computer language developed and sold by Microsoft, Inc.. The spectra to be compared can be: predicted by a molecular modeling program such as *HyperChem*, experimentally determined or a combination of these depending on the purpose of the exercise. By comparing two predicted or sample spectra a student sees how the infrared spectrum changes as a result of changes made to a molecule. Comparison of a sample spectrum and a predicted spectrum can be used to aid in identifying compounds and in showing the limitations of current modeling techniques. PM3, the premiere algorithm used for calculating vibrational spectra, often has an error of 10 percent or more. Thus, we have also analyzed the feasibility of using *Visual BASIC* and Ward Systems' *NeuroWindows DLL* to implement an artificial neural network program which will refine the spectrum predicted by the PM3 algorithm.

SURFACE MODIFICATION OF GLASS BEADS AND SILICON PARTICLES. R. Yin, R. M. Ottenbrite, Dept. of Chem., Va. Commonwealth Univ., Richmond, Va. 23284. Surface modification of glass beads was achieved by two approaches, graft polymerization of acrylic acid and dendritic process. The optimum reaction conditions such as solvent, temperature and the concentrations of the initiator, monomer and glass beads were determined to effectively graft poly(acrylic acid) onto the glass beads. It was found out that AIBN is as effective as BPO in the graft polymerization of acrylic acid if suitable reaction conditions were chosen. In contrast with the polymer grafting, a dendritic-modified procedure provided high grafting percentage by a step-wise strategy. The glass beads were used as a "starburst core", and a uniform fractal molecular structures were formed on glass via the "divergent generation" growth. It was difficult to achieve 100% conversion at any generation during the dendritic process, and an alternating high/low conversion was found for consecutive generations. The surface properties of the modified glass depended on the molecular structure of terminal generation. Surface modification of methyl polysiloxane particle was proceeded via photo initiating chlorination, NH₂ replacement, and functionalization.

HYDROPHOBIC DERIVATIZATION OF ANIONIC POLYMERS FOR ENHANCED BIOLOGICAL ACTIVITY. Syed Imran Zaidi and R. M. Ottenbrite, Dept. of Chem., Virginia Commonwealth Univ., Richmond, VA 23284-2006. The monomer (2-propenyl)benzene-3,4-diacetate was synthesized from safrole by ring opening followed by the protection of dihydroxyl groups by acetylation. The polymer poly(maleic anhydride-co-(2-propenyl)benzene-3,4-diacetate) was synthesized by free radical copolymerization of maleic anhydride and (2-propenyl)benzene-3,4-diacetate. The copolymerization reaction was studied in detail to optimize the reaction conditions and to obtain controlled molecular weight polymers with the narrow polydispersity. Several alkyl amines were grafted to the polymer to enhance the biological activity of these polymers.

SYNTHESIS OF OLIGOPEPTIDES FOR ORAL DRUG DELIVERY. Ruifeng Zhao and R.M.Ottenbrite, Dept. of Chem., Va. Commonwealth Univ., Richmond, Va. 23284-2006. Recently, proteinoid materials have been used successfully for oral drug delivery of polysaccharide and protein drugs. The basis of this technology is that these proteinoids can form microspheres with the drug at pH 1-3 and that these microspheres only dissociate at higher pH. Therefore, the trapped drug in the microspheres is protected from the hostile environment in the stomach (pH 1-2 and high concentration of enzymes) but release the drug in the upper GI tract at pH 7. More recently, in vivo and in vitro tests indicate that complexes between the drug and proteinoids are formed and these complexes enhance the drug transport through membrane. To prove this mechanism, specific oligopeptides were synthesized and characterized. The microsphere formation and complexation studies of these oligopeptides with specific drugs are currently being investigated.

Computer Science

APPLICATION OF BACKPROPAGATION FEEDFORWARD NEURAL NETWORK CREATED WITH MATHEMATICA. Angela R. Alexander and Lawrence R. Daley, Department of Computer Science, Hampton University, Hampton, Virginia, 23668. Neural networks are mathematical computer-based simulations of the living nervous system. Neural networks have become an innovative topic in computer science research. Neural networks are used in all aspects of science, liberal arts, business and industry, and medical research. The main idea behind neural networks is getting the computer to simulate the thought process, instead of the computer being programmed to routinely perform. Mathematica(c), a commercial software package, is used in creating this backpropagation feedforward network. This paper will present background information on neural networks in general, and backpropagation feedforward networks in particular. We will also present an actual application of the backpropagation feedforward neural network. (Supported by Office of Naval Research)

MAKING AN INTELLIGENT ABSTRACT DATA TYPE INTELLIGENT.

Tara N. Butler, Hampton Univ., Hampton, Va. 23668. This presentation will focus on the concept and implementation of Intelligent Abstract Data Types (IADT's). An IADT is an abstract data type which carries the properties of encapsulation and also runs concurrently with its clients. The driving force behind the concept of using IADT's, is that it is possible to create ADT's with a form of intelligence. This intelligence is shown through the IADT's "knowledge" of when to modify its own behavior through the use of a variety of internal functions. IADT's can also use their intelligence to change their structure if necessary, perhaps from a linked list to an array. Specifically, it is that ability which was tested. An unbounded list will begin to carry out a variety of operations, among them Insert and Delete. A history of operations will be maintained and when the number of Inserts/Deletes is equal to a certain percentage of the last "n" operations the unbounded list will "intelligently" switch to a bounded list, or an array. (Supported by the Office of Naval Research).

THE EFFECT OF TOPOLOGY AND PROTOCOL SELECTION ON LOCAL AREA NETWORKS. Ben J. Fornshell and Rita M. D'Arcangelis, Department of Computer Science, Mary Washington College, Fredericksburg, VA 22401. The topology of a computer network defines not only its geographical layout, but also influences the effectiveness of the network. The language that a network uses to communicate is called a protocol. Protocols, which define how messages are packaged and how they are communicated across the network, also affect network performance. A study has been undertaken to simulate the operation of both token passing and Carrier Sense Multiple Access/Collision Detection (CSMA/CD) communication protocols on Star Bus and Ring Bus network topologies, with and without switching, in order to compare their performances under a variety of conditions, including changes in packet size, number of transmitting nodes, hub buffer size, and network load. The architectures of the various models used are described, the phases of the simulation are explained, and an analysis of the results in terms of response time and throughput is presented. Implications for the design of optimal networks are discussed.

APPLICATION OF A HOPFIELD NEURAL NETWORK CREATED WITH MATHEMATICA. Demetrius Shaffer, Hampton Univ., Hampton, VA, 23668, & Lawrence R. Daley, Dept. of Comp. Sci., Hampton Univ., Hampton, VA, 23668. The human brain is thought to rely on massive parallelism among neurons. This enables data transfer to occur in a parallel fashion rather than a sequential fashion. This parallelism cannot be derived from computationally sequential algorithms and programs. The notion of computers mimicking the functions of neurons can be implemented by the use of neural networks. A neural network steps away from sequential algorithms, where information is processed one step at a time, and tries to simulate the parallelism of the human brain to process information all at once. In this paper, we present the key concepts of neural networks and we also demonstrate an application of the Discrete Hopfield network architecture that was created using Mathematica(c). (Supported by the Office of Naval Research grant for Student Enhancement in Mathematics and Sciences.)

CHALLENGES OF IMPLEMENTING A CONCURRENT PROGRAM ON A DISTRIBUTED SYSTEM. Sujuan Upshaw, Hampton Univ., Hampton, VA, 23668, & Robert Willis, Dept. of Comp. Sci., Hampton Univ., Hampton, VA, 23668. In order to achieve the theoretical speedup gained through concurrency, concurrent processes must be sent to a distributed system. In order to discover the level of difficulty associated with this procedure, a concurrent Ada program was transformed onto a distributed program. This new program was then implemented on NeXT machines using Zilla, an application which volunteers machines in a common network to participate in parallel computation. Two inherent problems in the transformation were protecting the critical sections from simultaneous access, and devising a means of communication among the distributed processes. Research was hindered by unexpected problems in learning idiosyncrasies of the Zilla application. (Supported by the Office of Naval Research grant for Student Enhancement in Mathematics and Sciences.)

DISPLAY AND STATIC LINKS: A STUDY OF SCOPE IMPLEMENTATION IN PASCAL. Frank Wang, & John Rabung, Dept. of CS, Randolph-Macon Col., Ashland, Va. 23005. In implementing block structured languages like Pascal, compiler designers often choose the so called "display" mechanism over the more conventional "static links" for reasons of "efficiency" in accessing information stored in higher level blocks. In our study, we tested this practice by modifying *UVAPC*, a Pascal compiler which was developed by the University of Virginia and which uses the display approach, to implement static links. We then compared the cost of using either method in SUN4 environment, and performed various tests on many Pascal programs to assess different aspects of scope accesses. Contrary to common belief, we found that static links work better in most scope access operations than a display does. Also the fact that programs written by students seldom access information from more than one level away made us believe that the static links method is a better choice for scope implementation.

Education

KNOWLEDGE OF THE HUMAN REPRODUCTIVE SYSTEM BY STUDENTS ENTERING A COLLEGE BIOLOGY COURSE: 1992 AND 1995. H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422. All students enrolled in the general biology class at Dabney S. Lancaster Community College in January, 1992 (n=51) and 1995 (n=48), were assessed for knowledge of the human reproductive system. Twenty-five questions dealt with male and twenty-five with female anatomy and physiology. Additionally, students were asked to rank order five methods of contraception, from most to least effective. Overall score of the 1995 group was five percentage points higher than that of 1992, with most gain made on the male reproductive system (nine points). In both years, female respondents averaged three to four percentage points higher than males overall. From 1992 to 1995, male knowledge of female systems improved by seven percentage points and female knowledge of male systems increased by eleven percentage points. Abstinence, the female oral pill, and the male condom were the most frequently mentioned methods of contraception by both sexes in both classes, although the 1995 students named a greater variety of contraceptives than did those in 1992. In summary, it would seem that students entering general biology in 1995 generally were more knowledgeable of the human reproductive system than those in 1992.

ANALYTICAL MULTIPLE CHOICE QUESTIONS: DO THEY BENEFIT STUDENTS? H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422. For the past two years, the relationship between the kind of weekly review exercise completed by students and student achievement has been assessed. Students attending a single lecture section in human anatomy and physiology and in general biology were divided into two lab sections in each course. Students in both lab sections of each course covered the same basic material and received two types of exercises, but were required to submit responses to only one type for grading. Students in one lab section submitted answers to factually-oriented questions (e.g., fill-in, true-false, matching, short-answer essay). Students in the alternate lab section submitted answers to analytical multiple choice questions intended to develop analytical thinking skills. Scores for these questions, tests, and any other graded material, as well as grades for the course, were compared for the two groups in the two courses. Where possible, grades in courses taken the following year were compared between groups. Although based on small sample sizes, results generally suggest that students completing the analytical multiple choice exercises have achieved at a higher level than students completing factually-oriented exercises.

DETERMINING STUDENT LEARNING STRATEGIES FOR THE INVESTIGATIVE STUDY OF BIOLOGY Diah Arvulina and Thomas G. Teates, Div. of Curriculum and Instruction, Va. Polytechnic Institute and State Univ., Blacksburg, VA 24061 - 0313. The use of investigative laboratory problems is one of the recommended methods of instruction for improving the outcomes of college science laboratory work. Much research has examined students' achievement or thinking development in science laboratories, but little research has been conducted to examine learning strategies students use in this setting. During fall semester, 1994, a study involving interviews with ten students who were taking an introductory biology laboratory was conducted at Virginia Tech. Qualitative analyses of field notes and transcripts of the interviews were used to identify the several types of learning and the primary learning strategies used by the students. Four learning themes and three learning strategies were identified.

ELEMENTARY SCIENCE EDUCATION REFORM IN AUSTRALIAN AND NEW ZEALAND PUBLIC SCHOOLS. Michael L. Bentley, Dept. of Science Education, National-Louis Univ., Evanston, IL 60201. Schools in Australia and New Zealand have been involved in a broad-based educational reform movement which includes revising the science curriculum. In both countries, many "primary" (K-6) schools are developing integrated and interdisciplinary programs in which the curriculum begins with children's interests and is developed through language-based and inquiry instructional strategies. In this approach, the teaching of science is characterized by text-rich classroom environments designed to engage children in educationally meaningful activities. The chief aim is that children retain their curiosity about the natural world while developing scientific understandings. Examples of practice in Australian and New Zealand schools will be shared and participants will be introduced to *Science Alive*, a new international core science program from "down under."

SPREADING THE WORD: DEVELOPMENT OF THE DANVILLE SCIENCE CENTER. Elizabeth Blatt, Eugene Maurakis, and Walter Witschey, Science Museum of Virginia, 2500 West Broad Street, Richmond, VA 23220. The Danville Science Center, a division of the Science Museum of Virginia, was developed through the combined efforts of local community organizations, City of Danville, and Science Museum of Virginia to promote science education through informal science methods for southside Virginia. The interactive hands-on science center will house three exhibition theme areas: Fundamentals of Science (e.g. Light and Vision, and Forces and Motion, Tour the Solar System, Electricity, Crystals), Local Science (e.g. natural history of the Dan River, textiles, rubber), and Visiting Science Exhibitions (Harvesting the Sun). Educational programs linked to the interactive exhibitions include: daily school group tours, science after school programs, teacher training and workshops, staff and volunteer training seminars, Science-by-Van, Airmobile, and Science-to-Go kits for classroom use. Additional science educational programs planned for the community at large are: summer science explorers programs, special science events during festival weekends, science camp-ins, skywatch, teacher conferences, and resource dissemination through the Science Museum's *Center for Science Education*.

V-QUEST REFORM EFFORTS: INVESTIGATIVE BIOLOGY AT THE UNDERGRADUATE LEVEL, George E. Glasson & Woodrow McKenzie, Div. of Curriculum & Instruction, Virginia Tech, Blacksburg, VA 24061-0313. Presenters will share findings from a multi-media authentic assessment program which documents the progress of a project designed to reform how undergraduate biology is taught. The goal of the reformed curriculum was to engage freshman biology students in investigative learning in which they worked collaboratively to design their own experiments. Through videotaped excerpts of laboratory instruction and interviews of the professor, graduate teaching assistants, and students, we found that faculty and students were actively engaged in risk-taking and decision-making. Examples of student work demonstrate that students were successful in designing experiments to investigate variables involved in fermentation. (Supported by NSF # OSR 920058)

A COMPARISON OF FOUR CONTEMPORARY SCIENCE EDUCATION INITIATIVES. Tanya K. Grace, Kristen A. Anonick, Mary C. H. Weller, Joy R. Woodruff, Enza J. McCauley, & Barry R. Thompson, Curry School of Education, Univ. of Va., Charlottesville, Va. 22904. Several science education initiatives have been recently proposed in response to current trends in American education. We conducted a comparative analysis of the National Science Education Standards, Project 2061 Benchmarks for Science Literacy, Scope, Sequence and Coordination of Secondary School Science, and the Virginia Science Standards of Learning. Comparisons were made across these four documents in content, process, goals, philosophy, and application to science curriculum reform. The National Science Education Standards served as a baseline for comparison in our research. Matrix format was used to compare content for life science, physical science, and general science topics. Process, teaching strategies, and philosophies were analyzed using charts of comparison. Our findings show similarities among the documents in terms of science content. Each document generally contains the same concepts, yet each has a varying degree of specificity and breadth of content coverage. Major differences were found among the documents in terms of teaching methods and educational philosophies. (Sponsored by Ertle Thompson, University of Virginia)

ENCOURAGING SECONDARY SCIENCE TEACHERS TO IMPLEMENT A GREATER VARIETY OF WRITING BY THEIR STUDENTS. Kenneth S. Lawwill, Chantilly High School, 4201 Stringfellow Road, Chantilly, VA, 22021 and Thomas G. Teates, Div. of Curr. & Inst., 305 War Memorial Hall, VPI&SU, Blacksburg, VA, 24061-0313. This study is an in-depth documentation and evaluation of the Chantilly High School Science Department's voluntary workshop effort to introduce and utilize several writing to learn strategies. Data from student and teacher surveys, ongoing interviews, and writing samples will be discussed as well as the strategies.

V-QUEST REFORM EFFORTS: INTERDISCIPLINARY SCIENCE AND MATH AT THE SECONDARY LEVEL. Woodrow L. McKenzie & George E. Glasson, Div. of Curriculum & Instruction, VA Tech, Blacksburg, VA 24061-0313. Presenters will share findings from a multimedia authentic assessment program which documents the efforts of an Algebra Teacher and an Earth Science Teacher to integrate aspects of their curriculum with a relevant environmental problem local to their school district. Their collaboration with each other and other professionals is presented with an assortment of data from students that highlights their exemplary efforts. Included are video clips of actual instruction, examples of student labwork, spreadsheets, journal entries, and interview data that help in the synthesis of our own assessment efforts. From this data, we conclude that through concerted effort, interdisciplinary efforts at the secondary level can be quite successful by engaging students in relevant projects that require skills that span disciplines.

MATH AND SCIENCE REFORM CONCERNS OF SOME RURAL VIRGINIA SCHOOLS, Thomas G. Teates, Department of Curriculum and Instruction, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0313. To obtain baseline data in preparation for a three-day workshop designed to enable six small rural school divisions to select and implement desired school science and math curriculum and instructional changes, a questionnaire was designed to obtain information about participants' knowledge of previous reform "products" and current concerns about reform needs. Results of the survey, including sampling of elementary and secondary science teachers in some of the school divisions in addition to the workshop participants, indicate that there is extensive lack of awareness about or experience with most of the curriculum products of the previous reform efforts in science and math. There is also widespread lack of teacher awareness of the current national and state curriculum reform efforts. There is awareness of the need to reform local school programs, and a belief that teachers should be directly involved with the effort.

A HISTORY OF SCIENCE EDUCATION AS SEEN THROUGH ADVERTISING.

Pamela C. Turpin, Chemistry Dept., Roanoke College, Salem, Va. 24153-3794. Can advertisements give us an accurate picture of what science educators expect from science instruction? The use of advertising in educational sources provides teachers, both today and in the early days of science instruction, a look at the new technologies and teaching methods of their current times. Periodic literature and textbooks of the late-nineteenth century provide evidence of the ideas and technologies to which science teachers of that time were exposed. This continues today. This paper uses a pictorial method of looking at the changing face of science education through the late-nineteenth and twentieth centuries as depicted through advertisements.

Environmental Science

PRELIMINARY ANALYSIS OF PERIPHYTON COMMUNITY STRUCTURE IN PREVIOUSLY IMPACTED AREA OF RAPPAHANNOCK RIVER BASIN. Michael L. Bass, Department of Environmental Science and Geology and Stephen B. Gough, Department of Biological Sciences, Mary Washington College, Fredericksburg, VA 22401. Studies of the periphyton communities structure are ideal environmental indicators when monitored over time. Periphyton growth and species composition reflect the impact of multiple stressors through time. In the Spring 1980 and Winter 1990 ruptures in Colonial Pipeline Company's refined oil products line spilled No. 2 fuel into Mine Run Creek in Orange Co., Virginia. Mine Run is a tributary of the Rapidan River that merges with the upper Rappahannock River a few miles west of Fredericksburg. Periphyton samples were taken using a bar-clamp sampler and analyzed by cell counting. Four sites coincident with previous samplings were selected. Previous studies indicated a low d of the periphyton community in the Rapidan River immediately below Mine Run. Although the diversity was found in this study to be higher, the lower d was still evident in the Rapidan immediately below Mine Run. This may follow the immediate disturbance theory and lack of uniform environment in this region of the river. Further study will attempt to clarify this.

EVALUATION OF A SCORING SYSTEM FOR TOOTH LESIONS IN MULE DEER (*ODOCOILEUS HEMIONUS*).

Luz M. Borrero and Patrick F. Scanlon. Dept. of Fisheries and Wildlife, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24061-0321. The purpose of the study was to evaluate the consistency in of a classification method to determine tooth lesions in mule deer (*Odocoileus hemionus*). The system used scored tooth lesions on a scale from 0 to 5, with the former having no lesions and the latter being severely affected. A group of 11 people, each with no previous experience, were trained to score tooth lesions and estimate age of the deer. The incisors of 14 jaws representing all possible scores were scored by the evaluators and their score were compared to the instructors score. On average, there was 71.3% consistency between the judges and the instructor. The method was used to standardize a technique to be used in future evaluations of tooth lesions in mule deer. [Supported by a grant from the U.S. Air Force and a Fulbright Grant.]

TEETH LESIONS IN MULE DEER (*ODOCOILEUS HEMIONUS*). Luz M. Borrero and Patrick F. Scanlon. Dept. of Fisheries and Wildlife, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24061-0321. Incisors from 228 jaws collected from mule deer (*Odocoileus hemionus*) at the USAF Academy Colorado Springs, Colorado during the Fall/Winter 1993 legal hunting season. The tooth lesions were classified based on a method used by Shupe et al., 1963 (Am. J. Vet. Res. 24:964-979) to determine tooth lesions produced by fluoride in cattle. The scale used ranged from 0 (no lesions) to 5 (severely affected). In 193 deer jaws (84.6%) lesions were present on at least one of the incisors. Of the deer with lesions, 166 (86%) had at least one tooth with very slight effect (one to few white spots), 19 (9.8%) had a slight effect (generalized mottling), 5 (2.6 %) had a moderate effect (generalized mottling and wear), 2 (1.04%) had a marked effect (mottling and hypoplasia of the enamel), and 1 (0.52%) of the deer had severe effect (hypoplasia of the enamel and abnormal wear). Lesions that affect the enamel are produced during the period of formation of the tooth. The severity of the lesion depends on the cause and the length of exposure to the causative agent. Generally mottling and hypoplasia of the enamel are associated with fluorosis. Other causes of hypoplasia are malnutrition and trauma to the tooth. [Supported by a grant from the U.S. Air Force and a Fulbright Grant.]

MACRONUTRIENT POOLS IN ACCIDENTAL WETLANDS ON SURFACE MINED LANDS OF SOUTHWEST VIRGINIA. C. R. Bern, R. B. Atkinson, and J. Cairns Jr., Dept. of Biology, VA Tech, Blacksburg, VA 24061-0406.

Carbon, nitrogen, and phosphorus levels were measured in four compartments in twelve accidental wetlands at the Powell River Project in Wise County, VA. All of the accidental wetlands formed on mine benches created prior to the 1977 Surface Mine Control and Reclamation Act. The compartments studied included: live aboveground plant structures, plant litter, belowground plant structures, and soil. These compartments were analyzed for 71 0.25m² plots in two communities. The communities were divided by indicator status of dominant vegetation species and included obligate wetland and facultative wetland communities, dominated by *Typha latifolia* and *Scirpus cyperinus* respectively. Nitrogen concentrations were highest in soil and in roots (5.7 g/0.25m²), while maximum phosphorus content was found in litter (0.15 g/0.25m²). National Wetland Inventory estimates of wetland frequency in the two quadrangles studied, Flat Gap and Norton, Virginia, found 270 and 421 accidental wetlands, respectively. Analysis of the macronutrient levels measured indicate that accidental wetlands may serve as a significant sink for nitrogen and possibly phosphorus in the region.

USE OF HPLC TO DETERMINE PHYTOPLANKTON PIGMENTS IN ALGAL CULTURES AND FIELD SAMPLES. Jiangfeng Chen (*) & R. Christian Jones, Dept. of Biol., George Mason Univ., Fairfax, Va. 22031. Major chlorophylls and carotenoids both in unialgal cultures and field samples of phytoplankton could be quickly separated, identified and quantitated by an pigment analytical method developed on high-performance liquid chromatography (HPLC). The usefulness of pigment chemotaxonomy in phytoplankton study was tested in lab cultures of many algal species isolated from the field and in a well studied tidal freshwater environment, Gunston Cove (Potomac River). By selecting taxon-specific pigments, the diverse phytoplankton community could be classified into different algal classes. A dominant genus of cyanobacteria, *Raphidiopsis*, was also positively identified. The concentrations of taxon-specific pigments also provided good indication of the relative abundance of the taxa they represent. Seasonal dynamics of phytoplankton community in the Cove studied by both pigment chemotaxonomic approach and conventional microscopic method demonstrated that pigment chemotaxonomic technique could be used as a useful alternative in environmental monitoring or ecological study of phytoplankton in nature waters.

STUDY OF FORESTED RIPARIAN BUFFER FOR REDUCTION OF NONPOINT SOURCE POLLUTION IN RAPPAHANNOCK RIVER BASIN. Kristen Eberly and Michael L. Bass, Department of Environmental Science and Geology, Mary Washington College, and Linda Porter, Friends of the Rappahannock, Fredericksburg, VA 22401. Riparian forest buffers are recognized as effective nutrient filters and erosion regulators to help improve water quality. The Rappahannock's major source of degradation is nonpoint source pollution which is tied to agricultural and urban run-off. Preliminary gathering of information about current forested riparian buffers in the counties surrounding the Rappahannock and Rapidan Rivers from the fall line up-river was begun. Studies of forested buffers from Maryland, Georgia and North Carolina have demonstrated significant reduction in nitrogen, phosphorous and sediments reaching waterways. Above the fall line of the Rappahannock, five of eleven monitoring stations have elevated nitrogen and phosphorous levels. Studies of aerial photographs show a good percentage of the shoreline is forested but many areas have thin or no forest buffer. Informative surveys and newsletters are being sent to agricultural landowners along the Rapidan and Rappahannock to encourage participation in local, state and federal programs that encourage riparian buffers.

A COMPARISON OF STRUCTURAL AND FUNCTIONAL MEASURES OF SOIL COMMUNITY DYNAMICS IN RECOVERING TERRESTRIAL SYSTEMS: PRELIMINARY RESULTS. John R. Heckman and John Cairns, Jr. Department of Biology, Virginia Polytechnic Institute, Blacksburg, VA 24061.

A primary concern for ecological restoration lies in the ability to determine the point at which a system has satisfactorily recovered. Common recovery indices center around the development of a macro-community structure similar to the predisturbance condition. However, predisturbance condition is rarely known in detail and restored community structure is often dramatically divergent from the undisturbed community. A more defensible basis for measuring restoration efficacy is a comparison of ecological functions. Rate processes such as system CO₂ evolution and cellulose decomposition can serve as integrative measures of system activity that are less sensitive to structural differences. In this study, both approaches are used to compare the recovery process on land impacted by heavy machinery and topsoil removal. Sites have been reseeded with simple (6 species) grass/legume mixtures patterned after standard landfill closure mixes, diverse (15 species) tallgrass prairie mixtures and with no seeding at all. Half of the sites also received composted organic soil amendment treatments. Sets of structural (vegetational, microarthropod and microbial communities) and functional (CO₂ efflux, CH₄ uptake and decomposition rate) end-points are being observed within the different reclamation areas. Comparisons made between the different reclamation treatments and undisturbed reference areas will determine restoration progress and dependence of community recovery on initial reclamation techniques.

EFFECTS OF BIRD-RESISTANT SORGHUM ON THE NUTRITIONAL AND PHYSIOLOGICAL WELL-BEING OF NORTHERN BOBWHITES (*COLINUS VIRGINIANUS*). Gerald A. Hish and Patrick F. Scanlon, Dept. of Fisheries and Wildlife, VPI & SU, Blacksburg, VA 24061-0321. The basis of bird resistance in sorghum (*Sorghum bicolor* L. Moench) is a higher concentration of condensed tannins. The effects of bird resistant sorghum (BRS) or several nutritionally related characteristics was measured in comparison to grain sorghum (GS) in a 2 x 2 factorial experiment with northern bobwhites (*Colinus virginianus*). Factors were ad libitum BRS vs GS and grit provided vs no grit provided. Mature, male bobwhites (N=48) were randomly assigned to one of the four treatments. Body mass and food and grit consumption were recorded weekly during a four-week trial and organ characteristics were measured after sacrifice. Body-mass in bobwhites eating GS diets remained consistent over time while those fed BRS decreased in body-mass during the trial. Food and grit consumption did not vary over time or between treatments. Cecal mass was not different between treatments though the mass of digesta contained in the ceca was higher for those with the BRS diet (P<0.05). The results indicate that weight loss due to BRS ingestion is not due to decreased food intake. [Supported by a John Lee Pratt Animal Nutrition Fellowship.]

CHANGES IN THE ACID-BASE COMPOSITION OF THREE HEADWATER STREAMS IN SHENANDOAH NATIONAL PARK DURING PRECIPITATION EVENTS. Kenneth E. Hyer and Keith N. Eshleman*. Dept. of Environmental Sciences, Univ. of Virginia, Charlottesville, VA 22903. The changes in the acid-base composition of a stream during stormflow periods are important considerations when assessing a stream's sensitivity to acidification. Episodic acidification is the short-term loss of acid neutralizing capacity (ANC) in a stream associated with either precipitation or snowmelt events, and has been shown to have significant biological impacts. The objectives of this study were to (1) examine quantitatively the impact of storm events on the acid-base chemistry of streams in Shenandoah National Park (SNP) and (2) describe the sensitivity of streams on each of the different bedrock geologies in the Park to acid rain inputs. To this end, three forested mountain streams (Paine Run, Piney River, and Staunton River) in SNP were selected for this study based on their similar watershed size (11-13 km²) but different bedrock geology and baseflow ANC. During this study, stream samples were collected at eight hour intervals during baseflow periods and at two-hour intervals during storm events. All samples were analyzed for pH, ANC, and all major anions and cations. Over forty individual events have been sampled in this three-year field study. During events, significant changes in the acid-base chemistry of each stream have been observed. The pH and ANC decreased in all streams, with the ANC becoming negative several times in Paine Run. The greatest decreases in ANC were observed in Piney River where the baseflow ANC was highest. The smallest decreases in ANC were observed in Paine Run where the baseflow ANC was the lowest. Episodic acidification is occurring throughout SNP with low baseflow ANC streams appearing to be the most sensitive.

MACROINVERTEBRATE RICHNESS IN ACCIDENTAL WETLANDS ON SURFACE MINED LANDS OF SOUTHWEST VIRGINIA. David H. Jones, R. B. Atkinson, J. Cairns, Jr., Department of Biology, Virginia Tech, Blacksburg, VA 24061.

Surface mining operations completed prior to current regulations left novel features on the landscape. Specifically flat, compacted benches were created. In depressions on these benches accidental wetlands have formed. The macroinvertebrate community of nine accidental wetlands was inventoried during four sample periods between July 1993 and May 1994. During each period, three samples were taken from each site using a D-frame net. A total of 71 genera were identified, ranging from a maximum of 33 per site to 7 per site. These values are lower than natural wetlands, but comparable to wetlands on similar sites such as those associated with ball clay mining and relic gravel pits. Canonical Correspondence Analysis was used to identify relationships between the macroinvertebrate community and environmental parameters. The first axis was strongly correlated to hydrology and litter biomass. The second axis was related to water quality parameters. This information suggests design specifications for creating wetlands for ecological restoration. To encourage the development of the macroinvertebrate community wetlands should be positioned to avoid poor water quality and constructed deep enough to be permanently flooded.

SEASONAL PATTERNS IN SIZE AND ABUNDANCE OF *Eurytemora affinis* IN THE TIDAL FRESHWATER POTOMAC RIVER. R. C. Jones and A. Via-Norton, Department of Biology, George Mason University. Mesozooplankton were collected in Gunston Cove by horizontal tows with a 202µ mesh plankton net. Zooplankton were counted until 200 animals had been collected. Total length of the first 10 adults and the first 40 copepodids was measured. Biweekly averages of *E. affinis* density from 8/10/93 through 7/20/94 show that for late summer and fall months adult density remains below 100 animals/m³. In late February the first of four moderately sized sequential peaks in adult abundance is observed. The largest of these peaks occurs in April, reaching just under 5000 individuals/m³. Adult density exceeds copepodid density in February, March and early April. Copepodid abundance in late summer, fall and winter remains below 1000 copepodids/m³. Between 3/31/94 and 5/4/94 copepodid density changes from a low of less than 100/m³ to a peak of nearly 15,000/m³. This peak rapidly declines to less than 2000 copepodids/m³ in late May and early June and is followed by a secondary peak of approximately 7000 copepodids/m³ in late June. The mean length of *E. affinis* adults and copepodid stage 3, 4, and 5 was found to decrease through late spring and summer. This decrease in size is possibly due to the differential effects of temperature on growth and maturation rates. It is likely that the maturation rate of *E. affinis* increases more rapidly with temperature than the growth rate resulting in smaller animals at maturity.

THE LOWER CHESAPEAKE BAY ZOOPLANKTON MONITORING PROGRAM: METHODOLOGY AND PROGRESS REPORT. George Mateja, R.S. Birdsong, H.G. Marshall, and R.W. Alden. Dept. Biological Sciences, Old Dominion Univ., Norfolk, Va. 23529-0266.

Zooplankton monitoring began in 1985 for the lower Chesapeake Bay and later expanded to include Elizabeth, James, York and Rappahannock River stations. Four distinct site groups were identified in relation to species composition (Bay entrance, eastern Bay, western and central Bay, and James River entrance). An abundance peak characterized July through October (that was associated with low flow periods), with a lesser pulse February-March. The annual mean concentration of the mesozooplankton was $16,600 \text{ m}^{-3}$, ranging from $12,500$ to $21,600 \text{ m}^{-3}$, with a mean of 21 taxa per sample. In comparison, concentrations in the Elizabeth River were much lower. Results of a long term trend analysis (1985-1992) indicated positive trends in abundance and diversity occurred during spring, with negative abundance trends during November and December, and in diversity during July and August. Supported by the Va. Dept. Environmental Quality and EPA.

IMPACT OF PREDATION BY LARGEMOUTH BASS ON STOCKED STRIPED BASS IN SMITH MOUNTAIN LAKE, VIRGINIA. D.P. Michaelson*, and J.J. Ney. Dept. of Fisheries and Wildlife Sciences, VPI & SU, Blacksburg, VA 24061-0321.

Annual stockings of 300,000 fingerling striped bass, *Morone saxatilis*, into Smith Mountain Lake maintains a successful put-grow-take fishery. However, in this system only 20% of stocked fish survive their first year. Predation by adult largemouth bass, *Micropterus salmoides*, may be a significant cause of high mortality. We used night electrofishing in the summer of 1994 to examine largemouth bass gut contents and striped bass distribution patterns in two stocking coves. Striped bass made up less than 0.1% of largemouth bass diet whereas alewives, *Alosa pseudoharengus*, accounted for over 60%. We estimated by mark-recapture sampling that populations of largemouth bass averaged 700 fish per cove. Using bioenergetic expansion, total consumption by largemouth bass in each cove amounted to only about 30 striped bass. Predation on striped bass by largemouth bass is not a major component of initial mortality of stocked striped bass in Smith Mountain Lake and may be minimized by high availability of alewives as alternate prey.

LAND USE AND WATERSHED AREA AS DETERMINANTS OF FISH COMMUNITIES IN PRINCE WILLIAM COUNTY, VIRGINIA. Donald R. Morgan, Dept. of Biol., George Mason Univ., Fairfax Va. 22030., R.C. Jones, Dept. of Biol., George Mason Univ., Fairfax Va. 22030., & D.P. Kelso, Dept. of Biol., George Mason Univ., Fairfax Va. 22030. Three watersheds in Prince William County, Va., Neabsco, Powells and Quantico, are in various stages of development. An index of biological integrity (IBI) was used to evaluate the effects of watershed area and land use on fish communities within these watersheds. The IBI integrates twelve metrics of stream fish assemblages for assessing stream quality. Principal component analysis (PCA) on fish presence - absence data was also used as an index of community structure. Three rounds of sampling were conducted at 36 sites over a two year period. Sites in the three watersheds were divided into three sub-watershed size classes: Small ($0.2\text{-}3 \text{ Km}^2$), Medium ($3\text{-}9 \text{ Km}^2$), and Large ($12\text{-}44 \text{ Km}^2$). The results indicate major differences in IBI scores among sampling sites were related primarily to watershed area. Average IBI scores for the three sampling rounds revealed that sites in large sub-watersheds consistently received higher IBI scores than did sites located in small and medium sub-watersheds. The effects of surrounding land use were also demonstrated using average IBI scores. Sites in the small and medium sized sub-watersheds of Neabsco and Quantico received noticeably different average IBI scores based on metrics of species richness and composition. Little difference in average IBI was noted between sites located in large sub-watersheds. PCA showed similar results to those of the IBI, with noticeable differences in average PCA scores received by sites in the small to medium sub-watersheds of Neabsco and Quantico.

SEASONAL ABUNDANCE AND SPECIES COMPOSITION OF ROTIFERS IN LOWER CHESAPEAKE BAY AND ITS TRIBUTARIES. Gyung Soo Park, R.S. Birdsong, and H.G. Marshall. Dept. Biological Sciences, Old Dominion Univ. Norfolk, Va. 23529-0266

The abundance and seasonal succession of rotifers were examined in the lower Chesapeake Bay and four major tributaries (Rappahannock, York, James, and Elizabeth Rivers) over a 30 month period. Rotifers were most abundant in June (500/l), followed by July and August. The dominant species were Trichocerca marina, Keratella cochlearis, Polyarthra vulgaris, Brachionus angularis and Filinia longiseta in the freshwater stations during summer, and Synchaeta sp. in the mesohaline and polyhaline stations during winter. There was a significant inverse correlation ($r=0.9$, $P<0.01$) between the abundance of rotifers and salinity. The number of species and species diversity (H') also decreased with increased salinity. Supported in part by the Virginia Dept. Environmental Quality and EPA.

THE BIOACCUMULATION OF HEAVY METALS BY *PHRAGMITES AUSTRALIS*

Michael B. Price and Barbara Shipes, Dept. of Biology, and Wing Leung, Dept. of Chemistry, Hampton University, Hampton, VA 23668. A plant bioassay has been initiated for heavy metal accumulation by the halophyte *Phragmites australis* growing at the Craney Island Dredge Disposal Facility in Portsmouth, Virginia. The study analyzes heavy metal uptake and compartmentalization within *P. australis*, and compares metal uptake amounts in wetland and upland sediments.

FACTORS INFLUENCING BIOMASS PRODUCTION IN ACCIDENTAL WETLANDS ON SURFACE MINED LANDS OF SOUTHWEST VIRGINIA. C. Matthew Rosenquist, Robert B. Atkinson, and J. Cairns Jr., Dept. Biology, VA Tech, Blacksburg VA 24061.

Primary productivity in accidental wetlands is important for hydric soil development and several ecosystem services, e.g., sediment trapping and wildlife habitat. This study compared sediment depth, hydrology, and soil nutrient concentrations with peak aboveground biomass at 12 accidentally formed wetlands at the Powell River Project in Wise County, VA. Biomass estimates and soil samples were taken at 71 0.25-m^2 plots, which were differentiated into two dominant community types. Mean biomass estimates were similar in 1993 (405 g/m^2) and in 1994 (485 g/m^2). Species biomass and environmental parameters for each plot were analyzed using canonical correspondence analysis. Results of this study revealed that (1) the accidental wetlands showed biomass production within the range for similar, naturally-occurring wetland communities, (2) sediment depth and water depth were most strongly associated with species-wise biomass estimates, followed by P and N soil concentrations, and (3) biomass production demonstrated resilience to drought. Certain accidental wetlands may provide a model for wetland construction, which would improve reclamation practices.

SIMULATION OF A SHALLOW ESTUARINE ENVIRONMENT WITH A NOVEL MICROCOSM SYSTEM. Thomas Snall and Stephen Gough, Dept. of Biological Sciences, Mary Washington Col., Fredericksburg, VA 22401. For the past fifteen years, the Marine Systems Laboratory (MSL) of the Smithsonian Institute has designed and implemented many unique microcosms and mesocosms which are long-lived and virtually self-sufficient. These systems utilize turf algae to remove excess animal waste. Unlike standard methods of water filtration, the algae more readily replicates natural nutrient cycling. To date, research has focused on large synthetic environments (e.g., a 65,000 liter Delaware Bay ecosystem and a 2,000,000 liter Great Barrier Reef ecosystem). The potential for using encapsulated ecosystems for fundamental environmental research and ecological damage assessment is great, although the concept has been fraught with high construction costs (\$100,000 or more) and space constraints. To better exploit these systems in environmental research, we have designed and constructed a small scale, inexpensive (\$5,000) 2,000 liter microcosm based on the MSL algal turf scrubber design. This system emulates a shallow mesohaline environment located on the York River in Virginia. We are assessing the biological and chemical stability and are comparing the results with (a) organisms maintained under traditional (non-microcosm) conditions and (b) biotic and abiotic components of the York River site. At present, the microcosm has functioned successfully as an independent ecosystem and appears to have similarities with the natural environment.

A COMPARISON OF PERIPHYTON ON NATURAL AND ARTIFICIAL SUBSTRATES. Andrew C. Soles, Dept. of Biol., Mary Washington Col., Fredricksburg, VA 22401, & S. B. Gough Dept. of Biol. Mary Washington Col. Fredricksburg, VA 22401. Periphyton communities have been used as indicators of ecosystem health because they represent the net effect of physical and chemical factors on aquatic organisms. To study the diatom community, researchers can either sample from naturally occurring surfaces or establish their own artificial substrates. Natural surfaces tend to portray natural assemblages but may be less statistically precise. Conversely, artificial substrates may be more statistically valid, but can fail to accurately represent the true community. In this investigation, the diatom communities on natural rock, clay tile, and glass slide substrates were compared. The genera on the glass slides were more evenly distributed, whereas the natural rock tended to be dominated by *Melosira*. Additionally, both artificial surfaces did not contain the large quantity of silt particles found on the natural rock. Moreover, a technique was developed which allowed for rapid preparation of slides and avoided the need for cumbersome nitric acid treatment of the samples.

GROWTH, DIET, AND DISTRIBUTION OF AGE-0 STRIPED BASS (*Morone saxatilis*) IN SMITH MOUNTAIN LAKE, VIRGINIA. Trent M. Sutton* and John J. Ney. Dept. of Fisheries and Wildlife Sciences, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061.

First-year survival of stocked fingerling striped bass (*Morone saxatilis*) in Smith Mountain Lake, Virginia, is inversely density-dependent; trophically-induced starvation is a probable cause. Age-0 striped bass were collected weekly from mid-June through mid-September 1994 by night electrofishing to describe temporal patterns of growth, diet composition, and distribution during the first summer of life. Over this period, age-0 striped bass grew from 42 to 99-mm median total length (TL) and a bimodal size distribution developed by mid-August with modes at 76 and 115-mm TL. The divergence in size distribution appeared to be due to differences in diet composition and dispersion from the stocking site. Large age-0 striped bass shifted from a diet consisting of zooplankton and benthic aquatic insects to one dominated by age-0 fish beginning in mid-July as they dispersed from the stocking site. In contrast, small age-0 striped bass remained within the general stocking area and fed predominantly on zooplankton and benthic aquatic insects. As a result, small age-0 striped bass may suffer disproportionate overwinter starvation due to low accumulation of energy reserves.

PATTERNS IN OCCURRENCES OF DEER-VEHICLE COLLISIONS. J. R. Swift, P. F. Scanlon, M. G. Babler, and R. W. Rexroad, Dept. of Fisheries and Wildlife, VPI & SU, Blacksburg, VA 24061-0321. Patterns of collisions involving white-tailed deer (*Odocoileus virginianus*) in a Virginia city were examined before and after a population control method was initiated. Deer-vehicle collisions occurred most frequently in November, and the interval of October through December. Collisions were more likely to occur in dark conditions with lesser numbers during periods of dawn and dusk. A substantial decline in deer-collision frequency occurred after the population control program was undertaken; however, the same temporal patterns of collisions was noted. Comparable temporal patterns in vehicle collisions with mule deer (*O. hemionus*) were noted at a military base in Colorado, i.e. collisions peaked in November, occurred most frequently during the months October through December, and under night-time conditions. Population control measures were associated with fewer accidents. Results indicate that driver educational efforts can be designed and focused to concentrate on the times of highest accident probability.

Geography

MODELING NEOTROPICAL MIGRATORY BIRD HABITAT ON THE GEORGE WASHINGTON & JEFFERSON NATIONAL FORESTS. Gregory K. Dillon,* Dept. of Geology and Geography, James Madison Univ., Harrisonburg, Va. 22807. The purpose of this project has been to develop a model that will reliably show areas of potential neotropical migratory bird habitat on the George Washington and Jefferson National Forests (GW&J NFs). Such a model would provide a useful tool to Forest Service officials in making forest management decisions. The prototype model was developed by the Deerfield Ranger District. A matrix was first compiled showing the optimal breeding habitats for ninety-one bird species. The criteria used in determining optimal habitat were forest type and successional stage, based on existing work on relationships of bird species to vegetation types (Hamel, 1992). Using this matrix and the GW&J NFs' Continued Inventory of Stand Condition (CISC) GIS database, an Arc Macro Language (AML) script was created within Arc/Info to model the habitat areas. Using the AML to query the database for the forest types and stand ages required by a particular species, the GIS is able to select and graphically display all areas meeting those requirements. The resultant product is a map showing areas of optimal habitat for each neotropical migratory bird species.

LAND USE/LAND COVER ANALYSIS OF AN AREA BEHIND THE VALLEY MALL, HARRISONBURG, VIRGINIA, 1966-1992. Jennifer A. Ware,* Dept. of Geology and Geography, James Madison Univ., Harrisonburg, Va. 22807. Urban encroachment onto rural land is a major feature of land use change. Cropland is twice as likely to be urbanized than non-cropland. Other land use problems include degradation of the environment, such as erosion and loss of wildlife habitat, and conflicts over control of land. Studies based on aerial photography were used to compile a land use/land cover analysis of an area behind the Valley Mall in Harrisonburg, Virginia. Their data was normalized to reduce discrepancies, particularly in the delineation of the area's boundary. An additional year of data was extracted from a land use/land cover map based on Landsat TM imagery dated August 24, 1992. The map was created using supervised training, maximum likelihood classification, and thresholding. The data was then graphed to show change over time of four land uses: urban, agricultural, forested, and barren. Urban and barren land use increased, agricultural use decreased, and forested use stayed about the same. This pattern was the expected result.

Geology

MAGNETIC AND GRAVITY SURVEYS OF AMELIA COUNTY:PRELIMINARY RESULTS. Earl H. Budke, Jr. Dept. of Geol., Va. State Univ. Petersburg, VA 23806. Amelia County is noted for its rich geology; particularly over seventy old mines and prospects-like the Morefield. Using a proton magnetometer and taking readings every fifty feet, over one hundred and fifty miles of road were covered in Amelia County and part of northern Nottoway County. The magnetometer data revealed the presence of a number of faults and dikes: of particular interest were five "graben-like" objects. A detailed gravity survey was run over two of them and again indicates the presence of a graben-like object. The gravity map of the Richmond Basin indicates a gravity low in the middle of the Amelia Courthouse quadrangle map on either side of Five Forks Road. A detailed gravity survey was run along approximately two miles of this road to determine the reality of the indicated gravity low. (Unfunded research.)

A MAGNETIC SURVEY OF A PORTION OF THE MOUNT HOREB KIMBERLITE.

Andrew W. McThenia III, Dept. of Environmental Sciences, Univ. of Va., Charlottesville, Va. 22903. Preston Hawkins, North American Exploration, Charlottesville, Va. 22903. Several traverses were made with a proton precession magnetometer (GeoMetrics model G-856A) across two of the three known intrusions of kimberlite near the Mt. Horeb Church in southwestern Rockbridge County. A grid was established across the northernmost mapped body and the magnetic data was collected and contoured. This survey failed to reveal any significant variation between the magnetic field of the kimberlite and that of the surrounding Ordovician carbonate rocks.

Two parallel traverses approximately 200 feet apart were made across the most accessible portion of the largest southernmost exposure of kimberlite. Measurements of the total magnetic field were collected every twenty feet along these two lines. A significant (> 200 gammas) magnetic anomaly less than 100 feet wide was detected, but no appreciable variation in total field was observed across traversed host rock contacts. The anomaly suggests that the intrusion is inhomogeneous with respect to ilmenite and magnetite content and perhaps represents a distinct phase of intrusion.

USE OF THE DIRECT SHEAR DEVICE AS AN AID TO THE STUDY OF MOHR'S

CIRCLE. Michael T. Coffey*, W. Cullen Sherwood, Dept. of Geology and Geography, James Madison Univ., Harrisonburg, Va. 22807. Shear strength data derived from Mohr's Circles are used in a wide range of geotechnical applications. For soils, the two most commonly used methods for developing the Mohr's envelope are the triaxial method and the direct shear method. The direct shear device is the least expensive and simplest of the two which makes it an ideal tool for educational use. Briefly, the method involves compacting the soil under test in a split chamber and moving one half of the chamber, causing the soil to shear. The shear stress (τ) required is measured by proving rings and dial. By varying the weight perpendicular to the shear plane (σ_n), τ can be determined for a range of σ_n values. The values for σ_n and τ can then be plotted to produce the Mohr's envelope. The envelope allows the determination of maximum shear strength (σ_1), shear stress in the shear plane (τ), stress perpendicular to the shear plane (σ_n), angle of internal friction (ϕ), and cohesion, at any confining stress (σ_3).

NARROWS LANDSLIDE, GILES COUNTY, VIRGINIA. Gary K. Rogers, P.E., Ph.D., W.

Grigg Mullen, Jr., P.E., Ph.D. Dept. of Civil and Environmental Engineering, Virginia Military Institute, Lexington, VA, 24450-0304. [ROGERSGK% CIVILENGR% VMI@IST.VMI.EDU] A historical, geological, and geotechnical overview of a famous landslide, nicknamed "Galloping Gertie", that has had deformations documented since 1916. Current evaluation techniques (e.g. geotechnical sampling/testing and two-dimensional limit-equilibrium analyses) and remediation plans are discussed as well as long-term monitoring options for this complex and difficult site. (Supported by the Virginia Department of Transportation via the Virginia Military Institute Research Laboratories, Inc., VMIRL).

TEST VARIABILITY IN THE PIPETTE METHOD OF TEXTURAL ANALYSIS FOR SOILS. Emily M. Newman*, W. Cullen Sherwood, Dept. of Geology and Geography, James Madison Univ., Harrisonburg, Va. 22807. The variability of the pipette textural analysis method for soils was examined by analyzing the variance for the sand, silt, and clay fractions of three common Virginia soils. The soils selected for the test were a clayey residuum over Edinburg Limestone; a sandy alluvium; and mica-rich residuum over schist and gneiss. The number of tests required to assume whether the test results fell within a 5% tolerance interval of that specified, at 95% confidence were computed for each size fraction for each soil. The experiment included ten pipette analyses for each of the three soils. Variance was found to range from a low of 2.12% for the sand fraction of the Millrock to a high of 56.08% for the clay fraction of the Millrock. It was concluded that variance is generally inversely proportional to the mean weight percent of the fraction, and in cases where fraction size is low and variance is high, more samples must be tested in order to maintain a + or - 5% tolerance and low risk. For example, required tests ranged from a low of 1 for the Millrock sand fraction to a high of 503 for the Millrock clay fraction. These results appear to be related to the very small sample sizes involved in the pipette method. Even small weighing and other errors are magnified significantly, increasing test variability.

THE OXIDATION STATE OF SPINEL XENOCRYSTS FROM MOLE HILL, ROCKINGHAM COUNTY, VA. Kelly K. Greaser[†] and F. Ö. Dudas*, Dept. of Geology, and Desmond C. Cook, Dept. of Physics, Old Dominion Univ., Norfolk, VA 23529. The olivine basalt of Mole Hill contains mantle xenocrysts of spinel, pyroxene and olivine. The 48±1 Ma (Wampler, 1975), plug-shaped intrusion consists of nepheline-normative, uniformly fine-grained basalt that is compositionally similar to other Eocene igneous rocks in western Virginia. Intrusion in this tectonically stable region might be due to decompression during reactivation of deep fractures. The basalt contains ≤ 8 vol. % xenocrysts ranging from 0.5 to 4 cm in size. Most xenocrysts are monomineralic; clinopyroxene is predominant, with subordinate olivine and spinel. Orthopyroxene may be present, suggesting a spinel lherzolitic source. Unlike phenocrysts, the xenocrysts have distinct reaction rims. Clinopyroxene is rimmed by another generation of pyroxene; spinel has rims of magnetite + plagioclase. Because the spinel to plagioclase reaction occurs at $P \leq 10$ kbar, the inferred source of the xenocrysts lies at depths exceeding 30 km, in the lower crust or mantle. Electron microprobe analyses of the xenocrysts show compositions that are similar to those of mantle-derived minerals in other xenolith suites. Mössbauer spectroscopy of the spinels allows precise determination of their Fe^{2+}/Fe^{3+} , and, combined with the microprobe data, leads to estimates of temperature from the olivine - spinel geothermometer, and oxidation state of the mantle source. [†]Supported by an ODU undergraduate research award to KKG.

COMPUTER SIMULATION OF EVOLUTION OF FABRICS IN IGNEOUS ROCKS: PLANS FOR A NEW RESEARCH TOOL. Trudy G. Krohn*, Michael J. Bonder*, Michael C. Leopold*, Roddy V. Amenta, Dept. of Geology and Geography, James Madison Univ., Harrisonburg, Va. 22807. Experimental methods in petrology coupled with thermodynamics have yielded information on the stability fields of rock forming minerals. However, current methods are not able to reproduce the coarse grained igneous and metamorphic rocks due to the slow reaction rates involved. Computer simulation of geologic crystallization processes may be the only way to study the evolution of these rocks and their fabrics. Earlier efforts on this project dealt with the growth of circles and then of polygons as representations of crystals, and on resolving the competition for growth space among growing moving crystals in a melt. Our present efforts deal with methods for changing the shapes of crystals as they grow so that they exhibit more natural looking boundaries, and on adding unit cell-like elements to each crystal. These elements provide a means for controlling the location and composition of chemical species in a crystal.

Materials Science

INVESTIGATION OF UNIDIRECTIONAL COMPOSITE STRENGTH USING A SINGLE TOW COMPOSITE TEST. Paul E. Cantonwine, and Haydn N. G. Wadley, Dept. of Materials Science and Engineering, University of Virginia, Charlottesville, VA 22903. Composite processing has traditionally involved surrounding a coated single fiber with either a metal or ceramic matrix. For the monofilaments like SCS-6 (SiC) which have a diameter of 140 μm , traditional processing works well. However, tow based fibers like Nextel 610 (Al_2O_3) which have a 10 μm diameter and come in bundles of 400 to 1000 filaments are inherently more difficult to process traditionally. An alternative process for a tow based fiber is to make the tow like a monofilament by binding the filaments together with a thermodynamically compatible material and then surrounding this "hybrid" monofilament with the desired matrix material. The work presented at VAS will pertain to how fiber strength is affected during this new composite process. Specifically showing how damage occurs and can be avoided.

MICROSTRUCTURAL PROPERTIES OF MECHANICALLY PROCESSED HIGH NITROGEN IRON ALLOY POWDERS. Desmond C. Cook and James C. Rawers*, Department of Physics, Old Dominion University, Norfolk, VA 23529. *U.S. Bureau of Mines, Albany Research Center, Oregon 97321.

Iron powder has been mechanically processed in an ATTRITOR ball mill in nitrogen gas for up to 250 hours and investigated by Mössbauer spectroscopy, X-ray diffraction and TEM. We have separated microstructural changes due to mechanical processing from those due to nitrogen infusement by also processing the powders in argon gas. Processing in argon resulted in a continuous decrease in grain size and after 150 hours produced 5-10 μm particles with 70 nm grains. When processed in nitrogen, the nitrogen concentration in the iron powder increased linearly with processing time. After 50 hours, the nitrogen concentration was 0.5 wt%. With continued processing, a highly stable subnanocrystalline bct-Fe microstructure formed in a nanocrystalline bcc-Fe matrix. For the iron powder we observed an increase in internal strain and interstitial nitrogen concentration which resulted in a supersaturated, highly strained bcc-Fe structure. The locally induced strain suddenly decreased through continual processing to form the bct-Fe microstructure as a result of the redistribution of some highly mobile nitrogen atoms.

ANALYSIS OF CRACK PROPAGATION IN ADHESIVE LAYERS. Victor Giurgiutiu, Dave Dillard, Jeff Graffeo, Dept. of Eng. Science and Mech., Virginia Tech, VA 24061-0219. Cracks in adhesive layers have been experimentally observed to propagate both interfacially as well as cohesively in straight or wavy paths. A common approach to the analysis of such cracks is to study a layer of brittle adhesive bounded between 2 elastic half-planes representing the substrate. Hence, a 2-material 3-region elasticity problem is set up and has to be solved. A theoretical model based on work done by Fleck, Hutchinson, and Suo (1991) is used to predict the stress distribution around the crack tip. Two complex potential problems were set up for the 3-region, 2 material model: (a) a distribution of edge dislocations to simulate the crack and its near field; and (b) a crack-free problem to simulate the external loads applied in the far field. Superposition of the two problems was followed by stress and displacements match at the boundaries. Imposing the traction-free boundary conditions over the entire crack length yields an integral equation formulation. To find the numerical solution, the distribution of dislocations is represented by a series of Chebyshev polynomials. Next, the integral equation is collocated on Gauss-Legendre points. The resulting linear system of equations yields the Chebyshev series coefficients and, hence, the distribution of dislocations. Several advanced numerical techniques were utilized to perform the computation on a standard PC with controlled accuracy. High order Gauss quadrature and Romberg exact integration were comparatively used to evaluate convergence of the integrals. "Numerical freeze" and interpolated functions were used to reduce computational time. The Fast Fourier Transform was employed to calculate sine and cosine Fourier integrals. (Supported by the Virginia Tech NSF-STC High Performance Polymeric Adhesives and Composites, contract DMR 9120004)

IDENTIFICATION OF THE FE-ZN INTERMETALLIC PHASES IN COMMERCIAL GALVANNEAL STEEL^{*}. Richard G. Grant and Desmond C. Cook, Department of Physics, Old Dominion University, Norfolk, VA 23529.

Commercially produced galvanized, (Zn-Fe alloy), coatings on steel sheet have been studied using transmission and scattering Mössbauer spectroscopy. In scattering geometry spectra were recorded using conversion electron, (CEMS), X-rays, (XMS), and re-emitted γ -rays, (GMS). The results show that different amounts of four iron-zinc phases are present depending on the production conditions of the coating. The different phases are also distinctly layered with the high iron concentration Gamma phase forming as a very thin layer at the steel-coating interface. The Gamma-1, Delta and Zeta phases have also been identified as layered phases with the Delta phase being the most abundant. Many coatings often form without the zinc rich Zeta phase being present. Different numbers of iron sites are present in each phase, in agreement with our recent studies of laboratory produced high purity iron-zinc intermetallics. The layering characteristics of the phases are compared with metallographic cross section analysis.

^{*}Supported in part by International Lead Zinc Research Organization, Inc, grant ZM-403 and Virginia's Center for Innovative Technology, grant MAT 93-018.

DIRECTED VAPOR DEPOSITION OF ELECTRON BEAM EVAPORANT FOR STRUCTURAL AND ELECTRONIC MATERIALS PRODUCTION. James F. Groves and Haydn N. G. Wadley*. Materials Science and Engineering Dept., Univ. of Virginia, Charlottesville, VA 22903. A unique system for producing materials has been invented which makes possible high rate, efficient, and inexpensive creation of thick and thin films for various applications. Using a modified electron beam gun, the directed vapor deposition (DVD) system possesses the same rapid, high temperature heating and evaporation capabilities of traditional e-beam systems but is capable of operating in low vacuum (0.1 - 5 Torr) rather than the high vacuum (10^{-5} - 10^{-7} Torr) of traditional e-beam systems. This environment shortens processing times and eliminates the need for expensive pieces of high vacuum equipment. Directed vapor deposition of e-beam evaporant facilitates efficient materials creation by allowing capture of evaporated materials in a helium gas stream which directs the concentrated vapor onto any desired substrate, (e.g., flat, fibrous, or multifaceted). This focussing of the vapor stream makes DVD more efficient than traditional e-beam systems where vapor streams follow a \cos^{θ} distribution ($n = 2, 3, 4$, or higher) and thus fail to deposit large amounts of valuable source material on the desired substrate. The higher deposition efficiency of the DVD system may decrease processing time and final product costs enough to make it the most cost competitive method for the production of numerous structural and electronic materials. A wide variety of materials have been successfully evaporated and deposited including copper, titanium, zirconium, silicon, and holmia. Compound production (e.g., zirconia) has been achieved by injecting reactive gases into the gas stream after metal vapor entrainment. Results show that the deposition rate and microstructural quality of the deposited films is directly dependent upon processing conditions. The most important processing conditions for controlling deposition rate and microstructural quality are 1) the velocity of the helium gas flow as it enters the processing chamber, 2) the pressure in the processing chamber, and 3) the temperature of the substrate.

DIELECTRIC PROPERTIES OF TAPE CASTING SLURRIES. Derek D. Hass, and Haydn N. G. Wadley, Dept. of Materials Science and Engineering, University of Virginia, Charlottesville, VA 22903. Advanced ceramic materials offer many advantageous properties for high performance structural applications such as low density, excellent high temperature strength, and high stiffness. Unfortunately the low toughness of these materials limits their use in aerospace applications where their properties offer the greatest potential. Ceramic matrix composites, in which continuous fibers are imbedded in a ceramic matrix can markedly improve the toughness of these materials by impeding crack propagation. Economical production of these materials requires a low cost processing approach able to produce the consistently high properties needed. Tape casting is an approach currently being investigated that satisfies these requirements. It involves a multicomponent slurry containing ceramic powder which is infiltrated into a woven fabric of continuous fibers. After heating to remove organic constituents a composite is produced by sintering a laminate of ceramic tapes. Compositional control of these slurries are dependent on slurry composition. An investigation of the effect of compositional changes on the dielectric properties of these slurries is being investigated to determine the possibility of using dielectric measurements for the on-line sensing of compositional changes during composite processing.

MÖSSBAUER AND X-RAY STUDY OF HIGH NITROGEN IRON ALLOYS PRODUCED BY HOT-ISOSTATIC-PRESSURE DIFFUSION. Tae H. Kim, Desmond C. Cook and James C. Rawers, Department of Physics, Old Dominion University, Norfolk, VA 23529. U.S. Bureau of Mines, Albany Research Center, Oregon 97321.

Investigation of the microstructural characteristics of powders of high nitrogen iron and iron-aluminum, produced by Hot-Isostatic-Pressure diffusion of nitrogen has been made using Mössbauer spectroscopy and X-ray diffraction. Nitrogen diffusion of the powders was performed at 1000°C at pressures up to 150 MPa. Vacuum fusion analysis indicated that nitrogen concentrations up to 4 a% and 7.3 a% were obtained in the iron and iron-aluminum samples respectively. Mössbauer analysis showed that for the iron and iron-aluminum powders the nitride Fe_3N formed at nitrogen concentrations greater than 1 a% and 4 a% respectively. The data indicates that the interstitial nitrogen content in the powders is substantially greater than the normal solubility limit.

PREPARATION OF PATTERNED GaAs SUBSTRATES FOR OPTOELECTRONIC INTEGRATION BY SELECTIVE LIQUID PHASE EPITAXY. David J. Lawrence, Integrated Science and Technology Program, James Madison University, Harrisonburg, VA 22807. Optoelectronic integration requires the fabrication of optical and electronic devices on a common substrate. Moreover, control of device isolation and interconnection must be achieved. Some devices (e.g., light emitting diodes, laser diodes and photodiode detectors) are most easily fabricated on a highly conducting substrate, while for others (e.g., field effect transistors and photoconductive detectors) an insulating substrate is preferred. Selective liquid phase epitaxy (LPE) is used to prepare patterned substrates for optoelectronic integration. These substrates consist of highly conducting (n^+ or p^+) GaAs regions embedded in semi-insulating GaAs. The desired optical and electronic devices can then be fabricated in the appropriate regions and interconnected as required. The substrate preparation process includes silicon nitride masking, channel etching, LPE refill and planarization. The solubility behavior of GaAs in gallium is exploited to allow in situ etching and refill during the LPE step.

CHARACTERIZATION OF FUNDAMENTAL HYDROTALCITE COATINGS ON ALUMINUM. Lysle Montes, Glenn Stoner, CESE, Dept. of Materials Science, University of Virginia, Charlottesville VA. 22903 & Rudy Buchheit*, Sandia Nat. Lab., Albuquerque, NM. 87185. Corrosion accounts for 4 to 5% of the U.S. GNP, of that 10-20% is spent on organic coatings. New EPA regulations restrict substances classified as toxic, hazardous or carcinogenic which has greatly impacted the coatings industry. Focus has been placed on development of non-toxic coatings. Hydrotalcite (HT) is a recently developed coating which is capable of passing many standard industry tests. Although the performance of advanced HT coatings looks promising, very little is known about the fundamental structure/morphology of this unique protective barrier. The purpose of the current research is to investigate the role of aluminum ion concentration and fluoride ion in coating formation. (Supported by the National Science Foundation and DOE - Sandia National Labs)

TWO DIMENSIONAL RECONSTRUCTION OF INTERNAL VELOCITY DISTRIBUTIONS IN MATERIALS BY ULTRASOUND TOMOGRAPHY. Haydn N. G. Wadley, Giridhar M. Prabhakar, Dept. of Materials Science and Eng., Univ. of Va., Charlottesville, Va. 22903. Near net shape processing of metallic powders can produce internal density gradients in the product. The need for non-destructive evaluation of these density gradients is addressed by measuring ultrasonic times of flight along various paths across the samples. From this information, the internal slowness (i.e., reciprocal velocity) distributions may be reconstructed. The ultrasonic velocity of a material is a strong function of its relative density. Hence, the relative density field can be assessed. A non-contact system for the laser generation and detection of ultrasound developed in our laboratory has been used to characterize the internal slowness distributions of test samples. These samples are metallic blocks of regular geometry (cylindrical, cuboidal) with other metallic inclusions that simulate abrupt density gradients. Two projection geometries (fan and parallel beam) have been used. Algebraic Reconstruction Techniques (ART) have been implemented in the two dimensional reconstruction of the images from these projections. Acoustic ray tracing has been carried out assuming continuous and discrete refractive boundaries. Results compare well with the a priori knowledge of the velocity fields of the samples. (Supported by ARPA/NASA)

INVESTIGATION OF THE ATMOSPHERIC CORROSION PRODUCTS ON LOW CARBON MILD STEEL EXPOSED IN A MARINE ENVIRONMENT. Sei Jin Oh, D.C. Cook and A.C. Van Orden*, Department of Physics and Department of Mechanical Engineering*, Old Dominion University, Norfolk, VA 23529.

The atmospheric corrosion products formed on low carbon mild steel exposed in a marine environment in Mexico for up to 1 year, have been investigated using Mössbauer spectroscopy, X-ray diffraction, and Raman spectroscopy. The Mössbauer analysis was performed in scattering geometry with the original coupons, as well as in transmission geometry with the naturally flaked powder from the corrosion coating and with the scraped powder. The spectra were recorded at 300K and 77K in order to separately identify the iron oxide phases present through their different temperature dependent hyperfine parameters. α -FeOOH, β -FeOOH, γ -FeOOH and Fe_3O_4 were uniquely identified. The β -FeOOH and γ -FeOOH phases are very adherent and form as the largest fraction for small exposure times. We determined from the analysis that the β -FeOOH fraction increased with increasing Cl⁻ concentration. The X-ray diffraction data and Raman spectroscopy agree well with the phases and their fraction as determined by Mössbauer spectroscopy.

PROCESSING OF AMORPHOUS FeW REINFORCED METAL MATRIX COMPOSITES BY MECHANICAL ALLOYING. Michael T. Stawovy and Alex O. Aning, Materials Science and Engineering Dept., Virginia Tech, Blacksburg, VA, 24061. Metal matrix composites commonly have bonding and chemical instability problems at the matrix and reinforcement interface which can result in poor mechanical properties. The mechanical alloying (MA) process was used to produce an amorphous FeW alloy reinforcement powder. The reinforcement powder was then blended at various volume fractions with a crystalline Fe matrix again using MA. The resulting composite powders were compacted and compression tests were performed. It was concluded that the amorphous particles produced significant strengthening, however, the strengthening was offset by a weakening due to porosity.

CONTROL OF METAL MATRIX COMPOSITE MONOTAPE DENSIFICATION DUE TO ASPERITIES. R. Vancheeswaran¹, R. Gampala², H.N.G. Wadley³. Dept. of Mechanical Engineering¹, University of Virginia, Charlottesville, VA 22903, Concurrent Technologies Corp.², Johnstown, PA 15904, Dept. of Materials Science and Engineering³, University of Virginia. In previous studies, the contact blunting of metal/alloy powders and of spray deposited MMC monotape surface asperities due both to time independent and time dependent plastic deformation have been analyzed. These contact blunting models have also been implemented into the densification and damage models of the MMC monotape given by Elzey and Wadley. Vancheeswaran et al. have utilized these densification models in turn to (i) predict the optimal process parameters and (ii) to subsequently control the consolidation processing of MMC monotapes. Here, a model for the contact blunting of monotape surface asperities due to primary (or transient) creep is first formulated following Ogbonna et al. In this formulation, the problem is set-up to analyze the contact blunting behavior of a representative hemispherical asperity and express the resulting response of the solid by a simple, uniaxial effective flow rule relating the mean contact stress with the displacement and velocity of deformation (In earlier studies it was shown that the mean stress at contact is dependent only upon the displacement and the velocity of deformation). This formulation also enables combining the blunting models due to time independent and time dependent mechanisms into one "unified" model. This unified blunting problem is then numerically solved using ABAQUS finite element analysis code for two composite systems of interest to the aerospace industry (Ti-24Al-11Nb/SCS-6 and Ti-6Al-4V/SCS-6). It will also be shown that a substantial simplification of the consolidation control algorithm is achieved with a densification model derived from a unified contact blunting. The simplifications are realized both from improved computational efficiency and ease of implementation of models into the control algorithm.

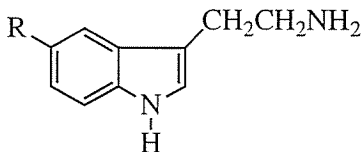
PATH PLANNING THE MICROSTRUCTURE DURING CONSOLIDATION OF POROUS TITANIUM METAL MATRIX COMPOSITE MONOTAPES. R. Vancheeswaran¹, H.N.G. Wadley². Dept. of Mechanical Engineering¹, University of Virginia, Charlottesville, VA 22903, Dept. of Materials Science and Engineering², University of Virginia. The high temperature consolidation of fiber reinforced titanium matrix composites (TMC's) seeks to reduce the concentration of matrix pores (i.e. increase relative density), simultaneously minimizing fiber microbending/fracture, and the growth of reaction product layers at the fiber-matrix interface. These three goals have conflicting dependencies upon the consolidation process variables (temperature and pressure), and it has been difficult to identify process pathways by "trial and error" that lead to composites of acceptable quality (where the fiber damage and reaction layer thickness are kept below some bounds, while matrix porosity is eliminated). Here, generalized predictive control (GPC) concepts have been combined with dynamic consolidation models to investigate the design of "locally" optimal process cycles that minimize fiber damage, reaction product layer thickness, and the pore concentration. The approach is then used to path plan the input process schedules for a variety of TMC systems. It identifies feasible process pathways for highly "processable" TMC systems such as Ti-6Al-4V/SCS-6, and reveals the best path for less processable systems like Ti-24Al-11Nb/SCS-6 and Ti-6Al-4V/Sigma-1240, and can determine when no successful path exists.

CORONA AND PLASMA PRETREATMENT OF CARBON FIBER/POLYMER MATRIX COMPOSITES. C. Espinoza, N. L. Lawrence and J. P. Wightman, Dept. of Chemistry, Va. Tech, Blacksburg, VA 24061. Adhesion is a multi-disciplinary science which involves in part an understanding of surface science and specifically, the interface between the substrate and the adhesive. The objective of this work was to document changes in composite surfaces following exposure to two types of electrical discharge. A commercial carbon fiber / epoxy matrix composite obtained from BASF was studied. Both a corona and plasma was used to pretreat the surfaces. Scanning electron microscopy showed minimal changes in surface topography due to pretreatment. On the other hand, the surface composition measured by x-ray photoelectron spectroscopy was altered significantly by corona and plasma exposure in air showing an increase in surface oxygen content. The surface energy of the pretreated composites was also higher than the untreated surfaces. Adhesion as measured by peel strengths increased with exposure to electrical discharges. [Research supported by NSF Science & Technology Center at Virginia Tech]

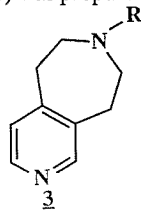
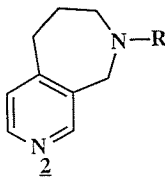
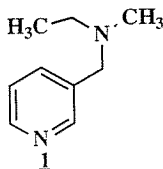
Medical Science

ALTERATIONS IN DIHYDROPYRIDINE-SENSITIVE CALCIUM CHANNELS IN THE BRAIN AND SPINAL CORD OF ACUTELY TREATED AND MORPHINE-TOLERANT MICE. Marissa A. Bernstein & Sandra P. Welch, Dept. of Pharmacology and Toxicology, Va. Commonwealth Univ., Richmond, Va. Opiate tolerance has been associated with changes in neuronal intracellular calcium levels. *In vivo* studies have indicated the involvement of dihydropyridine (DHP)-sensitive ("L-type") voltage-gated calcium channels in the morphine-tolerant state. In this study, we assessed how the morphine-tolerant state would affect the antinociception produced by intrathecal administration of two agents (Bay K 8644 and thapsigargin) that increase intracellular calcium. Morphine-tolerant mice displayed a 7-fold greater ED₅₀ for Bay K 8644 antinociception than placebo-treated animals; no difference was found in the dose-response curve for thapsigargin. To further explore the role of the L-type channel in morphine tolerance development, we performed radiolabeled nitrendipine binding studies in the spinal cord and brain regions associated with pain modulation from acutely treated, tolerant, and control mice. Binding site number and affinity were determined using Scatchard analysis for the following timepoints: 20 min and 60 min after s.c. injection of morphine or vehicle, as well as after 4 days of chronic administration, and after naloxone-precipitated withdrawal. Although some changes were observed in the affinity of nitrendipine for its receptor, a significant change in these measures was found only following naloxone withdrawal, which produced increases in B_{max} in both placebo- and morphine-treated mice. (Supported by NIDA grants DA06031 and DA07027.)

NOVEL TRYPTAMINE DERIVATIVES AS 5-HT_{1D}β SEROTONIN RECEPTOR LIGANDS. M. Bondarey;* S. Hong;* M. Dukat;* H. Law;* M. Teitler;* R.A. Glennon. Dept. of Med. Chem., MCV/VCU; Richmond, VA 23298. Although a few 5-HT_{1D} agonists have been reported, none displays > 50 fold selectivity for 5-HT_{1D} versus 5-HT_{1A} receptors. In the course of our work with 5-HT_{1D} and 5-HT_{1A} receptors we suggested that both have regions of bulk tolerance associated with the aromatic portion of 5-HT. Due to low TM sequence homology (ca 50%) between the two receptors, we should be able to exploit structural differences in these regions. Accordingly, we examined a series of 5-alkoxytryptamine derivatives and identified several that bind with high affinity and up to 400-fold selectivity. For example, NOT (where R = CH₃(CH₂)₈-) binds at 5-HT_{1D}β sites (K_i = 1 nM) with 300-fold selectivity. These types of compounds represent the most 5-HT_{1D} selective agents reported to date.



CONFORMATIONALLY-RESTRICTED AMINOMETHYLPYRIDINE DERIVATIVES AS NOVEL NICOTINE RECEPTOR LIGANDS. Y.X. Cheng*, W. Fiedler,* M. Dukat,* I. Damaj,* B. Martin,* R.A. Glennon. Dept. Med. Chem., MCV/VCU, Richmond, VA 23298. The aminomethylpyridine **1** (K_i = 28 nM) represents a novel nicotine receptor ligand. Due to its rotational flexibility, we prepared the more conformationally restricted **2**. Interestingly **2** (R = H or Me) binds with significantly reduced affinity (K_i = > 1,000 and 780 nM, respectively). Although **3** contains an additional methylene between the aromatic ring and terminal amine, it possesses molecular dimensions similar to nicotine. Compound **3** (R = H, Me) was prepared and examined for nicotinic activity.

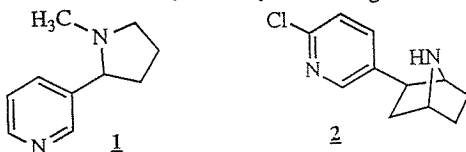


THE DEVELOPMENT OF TOLERANCE IN MICE TO EPIBATIDINE DIFFERS FROM THAT OF NICOTINE. Kimberly R. Creasy, M.I. Damaj, B.R. Martin, Dept. of Pharmacology and Toxicology, Medical College of Virginia, Virginia Commonwealth University, Richmond, VA 23298-0613. Epibatidine, an alkaloid originally isolated from frog skin, is a potent nicotinic agonist that produces analgesia in different animal tests. Tolerance to nicotine's behavioral and physiological effects after acute and chronic administration has been established and previously reported. In this study, we evaluated the tolerance profile of epibatidine optical isomers and compared it to that of nicotine. Male ICR mice were used and analgesia was measured by the tail flick test. Contrary to nicotine, mice treated with subcutaneous administration of epibatidine at different doses did not display significant tolerance after acute administration in the tail flick test. After chronic administration of epibatidine (12 $\mu\text{g}/\text{kg}$, sc, bid, 10 days), a significant shift of the dose response curve was observed in the (-) isomer only, however this shift was only slight (two fold compared to a five fold shift in nicotine). Cross tolerance studies involving both isomers and nicotine revealed only a slight, desensitized response to the (-) isomer after previous exposure to nicotine. Studies to provide explanations for the differential mechanisms of tolerance development in epibatidine and nicotine are needed. (Supported by the National Institute on Drug Abuse DA-05274.)

BENZO[a]PYRENE-INDUCED IMMUNOSUPPRESSION *IN VITRO* MAY BE ATTENUATED BY CO-CULTURE WITH INHIBITORS OF THE PEROXYL RADICAL PATHWAY. Clifford L. Deal, III,¹ and Kimber L. White, Jr.,^{1,2} Depts. of Pharmacology and Toxicology,¹ and Biomedical Engineering,² Med. Col. of Va./VCU, Richmond, Va. 23298. Metabolism of benzo[a]pyrene, B(a)P, an ubiquitous environmental contaminant, by splenic macrophages has been shown to be mediated by P-450 and peroxyl radical pathways. Previous work has also demonstrated that the suppression of the *in vitro* T-dependent antibody forming cell (AFC) response following exposure to B(a)P or B(a)P 7,8 diol is able to be attenuated by co-incubation with the P-450 enzyme inhibitor, alpha-naphthoflavone (ANF). The objective of these studies was to determine if the *in vitro* immunosuppression was attenuated by the dual cyclooxygenase and lipoxygenase enzyme inhibitors, eicosatetraenoic acid (ETYA) or BW 755C. Immunosuppression was evaluated using the *in vitro* T-dependent AFC assay to sheep erythrocytes (sRBC). Naive splenocytes from B6C3F1 female mice were incubated with vehicle or B(a)P (0.1 nM-10 μM) \pm ETYA (10 nM -10 μM) or BW 755C (50 nM -50 μM) for 30 minutes or five days, then placed in culture with sRBC. AFC were enumerated on day five. As a result of inherent immunosuppression with five day exposure to drugs, an alternate experimental approach was undertaken, limiting exposure of B(a)P and drugs to the first 30 minutes, followed by washing and resuspending the splenocytes in fresh media. No effect levels for the 30 minute exposure to ETYA and BW 755C were 10 μM and 500 μM , respectively. No reversal of B(a)P induced immunosuppression was observed following 30 minute co-incubation with 10 μM ETYA. However, the B(a)P-induced decrease in the AFC response was attenuated at all dose levels by the co-incubation with 50 μM BW 755C for 30 minutes. Our data demonstrate that inhibition of the peroxyl radical pathway may attenuate B(a)P-induced immunosuppression, probably through the inhibition of B(a)P activation to its immunosuppressive metabolites. Supported in part by NIEHS contract ESO 05288.

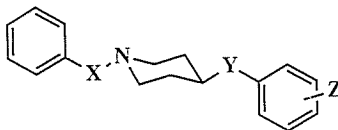
DIFFERENTIAL CONTRIBUTION OF THE OXYGEN ATOMS TO THE BINDING OF PROPRANOLOL ANALOGS AT 5-HT1D β AND MUTANT 5-HT1D β SEROTONIN RECEPTORS. M. Dukat,* A.M. Ismaiel,* R.B. Westkaemper,* E. Parker,* R.A. Glennon. Dept. Med. Chem., MCV/VCU, Richmond, VA 23298. 5-HT1B serotonin receptors represent rodent autoreceptors, whereas in humans, these receptors are termed 5-HT1D β receptors. These receptors represent species homologs and agents that bind at one population generally bind to the other. Propranolol is an agent that binds at 5-HT1B receptors but represents an anomaly in that it binds with low affinity at 5-HT1D β receptors. Because a key structural difference between these two receptors is the presence of an asparagine in TM7 of 5-HT1B versus a threonine (T355) at the corresponding position of 5-HT1D receptors, we synthesis and examined the binding a series of propranolol analogs at 5-HT1D β receptors and at mutant 5-HT1D β receptors where T355 had been replaced by asparagine. We conclude that propranolol displays high affinity for 5-HT1B/mutant 5-HT1D β receptors by virtue of being able to form a double hydrogen bond with the asparagine residue in TM7, whereas it displays lower affinity for 5-HT1D β receptors because it can not bind to the T355 in the same manner.

STRUCTURE-ACTIVITY RELATIONSHIPS FOR CENTRAL NICOTINE RECEPTOR BINDING. D. Dumas,* M. Dukat,* W. Fiedler,* I. Damaj,* B. Martin,* R.A. Glennon. Dept. Med. Chem., MCV/VCU, Richmond, VA 23298. Nicotine (**1**) seems to play a role in appetite, anxiety, and various other mental disorders and is now being regarded as a template for the design of new therapeutically useful agents. We have undertaken an investigation to determine the contribution of each molecular feature of **1** to binding at central nicotine receptors. In addition, because we have demonstrated on the basis of molecular modeling studies, a significant structural relationship between nicotine and the naturally occurring high-affinity nicotine receptor ligand epibatidine (**2**), we have particularly focussed on 6-position substitution in the nicotine series. On the basis of these studies, several new high-affinity nicotine ligands have been developed.



TACTILE STIMULATION FOR INFANTS: DEVELOPMENT OF A GUIDE FOR NEW PARENTS. Ronda K. Hansen and James P. O'Brien, Virginia Beach Campus, Tidewater Community College, Virginia Beach, Va. 23456. Presented for review and comment is a draft pamphlet for new parents on infant massage. The importance of touch stimulation on infants (both human and animal) has been repeatedly demonstrated in over 50 years of research. On the other hand, few medical professionals consider it necessary to teach parents about the detrimental effects of touch deprivation and the significant benefits of tactile stimulation for their infants. The draft pamphlet was created to show medical and psychological research support for the importance of this practice to new parents. The draft pamphlet describes, in lay language, the infant's need for touch excerpts of the research literature with bibliography, and basic methods, and suggestions for infant massage. The pamphlet also includes photographs of infants and parents engaged in various forms of infant massage and touch. Tidewater Community College will do the first printing for distribution to Hampton Roads pediatric units as a community service.

KETANSERIN: EFFECT OF BENZYLIC MODIFICATION ON 5-HT_{2A} AND 5-HT_{2C} SEROTONIN RECEPTORS AFFINITY. A.M. Ismaiel,* M. Teitler,* R.A. Glennon. Dept. Med. Chem., MCV/VCU. Richmond, VA 23298. Ketanserin (KET) is a prototypical 5-HT₂ serotonin receptor antagonist. Our previous SAR study revealed that the benzoylpiperidine portion of KET is important for binding, but that the remainder of the molecule can be substantially truncated. Although the truncated compounds bind with comparable affinity to KET, preliminary studies suggested that parallel structural modification of different truncated analogs resulted in non-parallel differences in receptor affinity. Accordingly, we examined a series of compounds where X = (CH₂)₂ and (CH₂)₄ and where Y and Z were varied. It is concluded that the truncated analogs bind at the receptor in a different manner depending upon the nature of Y. All compounds displayed greater 5-HT_{2A} vs 5-HT_{2C} selectivity than KET.



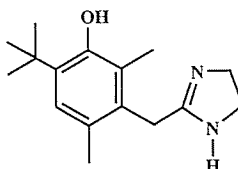
Lowering Zinc Concentrations to Determine the Minimum Zinc Requirements for the Growth of *Cryptococcus neoformans*. Higgs, Rebecca, Denise Hopkins*, and Judy H. Niehaus, Dept. of Biol., Radford Univ., Radford, VA 24142. *Cryptococcus neoformans*, a yeast-like organism widely distributed in nature, is an opportunistic pathogen that often infects immunocompromised patients. The present study investigates the zinc requirements of *C. neoformans*. To minimize zinc levels, glassware was washed with 12N HCl, water was purified with a mixed bed ion exchange column, and glucose was chromatographed through a Dowex 50 cation exchange resin. Preliminary studies indicated that peptone and yeast extract could be eliminated from the culture medium without adversely affecting growth rate, thereby eliminating possible sources of zinc contamination in the medium. When *C. neoformans* was cultured in minimal medium, growth was proportional to zinc concentration in the range of 1 to 35 μM zinc.

SCHISTOSOMA MANSONI: SUBCLONING AND MAPPING OF CDNA FROM THE ADULT WORM. Katherine Knight & Maryanne Simurda. Washington & Lee Univ., Lexington, VA. 24450

Clones from an adult worm cDNA library that are potentially of interest in developmental or immunological studies have been isolated and subcloned into the plasmid vector pGEM5Zf' (Promega). This project involves the generation of restriction endonuclease maps in preparation for DNA sequencing. A series of restriction endonucleases that recognize specific 6-base sites were used to digest the DNAs and the resulting fragments were analyzed by gel electrophoresis.

NOVEL CANNABINOID RECEPTOR ANTAGONIST INHIBITS ANANDAMIDE AND Δ^9 -THC INDUCED HYPOTENSION IN ANESTHETIZED RATS. Kristy D. Lake and George Kunos, Dept. of Pharmacology and Toxicology, Va. Commonwealth Univ.-Medical Col. of Va., Richmond, VA 23298. Cannabinoids (CB) affect blood pressure (BP) and heart rate (HR) in animals and humans. Our previous studies documented the cardiovascular effects of anandamide (AN) in urethane anesthetized Sprague-Dawley (SD) rats. The response to AN (1-20 mg/kg, iv) was dose-dependent and multiphasic: phase 1 bradycardia with concomitant decreased BP was mediated via central vagal activation; phase 2 pressor component was peripherally (but not sympathetically) mediated; and phase 3 hypotension resulted in a decrease in peripheral sympathetic activity. Furthermore, the CB₁ receptor antagonist (SR141716A; 0.01-10 mg/kg, iv) did not alter the pressor effect but dose-dependently ($p < 0.05$) antagonized the phase 3 hypotension observed following AN or Δ^9 -THC. These data imply that the phase 3 hypotension is due to CB₁ receptor-mediated reduction of sympathetic outflow to the vasculature. We have further characterized the cardiovascular effect of AN in conscious, unrestrained normotensive SD and hypertensive SHR rats. In conscious SD rats, AN (4 mg/kg, iv) elicited bradycardia and pressor effects but no hypotension. In contrast, in both conscious and anesthetized SHR, AN elicited a triphasic BP effect with the phase 3 hypotension being slower in onset and longer in duration than in urethane anesthetized SD rats. In pentobarbital anesthetized SD rats AN elicited dampened triphasic BP changes. Thus, the AN-induced hypotension is dependent on elevated intrinsic sympathetic tone.

BINDING OF OXYMETAZOLINE ANALOGS AT 5-HT_{1D} β SEROTONIN RECEPTORS. H. Law,* M. Dukat,* R. Kamboj (Allelix),* R.A. Glennon. Dept. Med. Chem., MCV/VCU, Richmond, VA 23298. Oxymetazoline, an adrenergic receptor ligand, has been demonstrated to bind with high affinity ($K_i = 1 \text{ nM}$) at 5-HT_{1D} β serotonin receptors. As such, it serves as a novel template for the design of new 5-HT_{1D} β ligands. Keeping the imidazoline portion of the molecule intact, we examined the contribution to binding of each of the aryl substituents by synthesizing and evaluating various mono-, di-, tri-, and tetra-substituted analogs. Structure-affinity relationships have been formulated which should aid in the subsequent design of high-affinity and more selective 5-HT_{1D} β receptor agents.



Oxymetazoline

IMMUNOTOXIC EFFECTS OF COBRA VENOM FACTOR (Naja Haje) ON C3 AND ISOTYPE SWITCHING AS EVALUATED BY ELISA. G. Craig Llewellyn¹, Leon F. Butterworth*¹, & Kimber L. White Jr.^{1,2}, Depts. of Pharmacology and Toxicology,¹ & Biomedical Engineering², Med. Col. of Va., Va. Commonwealth Univ., Richmond, VA. 23298-0613. Environmental immunotoxins such as 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and pentachlorophenol have been shown to have detrimental effects on C3, a component of the complement system and humoral immune responses. Genetically C3 deficient animals and humans lack the ability to undergo immunoglobulin isotype switching and have been shown to be prone to recurrent infections. This study was undertaken to determine if compounds capable of altering C3 levels have the potential to modulate isotype switching to a T-dependent antigen, sheep erythrocytes (sRBC). Cobra venom factor (CVF), a known C3 depleting agent, was evaluated for its ability to decrease C3 levels and modulate isotype switching, following sensitization with low (10^6 sRBC) and high (7.5×10^7 sRBC) concentrations of antigen. Female B6C3F1 mice were intravenously injected with saline, 1, 10, or 100 anticomplementary units (ACU)/kg, and serum C3, IgM, and IgG titers evaluated by ELISA. A decrease of 20%, 29%, and 84% in C3 levels was observed with the low antigen concentration, and a decrease of 7%, 54%, and 87% in C3 levels was observed with the high antigen concentration following 1, 10, and 100 ACU/kg doses of CVF. In the primary IgM response, a dose dependent increasing titer was observed following both low and high antigen challenge. Statistical significant differences were observed only at the 10 and 100 ACU/kg doses of the high antigen groups. In the secondary IgG response, the animals receiving high antigen challenge and CVF did not differ from the saline control. However with the low antigen challenge, a decrease of 58%, 60%, 76% was observed in animals receiving 1, 10, and 100 ACU/kg CVF. Animals receiving a low concentration of antigen and having a significant decrease in C3, also showed a significant decrease in IgG response. As was observed with the genetically deficient C3 animals, isotype switch was decreased following CVF administration and low antigen challenge. However, the inability to isotype switch was overcome when a high antigen concentration was utilized.

THE EFFECTS OF ACUTE AND CHRONIC ADMINISTRATION OF CI-977 ON [³H] -NITRENDIPINE BINDING IN MOUSE BRAIN AND SPINAL CORD TISSUE. David J. Mason Jr. and Sandra P. Welch. Department of Pharmacology and Toxicology, Medical College of Virginia/Virginia Commonwealth University, Richmond, VA 23298. Kappa (k) receptor agonists have been shown to produce antinociception with fewer side effects than morphine and other m-agonists. Studies indicate that acute administration of k-agonists produce a decrease in calcium conductance via the voltage sensitive calcium channels. We investigated the effects of acute and chronic administration of the k-agonist, CI-977, on the voltage gated L-type calcium channels. Acute administration consisted of a single i.p. administration of CI-977. Tolerance was developed by a 3 day regimen consisting of a 5 mg/kg i.p. dosage delivered twice daily at 8:00 a.m. and 4:00p.m. on days 1 and 2 followed by a 10 mg/kg i.p. dosage on day 3. Neither acute nor chronic administration of CI-977 produced significant alterations in [³H] - nitrendipine affinity or maximal binding in mouse whole brain homogenates. Acute administration of CI-977 produced no significant changes in [³H] - nitrendipine binding or affinity in mouse spinal cord homogenates. These data indicate that L-type calcium channels may not be involved in k-tolerance in the brain. (Supported by NIDA grants DA06031 and DA07027.)

THE EFFECTS OF ACUTE AND CHRONIC ANABOLIC ANDROGENIC STEROID TREATMENT ON DIFFERENT LOCOMOTOR STIMULANTS. Sean D. McAllister and David Compton. Dept. of Pharm/Tox, MCV, Richmond VA 23298-0613. Previous studies have indicated an interaction between anabolic-androgenic steroid (AAS) treatment and the locomotor stimulatory effect of cocaine. This investigation evaluated the effect of AAS treatment on differing classes of stimulants. Male ICR mice were treated (i.p.) acutely or chronically (4 weeks) with testosterone propionate (TP) or sesame oil (veh). An hour after the acute or last chronic TP injection, mice were administered various stimulants and evaluated for locomotor stimulation. Dose response curves were generated for cocaine (COC), amphetamine (AMP), amfonelic acid (AFA) and caffeine (CAF) following acute AAS treatment and for COC following chronic AAS treatment. The E_{max} and ED_{50} were determined from the stimulatory portion of the dose response curves utilizing sigmoidal curve linear analysis. Acute TP treatment significantly reduced the E_{max} (counts) of COC (7016 to 4492) and AFA (8433 to 6106) but not CAF (3501 to 3300). Chronic AAS treatment did not significantly reduce the E_{max} of COC (8555 to 7448). The ED_{50} values of treatment groups did not differ from controls. These data indicate that acute AAS treatment decreases the maximum stimulatory effect of some, but not all, stimulants and chronic AAS treatment might induce some degree of tolerance. Supported by NIDA grant DA-07507.

TAXOL-MEDIATED CHANGES IN FIBROSARCOMA-INDUCED MACROPHAGE FUNCTION: DOWNREGULATION OF IMMUNOSUPPRESSION AND ENHANCED ANTITUMOR ACTIVITIES. D.W. Mullins and K.D. Elgert. Dept. of Biol., Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061-0406. Tumor-bearing host (TBH) macrophages (M ϕ) mediate immunosuppression, in part, through overproduction of nitric oxide (NO) and tumor-necrosis factor-alpha (TNF- α). In tumor-distal sites, NO and TNF- α suppress T cell proliferation but lack anti-tumor activities. Because taxol stimulates M ϕ activities and tumor growth induces functional changes among M ϕ populations, we studied whether murine fibrosarcoma growth altered taxol-mediated regulation of M ϕ activities. Activated normal host (NH) M ϕ produced less NO than did TBH M ϕ ; taxol pretreatment increased NO production by NH M ϕ but decreased TBH M ϕ NO production. Taxol increased TNF- α production by NH and TBH M ϕ . Exogenous TNF- α decreased NO production by activated M ϕ populations, and neutralization of TNF- α activity increased NO production by activated M ϕ but blocked taxol-mediated downregulation of TBH M ϕ NO production. This suggests that TNF- α may autocrinely regulate M ϕ NO production and taxol may suppress TBH M ϕ NO synthesis through TNF- α . Taxol-pretreated TBH M ϕ were less suppressive of T cell proliferation, suggesting that taxol-mediated downregulation of NO production may partially reverse tumor-induced immunosuppression. Although tumor growth primes M ϕ for increased NO and TNF- α production, taxol may regulate these suppressive molecules in tumor-distal locations, partially reversing tumor-induced immunosuppression. The success of taxol as an anticancer agent may partially derive from its immunotherapeutic efficacy.

N-GLUCURONIDATION OF PHENOBARBITAL: *IN-VITRO* STUDIES IN HUMAN AND MOUSE LIVER MICROSOMES. Sheela G. Paibir, William H. Soine, Diana Thomas and Robert A. Fisher[†], Dept. Medicinal Chemistry and Dept. Surgery[†], MCV/VCU, Richmond, VA-23298. Phenobarbital *N*-glycosides (PbG) are urinary metabolites of phenobarbital (Pb) in mouse and human. Studies on the formation of PbG conjugates required the development of an *in-vitro* assay for Pb *N*-glucuronidation using liver microsomes. Co-incubation of the liver microsomes from either the mouse or the humans with Pb and [¹⁴C]-UDP-glucuronic acid (UDP-GA), led to the formation of radiolabeled (*R*)- and (*S*)-Phenobarbital *N*-glucuronide (PbGA). The glucuronidation activity of the native liver microsomes was increased 5-fold and 2-fold by CHAPS in the mouse and the human, respectively. In both species, PbGA formation was optimal over a pH ranging from 6.5-7.3; and in the presence of magnesium. Presence of saccharolactone, a β -glucuronidase inhibitor showed no increase in the specific activity. The K_m (mM) and V_{max} (picomoles/mg-prot/min), respectively, for Pb (presence of 200 μ M UDP-GA), were 3.52 ± 0.50 and 7.74 ± 0.51 (male mouse), 1.04 ± 0.15 and 1.23 ± 0.05 (human male), 1.57 ± 0.24 and 0.91 ± 0.05 (human female). The K_m and V_{max} , respectively, for UDP-GA (presence of 5 mM Pb), were 1.15 ± 0.18 and 8.67 ± 0.51 (male mouse), 0.41 ± 0.04 and 4.98 ± 0.15 (human male), 0.095 ± 0.018 and 1.14 ± 0.05 (human female). These studies demonstrate that PbGA is biosynthesized by both the mouse and the human liver microsomes *in-vitro* with comparable enzymatic characteristics. (Supported by NIH Grant GM 34507).

A COMPARISON OF *N*-GLUCOSYLATION AND *N*-GLUCURONIDATION OF PHENOBARBITAL IN HUMAN LIVER MICROSOMES. Sheela G. Paibir, William H. Soine, Diana Thomas and Robert A. Fisher[†], Dept. Medicinal Chemistry and [†]Dept. Surgery, MCV/VCU, Richmond, VA-23298. Phenobarbital *N*-glucoside (PbG) and phenobarbital *N*-glucuronide (PbGA) are formed *in-vitro* by mouse liver microsomes co-incubated with phenobarbital (Pb). Typically, biosynthesis of glucoside and glucuronide conjugates is catalyzed by UDP-glucosyltransferase(s) and UDP-glucuronyltransferase(s) enzymes, respectively. The radiochemical assay developed to study these glycosylation pathways *in-vitro* in the liver microsomes of mouse was extended to the humans. The conjugation activities of the liver microsomes were analyzed from 18 humans (12 males, 6 females) aged from 7-69 years. Presence of CHAPS increased Pb *N*-glucuronidation but decreased Pb *N*-glucosylation. The average specific activities for the formation of PbG (no detergent) and PbGA (1 mg-CHAPS/mg-prot.), in the presence of 2 mM Pb, were 1.30 ± 0.93 and 1.03 ± 0.59 picomoles/mg-prot/min, respectively. The observed activities for either PbG or PbGA formation did not appear to correlate to prior drug exposure, bilirubin levels, race, age or sex of the patient. The ratios of V_{max}/K_m for Pb in two males were 3.93 and 0.86 for PbG formation, and 1.18 and 1.63 for PbGA formation; and in two females were 0.47 and 0.42 for PbG, and 0.20 and 0.58 for PbGA. The mean of the ratios of the *in-vitro* specific activities for PbG and PbGA formation was 1.51 ± 0.93 , suggesting that Pb should undergo *N*-glucosylation and *N*-glucuronidation to a comparable extent in humans *in-vivo*. (Supported by NIH Grant GM 34507).

DIFFERENTIAL EXPRESSION OF NEURONAL NICOTINIC RECEPTOR $\alpha 4$ SUBUNIT mRNA IN RAT BRAIN. J. J. Shacka and S. E. Robinson*, Dept. of Pharmacology & Toxicology, Med. Col. of Va., Va. Commonwealth Univ., Richmond, Va. 23298-0613. The goal of this study was to compare neuronal nicotinic receptor (nNR) $\alpha 4$ subunit mRNA development in Sprague-Dawley CD rat brain. 50 μ g total RNA from adult or three-week old hippocampus (hippocampus+septum), cortex and thalamus was size-fractionated and transferred to nitrocellulose. Northern hybridization was performed via an α - 32 P dCTP-labelled 200 bp probe encoding the non-conserved 3' intracellular loop of nNR $\alpha 4$ -1 subunit cDNA. Total RNA was normalized for gel loading via γ - 32 P ATP-labelled 28S rRNA. Data were quantified via Molecular Dynamics intensity units as the ratio of $\alpha 4$ mRNA to 28S rRNA. Preliminary studies have identified three transcripts (8.5, 4.2 and 2.4 kb) homologous to $\alpha 4$ -1 cDNA, with similar quantities in both age groups. Upon normalization, the 8.5 kb transcript was more pronounced in the thalamus than in the cortex, and barely detectable in the hippocampus. The ratio of the 4.2 kb transcript to 28S was greater in the thalamus than in the cortex or hippocampus, which had similar ratios. The ratio of the 2.4 kb fragment to 28S was higher in the thalamus than in the cortex, and much lower in the hippocampus. These findings suggest brain region-specific processing of multiple transcripts encoding the $\alpha 4$ subunit in rat brain.

INVESTIGATION OF THE CANNABINOID ANTAGONIST, CP330,947. Lori Showalter, and Aron Lichtman, Dept. of Pharmacology and Toxicology, Va. Commonwealth Univ., Richmond, Va. 23284. It is well established that the cannabinoid agonist, CP 55,940 produces antinociception, hypothermia and catalepsy in rodents. The purpose of this study was to examine the effects of pretreatment of CP 330,947, a putative antagonist of the brain cannabinoid receptor, on the pharmacological effects of cannabinoids. Rats were implanted with intracerebroventricular (ICV) cannula guides directed at the left lateral ventricle. After a one week recovery period, the animals were given two ICV injections; the first was dimethyl sulfoxide (DMSO) vehicle or CP 330,947 (100 or 300 μ g) and ten minutes later each animal was given DMSO or CP 55,940 (10, 25, 35, 50, 100 or 300 μ g). The antinociception and cataleptic effects of CP 55,940 were blocked by CP 330,947. The ED₅₀ for antinociception of CP 55,940 alone was 22 μ g, 100 μ g of CP330,947 decreased this antinociceptive effect two fold (ED₅₀ = 47), and 300 μ g of CP 330,947 completely blocked the antinociceptive effects of CP 55,940. These findings support the contention that CP 330,947 is a cannabinoid antagonist.

ANABOLIC STEROID ALTERATIONS OF ANDROGEN RECEPTOR mRNA LEVELS IN THE BRAIN. Suzanne R. Thornton, Mary E. Abood and David R. Compton, Dept. Pharm/Tox., Med. Col. of Va., Richmond, Va. 23298. Anabolic steroid abuse has dramatically increased, prompting the passage of the Anabolic Steroid Control Act of 1990. Although their abuse has increased, little has been done to characterize molecular and biochemical alterations in the central nervous system during their abuse. The present study was conducted to determine if androgen receptor mRNA could be detected in the brain and to determine the effects of acute and chronic anabolic steroids on androgen receptor mRNA levels. The study was conducted using male ICR mice (weighing 25-30 g) injected I.P. with either sesame oil or sesame oil with 5 % benzyl alcohol or 500 mg/kg of nandrolone deconoate, nandrolone propionate, testosterone deconoate 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 whole brains removed and prepared for Northern blot analysis. An 11 kb and a 9.3 kb androgen receptor mRNA band was detected using a rat androgen cDNA probe. Alterations in one or both of the mRNA species was observed in the acute and chronic steroid treated groups. These data are the first indication that androgen receptor mRNA species can be detected in brain tissue. Also, steroids administered acutely or chronically can cause alterations in the androgen receptor which could alter receptor expression or could be related to the clinical reports of sexual, motor and psychological disturbances in anabolic steroid abusers.

BLOCKADE OF KETOROLAC-INDUCED ANTINOCICEPTION BY NOR-BINALTORPHIMINE IN MICE. Anubha Tripathi and Sandra P. Welch, Dept. of Pharmacology and Toxicology, Medical College of VA, VA Commonwealth Univ., Richmond, VA 23298. The antinociceptive effects of ketorolac, administered intracerebroventricularly, were determined in mice by measuring inhibition of the p-phenylquinone-induced effects of abdominal stretching. The ED₅₀ value for ketorolac in the p-phenylquinone test was determined to be 7.34 µg/ mouse (4.97-10.82). Antinociceptive activity produced by ketorolac was found to be dose-dependent. Selective antagonists of the µ, δ, and κ-opioid receptors were used to determine ketorolac's mechanism of action. The antinociceptive effects produced by ketorolac were not blocked by the µ-opioid receptor antagonist, naloxone, and the δ-opioid receptor antagonist, ICI-174,864; however, nor-BNI, the κ-opioid receptor antagonist, significantly blocked these effects. These results suggest that the stimulation of κ receptors appears to play a role in the mechanism of action of the antinociception produced by ketorolac. In addition, ketorolac may cause the release of endogenous κ opioids to create central nervous system antinociception.

GLUTATHIONE AND PLANARIAN REGENERATION. R. B. Worobec, P.O.B. 162, Mt. Vernon, VA 22121-0162. Glutathione (GSH; L-γ-Glu-Cys-Gly), the most important and ubiquitous nonprotein thiol in living systems, is directly or indirectly involved in a wide spectrum of biological phenomena, including cell proliferation and tumorigenesis. Since planarians are recognized for their prodigious regenerative powers, they constitute an excellent model--within limitations--for assessing cell activation and proliferation. Studies from half a century ago, while ambiguous, indicated that GSH levels fluctuate in the course of planarian regeneration, and that exogenous GSH may enhance regeneration and fissioning. Accordingly, preliminary screening studies were undertaken with laboratory-bred asexual *Dugesia tigrina* to ascertain the effect of exogenous GSH on the rate of regeneration and fissioning of worms maintained at room temperature (21 ± 3°) in spring water, pH 7.51. Observations on one population of sectioned 8-12 mm *Dugesia tigrina* gave the impression that the rate of regeneration was not affected by exogenous GSH (20-80 µg/ml); however, tail segment fissioning was enhanced prior to full head regeneration. After 8 days 100% of the tail segments exposed to 40 µg/ml GSH had fissioned, 65% of those exposed to 20 µg/ml GSH, and none of the control tails. In order to further define the role of GSH in planarian regeneration, studies are underway with L-buthionine-SR-sulfoxime, a specific inhibitor of γ-glutamylcysteine synthetase, and GSH monomethyl ester (for efficient delivery) to more effectively modulate intracellular GSH concentrations in planaria.

Microbiology and Molecular Biology (No Abstracts Submitted)

Natural History and Biodiversity

FIRE HISTORY OF THE GEORGE WASHINGTON NATIONAL FOREST. H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422 and S. Croy, USDA For. Serv., Roanoke, VA 24019. Data were obtained from records for 2,198 fires occurring in the George Washington National Forest through 1993. Whenever available, elevation, aspect, topographic position, size, forest type, and cause of each fire were noted. Sixteen possible "causes" of fire were categorized, most (21%) due to arson. Smoker-related fires accounted for an additional nineteen percent, "unknown" origin for fourteen percent, and lightning for thirteen percent. Forty-eight percent of all fires during the year occurred in March, April (alone, 26%), and May with another fifteen percent in November. Of the fifty-nine fires (2.7 percent of all fires) that were five hundred or more acres in size, eighteen (thirty percent) were attributed to arson. The largest lightning-caused fire was 640 acres, occurring in May, 1925. Forty percent of the largest fires (for which records were available) occurred in April and another twenty percent in November. Nearly 50 fires per year (higher than for other decades) occurred during the 1970s and 1980s with arson origin peaking in the 80s. Fires attributed to camping have steadily increased since the 1950s. In general, fires due to lightning tended to occur during months with more precipitation (June - August) and vice versa for fires attributed to other causes. Based on our data, the most likely "strike zone" in the GWNF for lightning fires is southeast or southwest upper slopes or ridgetops in an elevational range of 1,600 to 3,200 feet. (This study was supported in part by funds provided by the USDA Forest Service.)

REARING OF JUVENILE FRESHWATER MUSSELS IN AN ARTIFICIAL STREAM SYSTEM. Braven B. Beatty & Richard J. Neves, NBS Cooperative Research Unit, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. An experimental system for rearing juvenile freshwater mussels (Unionidae) has been developed and designed with natural river water supplied to the animals. The artificial stream beside the Clinch River at the Clinch River Steam Plant in Carbo, VA ensures that the food and chemical composition of the water overlying the juveniles is similar to that experienced in rivers. The streams consist of oval tanks with center islands, and paddlewheels continuously provide a unidirectional current in the tanks. Juveniles were placed in the tanks in small containers so that they could be located by researchers during the experiment. In June, 1993, 18 containers with 100 juvenile rainbow mussels (*Villosa iris*) each were placed in the artificial streams in one of two substrate sizes (< 120 μm and between 120 and 600 μm). The animals were allowed to grow for 4.5 months, after which survival rates and growth were measured. Neither survival rate nor growth was statistically different between the substrate sizes. Mean survival rates were 27.7% and 27.3% for the fine and coarse substrate, respectively. Mussels in the fine substrate attained a mean size of 10.8 mm^2 , while those in the coarse substrate reached a mean size of 8.9 mm^2 . The experiment was modified in 1994 to include the same two substrate sizes and two substrate depths, 5 mm and 20 mm. In September, 1994, 80 containers with 100 juveniles each were placed in the artificial streams. The animals were allowed to remain in the streams for 3 months. These animals had survival rates of less than 3% and exhibited no growth. We believe that the late start for this experiment, the resulting low water temperatures, or other factors contributed to this poor performance.

SYSTEMATICS OF THE SPIDER GENERA *MALLOS* AND *MEXITILIA* (ARANEAE: DICTYNYNIDAE). Jason E. Bond, Dept. of Biol., Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. This systematic study recognizes 15 species of the genus *Mallos* Pickard-Cambridge and three species of the genus *Mexitilia* Lehtinen. Three species of *Mallos* and one species of *Mexitilia* are newly described. Two *Mallos* species are placed in synonymy and two species are transferred to other dictynid genera. The males of two *Mallos* species are described for the first time. A cladistic analysis based on 22 morphological characters produced a cladogram that supports the monophyly of *Mallos* and the validity of *Mexitilia*. For five species of *Mallos* and one species of *Mexitilia* mitochondrial and nuclear DNA sequences were analyzed by restriction digest. The seventeen resulting restriction sites produced a cladogram that agreed with the one based on the morphology of these six species. When morphological and molecular characters were combined they produced a single tree that was identical to that based on molecular data alone. These molecular and morphological characters present the same picture of *Mallos* and *Mexitilia* phylogeny. (Supported by: Sigma Xi, American Museum of Natural History, GSA Virginia Tech., Dept. of Biology Virginia Tech., and Promega)

THE SOUTHERN WATERSHEDS COMMON REED PROJECT: MANAGEMENT OF AN INVASIVE PLANT. Kennedy H. Clark, Va. Dept. of Conservation and Recreation, Div. of Natural Heritage, 1500 E. Main St., Suite 312, Richmond, VA 23219. Common reed (*Phragmites australis*) is an invasive wetland grass which has become especially pernicious in the Southern Watersheds, an area in the southeastern corner of Virginia. Common reed is a threat to many of the rare species and the exemplary marsh communities of the Southern Watersheds because its aggressive growth patterns displace native plants and degrade wildlife habitat. In order to address the common reed problem, the Virginia Department of Conservation and Recreation along with many partners began a two-year project in 1993 designed to demonstrate effective control of common reed on stands which are imminently threatening some of the more significant marshes of the Southern Watersheds. The project, which will conclude at the end of 1995, entails a site selection phase, control of common reed through herbicide application and prescribed burning, quantitative vegetation monitoring, public education initiatives, and a cooperative comprehensive planning effort among the conservation interests of the Southern Watersheds.

RECENT EXOTIC INSECT INTRODUCTIONS OF ECONOMIC IMPORTANCE: 1985-1995. Eric R. Day, Department of Entomology, VPI&SU, Blacksburg, VA 24061-0319. Exotic insects are defined as insects with a native range outside of Virginia or the North American continent. Introductions are successful establishments of these insects in the Commonwealth. The Asian Tiger Mosquito, Western Corn Rootworm, Multicolored Asian Lady Beetle, *Miscanthus Mealybug*, and Beech Scale all have established themselves in Virginia in the last decade. These insects have varying degrees of importance and spread in Virginia. Two other insects are also discussed, the gypsy moth which continues its southward spread and the boll weevil which has been eradicated from Virginia allowing many growers to try growing cotton again. Exotic detection programs are also discussed.

RELIABILITY AND EFFICIENCY OF MORPHOLOGICAL INDICES OF SALAMANDER NUTRITIONAL CONDITION. Kevin L. S. Drury, Douglas N. Harpole, and Carola A. Haas. Dept. of Fisheries and Wildlife Sciences, Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061. Estimating the nutritional condition of animals in the field may be useful for determining health of populations. We maintained 84 red-backed salamanders (*Plethodon cinereus*) in the lab on different diets. We then measured morphological characters that have been used as indices of condition. The measurements were: 1) mass/SVL (snout-vent-length), 2) vol/SVL, and 3) tail width (TW)/SVL. We timed investigators taking the measurements and tested the techniques for differences in efficiency using the Kruskal-Wallis k-test. The TW/SVL measurement was most efficient with a mean time of 42.5 sec. Mass/SVL was next at 48.6 sec and vol/SVL was least efficient at 114.1 sec. Additionally, we compared changes in volume to changes in mass and found no significant difference between the two ($p > 0.61$). Results from changes in TW were inconclusive and are under further study.

RECONNAISSANCE VEGETATION STUDY OF FOUR RIVER GORGES IN WEST VIRGINIA. R. H. Fortney*, Dept. of Nat. Sci. and Math, Salem-Teikyo Univ., Salem WV 26426, S. L. Stephenson, Dept. of Biology, Fairmont State College, Fairmont, WV 26554, and H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422. During the 1994 field season, we collected quantitative data on composition and structure of the vegetation in the Bluestone, Gauley, Meadow, and New River Gorges of West Virginia. A single transect was located on a representative slope of each gorge (except Meadow River) and at least three twenty by fifty meter (0.1 ha) quadrats (with smaller nested quadrats) were established equidistantly along this gradient to sample vegetation. Tree core and soil samples also were collected in or near each quadrat. Additional cores were obtained from trees growing at selected rock outcrops in the Gauley, New, and Meadow River Gorges. Dry site oak-dominated forests generally occupied the upper slopes, whereas more mesophytic forests were found down slope. Levels of pH and concentrations of Ca, N, Mg, Mn, K, and P typically increased along this same gradient. The finding of trees exceeding 250 years at the Carnifex Ferry State Park site in the Gauley River Gorge and in a stand located on a very steep mid-slope between two rock outcrops in the Bluestone Gorge suggests possible existence of other old-age trees in these steep gorges. (This study was supported by the National Park Service.)

TERRESTRIAL SALAMANDER DENSITY AND DIVERSITY IN THE MOUNTAINS OF SOUTHWESTERN VIRGINIA. Douglas N. Harpole and Carola A. Haas. Dept. of Fisheries and Wildlife Sciences. Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. As part of an ongoing study to examine the effects of silvicultural practices on biodiversity in the southern Appalachians, we sampled terrestrial salamander populations at five sites in the Jefferson National Forest. From April through October of 1994, we sampled one 14 ha study area in each of the Newcastle, Blacksburg, and Wythe ranger districts and two in the Clinch ranger district. We used night searches of 2x15 m transects to determine species richness and relative abundance. The number of species encountered on each site ranged from 4 to 12. Mean densities of animals captured on transects ranged from 0.01 individuals per m² at the Newcastle site to 0.74 individuals per m² at one Clinch site.

ECOLOGY OF SCALE INSECTS IN VIRGINIA. Michael Kosztarab, Dept. of Entomology, Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061. Abiotic conditions such as high humidity, summer heat and drought, wind velocity, and heavy rains adversely affect most scale insects. Some scale insects are adapted to saltwater inundation, and to nutrient abundance or deficiency in the soil and/or in their host plants. These insects have adapted to a variety of biotic conditions, including most terrestrial macrohabitats having plant life, and they also occupy special microhabitats. A number of unique plant-host associations are discussed, including host induced biotypes, such as stem and leaf forms. Their parasites and predators are also presented, and their mutualistic relationship with ants discussed.

FIELD STUDIES ON THE SEX RATIO AND SEXUAL DIMORPHISM OF WESTERN CORN ROOTWORM. Thomas P. Kuhar, Dept. of Entomology, VPI & SU, Blacksburg, Va 24061-0319. Field studies were conducted in 1993 to investigate a possible sexual dimorphism in the elytra coloration pattern of western corn rootworm, *Diabrotica virgifera virgifera* LeConte, adults, and to compare the sex ratio of adults captured on two commercial yellow sticky traps with those obtained by aspiration. Striped and solid variations in elytra pattern were found in both sexes. Of the western corn rootworm adults which exhibited the solid elytra pattern, over 99% captured on yellow sticky traps and 97% collected by aspiration were male. In contrast, of those adults which exhibited the striped elytra pattern, 79% captured on yellow sticky traps and 42% collected by aspiration were male. Sex ratio of adults varied significantly over time and among sampling methods. Sticky traps captured a significantly greater proportion of males compared with aspiration. No significant difference in sex ratio was found between the two brands of sticky traps, however, the Olson trap captured significantly more corn rootworm adults overall than the modified Pherocon AM trap.

DISTRIBUTION OF FISH ABOVE AND BELOW A HYDROLOGICAL BARRIER IN THE RUSSELL FORK, VIRGINIA. Kevin N. Leftwich, U.S. Forest Service, Dept. of Fish. and Wildl. Sci., Virginia Tech, Blacksburg, VA 24061-0321, William E. Ensign* and Paul L. Angermeier*, Virginia Coop. Fish and Wildl. Res. Unit, Dept. of Fish. and Wildl. Sci., Virginia Tech, Blacksburg, VA 24061-0321. We used electrofishing and underwater observation techniques to determine fish distribution in 16 river-kilometers (divided into four segments) of the Russell Fork (Big Sandy drainage) in Fall of 1994. Twenty-eight species were captured or observed in the study area. Species richness increased from 12 species in the upstream segment to 22 species in the downstream segment. The change in species richness primarily occurred at a series of cascades and waterfalls located within an area one kilometer upstream from the Virginia-Kentucky border. Six species (*Moxostoma* sp., *Percina caprodes*, *P. maculata*, *Etheostoma zonale*, *E. blennioides*, and *Stizostedion vitreum*), observed only below these falls, are new records for the Russell Fork in Virginia. (Supported by funding from the U.S. Army Corps of Engineers)

TECHNIQUES OF VIDEOTAPING FISHES FROM ABOVE THE SURFACE OF THE WATER. Eugene G. Maurakis, Science Museum of Virginia, Richmond, VA 23220 and William S. Woolcott, University of Richmond, VA 23173. Few biologists have successfully taped activities of fishes in streams from above the surface of the water. This presentation describes the cameras, recorders, power supply, lighting sources, cinematographic techniques (camera angle, continuity, cutting, close-ups, composition), recording methods, and analytical techniques that we have used to videotape reproductive behaviors of fishes from above the surface of the water. Prior to our use of frame-by-frame analysis of videotapes beginning in 1986, not a single author had reported 20 conspicuous reproductive behaviors that we now have identified and categorized into sequences of behavior for over 35 species in 375 hours of recordings. Species-specific behaviors can be used as effective management tools in preserving habitats of species as they directly relate to the habitat requirements of species. Funded by University of Richmond, and Richard and Carolyn T. Gwathmey Memorial Trust.

LOW REPRODUCTIVE SUCCESS OF A NEOTROPICAL MIGRANT SONGBIRD IN AN EXTENSIVELY FORESTED LANDSCAPE. Amy L. Meehan and Carola A. Haas, Dept. of Fisheries and Wildlife Sciences, Va. Polytechnic Inst. & State Univ., Blacksburg, VA. 24061-0321. One year of preliminary data collected on a site in an extensively forested landscape in Virginia indicated low reproductive success for solitary vireos (*Vireo solitarius*). The Mayfield estimate of nest success was 12% as compared to an average of 42% for Neotropical migrants (Martin 1992). Fall cankerworm (*Alsophila pometaria*) defoliation and some ice storm damage created a relatively open canopy in the summer of 1994. The increased visibility of nests to predators and parasites may be responsible for the depredation rate of 47% and the cowbird (*Molothrus ater*) parasitism rate of 23%. Pairing success, however, was 88%, indicating that females did settle in this habitat, despite the low rate of nesting success.

CARABID BEETLE BIODIVERSITY IN CONTRASTING HABITATS IN NORTHERN VIRGINIA. Adrienne A. Hall & Joseph C. Mitchell, Dept. of Biology, Univ. of Richmond, VA 23173, and Richard L. Hoffman, Virginia Museum of Natural History, 1001 Douglas Ave., Martinsville, VA 24112. We studied the composition and structure of ground beetle communities in Quantico Marine Corps Base, Prince William and Stafford counties, Virginia for two six-week periods: 30 August - 11 October 1990 (Fall sample) and 17 April - 29 May 1991 (Spring sample). Three-armed drift fence arrays with a 19 l plastic bucket at each end of each 7.5 m arm of aluminum flashing (6 pitfalls per array) were established in two riparian hardwood forest sites, two upland hardwood sites, and two old field sites. The 3041 individual captures represented 35 genera and 71 species. Number of species per site varied from 26 in an upland hardwood forest to 39 in a field consisting of grasses and two-year old loblolly pine. Except for this site (spring 32, fall 19), the number of species between spring and fall samples did not differ significantly. Shannon diversity indices were similar among sites and seasons. Our measures of microhabitat diversity exhibited no relationships with measures of beetle community structure. Evaluating beetle communities at the family level yielded no substantive inferences. However, 15 of 21 species occurring only in hardwoods are in mesic and hydrophilic-adapted genera and 7 of 12 species found only in old fields are in xeric-adapted genera. Inferences on the effects of habitat disturbance to carabid beetle communities should be made at the generic level.

CHEMOSENSORY ABILITIES OF FEMALE FRESHWATER MUSSELS (UNIONIDAE). William F. Henley and Richard J. Neves, Va. Cooperative Fish and Wildlife Res. Unit, Dept. of Fisheries and Wildlife Sciences, Va. Polytechnic Inst. & State Univ., Blacksburg, Va. 24061-0321. Behavioral changes in gravid *Lampsilis fasciola* and *Villosa iris* indicate their ability to detect host (*Micropterus dolomieu*) and non-host (*Cyprinus carpio*) fishes and mucus. Behavioral observations of adult mussels included degree of mantle presentation, mantle pulse rate, glochidial ejection, shell spread, and inhalant aperture length. Measurements associated with these observations were used to create a composite behavioral index. *Lampsilis fasciola* was more active with exposure to host fishes and mucus ($p < .00001$ and $p < .0001$, respectively), and less active with exposure to non-host fishes ($p < .00001$). Also, activity levels were higher with exposure to host fishes than mucus ($p < .00001$). Similar behavioral changes were noted with *V. iris*. *L. fasciola* was found to be more active diurnally, whereas *V. iris* was found to be more active nocturnally.

OLD GROWTH FORESTS OF PETERS MOUNTAIN, ALLEGHANY COUNTY, VIRGINIA. William H. Moorhead III, Va. Dept. of Conservation and Recreation, Div. of Natural Heritage, Main Street Station, 1500 E. Main St., Suite 312, Richmond, Va. 23219. Two large stands of primary, old-growth Appalachian oak forest, totaling 1400 ha. were unexpectedly discovered in 1994 on Peters Mountain in the George Washington and Jefferson National Forests. The discovery was made during a cooperative research project between the Virginia Dept. of Conservation and Recreation and USDA Forest Service. The project resulted in the establishment of 50 0.04-ha permanent plots used to classify and map the vegetation and ecological land units of a 4050 ha study area which represented a typical Ridge and Valley Province landscape. Plot sampling documented total floristic composition, vegetation structure, 14 environmental variables including soil chemistry, and the aging of the largest trees present. Dominant canopy trees with trunk diameters between 43 and 81 cm were 150-300 years old. Other large stands of old-growth forest are likely to exist in Virginia, especially on poorer mountain sites where the canopy trees aren't especially large, but comprise pristine or nearly pristine forest conditions.

DISCOVERY OF SHALE BARRENS IN THE BLUE RIDGE MOUNTAINS OF WEST-CENTRAL VIRGINIA. Thomas J. Rawinski, Va. Dept. of Conservation and Recreation, Div. of Natural Heritage, Main Street Station, 1500 E. Main St., Suite 312, Richmond, Va. 23219, Edith Beck, 1405 Landon Ct., Lynchburg, Va. 24503, & Kenneth Hickman, George Washington and Jefferson National Forests, Box 10, Rt. 130, Natural Bridge Station, Va. 24579. Shale barrens are natural environments supporting xerophytic vegetation characterized by several endemic, near-endemic, and disjunct plant species. Shale barrens were thought to occur only in the Ridge and Valley physiographic province, but brief accounts in the literature, plant collection records, and subsequent field sampling confirm the occurrence of shale barrens in the Blue Ridge Mountains of Rockbridge and Botetourt Counties. These barrens occur on steep, south-facing slopes of the Harpers Formation. Typical rocks are metasandstone, metasilstone, and phyllite. Four distinct subassociations of the *Pinus virginiana-Quercus montana-Senecio antennariifolius* Association were classified, which demonstrated overall similarity to the Ridge and Valley barrens. The Blue Ridge shale barrens are distinguished by the consistent absence of most shale barren endemics. Additional biological inventory, ecological study, and site protection are recommended.

OLD-GROWTH FORESTS IN THE MID-APPALACHIANS. S. L. Stephenson, Dept. of Biology, Fairmont State Col., Fairmont, WV 26554 and H. S. Adams, D. S. Lancaster Cmnty. Col., Clifton Forge, VA 24422. Areas of upland forest that apparently escaped logging are uncommon in the mid-Appalachians, but a few examples do exist. One of the largest and best know of these is the Gaudineer Scenic Area (a mixed northern hardwood/red spruce community) on Cheat Mountain in West Virginia. Other examples include two sites. Pond Drain (a mixed mesophytic community) and War Spur Branch (a hemlock/red spruce community), on Salt Pond Mountain in southwestern Virginia, and Turkey Run (red spruce/hemlock community) on McGowan Mountain in West Virginia. Throughout the region, individual trees of sufficient age (>150 yrs) to predate logging are sometimes present on isolated ridgetops and steep, relatively inaccessible slopes. Tree species represented by old-growth individuals (with maximum age of any tree we have cored given in parentheses) include red spruce (368), yellow-poplar (310), white oak (306), chestnut oak (275), eastern red cedar (258), northern white cedar (246), eastern hemlock (220), northern red oak (180), and white pine (174).

TROJAN HORSES IN APPALACHIAN FORESTS. R. Jay Stipes, Dept. Plant Pathol., Physiol. & Weed Sci., Virginia Tech, Blacksburg, VA 24061-0331. It is now well documented that humankind and anthropogenic stresses have been responsible for the dissemination and induction of widespread tree diseases, and the resultant loss of considerable global biodiversity. The introduction of three major tree diseases ("Trojan horses") in the 20th century have exacted a tremendous toll on the survival of three major species of our indigenous tree flora in the Appalachians. Chestnut blight, introduced from the Orient at the turn of the century, destroyed about 5 billion American chestnut trees that constituted about 25% of the forest. Dutch elm disease, introduced about 1930 from Europe, has decimated millions of America's favorite landscape tree. Just recently, in the 1980s, yet a new killer, dogwood anthracnose, a suspected introduction on ornamental stock from the Orient, is now threatening the survival of the beautiful harbinger of spring, the flowering dogwood, food source for more than 30 species of birds. Will humankind ever learn? Can these phenomena be avoided as we are rapidly becoming a global village?

INSECTS OF MOSS PHLOX (PHLOX SUBULATA): UNEXPECTED DIVERSITY IN APPALACHIAN SHALE BARRENS. A. G. WHEELER, JR., Bur. of Plant Ind., Pa. Dept. of Agric., Harrisburg, PA 17110. Moss phlox (*P. subulata*, Polemoniaceae) is a mat-forming, suffruticose perennial that is common in mid-Appalachian shale barrens. This pioneer, xerophytic plant has been largely ignored by entomologists. Studies conducted mainly in southwestern Virginia and eastern West Virginia (1989-1994) have shown that moss phlox supports a rich insect community--one more diverse than that associated with plants of more complex architecture. The fauna includes two recently described species and at least four other new species that remain undescribed. Several of these insects also develop on the other eastern narrow-leaved phloxes of prostrate growth habit, *P. bifida* and *P. nivalis*. Insects associated with these plants are not generally found on phloxes of more erect growth, e.g., *P. divaricata*. Several of the specialist herbivores of moss phlox may be endemic to the mid-Appalachians; they are as characteristic of shale barrens as are endemic plants of these specialized communities.

Psychology

THE INFLUENCES OF CAREER COMMITMENT AND CHILD REARING ON RETENTION FOR ENLISTED WOMEN IN THE NAVY. Marsha Anderson, Janice Halecki, Andrea Berndt, Michelle Kelley, Dept. of Psychology, Old Dominion University, Norfolk, Va. This study examined the extent to which career commitment and child rearing variables influenced retention decisions early in the enlisted woman's career. The Maternal Separation Anxiety Scale (MSAS) was used to measure relations between three specific aspects of separation anxiety (Maternal Separation Anxiety, Perception of Separation Effects on the Child, and Employment-Related Separation Concerns) and retention. Results demonstrated correlations between Employment-Related Separation Concerns and retention ($r = .43$) and Maternal Separation Anxiety and retention ($r = -.32$). Future studies may wish to examine these correlations for use as predictive measures of retention among young enlisted women with children.

THE EFFECT OF COMBINATIONS OF INSULIN, GLUCOSE, AND SCOPOLAMINE ON MEMORY RETENTION OF RATS IN THE RADIAL ARM MAZE. J. Blanchard, S. Shands*, & P. Duncan, Dept. of Psych., Old Dominion Univ., Norfolk, Va. 23529. Previous research has shown that glucose is an effective agent in facilitating memory performance as well as attenuating scopolamine-induced amnesia. Insulin has also been shown to attenuate scopolamine's detrimental effects upon memory. This study was designed in order to determine how various combinations of insulin (IN), glucose (GL), and scopolamine (SC) would affect memory retention. It involved nine rats whose memory performance was assessed through a win-shift radial arm maze (RAM) task under various drug treatments. The percentage of memory errors made in the RAM task under each condition was recorded. A 2 X 2 X 2 (IN X GL X SC) within-subjects design was employed. The results indicated that SC disrupted memory performance. An antagonistic interaction between GL and IN, as well as a two-way interaction between IN and SC was found. IN attenuated SC-induced amnesia but IN alone had no effect upon memory performance. GL counteracted SC's effects as well. Post-experimental blood glucose (BG) tests suggest that the drug treatments had no effect upon BG levels. The noncritical nature of BG levels in GL and IN attenuation of SC is discussed.

THE EFFECTS OF GENDER AND SOCIAL SETTING ON PEERS' PERCEPTIONS OF UNEXPLAINED SYMPTOM COMPLAINTS. Jennifer Cheavens and Barbara Winstead*, Dept. of Psych., Old Dominion Univ., Norfolk, Va. 23529. Multiple Chemical Sensitivity (MCS) is a poorly understood health problem that affects mainly women. The present study attempted to examine the effects of gender and social setting on peers' perceptions of the unexplained symptom complaints associated with MCS. It was hypothesized that symptoms of males would be perceived as physiological in nature and symptoms of females would be perceived as psychological in nature. It was also hypothesized that symptoms of characters affected in a work environment would be perceived as more physiological than those in a non-work environment. Participants read a vignette describing a character with MCS then recorded perceptions about the character on a corresponding questionnaire. Results indicated that the symptoms of male characters were rated as more psychological in nature and symptoms of female characters were rated as more physiological in nature. There was no significant difference for the work/non-work environment. Participants' willingness to help characters in the vignettes was also examined. Further research is needed to explain incongruities between the present study and previous literature.

EFFECTS OF ENTORHINAL CORTEX LESIONS ON ACTIVITY, EATING AND DRINKING. R. T. Cober, N. A. Tatar*, K. A. Freeman, C. M. Hemmert*, J. A. Olejniczak, and L. E. Jarrard. Dept. of Psychol., Washington & Lee Univ., Lexington, Va. 24450. The effects on behavior of conventional electrolytic as compared to more selective aspiration lesions of entorhinal cortex (EC) was studied using a computer-controlled system that automatically records activity, eating, and drinking in the home cage. In addition to recording when these behaviors occurred, the amount of food and water consumed each day was determined. The rats were placed in the system for 7 days before the operations, the operations were carried out, and behavior was recorded postoperatively for 13 days. Rats in the control and aspiration EC groups did not differ; however, electrolytic EC lesions resulted in increases in home-cage activity both during the day and night. Since electrolytic lesions of EC result in damage to adjacent structures (subiculum, hippocampus), the increase in activity that was found can probably be attributed to this extra-entorhinal damage.

DEPRESSION AND SIMPLE MANUAL MANIPULATION: ABSENCE OF EFFECT IN POPPING SEALED AIR CAPSULES. Joy M. Conner and James P. O'Brien, Tidewater Community College, Virginia Beach, Va. 23456. Dillon (1992) found that popping two sheets of sealed air capsules in a 5-min. period was more stress-reducing than doing nothing for a 5-min. period. To the contrary, Taylor, Purser, and Baluch (1994) found an increase in state-anxiety for subjects popping capsules for a 5-min. period compared to subjects who did nothing for 5 min., and no differences in trait-anxiety. Since depression should be as stable a personality characteristic as trait-anxiety and since it is characterized by withdrawal from activity and motor retardation, 53 subjects were administered the Beck Depression Inventory (BDI) and then had the opportunity to pop capsules as they wished for a 15 sec. period. Contrary to predictions, there was no significant inverse correlation between BDI scores and capsules popped ($r = -.148$, $p = .29$), capsule popping means were in the hypothesized direction but not significantly different ($t = 1.02$, $p > .31$). For further study, it is recommended that the capsule popping task be conducted in isolation to avoid group effects.

ABSENCE OF A "SPRING BREAK EFFECT" IN ALCOHOL CONSUMPTION AMONG COMMUNITY COLLEGE STUDENTS EXCEPT FOR HEAVY DRINKERS. Sharon L. Duprey, Donna M. Henderson, and James P. O'Brien, Tidewater Community College, Va. Beach Campus, 1700 College Crescent, Virginia Beach Va. 23456. While alcohol abuse has become a notorious aspect of the annual college "Spring Break," little, if any, research has been reported on its effect, in spite of the fact that it may affect consumption surveys spuriously. Community college students ($N = 46$) provided matched samples for before and after "Spring Break" consumption on four 7-day Retrospective Diary (RD) items (occasions and quantities) and two Quantity Frequencies (QF) items: one item for occasions/month (30-day QF) and one for occasions and quantities/2 weeks (14-day QF). Except for 14-day QF, all other RD and QF items fail to support the alternative hypothesis of a "Spring Break Effect" for this community college sample. On the 14-day QF, heavy drinkers (5+ drinks in at least one sitting) were 5 times more likely to increase than to decrease occasions because of "Spring Break" (Chi square = 9.08, $p < .02$, $df = 2$). Since this sample is a non-traditional college population, future research should apply the same approach to typical 4-year college students.

A NOVEL TECHNIQUE FOR ASSAYING BEHAVIORAL RESPONSIVITY OF GOLDFISH TO WATERBORNE OLFACTORY STIMULI. Kimberly A. Freeman, Emily Pfister*, & Jeanine S. Stewart*, Dept. of Psychology, Washington & Lee University, Lexington, VA 24450. Goldfish exhibit regeneration of lesioned peripheral olfactory structures within a matter of weeks (Stewart & Brunjes, *Brain Res.*, 628:243, 1993). A question remains regarding the functional recovery which may accompany this regrowth. We have begun developing a simple behavioral assay of olfactory function in goldfish, in order to assess post-lesion recovery in these animals. In our preliminary design, goldfish ($N = 16$) were placed in an aquarium filled with tap water and allowed to acclimate to their surroundings for 5 min. After this adjustment period, 4 aliquots (approximately 0.1 cc each) of 0.2M L-glutamine (an excellent olfactory stimulus for this animal) were added to the tank at timed intervals, by expulsion of the solution from a syringe mounted inside the aquarium. Animals were observed for a total of 10 min. following the first addition of amino acid, and an experimenter recorded the amount of time the fish spent in each half (with vs. without odorant) of the aquarium. Data revealed no preference for one side of the tank vs. the other, suggesting that the paradigm in its present form is not effective for assaying olfactory function. We are currently testing modifications of this paradigm which promise to be more useful for our purposes.

PERCEPTIONS OF ANOREXIA NERVOSA: INFLUENCE OF RATER AND TARGET GENDER. Melissa Garrido, Dept. of Psychology, Old Dominion University, Norfolk, Va. 23529. This study examined differences in perceptions of targets with Anorexia Nervosa based on rater and target gender. Raters ($N = 225$) read brief descriptions of a male or female target with eating patterns similar to persons with Anorexia Nervosa, and completed a questionnaire rating targets on health, intelligence, psychological stability and vanity. Female raters rated all targets lower on health and psychological stability than male raters. Male targets were rated lower on intelligence and higher on vanity than female targets. Many raters (51%) stated they knew someone who followed diets similar to the target.

THE INFLUENCE OF PERSONALITY ON CLOTHING SELECTION. Kathleen M. Gibson and H. Barry Gillen, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23510. This experiment, based on Eysenck's theory of extraversion, was designed to test the hypothesis that personality influences selection of clothing style, color, and pattern complexity. After completing the Eysenck Personality Inventory, female participant's clothing preferences were measured. These variables in dress included decoration, conformity, economy, comfort, and general interest in clothing; color preference and pattern complexity were also gauged. Results based on correlations and a multivariate analysis of variance indicate that extraverts are generally more interested in clothing and prefer its decorative aspects. Moreover, extraverts choose complex patterns and bright/intense colors. Conversely, introverts seek comfort and utility in clothing, prefer simple patterns, and select muted or non-intense colors.

MENTAL MODEL FORMATION AND EVOLUTION. Michael G. Grasso and Mark W. Scerbo, Dept. of Psychology, Old Dominion University, Norfolk Va. When interacting with systems or machinery, humans develop cognitive models that represent their understanding of how the system functions. These "mental models" are internal representations that provide operators with a framework that can be accessed when working with systems. The purpose of this project was to explore the initial formation and evolution of mental models. A commercial simulation program, SimCity 2000, was used as a vehicle for examining subjects' mental models. The program simulates the building, planning, designing, and governing of a city. One group of subjects served as a control group to determine the extent of existing mental models concerning city governing and development within this population. The remaining subjects reported for three 2-hour sessions in which 90 minutes were utilized for interaction with the SimCity 2000 program and 30 minutes to record their knowledge and understanding of the simulation. Assessment of the subjects' mental models was obtained by enumerating the number of charts and diagrams, major elements, declarative and operational statements, errors, and words used in their written reports at the end of each session. Contrary to expectations, there was a downward trend across all dependent measures over the three sessions. An analysis of variance showed that there was a significant reduction in the number of major elements and words used by the subjects between the first session and the remaining two sessions. This pattern of results suggests that subjects established and conveyed the majority of their mental models in the first session. In addition, it is also possible that the subjects became fatigued during the experimentation producing a reduction in their verbal descriptions.

INFLUENCE OF FAMILY NAVY TRADITIONS AND STRESSOR VARIABLES ON WOMEN'S RETENTION IN THE NAVY. Janice E. Halecki, Marsha Anderson, Andrea Berndt, Michelle Kelley. Dept. of Psychology, Old Dominion University, Norfolk, Va. The current climate of cutbacks and downsizing demands that organizations take a hard look at employee retention. This study examined effect of length of service, child care, and family issues on retention of Navy women who were custodial parents and assigned to ships. Women (N=89) with a mean age of 29 ($SD = 5.64$) and with 1 to 22 years of military service participated. One month after returning from a seven month deployment, the women completed the Maternal Separation Anxiety Scale, Family Environment Scale, a demographic questionnaire and a semi-structured interview designed to examine attitudes about Navy service and its effect on families. Years of service correlated positively ($r = .41, p < .001$) with intention to reenlist, while Maternal Separation Anxiety correlated negatively ($r = -.32$). Future research should examine how family issues affect retention particularly for the first enlistment of Navy mothers.

PREDICTING TEAM MEMBER BEHAVIOR FROM THE LEADER'S PERFORMANCE HISTORY. Bryan C. Hayes and Debra A. Major*, Dept. of Psychology, Old Dominion Univ., Norfolk, Va. 23529. In a team context, leader performance history has been shown to affect team members' attitudes. In theory, the attitudes should be predictive of team members' behaviors. A laboratory study demonstrated that team member attitudes were significantly influenced by the leader's performance history. However, team member's behaviors were neither affected by the performance history nor related to the attitudinal measures. Results are consistent with empirical evidence on the relationship of attitudinal predictors and criterion behaviors. Attitudes accurately predict overt behavior only when the attitudinal and behavioral measures correspond on specific dimensions. One important dimension is correspondence on the specific behavioral action.

MOTHERS' USE OF INFORMATIONAL AND SOCIAL RESOURCES PREDICTS PARENTING STRESS. Kelly Heiges & Jeffrey Pickens, Dept. of Psych., James Madison Univ., Harrisonburg, Va. 22807. A survey was used to assess the relationship between mothers' use of informational resources (including books and parenting classes), use of social resources (receiving help from a friend or relative), and maternal stress levels reported on the Parenting Stress Index. Sixty-three mothers completed the questionnaire; half classified as low socioeconomic status and half from a high social status group using the Hollingshead Four Factor Index of Social Status. Use of social resources was significantly correlated with overall maternal stress levels, indicating that social support can mitigate parenting stress. Those subjects that used more social resources were also less likely to report feeling restricted in their role as mothers. Higher social status mothers reported greater use of books and child care workers for childrearing advice than low social status mothers. These findings support previous research on the effectiveness of social support in alleviating parenting stress.

A FEEDBACK CONTROL SYSTEM FOR REGULATING OPERATOR ENGAGEMENT IN A SIMULATED FLIGHT ENVIRONMENT. James M. Hill, II, Lawrence Prinzel, III, Frederick G. Freeman', and Mark W. Scerbo', Dept. of Psych., Old Dominion Univ., Norfolk, Va., 23529-0267. Understanding pilot error has been one of the primary issues confronting human factors and ergonomics professionals over the years. One approach to preventing human error would be to monitor the levels of workload and attention in human operators. Decrements can then be assessed and necessary safeguards can be implemented before disaster occurs. Little research has been conducted to determine the possible indices for measuring fluctuating states of attention and workload. The current study sought to validate an index using a physiological measurement (EEG). The rationale behind the research was to determine if the chosen index, (Beta)/(Alpha+Theta), is sensitive to fluctuating states of attention under positive and negative feedback contingencies and automatic and manual modes of operation. The level of automation in the system was determined using the absolute power bands of the Alpha, Beta, and Theta waves recorded from four cortical sites (Pz, Cz, P3, P4). Participants performed a compensatory tracking task for two sixteen-minute periods. Tracking performance was measured using the RMSE from the task. Scores from the NASA-TLX mental workload scale provided a subjective workload measure after each trial. The results from the experiment indicated that the bio-cybernetic, closed loop system was sensitive to fluctuating states of attention. This was illustrated in an interaction effect found between the engagement index and the level of automation. Further validation of the system was shown by the results of the tracking task and the NASA-TLX scores. RMSE was found to be significantly lower in the negative feedback condition. Scores from the NASA-TLX showed that workload in the negative feedback condition presented moderate levels of workload. The present study demonstrates convergent validity for a bio-cybernetic system and its usefulness in achieving dynamic task allocation while on-line.

EXPERIMENTAL INVESTIGATIONS OF ODOR IMAGERY. Samuel R. Jones, J.D. Cochran*, J. Ayers*, D.G. Elmes, L. Murphy*, S. Sharp*, and D. Thomas*, Dept. of Psychol., Washington and Lee Univ., Lexington, VA 24450. In the first of two experiments, three independent groups of subjects engaged in different processing tasks prior to olfactory identification. One group saw a visual representation of an odor stimulus (e.g., a *lemon*), a second group saw the representation and also imagined its odor, and a third group did nothing prior to odor identification. Although subjects who imagined the target odors correctly identified more odors than any other subjects, the differential amount of odor priming was not appreciable. The second experiment used a within-subjects design, in which blindfolded subjects either sniffed an odorant, imagined its odor, or imagined its visual representation. After filler tasks the subjects engaged in an old/new odor recognition task. Corrected recognition was highest for old odors that were sniffed, and there was little difference in recognition for odors that were imagined or visualized. Consistent with other work, the present results provide minimal evidence for the existence of odor imagery.

EFFECTS OF PAVLOVIAN CONDITIONING ON CAFFEINE INDUCED HYPERLOCOMOTION IN THE RAT. Lisa A. Kaminski & Perry M. Duncan, Dept. of Psych., Old Dominion Univ., Norfolk, Va. 23529. This study investigated the effects of classical conditioning on caffeine-induced hyperlocomotion in rats. In the conditioning paradigm animals received a low dose (15 mg/kg) or high dose (30 mg/kg) of caffeine by IP injection immediately before placement into an activity counter. A predictive stimulus of menthol odorant was also used. Following eight days of conditioning, test trials were conducted in which rats were given IP injections of saline before activity measurement. Analysis of conditioning trials revealed that the animals showed increased locomotor activity following caffeine administration but did not show sensitization to caffeine's stimulus effects over trials. The subjects also did not demonstrate a conditioned hyperlocomotion response during test trials.

THE EFFECT OF MOOD ON ACTIVITY SELECTION AND ACTIVITY SELECTION ON MOOD: A POTENTIAL CYCLE FOR INTENSIFIED MOOD STATES. Michael L. Kohn and Raymond H. Kirby. Dept. of Psyc., Old Dominion Univ., Norfolk, Va. 23529. The effects of mood on activity selection and the effects of activity participation on mood were examined. Twenty-two subjects experienced a neutral or a negative mood induction and were then given an option to participate in either a negative or positive activity (viewing a 5 to 10-min film clip). In addition, to explore how participation in different activities affects moods, 14 subjects received a negative mood induction and were then assigned to view either a negative or a positive film clip. It was hypothesized that (1) the depressed mood group would prefer the negative over the positive film, (2) attending to a mood-congruent activity would augment the mood, and (3) attending to an incongruent activity would diminish the mood. The results revealed the opposite effect for Hypothesis 1, no significant effect for Hypothesis 2, and confirmed Hypothesis 3. Mood repair and modes of mood induction are discussed as possible explanations for the findings.

EFFECTS OF NURSING HOME VISITATION ON CHILDREN'S ATTITUDES TOWARD THE ELDERLY. Mary Carole Davis'Libre, Tidewater Cmnty. Col. and Virginia Wesleyan Col., Maria R. Hobbs, Kort Miller, Steven E. Litherland, and James P. O'Brien, Tidewater Cmnty. Col., VBC, Virginia Beach, VA. 23456. Seefeldt, et al. found more negative attitudes toward the elderly and one's own aging especially among younger elementary and pre-school children on post-test vs pre-test measures. This study evaluated 4th grade students: 26 in the experimental group who visited a nursing home monthly and 15 control 4th graders. Subjects' attitudes, as assessed by subtests of The CATE (Children's Attitudes Toward the Elderly), yielded insignificant t-tests; however, 9 of 10 semantic differential items for the old were more positively rated by experimental subjects than controls. No significant differences in prosocial peer behavior were observed in various classroom activities. These findings, contra to Seefeldt, et al., for these older subjects visiting less infirmed elderly and implications for future research are discussed.

HOW SOCIAL SUPPORT AFFECTS EMPLOYEE PERFORMANCE: AN EMPIRICAL STUDY. Curtis S. McKee, Dept. of Psychology, Radford Univ., Radford, Va. 24142. Gail H. McKee, Dept. of Business Administration and Economics, Roanoke College, Salem, Va. 24153. The impact of social support on the job performance of 156 piecework employees at a sewing plant in the southeastern U.S. was examined. Job performance was measured by supervisory ratings and average hourly piece rate earnings, which were found to be highly correlated in this study ($r=.67$, $p<.001$). Various sources of social support (e.g. one's supervisor, co-workers, and family members or friends) were also studied in order to see if the provider of social support had a differential impact on job performance. Employees perceiving more supervisory social support received higher supervisory ratings, but did not have higher average hourly piece rate earnings. An unexpected finding was that those employees perceiving little social support from co-workers outside their unit, had higher piecework earnings. This may reflect disinterest or even antagonism by the high producers toward anyone outside their unit, who either had no effect upon their work or who could potentially impede their productivity.

AN EMPIRICAL INVESTIGATION OF THE RELATIONSHIP BETWEEN JOB FRUSTRATION AND PERFORMANCE: SOME PRELIMINARY FINDINGS. Gail H. McKee, Dept. of Business Administration and Economics, Roanoke College, Salem, Va. 24153. Curtis S. McKee, Dept. of Psychology, Radford Univ., Radford, Va. 24142. This study took place in a sewing plant in the southeastern part of the United States. The sample was comprised of 155 employees, who were paid on a piecework basis. Performance was measured by an employee's 13 week average piece rate and by each employee's supervisory rating. It was found that the more frustration employees perceived, the lower was their piece rate earnings ($r = -.24$, $p<.01$) and the lower was their supervisor's rating of their performance ($r = -.18$, $p<.05$). There was no relationship found between frustration and self-reported number of repairs ($r = .05$, n.s.) Some preliminary findings on sources of frustration in an organization and expected organizational outcomes are also discussed in relationship to Spector's (1978) model of organizational frustration.

THE RELATIONSHIP BETWEEN HEALTH ISSUES AND PERSONALITY VARIABLES AS A FUNCTION OF GENDER. Richard K. Neal III, Dept of Psychology, Old Dominion University, Norfolk, Va. 23529. The present study examined relationships between personality variables and self reports of nine health related behaviors for 65 college students (male=30, female=35). Personality variables were assessed using questionnaire items from prior research. It was hypothesized that males would report less healthy behaviors (i.e., more one-night stands, more drinking, and more cigarette smoking) than would females. Results supported the hypothesis that males would report more one night stands. One night stands and drinking behaviors for males and females were moderated by levels of depression, self-esteem, and extroversion. Future research should investigate the influence of these personality variables on a wider range of health issues.

ON THE ROLE OF THE SUBICULAR COMPLEX IN PLACE LEARNING IN THE RAT. R. W. Neel, M. P. Beenhakker*, J. D. Cochran*, S. E. Dallvechia*, K. H. Richter*, and L. E. Jarrard, Dept. of Psychol., Washington & Lee Univ., Lexington, Va. 24450. Selective lesions limited to either the pre- and parasubiculum (PPS) or the complete subicular complex (subiculum, pre- and parasubiculum) (CSC) were used to study the involvement of these areas of the brain in learning and memory in the rat. Selective lesions were made by using multiple, focal injections of ibotenic acid. Following recovery, the animals in three groups (PPS, CSC, Control) were tested for utilization of spatial information by employing different versions of the Morris water maze. The PPS group, although initially impaired in locating the platform that was hidden just below the surface of the water, were able to find the platform as well as controls by the fifth day of training. Rats in the CSC group were more impaired than either controls or the PPS group. Results of the test for memory of spatial location showed that rats in the CSC group were especially impaired. These findings will be discussed in terms of the involvement of different components of the hippocampal formation in spatial learning and memory.

SMILE RECIPROCITY IN BRIEF ENCOUNTERS: REDUCED EFFECT DUE TO FINAL EXAM PERIOD. James P. O'Brien and Sue Rooker, Tidewater Cmnty. Col., Virginia Beach, Va. 23456. Hinsz & Tomhave (1991) and Walls (1981) found somewhat more than half of subjects smiled-at returned a smile or acknowledgement. This study replicated Walls' with modifications including operational definitions of smile vs no-smile, similar appearance of male and female senders, and one venue--a 12-yard sidewalk approaching a campus library entrance. Of 100 observations of cmnty. col. students on a Friday morning preceding final exam week, over half of the subjects were completely unaware of the male and female senders, as if they were focused on getting to the library to study for exams or to complete assignments. Of those responding, the female sender was positively reciprocated four times more often than the male sender. Future research should consider interactions of gender, age, and circumstance (i.e., exam periods vs other times).

ON THE ENTORHINAL CORTEX AND PLACE LEARNING: EFFECTS OF ASPIRATION VS. ELECTROLYTIC LESIONS. J. A. Olejniczak, K. A. Freeman, C. M. Hemmert*, N. A. Tatar*, R. T. Cober, and L. E. Jarrard. Dept. of Psychol., Washington & Lee Univ., Lexington, Va. 24450. The effects of conventional electrolytic and more selective aspiration lesions of the entorhinal cortex (EC) on spatial learning were studied using two versions of the Morris water maze. Conventional electrolytic lesions impaired performance on an initial multiple-trial task (4 trials/day for 5 days, plus a probe trial) and reversal learning. More selective removal of the EC using aspiration had no effect on spatial learning. In a test of forgetting (2 trials/day with location of the platform varying over days) using 30 s and 5 min delays between the daily trials, aspiration lesioned rats performed like controls but rats with conventional EC lesions were impaired at both delays. These results will be discussed with regard to the role of the entorhinal cortex in learning and memory.

ERPS (EVENT-RELATED BRAIN POTENTIALS) IN RESPONSE TO INFLECTIONAL AND DERIVATIONAL ANOMALIES. Annamarie Paulin and Thomas P. Urbach, Dept. of Psychology, Washington and Lee Univ., Lexington, Va. 24450. Two experiments were conducted to further investigate the late positive deflection (P600) elicited in other studies of inflectional anomalies with subject/verb agreement and other morpho-syntactic violations. Experiment 1 addressed the issue of whether both inflected and derived anomalies elicit a P600. The stimuli consisted of non-anomalous sentences and sentences containing inflectional anomalies and derivational anomalies. Both types of sentence medial anomalous words elicited a significant P600 relative to the non-anomalous control. In addition, the amplitude of the P600 in the inflectional and derivational anomalies differed significantly at the posterior electrode sites. The hypothesis that this difference was due to a difference between storage-and-retrieval processes and decompositional analysis processes was investigated in Experiment 2. ERPs elicited by appropriate base forms, anomalous regularly inflected forms and anomalous irregularly inflected forms. No difference was found between the regular and irregular inflected forms, so it is unlikely that the difference in Experiment 1 is attributable to the differences in processing mechanisms noted above. An alternative explanation in terms of the extent to which the anomaly disrupts the on-line analysis is proposed.

ADAPTIVE AUTOMATION: BEHAVIORAL CORRELATES AND SYSTEM DYNAMICS OF A BIO-CYBERNETIC SYSTEM. M. Risser, L. Prinzel III, & F. Freeman*, Dept. of Psych., Old Dominion Univ., Norfolk, Va. 23529. A biocybernetic system has been developed to moderate an individual's level of arousal during varied task automation. This closed loop feedback design investigated varied levels of automation in a compensatory tracking task based upon the operator's EEG that reflected their level of engagement in the task. The experiment included 18 subjects who were run under three 16 minute trials and their EEG was continuously sampled. Each subject was run under one of three indices used as a measure of engagement ($20\beta/\alpha + \theta$, $10\beta/\alpha$, or $1/\alpha$). Task modes functioned in either manual or automatic dependent on the level of operator engagement. Automation levels varied due to positive and negative feedback conditions. Under negative feedback, the task was switched to (or maintained in) automatic mode when the index reflected increasing arousal, but was switched to (or maintained in) manual when the index was decreasing. Under positive feedback, task mode was switched to (or maintained in) automatic when the index reflected decreasing arousal, but was switched to (or maintained in) manual when the index was increasing. Therefore negative feedback (stable operation) is intended to induce optimal states of engagement through short cycles of automation as opposed to positive feedback (unstable operation). The results demonstrate that the system functioned differently dependent upon the level of automation in the task and the level of operator engagement. Both negative feedback and $20\beta/\alpha + \theta$ were each found to be the most sensitive to levels of arousal operating under this system. Furthermore, tracking performance was also found to be significantly better under these conditions. The results are discussed in terms of the system's utility to regulate changing operator engagement in flight environments.

EFFECTS OF TEACHER TOUCH CUES ON CHILDREN WITH ADHD/ED.

Kimberly W. Sebrell, & Jeffrey Pickens, Dept. of Psy., JMU, Harrisonburg, Va. 22801. Teacher's use of touch cues in the classroom with students with ED/ADHD was investigated. It was hypothesized that students would demonstrate more optimal attention, affect, physical activity and proximity to a teacher in individual versus group contexts. Furthermore, within the individual settings it was hypothesized that teacher touch would produce more optimal attention, affect, physical activity and proximity in the students. Students and teachers were videotaped during a group reading activity and a series of one-on-one reading conditions. The results supported the hypotheses, showing that students with ADHD/ED were more attentive, showed more positive affect, showed less physical activity and were in closer physical proximity to teachers in the one-on-one than group conditions. Students responded positively to teacher touch, as evidenced by students' lowered physical activity and closer proximity to the teacher during the one-on-one conditions. The results suggested that both individualized attention, and the use of touch cues, are effective strategies for educators.

USING PROCESS DISSOCIATION AND ERPS TO INVESTIGATE IMPLICIT MEMORY.

Todd H. Stanton, Thomas P. Urbach, and David G. Elmes. Dept. of Psychology, Washington and Lee Univ., Lexington, Va. 24450. Current memory theory generally divides memory in two different types: explicit and implicit. The purity of implicit tasks, however, has been questioned, and to address this, L.L. Jacoby *et al.* (1991) developed the process dissociation procedure, which provides a theoretical framework intended to estimate the contributions of both explicit and implicit memory. Nine male and eleven female volunteers were given an implicit memory task within a process dissociation paradigm while EEG data were recorded. The behavioral results show that, as predicted, subjects were more likely to complete a word stem with a word they had already seen before. In addition, Jacoby's procedure was used to estimate the influences of explicit and implicit memory. Analysis of the event-related potentials (ERPs) elicited by the word stem found significant late positive deflections similar to effects reported in other memory tasks for those stems that were completed with previously presented words.

AIDS INFORMATION: HOW MUCH DO COLLEGE STUDENTS KNOW?

Patricia Tillman, Melissa Graul, Tiffany Graves. Dept. of Psychology, Old Dominion University, Norfolk, Va. 23529. The current study assessed the knowledge of Acquired Immune Deficiency Syndrome (AIDS) among 313 college students (ages 18-26) with a questionnaire examining general knowledge of AIDS, transmission, early warning signs, preventive measures, and sexual practices. The percentage of students with knowledge about AIDS was low: general knowledge of AIDS was 36%; AIDS transmission was 14%; and early warning signs was 7%. Students were more knowledgeable about preventive measures (40%), but reported usage and knowledge of condoms was low (25%). It appears additional AIDS education is needed.

THE EFFECT OF TASK DEMANDS AND ATTENTION ON OLFACTORY RESPONSE. Mariecken A. Verspoor, Dept. of Psych., Washington and Lee Univ., Lexington, Va. 24450. It has been shown that the response to olfactory information is inhibited when performing high-demand cognitive tasks. The left hemisphere may be an integral part in the process of inhibiting olfactory information. The right hemisphere seems to be somewhat specialized for olfactory information processing. This experiment examines the effect of task demands on the topographical distribution of the olfactory response through the use of EEG data. It was found that while cortical activity decreased in the left hemisphere when an odor was presented (versus the no odor condition) across all three task types (linguistic processing, spatial processing, and olfactory processing), the cortical activity in the right hemisphere differed according to task demands. While processing both linguistic and spatial information, cortical activity in the right hemisphere decreased when an odor was presented. When processing olfactory information, cortical activity increased with odor presentation.

Statistics

OPTIMAL DESIGNS AND RESPONSE SURFACE ANALYSIS IN THE PRESENCE OF BI-RANDOMIZATION ERROR STRUCTURES. Jennifer J. Davison, Raymond H. Myers*, Marvin Lenter*, Dept. of Statistics, Va. Tech, Blacksburg, Va. 24061-0439. Cost control, resource availability, or difficulty in performing complete randomizations may dictate the necessity to run response surface experiments in a bi-randomization format of which the split-plot design is a special case. A bi-randomization (BRD) scheme allows for certain factor levels to be applied to larger experimental units with remaining factor levels randomly applied to nested smaller units. For example, in the dual response surface approach to robust parameter design, process mean and variance models are formulated to aid in designing products to be "robust" to uncontrollable system influences, noise. In model development, noise variables are controlled in the laboratory, but due to their random nature this may be quite difficult. This suggests the need for a bi-randomization scheme in which the noise variables constitute the levels applied to the larger experimental units. For the bi-randomization situation, various error estimation procedures and analyses are explored. The efficiency/optimality of common response surface designs are examined in the presence of this error structure to determine the necessity of design modification. General recommendations for efficient designs and practical analysis methods are outlined.

ESTIMATING CHANGES IN CANCER SCREENING RATES: A COMPARISON OF METHODS. Robert E. Johnson & Christie Riles, Dept. of Mathematical Sciences, Va. Commonwealth Univ., Richmond, VA, 23284-2014. The purpose of this paper is to explore the effects of an informational intervention on the probability that an eligible patient will be screened for breast cancer. These probabilities are estimated and compared across two time periods and between two experimental groups. The objectives are approached through the context of screening for cancer amongst asymptomatic patients by a method of comparison of means and a "life testing" method. The first method uses adjustments to the variance of the means and mean differences based on a two-stage sampling design. The second method adds an adjustment for the degree of exposure to the completion of screening.

OPTIMAL ONE AND TWO-STAGE DESIGNS FOR THE LOGISTIC REGRESSION MODEL. William C. Letsinger, Raymond H. Myers, Dept. of Statistics, Va Tech, Blacksburg, VA 24061-0439. Binary response data is often modeled using the logistic regression model, a well known nonlinear model. Designing an optimal experiment for this nonlinear situation poses some problems not encountered with a linear model. Primarily, the implementation of an optimal designs requires the parameters of the model to be known. However, the model parameters are not known. Consequently the parameters must be specified prior to implementing a design. Standard one-stage optimal designs are quite sensitive to parameter misspecification and are therefore unsatisfactory in practice. A two-stage Bayesian design procedure is presented which effectively copes with poor parameter knowledge while maintaining high efficiency. Asymptotically, the two-stage design procedure is considerably more efficient than the one-stage designs when the parameters are misspecified and only slightly less efficient when the parameters are known. However, the true advantage of the two-stage procedure is most evident for small samples.

OPTIMAL CENTRAL COMPOSITE DESIGNS WITH DISPERSION EFFECTS. D'Arcy P. Mays, Dept. of Mathematical Sciences, Va. Commonwealth Univ., Richmond, Va. 23284. The central composite design (ccd) is often used to provide estimation of a second order regression model. The ccd involves a (possibly fractionated) two level factorial design, axial points, and replicated runs in the design center, and is usually used with the assumption of homogeneous variance in the design region. However, when dispersion effects exist the standard ccd may not be optimal. With a specified number of experimental runs available the goal is to find the optimal allocation of the runs to the ccd locations. Several variance structures will be considered, in conjunction with several (scaled) degrees of heterogeneity expressed in terms of variance ratios. Optimality criteria based on the determinant of the variance-covariance matrix of coefficients (D-optimality) and on the integrated prediction variance (Q-optimality) will be used. Due to constraints created by the scaled variances and variance structures, the procedure places restrictions on the choice of the axial distance. These restrictions will be analyzed, and the optimal designs will be presented for several variance structures, variance ratios, and appropriate choices of axial distance. The analysis will show that the ccd used when homogeneous variance exists is not the optimal design when dispersion effects exist.

SOME DEVELOPMENTS IN MODEL ROBUST REGRESSION. James E. Mays & Jeffrey B. Birch, Dept. of Statistics, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. In obtaining a regression fit to a set of data, ordinary least squares regression depends directly on the parametric model formulated by the researcher. If this model is incorrect, a least squares analysis may be misleading. Alternatively, nonparametric regression (kernel or local polynomial regression, for example) has no dependence on an underlying parametric model, but instead depends entirely on the distances between regressor coordinates and the prediction point of interest. This procedure avoids the necessity of a reliable model, but in using no information from the researcher, may fit to irregular patterns in the data. The proper combination of these two regression procedures can overcome their respective problems. Considered is the situation where the researcher has an idea of which model should explain the behavior of the data, but this model is not adequate throughout the entire range of the data. An extension of partial linear regression and two methods of model robust regression are discussed and compared in this context. These methods involve parametric fits to the data and nonparametric fits to either the data or residuals. The two fits are then combined in the most efficient proportions via a mixing parameter. Performance is based on bias and variance considerations.

ANALYSIS OF GROWTH CURVES UNDER AUTOREGRESSIVE COVARIANCE STRUCTURE. D.N. Naik & Shobha Prabhala, Dept. of Math. & Stat., Old Dominion Univ., Norfolk, Va. 23529. The growth curve model $Y_{i_1 \times p_i} = A_{i_1 \times m} \xi_{m \times k} B_{ik \times p_i} + \epsilon_{i_1 \times p_i}$, $i = 1, 2, \dots, g$, where ξ is a vector of unknown parameters, and for the i^{th} group Y_i is observation matrix, A_i is a known matrix of rank m , B_i is a matrix of rank k_i and the rows of ϵ_i are independent each distributed as $N_{p_i}(0, \Sigma_i)$, Σ_i having an autoregressive structure. The maximum likelihood estimators (MLEs) of various parameters are obtained. Prediction of future observations is discussed. The situation where data are missing leads to the Markov covariance structure for Σ_i . The MLEs under this case are also derived.

ANALYSIS OF MULTIVARIATE REPEATED MEASUREMENTS. D.N. Naik & Shantha S. Rao, Dept. of Math. & Stat., Old Dominion Univ., Norfolk, Va. 23529. In this article we consider a set of 't' repeated measurements on 'p' variables (or characteristics) on each of the 'n' individuals. Thus data on each individual is a $p \times t$ matrix. The 'n' individuals themselves may be divided and randomly assigned to 'g' groups. Analysis of these data using MANOVA model is considered. The well known Satterthwaite type approximation to the distribution of a quadratic form in normal variate is extended to the distribution of a multivariate quadratic form in multivariate normal variates. The multivariate tests using this approximation are developed for testing the usual hypotheses.

MODEL-ROBUST QUANTAL REGRESSION. Quinton J. Nottingham, Department of Statistics, Virginia Tech, Blacksburg, VA 24061, & Jeffrey B. Birch, Department of Statistics, Virginia Tech, Blacksburg, VA 24061. In the analysis of quantal dose-response data, the most commonly used parametric procedure is logistic regression, commonly referred to as "logit analysis." The adequacy of the fit by the logistic regression curve is tested using the chi-square lack-of-fit test. If the lack-of-fit test is not significant, then the logistic model is assumed to be adequate and estimation of effective doses and confidence intervals on the effective doses can be made. When the tolerance distribution of the dose-response data is not known and cannot be assumed by the user, one can use nonparametric methods, such as kernel regression or local linear regression, to estimate the dose-response curve, effective doses, and confidence intervals. This research proposes another alternative to analyzing quantal dose-response data called model-robust quantal regression (MRQR). MRQR linearly combines the parametric and nonparametric predictions with the use of a mixing parameter. MRQR uses logistic regression as the parametric portion of the model and either kernel or local linear regression as the nonparametric portion of the model. Preliminary research has shown promise in that the MRQR procedure improves the fit of the dose-response curve by producing narrower confidence intervals for predictions, while providing improved precision of estimates of the effective doses with respect to the logistic regression analysis.

THE ESTIMATION OF AGE DEPENDENCE IN THE SEASONAL DEPTH DISTRIBUTION OF MUSSELS. Steven R. Rein, Dept. of Math. Sciences, Va. Commonwealth Univ., Richmond, VA 23284-2014, David Balfour, Dept. of Biology, Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061, & Leonard Smock, Dept. of Biology, Va. Commonwealth Univ., Richmond, VA 23284-2012. It is believed that the mean depth (mid-mussel depth below stream bed) of mussels varies with season. One question of biological and ecological and interest is whether there are age (and thus length) differences in the depth distribution, net the seasonal effects. During each of ten months of 1994, ten 15 meter long plots were sampled from a 1.5 kilometer section of brackish stream in Southeast, Virginia. The depth, to the nearest centimeter, and length of all mussels in these 150 plots was recorded. Mussels that were on top of the stream bed were recorded as having zero depth. In whole, 251 mussels were found, with the monthly count ranging from 8 to 46. We propose to model the depth distribution as a Poisson with zeroes, where the contagion parameter and the expectation of the Poisson are each functions of date and length. Some exploratory work will be done to determine the shape of these functions, then function parameters will be estimated via maximum likelihood. Attention will be given to assessing the departure of the data from the Poisson with zeroes.

USING SIMULATED ANNEALING TO FIT PHASE-TYPE DISTRIBUTIONS. Leah C. Snediker & John A. Barnes, Dept of Mathematical Sciences, Virginia Commonwealth University, Richmond, VA 23284. There has been much research in recent years on using phase distribution in queueing modeling. Phase distributions are based on convolutions of exponential distributions and hence can be used in the building of Markovian models. Theoretically, any non-negative random variable can be approximated arbitrarily closely (non-uniquely) using phase distributions. There has been limited research on the practical matter of finding such approximations. In our research we use a Simulated Annealing approach to fitting phase distributions to other types of distributions. Unlike other approaches that only attempt to fit a few moments, our approach is to fit the distribution function itself.

ROBUST ESTIMATION OF SCALE IN THE TWO-SAMPLE MODEL. Jeffrey D. Vest and Clint W. Coakley*, Dept. of Stat., Va. Polytechnic Inst. and State Univ., Blacksburg, VA 24061-0439. In the last few years, estimators of the scale of a univariate distribution have been developed that are location-free in the sense that they do not depend on an estimate of the center of the underlying distribution. These proposed location-free estimators have generally been quite robust in terms of having a high breakdown point and can achieve a surprisingly high Gaussian efficiency. This idea has also been extended to the simple linear regression model, where typical estimators of the dispersion of the errors depend on an estimator of the regression line. The few estimators that have been developed that do not depend on a line estimator, called regression-free scale estimators, do achieve a high breakdown point but are useful mainly for data sets that have no replication at any regressor value. We propose new regression-free scale estimators that achieve a high breakdown point and are useful when the data contain replication. Additionally, the proposed estimators reduce to existing location-free estimators in the case of univariate data. Breakdown points and efficiency results are given for the special case where there are only two regressor values.

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COHERENCE: A NEW METHOD OF ANALYZING MULTICHANNEL ELECTROGRAMS FOR DEFIBRILLATION RESEARCH. Lahn Fendelander, Dept. of Biomedical Eng., Va. Commonwealth Univ., Richmond, Va. 23298. Many factors have been identified which affect the outcome of a defibrillation attempt. However, defibrillation remains probabilistic in nature. We are still unable to explain the occurrence of many low-energy successes and high-energy failures. This suggests that other factors may exist. This research attempts to determine if one parameter in particular -- the electrical organization of the heart -- affects the outcome of a defibrillation attempt. A new method of quantifying the organization of the electrical activity of the heart is introduced. The method employs the coherence spectrum to analyze multichannel electrograms. Specifically, the magnitude-squared coherence function is used to compare the similarity of multiple electrograms recorded from an epicardial electrode plaque. From this analysis, a "coherence length" parameter is obtained. The coherence length parameter is a new concept and may be helpful in quantifying the electrical organization of the heart during ventricular fibrillation (VF).

ORIGINS OF THE SOPA SURFACES. William P. Harrison, Jr., Engr. Fundamentals Div., Va. Polytechnic Inst. & State Univ., Blacksburg, VA 24061. The SOPA surfaces introduced in 1994 created some interest in the origin and background development of these mathematical surfaces. This paper attempts to respond to those inquiries. The ideas that led to the creation of SOPA surfaces sprang principally from two main sources: (1) the formalized, graphical classification of planes in space, accompanied by measurement of their principal angles, θ_F , θ_H , and θ_P ; and, (2) the use of CAD software to manipulate plane-surfaced solids to allow such software to measure θ_F , θ_H , and θ_P values for these plane surfaces. Only planes classified as oblique present real interest, since all others produce the trivial and well-known result: $\Sigma\theta = 180^\circ$. Oblique planes, however, always result in $\Sigma\theta < 180^\circ$. Therefore, a systematic investigation of $\Sigma\theta$ values for the continuum of all oblique planes in space appeared warranted. Fortunately, double-rotation techniques developed in source (2) investigations provided a mechanism by which such a systematic investigation could be conducted, giving the SOPA surfaces.

MEASUREMENT OF RED BLOOD CELL VELOCITY AND SPATIAL DISTRIBUTION IN ARTERIOLES OF HAMSTER RETRACTOR MUSCLE USING VIDEO IMAGE ANALYSIS. Anand A. Parthasarathi*, & Roland N. Pittman, Dept. of Biomedical Engineering & Physiology, Va. Commonwealth Univ., Richmond, Va. 23298. A new technique for measuring red blood cell (RBC) velocity and spatial distribution using fluorescent video microscopy was developed. RBCs from anesthetized hamsters were labeled using fluorescein isothiocyanate (FITC) with a labeled cell fraction between 0.5 to 1.0%, so that on the average not more than two fluorescent RBCs (FRBC) should be observed at the point of measurement during a single video frame. The microscope and camera, fitted with an intensifier, were assembled to form a Ploem system with fluorescence excited through epi-illumination using objective magnifications of 20x and 50x. An external function generator was used to control the shuttering frequency of the intensifier. For velocities up to 20 mm/s a shuttering frequency of 180 Hz gave the best results; for higher velocities a shuttering frequency of 300 Hz was found to be optimal. Multiple images of a moving FRBC were obtained on a single video frame and recorded for later determination of velocity as the distance between successive FRBC images divided by the associated time interval. Calibration measurements using labeled RBCs gave values within 5% accuracy for velocities up to 10 mm/s and within 15% for velocities between 10 mm/s and 20 mm/s. Velocity profiles at the upstream and downstream sites of arterioles in hamster retractor muscle were determined. Upstream profiles were sharper than the downstream profiles even though the average value remained almost constant. The range of velocities that can be reliably measured using this technique depends on the intensity of the object, its size, and the shuttering frequency. This technique will be combined with existing video-based measurements of luminal oxyhemoglobin concentration to obtain improved estimates of convective and diffusive oxygen transport in microvessels. (Supported by NIH grant HL18292)

