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POSTER SESSION
9:00 - 10:00 AM
SATURDAY, APRIL 5, 1997
OLSCAMP HALL

BOARD A INTERACTION OF HIGH MOBILITY GROUP 1 WITH TATA BINDING PROTEIN. D. DAS., W. SCOVELL. DEPARTMENT OF CHEMISTRY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

High Mobility Group (HMG) 1, an abundant, ubiquitous and highly conserved protein, plays a major role in transcription. HMG 1 consists of three domains, a N-terminal A-domain, central-B-domain and C-terminal-domain. TBP, a sequence specific protein, recognizes the TATA element on the eukaryotic promoter and initiates transcription. Ge and Roeder reported that HMG 1 binds to TATA binding protein both in solution and also on a DNA template. We confirmed the binding of HMG 1 to TATA binding protein in solution. We are interested in mapping the domains of HMG 1 involved in TBP binding. The recombinant B domain of HMG 1 was expressed in E.coli and then isolated and purified. The TATA binding protein was expressed as a GST fusion protein. The binding studies were done with reaction of GST-TBP fusion protein with HMG 1 or polypeptides containing its structural domains (HMG 1-B-box). The HMG 1 or HMG 1-B-box protein was incubated with the reaction mixture containing the GST-TBP immobilized on the Glutathione Sepharose beads. After washing off unbound proteins, the bound proteins were eluted off the column and analyzed by SDS-PAGE and Western Blot. We report here the interaction of HMG 1 B-box with GST-TBP using GST-capture experiments. HMG 1-B-box binds to GST-TBP, with only residual binding to GST control. At least the B-domain of HMG 1 is, in part, responsible for this interaction.

BOARD B INTERACTION BETWEEN THE HIGH MOBILITY GROUP-1 PROTEIN, HMG-1, AND THE RETINOBLASTOMA PROTEIN, pRB. THOMAS J. KOWSKI & WILLIAM M. SCOVELL. DEPARTMENT OF CHEMISTRY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The high mobility group-1 protein, HMG-1, is an abundant, highly conserved protein composed of three domains, the A- and B-domain, and an acidic tail at its C-terminus. HMG-1 has been implicated in many processes such as replication, transcription, chromatin assembly and development. The A- and B-domains are canonical HMG boxes and are isostructural, but do not contain identical sequences. The B-domain of HMG-1 contains a sequence, LXCXE, that has been shown to be crucial for binding to the Retinoblastoma protein, pRb. This sequence is present in a few viral oncoproteins, as well as other cellular proteins that bind to the pocket region of pRb. pRb exerts its effect during the cell cycle in G1 phase. Briefly, in early G1 phase, pRb is complexed with a transcription factor, E2F, as the cell progresses, pRb becomes phosphorylated and releases E2F which allows the cell to enter S phase. Alternatively, certain viral oncoproteins bind to pRb and release E2F, this then results in uncontrolled cell proliferation. We have used a GST-capture experiment with a number of truncated GST-Rb fusion proteins to explore the interaction between HMG-1 and pRb using SDS-PAGE and Western Blotting. We find that HMG-1 interacts with the pRb pocket and also with the C-terminus as individual units or as one continuous protein segment. These results implicate HMG-1 as a cellular protein which influences pRb action and regulation of the cell cycle. Further experiments are underway to define the domain or domains in HMG-1 which are involved in this interaction.

BOARD C PRODUCTION AND CHARACTERIZATION OF MONOCLONAL ANTIBODIES AGAINST HUMAN ESOPHAGEAL CELL LINES. SHANE R. MAYACK, ROUDABEH R. JAMASBI. BOWLING GREEN STATE UNIVERSITY, DEPARTMENT OF BIOLOGICAL SCIENCE, BOWLING GREEN OH 43403.

Hybridoma cells producing monoclonal antibodies (mAbs) against human esophageal carcinoma cells were produced by fusion of SP2/0 myeloma cells with spleen cells from mice immunized with TE-10 human esophageal cell line. Fusion products were screened against a number of esophageal and non-esophageal cell lines by enzyme linked immunosorbent assay (ELISA). One mAb, designated mAb-10D, was selected. This mAb reacted with varying specificities to several human esophageal cell lines as determined by ELISA. mAb-10D also cross-reacted to some degree with carcinoma cell lines derived from other tissue but did not seem to cross-react with CLNF, a human fibroblast cell line. mAb-10D might be a useful reagent for the screening and diagnosis of early esophageal cancer.

BOARD D DIAZINON INDUCED CHANGES IN THE SERUM PROTEINS OF MICROPTERUS SALMOIDES. GUOZHANG PAN AND HIRAN DUTTA, DEPARTMENT OF BIOLOGICAL SCIENCES, KENT STATE UNIVERSITY, KENT OH 44242.

The study involves determination of the quantitative changes in

different serum proteins induced by sublethal doses of diazinon. Adult large mouth bass, *Micropterus salmoides* were exposed to 90µg/l, 180µg/l, 270µg/l, 360µg/l, and 450µg/l of diazinon for 24 hr. Electrophoretic results showed a significant increase in fraction 2 of the 270 and 450µg/l groups. In general, fraction 4 of all the diazinon exposed groups showed a significant decrease compared to the control group. Fraction 5 of the 270µg/l and fraction 6 of the 360 and 450µg/l exposure groups showed significant decreases. A new serum protein, fraction 7, appeared in the 180µg/l, 270µg/l and 360µg/l exposure groups. Fraction 2 is considered to be a low-mobility protein which contains globulin. Increase in fraction 2 may be an immune response. Decrease in fractions 4, 5 and 6, which are high-mobility proteins and includes albumin, may be related to necrosis in the hepatocytes of the liver. Formation of a new protein may be attributed to cellular damages caused by this pesticide.

BOARD E THE EFFECTS OF DIETARY LEAD AND CHOLESTEROL SUPPLEMENTATION UPON HEMOLYSIS IN THE SPRAGUE-DAWLEY RAT. BOYD R. RORABAUGH, LEE A. MESERVE, AND PAUL A. MOORE. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43402.

Hemolytic anemia has been observed in fish and in humans exposed to lead. The goal of the present investigation was to test the hypothesis that lead induces a cholesterol deficiency which is responsible for this hemolytic effect. Adult male Sprague-Dawley rats were divided into four groups. Group I was the untreated control, group II was fed a 4% cholesterol supplemented diet, group III was exposed to lead nitrate via the drinking water, and group IV was exposed to lead and the cholesterol supplemented diet. Blood samples were collected weekly for five weeks. Mean hematocrit, mean serum hemoglobin, and mean cholesterol concentrations were not significantly different in lead exposed animals. This indicated that acute lead exposure did not induce a cholesterol deficiency sufficient to cause hemolysis. The serum protein concentrations were significantly elevated in cholesterol supplemented rats irrespective of the addition of lead. However, the serum protein concentration of those animals exposed to both lead and cholesterol returned to normal after five weeks of exposure, while those exposed only to cholesterol remained elevated. This indicated the existence of a lead + cholesterol interaction that affected serum protein (albumin) synthesis.

BOARD F EFFECT OF MENTHOL ON POST-EXERCISE MUSCLE SORENESS. RYAN T. TERRY. 455 WOODLAWN AVE., SPRINGFIELD OH 45504.

Counterirritation involves the masking of one pain with the induction of another pain. Chemical counterirritants are used widely for the treatment of sore muscles, but they have been studied insufficiently. Menthol, a common ingredient in nonprescription chemical counterirritants, has qualities that may be able to ease the pain of sore muscles when applied topically. Subjects who were unaccustomed to upper body workouts engaged in a regimen of eccentric exercise on the elbow flexors. After 48 hours, when soreness generally reaches its peak, the subjects returned to the laboratory, where menthol or a placebo were tested for effects on soreness ratings and EMG activity. Menthol was ineffective in alleviating this soreness, and it did not affect the EMG measurements. Using the theory of metaesthesia, menthol seems to stimulate nociceptors at a low level and induces a burning feeling that may or may not be perceived by subjects as painful. This leads to a great deal of subject variability regarding the analgesic effects of menthol. Although the local application of menthol was ineffective in alleviating post-exercise muscle soreness, an application of menthol over a remote body site is recommended to separate the two painful stimuli and test menthol's ability to treat pain in a true counterirritant fashion.

BOARD G IN GROWTH OF SENSORY FIBERS INTO THE SUPERIOR CERVICAL GANGLION FOLLOWING EXOGENOUS NGF. ANDREW J. SHAFER AND LORI G. ISAACSON. CENTER FOR NEUROSCIENCE, DEPT ZOOLOGY, MIAMI UNIVERSITY, OXFORD OH 45056.

Following the intracerebroventricular infusion of the target derived neurotrophin nerve growth factor (NGF), we observe a robust ingrowth of axons staining positive for calcitonin gene related peptide (CGRP) in the superior cervical ganglion (SCG) of the rat. Control cases contained few, randomly oriented CGRP fibers. The in growth pattern observed in NGF cases is characterized by tufts of axons preferentially surrounding approximately 3-5 cell bodies within a 45µm frozen section. We hypothesize that the preferential ingrowth of CGRP axons is associated only with cell bodies in the SCG that have intracranial projections and that subsequently transport infused NGF back to the SCG. As a result, the transported NGF is made available to NGF-responsive, CGRP positive axons typically innervating the SCG. In order to determine the origin of CGRP positive axons, we examined the ingrowth pattern of the SCG in cases in which the pre-ganglionic trunk was severed from the SCG (i.e. deafferentation). Deafferentation and subsequent NGF infusion did not eliminate the robust in growth of CGRP axons, but prevented the preferential growth pattern observed in cases receiving only NGF infusion. These results indicate that CGRP in growth does not originate from pre-ganglionic axons but

possibly from a nearby dorsal root ganglion. In addition, the absence of a typical growth pattern following deafferentation suggests that connection with the pre-ganglionic trunk is a prerequisite for the specific innervation pattern with SCG cell bodies to occur. (Supported by NIH NS 32876 to LGI).

BOARD H EXPRESSION OF ACETYLCHOLINESTERASE AND CALBINDIN IN THE AUDITORY BRAINSTEM OF EMBRYONIC MICE. STACY A. WEBER¹, LINDA S. ROSS², JOHN M. ZOOK², AND STEPHANIE A. McABEE³. ¹DEPARTMENT OF BIOLOGY, HIRAM COLLEGE, HIRAM OH 44234; ²DEPARTMENT OF BIOLOGICAL SCIENCES, OHIO UNIVERSITY, ATHENS OH; ³DEPARTMENT OF PSYCHOLOGY, VANDERBILT UNIVERSITY, NASHVILLE TN.

Although the organization of the adult auditory brainstem has been well studied, the ontogeny of the connections in auditory brain development is poorly understood. Projections of the pontine auditory brainstem, from the cochlear nucleus to the nuclei of the olivary complex, were studied primarily. Two transiently expressed proteins, acetylcholinesterase and calbindin, were examined in embryonic mice auditory brain stems. Histochemical and immunocytochemical methods were used to visualize the proteins. These proteins were present in embryonic auditory brain stems, with younger embryos appearing to have lower levels of these proteins than the older. Qualitative analysis showed acetylcholinesterase to be present in midbrains of both older and younger embryos, while calbindin was found mainly in fiber tracts of younger brain stems but distributed in diffuse patches in later stage embryos.

BOARD I PROLACTIN RELEASE FOLLOWING LUTEINIZING HORMONE RELEASING HORMONE ADMINISTRATION TO RAT ANTERIOR PITUITARY GLANDS IN VITRO. WINNIFRED BRYANT, JAMES M. JANIK AND PHYLLIS CALLAHAN. MIAMI UNIV, CENTER FOR NEUROSCIENCE, DEPT OF ZOOLOGY, OXFORD OH 45056.

The purpose of these studies was to determine the effects of Luteinizing Hormone releasing Hormone (LHRH) on prolactin secretion from perfused female rat anterior pituitary glands. Ten, 100 or 200 nM doses of LHRH were administered to anterior pituitary glands collected from female rats during the diestrous stage of the estrous cycle. Pituitaries were minced and one half of a pituitary was placed in individual perfusion chambers. Glands were allowed to equilibrate for at least 90 minutes prior to sample collection. After equilibration, samples were collected prior to any treatment and following increasing concentrations of LHRH. Each addition of LHRH was followed by a 30 minute recovery period before adding the next dose of LHRH. Levels of prolactin and LH in the effluent were determined by RIA. Statistical analysis was accomplished utilizing area under the curve calculations. Administration of 10 nM LHRH significantly increased prolactin release even though this dose did not significantly affect LH release. 100 and 200 nM LHRH increase LH secretion, but did not significantly affect prolactin release. These results indicate that low levels of LHRH can stimulate Prolactin secretion from mature female rat anterior pituitary glands. Supported by NIH DK48023-01 to PC.

BOARD J THE DELTA OPIATE ANTAGONIST NALTRINDOLE BLOCKS SUCKLING-INDUCED PROLACTIN SECRETION. NICOLE CAMPBELL, MONICA GARDON, PHYLLIS CALLAHAN AND JAMES M. JANIK, DEPT OF ZOOLOGY, CENTER FOR NEUROSCIENCE, MIAMI UNIVERSITY, OXFORD OH 45056.

The endogenous opioid peptides (EOP) are involved in the Prolactin (PRL) secretory response to suckling. The purpose of this work was to further characterize the opiate receptor subtype involved in the suckling-induced PRL increase. Tuberoinfundibular dopaminergic (TIDA) neuronal activity was quantified by measuring DOPA accumulation in the median eminence to determine if increased opiate activity during suckling altered the activity of these neurons. Additionally, specific maternal behaviors, namely pup licking, latency to contact the pups and total suckling time were monitored. Sprague-Dawley female rats between days 7-12 post-partum were used in all experiments and suckling responses were monitored after 6 hours of pup separation. Pretreatment with the δ receptor antagonist, Naltrindole, inhibited the PRL response to suckling. Naltrindole also significantly reduced suckling time, but the prolactin response was still inhibited even when these animals were not included in the analysis indicating that the drug affected the hormonal response in addition to behavior. Naltrindole did not significantly alter TIDA neuronal activity. In conclusion, the suckling-induced PRL response is mediated, at least in part by the δ opiate receptor subtype, but not by acting through the TIDA neurons. Although this drug affects maternal behavior, its effects on behavior are not responsible for the decreased prolactin secretion. (This work was supported by NIH grant # HD30375 to JJ and PC).

BOARD K ANATOMICAL AND PHYSIOLOGICAL CHARACTERIZATION OF THE COMMISSURAL RING NERVE IN THE CRICKET *ACHETA DOMESTICUS*. JOHN P. BOLLING AND KATHLEEN A. KILLIAN. MIAMI UNIVERSITY, DEPARTMENT OF ZOOLOGY, OXFORD OH 45056.

Neurohemal organs play a crucial role in modulating the neural activity and behavior of organisms. The commissural ring nerve, which has

been described in a variety of orthopteran insects, may play such a role (Pipa, *Cell Tiss Res.* 1988). We have begun to characterize the physiology and structure of this commissural ring nerve in the cricket *Acheta domesticus* to give further insight towards its putative neurohemal role. This nerve links together the two cercal motor nerves arising from the terminal abdominal ganglion (TAG), the most posterior ganglion of the cricket central nervous system. Recordings of the nerve's electrical activity via a suction electrode reveal that neurons projecting into the nerve are activated by tactile stimulation of the ovipositor or cerci. Neurons innervating the nerve also respond with a burst of action potentials to a wind stimulus. Cobalt chloride backfills of the ring nerve reveal that three clusters of dorsal unpaired medial (VUM) neurons and one group of ventral unpaired medial (DUM) neurons have axons in this nerve. These cell clusters are arranged segmentally in the 8th through 10th neuropilar segments of the TAG. In addition to these four clusters, there are two ventral lateral clusters located symmetrically to each other in the ninth segment. The anatomy and physiology of the individual neurons projecting into the ring nerve is under investigation.

BOARD L DISTRIBUTION OF BASAL FOREBRAIN NEURONS CONTAINING GABA, CHAT, AND CALCIUM BINDING PROTEINS. LESLIE A. McCONKEY AND KEVIN PANG. BOWLING GREEN STATE UNIVERSITY, PSYCHOLOGY DEPARTMENT, BOWLING GREEN OH 43403.

Degeneration of neurons in the basal forebrain (BF) is associated with learning and memory deficits such as in Alzheimer's disease (AD). AD is characterized by the loss of cholinergic neurons in the BF. Non-cholinergic neurons are co-distributed with cholinergic neurons in BF, a major population of which are GABAergic. In other brain areas, GABAergic neurons are co-localized with calcium binding proteins (CaBP) such as parvalbumin (PV), calretinin (CR) and calbindin (CB). Male, Long Evans rats were perfused; brains were dissected and sectioned. Immunocytochemical techniques were used to identify neurons immunoreactive for GABA, choline acetyltransferase (ChAT), CB, CR, and PV. In the present study, the co-distribution of GABA and CaBP were examined in BF. Cholinergic and GABAergic neurons were co-distributed throughout BF. Preliminary data indicates that PV co-distributes with GABA2 throughout BF. In the medial septum and vertical limb of the diagonal band, co-distribution of PV and GABA is more prominent, especially along the midline. In the horizontal limb of the diagonal band, ChAT and GABA are codistributed with sparse populations of CR and CB. In the ventral pallidum PV is co-distributed with GABA and a moderate population of cholinergic neurons. The co-distribution of non-cholinergic neurons with cholinergic neurons in the BF may also be a factor in memory loss associated with AD.

BOARD M SURVEY OF STARK COUNTY RESIDENTS REGARDING THE DANGERS OF ENVIRONMENTAL TOBACCO SMOKE (ETS) AND REGULATION OF SMOKING IN PUBLIC PLACES. JERE M. BOYER, AULTMAN HOSPITAL, ADRIANNE RIDLEY, KAREN WOOD, MICHAEL GRIMES, CHRIS KALAPODIS, PAM CLARK, NEOUCOM, WILLIAM FRANKS, EMILY CANIFORD, STARK CO. HEALTH DEPT., AULTMAN HOSPITAL, 2600 6TH. ST., S.W., CANTON OH 44710.

Currently, Stark Co. does not have regulations regarding smoking in public places. The purpose of the survey was to determine the public's attitude toward implementation of smoking regulations in the County. A 20 question phone survey was asked of 600 County residents. The survey assessed attitudes of smokers and nonsmokers about whether they consider ETS harmful, their attitudes toward smoking legislation in public places such as restaurants, malls, banks the workplace and whether respondents favored an overall ban on public smoking in Stark. The results showed that the majority of respondents think ETS is harmful (83%). They also favored a legislative ban of smoking in all public places (76%). This included 82% of nonsmokers and 58% of smokers. The Boards of Health in Stark Co. are using the results to assess the possibility of implementing some form of smoking prohibition in the County.

BOARD N BIOLOGICALLY BASED DOSE-RESPONSE MODELING OF OXIDATIVE STRESS INDUCED BY CHEMICALS. J.Z. BYCZKOWSKI, MANTech ENVIRONMENTAL TECHNOLOGY, INC., P. O. Box 31009, DAYTON OH 45437.

Health risk from chemicals depends on both the extent of exposure and a dose-response relationship, which is reflecting, in turn, the mode of action of chemicals. The level of health risk may be estimated by fitting mathematical models to experimental dose-response data. To provide a tool potentially useful for risk characterization for pro-oxidant chemicals, a conceptual framework of biologically based pharmacodynamic (BBDR) model was set and tested using computerized programs. Based on the available literature and our own experimental data, the three basic modes of action of pro-oxidant chemicals were modeled and simulated in silico: 1. lipid peroxidation; 2. a single-hit interaction of free radicals with cellular targets; and 3. a stochastic multi-hit interaction of free radicals with multiple cellular targets. Based on the dose-response characteristics verified in vitro, a BBDR model of chemically initiated oxidative stress was developed and calibrated in B6C3F1 mice treated

with pro-oxidant chemicals in vivo, using the ethane exhalation as a measured end point. The BBDR model was written in the Advanced Continuous Simulation Language (ACSL) and simulations were performed using a SIMUSOLV software on a VAX/VMS mainframe computer. The developed model has been linked with physiologically based pharmacokinetic (PBPK) models which described local concentrations of pro-oxidant chemicals in the liver. The resultant BBDR/PBPK hybrid model may be used for a pharmacodynamic description of oxidative stress in mice and potentially may be useful for risk characterization. *Supported in part by Department of the Air Force Contract No. F41624-96-C-9010.

BOARD O NOTES ON HABITAT LOSS AND DEGRADATION AS IT RELATES TO ECONOMICS: A GUIDE FOR RESEARCH. FREDERICK JOHN KLUTH, 1060 DELEONE DR., KENT OH 44240-2026.

Natural habitats are more likely to be related to the goods and services of human society than to the creatures that live there. Traditionally, decisions regarding habitat use have been made on the basis of major direct uses that generate local and national benefits. In recent years increasing attention has been given to the important economic role non-market benefits play in providing incentives for the conservation of habitats. The most crucial benefits involve watershed conservation which involve both soil and water. This paper will review the various concepts involved with the problem of habitat conservation and its economic justification, survey relevant literature, and suggest experiments that would clarify decisions required of future policy makers. The relation of ethics and economics is clarified in a way that allows more productive analysis. Physical principles are discussed in the context of experimental design so that the assumptions of various societal solutions to perceived problems can be tested. The importance of anesthetics to the subject are reviewed so that this factor can be isolated in future experiments. A bibliography of materials useful for further research is included.

BOARD P SPATIAL INTERPOLATION OF LAKE WATER QUALITY DATA. MICHAEL R. BINKLEY DEPARTMENT OF GEOGRAPHY, KENT STATE UNIVERSITY, KENT OH 44242.

During the summer of 1994, volunteers from various lake monitoring programs across six Midwest states collected data concerning lake transparency as part of The Great American Secchi Dip-in. The resulting dataset consisted of several hundred, irregularly spaced, average transparency values, and their associated geographic coordinates. These transparency values were interpolated in order to visualize the general trends concerning lake water quality throughout the region. In addition to general trends, the interpolated transparency values provide a basis for estimating water quality between measured locations. A comparison of the kriging and Triangulated Irregular Network (TIN) interpolation methods was conducted to determine which is more suitable to cartographically transform this point data. The various methods of kriging use statistical theory to generate a mathematical surface directly from the original data points. The TIN methods use the point data to generate a surface composed of triangular facets in order to generate a lattice of data values which can be interpolated. Of the two methods, TIN interpolation provided a more consistent and realistic interpolation, effectively imitating the nature of the original point data. For the most part, kriging interpolation generated surfaces which smoothed the maximum and minimum values of the original dataset.

BOARD Q EFFECTS OF ZEBRA MUSSELS ON TURBIDITY, PHOSPHORUS AVAILABILITY AND MACROPHYTE ABUNDANCE IN SMALL RESERVOIRES. VASILIA VELISSARIOU¹, ELLEN T. McDONALD¹, DAVID A. CULVER², AND NENG YU². DEPT. CIVIL ENGINEERING¹ OR DEPT. ZOOLOGY², OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

A simulation model has been developed for the wetland at the inlet stream in Hargus Lake, a small reservoir near Circleville, Ohio, to describe and predict the temporal change in phosphorus concentration, algae and macrophyte biomass and zebra mussel density. Special attention has been paid to the role of zebra mussels in the improvement of the water transparency in the lake and in the consequent increased abundance of macrophytes. Due to the increase of the macrophyte biomass, the friction coefficient and the depth of the flow increase while the velocity of the flow decreases. Lower mean flow velocities decrease the amount of nutrients carried downstream (advection) and increase the availability of algae to zebra mussels. The effect of the macrophytes on flow in the reservoir ecosystem combined with their negative influence on light availability has been incorporated into the model. The model consists of four submodels (zebra mussels, macrophytes, phosphorus, and algae) which have been tested separately and in groups. The parameters used have been estimated from Hargus Lake field data from 1993 and 1994, and the model has been tested on data from 1995. The results show that zebra mussels do increase the depth of light penetration near the inlet and stimulate the expansion and abundance of macrophytes, which in turn provide additional space for settling of juvenile zebra mussels.

BOARD R PESTICIDE LABEL USE OF OHIO FARMERS. STEVEN C. PROCHASKA, OHIO STATE UNIVERSITY EXTENSION, 117 E. MANSFIELD ST., BUCYRUS OH 44820.

Significant human and monetary resources are expended for pesticide training. A descriptive and correlational study was conducted to measure pesticide use behaviors of Ohio certified private pesticide applicators (OCPPA). A sample size of OCPPA was used to provide .95 confidence interval for the population parameters. Internal and external validity threats were examined and controlled in the study. A random cluster sampling approach was used in this study. Inferential statistics such as student t-tests, multiple regression, and one-way analysis of variance were used to make generalizations to the population. OCPPA exhibit an adequate understanding of pesticide use principles, but did not know basic pesticide label signal words. About 20 percent of the variance in OCPPA reading of the pesticide label could be explained by the linear combination of the following variables: safety equipment worn, attitude toward OSU Extension pesticide training, environmental protection (water and wind), and rate of pesticide used.

**POSTER SESSION
10:00 - 11:00 AM
SATURDAY, APRIL 5, 1997
OLSCAMP HALL**

BOARD A THE CONSTRUCTION OF EXPRESSION VECTORS FOR *PARAMECIUM TETRAURELIA*. EMILY M. HENDEL, DEAN M. FRAGA. BOX C-1821, THE COLLEGE OF WOOSTER, 1189 BEALL AVE., WOOSTER OH 44691.

Paramecium tetraurelia is a single celled ciliated organism for which few expression vectors exist. For this reason, new expression vectors would be valuable tools for research concerning *Paramecium*. We have constructed two plasmid expression vectors: pEH-1 which will be used to demonstrate whether or not the *lac Z* gene is functional in *Paramecium* and pEH-3 which will be used to screen and isolate inducible promoters through a modification of the restriction enzyme mediated insertion (REMI) technique (Kuspa et al. 1992, *Proc. Natl. Acad. Sci. USA* 89: 8803-8807). REMI is a method for randomly inserting plasmid DNA into the genome involving the co-introduction of a restriction enzyme and the cut plasmid into the cell nucleus. Both plasmids were constructed using a method of restriction enzyme digestion and ligation. The first vector, pEH-1, was constructed by combining the *Paramecium* calmodulin (CAM) promoter of pPXV-neo (Haynes et al. 1995, *J. Euk. Microbiol.* 42(1): 83-91), with the *lac Z* gene of pPD-16.43 (Fire et al. 1990, *Gene* 93: 189-198). The second vector, pEH-3, was constructed by inserting the *Paramecium* calmodulin promoter along with the gene for neomycin resistance of pPXV-neo into pPD-16.43 just behind a multiple cloning site and the *lac Z* gene. This plasmid allows us to screen cells first for neomycin resistance and second for inducible expression of the *lac Z* gene. pEH-1 and pEH-3 will be electroporated into *Paramecium* cells in order to test their ability to be expressed within the cell.

BOARD B A SURVEY OF UNIONID MUSSEL SPECIES FROM THE WILD AND SCENIC SECTIONS OF NORTHEAST OHIO'S GRAND RIVER. MARTIN K. HUEHNER, GREG ZIMMERMAN AND MELISSA MEJJA, BIOLOGY DEPT., HIRAM COLLEGE, HIRAM OH 44234.

During July of 1995 and 1996, 45 stops covering 54 river miles (from State Rt. 322 to Painesville) were searched visually, by hand, with bottom sieves, and dip nets. A total of 8,426 living and 3,956 dead mussels comprising 24 species were observed. *Actinonaias ligamentina carinata* were most abundant and comprised 54.7% of living mussels found. Seven subdominant species (*Elliptio dilatata*, 10.3%; *Lasmsgona costata*, 9.8%; *Lampsilis radiata luteola*, 6.6%; *Lampsilis ventricosa*, 4.7%; *Fusconia flava*, 3.7%; *Ligumia recta*, 2.8%; *Ptychobranchius fasciolaris*, 1.9%) were also found and together with *A. carinata*, comprised 94.5% of living mussels. Four of the species, *Lampsilis fasciola*, *L. recta*, *Pleurobema sintoxia*, and *Truncilla truncata*, are listed as Ohio Special Interest, while two others, *Epioblasma triquetra* (OH Threatened) and *Simpsonia ambigua* are also listed as Federal Category 2. Quadrat samples were also taken in 6 transects near the Vrooman Road Bridge in Lake Co., and produced from 0 to 44 live mussels per square meter, with an average of 13.2. The number of species within the transects ranged from 5 to 13. Supported by an ODNR Natural Areas and Preserves Grant and by the Howard Hughes Medical Institute. Thanks also to Cathy Corr, who helped in the 1995 study.

BOARD C BEHAVIORAL RESPONSES OF *OPHIOCOMA ECHINATA* TO CHANGES IN LIGHT AND SALINITY. KELLY R. LOVELL, JENNIFER D. LEWIS. 1019 N. FOUNTAIN AVE., SPRINGFIELD OH 45504.

Ophiocoma echinata were studied to see if continuous darkness for several days would disrupt their pattern of hiding under rocks. The number of central discs covered during the day and night for a period of seven days was almost consistent for both tanks. This supports the idea that the species has an internal mechanism for determining when to seek shelter. A separate experiment was performed to see how the same species would react to a decrease in ambient salinity. The salinity was decreased over seven days from 35 to 20 parts per thousand at a rate of 5 parts per thousand every 24 hours. It was observed that the brittle stars' bodies swelled, their legs stiffened, and extended, and their central discs were lighter in color. When the salinity was increased again to 35 parts per thousand, the specimens showed improvements until their behavior and physical characteristics resembled those of the control tank. This indicates that short term survival of *Ophiocoma echinata* is possible in salinities lower than 35 parts per thousand. However, the changes that resulted were not beneficial because movement was restricted.

BOARD D HABITUATION OF THE WITHDRAWAL RESPONSE IN *NOTAULAX OCCIDENTALIS* (FAN WORMS) ON SAN SALVADOR, THE BAHAMAS. CHERISE L. COKLEY AND NICOLE FOGARTY. WITTENBERG UNIVERSITY, BOX 1494, P.O. BOX 6100, SPRINGFIELD OH 45501.

Research of habituation has been conducted on several members of the Sabellidae family to better understand the primary withdrawal response to different stimuli. However, the species *N. occidentalis* has received little attention. Other researchers have found that Sabellidae and closely related annelids do respond to repeated stimulation in a manner that suggest that habituation has taken place. In this experiment a random sample of 19 worms from two different sites, Sand Dollar Bay and Bonefish Bay underwent several trials of tactile stimulation. The environmental parameters, including cloud cover, depth, and time of day, were recorded at each site during high and low tide. Median values were compared with the Kruskal-Wallis One Way ANOVA. A comparison with the individual trials was analyzed with several linear regression tests to determine the effect of the environmental components. Results of both statistical analyses showed none of the environmental factors influenced the withdrawal response of *N. occidentalis*. It was found that the worms were not completely habituated during the repeated tactile exposure, necessary for thorough habituation. Alterations in the experimental design, such as shorter intermissions, may have increased the likelihood of complete habituation. These results show that with a slightly different approach, these individuals can undergo habituation.

BOARD E TEMPERATURE AND SALINITY CHANGES IN RELATION TO DEPTH IN SAN SALVADOR, THE BAHAMAS. COLLEEN J. WEISS AND NICOLE M. HAEERLE, DEPARTMENT OF BIOLOGY, WITTENBERG UNIVERSITY BOX 720 SPRINGFIELD OH 45501-0720.

This research suggests that temperature and salinity within the Pigeon Creek Estuary, San Salvador, The Bahamas, varies with tidal currents, as a function of depth. Pigeon Creek estuary floods the Southeast corner of the island. Water samples collected at high tide on 6-04, and 6-07-1996 and low tide on 6-08, 6-09, and 6-11-1996. A hand refractometer was used to calibrate salinity. Observed depths averaged 2 meters, with 4m maximum depth at high tide. Temperature increased consistently downstream, at high tide and fluctuated sporadically at low tide. Surface temperatures were generally warmer at high tide, averaging of 27.9° C. Surface and bottom salinity averaged 39.6 and 39.3 ppt, respectively, at high tide, decreasing downstream. Salinity averaged 38.8 ppt and 38.6 ppt at low tide. These data show that water flowing into the estuary at high tide is lower in temperature and salinity. Water flowing out at low tide is warmer and higher in salinity. However, the influence of insurgence from unknown sources has not been addressed.

BOARD F DIURNAL MIGRATION AND COMMUNITY ULTRASTRUCTURE OF BENTHIC ALGAE IN DOUGLAS LAKE, MICHIGAN. TODD A. CLASON. BOWLING GREEN STATE UNIVERSITY DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN OH 43403.

Using filter paper collection techniques (Eaton & Moss 1966), SCUBA divers collected migrating benthic algae from blue green mats at 7 m and epipelagic algae from sediment at 8.5 m after 8.5 hour incubation periods. Algae were at 3 hour intervals; subsequent analysis showed a steady rise in motile algae during daylight hours with a peak at about 1:30 p.m. *Navicula* spp. and *Oscillatoria* sp. made up the bulk of the algae followed by *Pinnularia* sp. and *Gyrosigma* sp.. After collecting benthic blue green mats and equilibrating them in aquaria with circulating lake water, the diurnal light cycle was reversed for one week. The greatest number of algal cells accumulated by the 5:30 a.m. collection, suggesting that light was involved as a cue for migration. At the conclusion of the field season, several algal mats were collected by divers for preservation and ultrastructural analysis using SEM techniques. Motile dia-

toms were noticeable at different depths in the mat along with significant numbers of non-motile species including *Stephanodiscus* sp. and *Fragilaria* sp..

BOARD G HOME RANGES OF SPOTTED TURTLES IN SOUTHWESTERN OHIO. TIMOTHY L. LEWIS AND CRAIG A. FAULHABER. DEPARTMENT OF BIOLOGY, WITTENBERG UNIVERSITY, 225 N. FOUNTAIN AVE., SPRINGFIELD OH 45501.

Numbers of spotted turtles (*Clemmys guttata*) have declined in Ohio largely due to wetlands habitat loss, over collection, and increased predation. Information on home ranges is necessary for management and protection of this species. We recorded locations of 35 spotted turtles during 4 years of study (1991-1995 excluding 1994) at Prairie Road Fen (PRF) in Clark County, Ohio. We used standard radio telemetry techniques to locate the turtles to within 1 sq.m. We analyzed locations using adaptive kernel analysis of core activity areas (50% activity area) and total home ranges (95% activity areas as well as minimum convex polygons (MCP) with Calhome software. We found no differences between males and females nor between years ($P > 0.05$). Turtles averaged core activity areas of 0.12 ha, 95% activity areas of 1.26 ha, and MCP home ranges of 0.62 ha. These areas are larger than home ranges reported for eastern spotted turtles, probably because successional growth at PRF provides suboptimal habitat.

BOARD H THE DYNAMICS OF CRAYFISH CHIMNEY MOUNDS IN A DEGRADED WETLAND RESTORATION SITE. KELLY ANNE R. DRISCOLL, ROBERT M. SCHNEBLE, MARK E. BENBOW, CARL F. FRIESE. UNIVERSITY OF DAYTON, BIOLOGY DEPARTMENT, 300 COLLEGE PARK, DAYTON OH 45469-2320.

In this study, the dynamics of crayfish chimney mounds in a degraded wetland restoration site was examined by comparing the biotic and abiotic characteristics of mound and off-mound areas. Soil nutrients were determined for chimney mounds and surface soils. Plant percent cover, density and distribution of crayfish mounds were calculated. Plot soil moisture and organic matter levels were determined from random surface soil samples. A strong correlation was observed between plant percent cover and spore counts, soil moisture, and organic matter levels. The driving variable in this degraded restoration site was the patchy structure of the plant community, not crayfish mound density and distribution. No correlation was found between crayfish density or distribution and mycorrhizal counts. Although crayfish were the dominant animal disturbance type, they were not the driving variables in this system. It is uncertain if this would be true in a non-degraded wetland site.

BOARD I ULTRASTRUCTURE, MORPHOLOGY AND DISTRIBUTION OF SENSORY STRUCTURES OF THE CHELAE OF THE CRAYFISH, *ORCONECTES RUSTICUS*, *ORCONECTES VIRILIS* AND *ORCONECTES PROPINQUUS*. JENNIFER L. BORASH AND PAUL A. MOORE. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Many aquatic organisms, especially decapod crustaceans, make foraging and mating decisions based on information received from their environment through chemo- and mechanosensitive organs. In particular, the cheliped, used for foraging, agonistic interactions, and procurement of mates (Lee, 1995), contain a large number of sensory structures. Most of the previous work has been done on either lobsters or hermit crabs, while the chelar sensory structures on crayfish remain relatively unexplored. Using SEM and TEM micrographs, the ultrastructure, morphology and distribution of chelar sensory structures on three species of Orconectid crayfish; *O. rusticus*, *O. virilis*, and *O. propinquus*. Three distinct sensory structures were identified; filiform hairs containing a single pore at the tip, feathered hairs with no apparent pore structure, and many circular raised areas of cuticle each containing a single pore. Each structure was further examined for innervation. The filiform hairs appear to have both a mechano- and chemosensory function, the feathered hairs appear to be mechanosensory and the function of the small pores is still unknown at this time. Each sensory structure has a unique spatial distribution on the chelae. The filiform hairs are grouped in pockets and are primarily concentrated on the distal tips of the biting edge of the chelae, while the feathered hairs, also grouped in pockets, are concentrated toward the proximal end of the biting edge of the chelae. The small cuticular pores only appear in small groups (1-4) on the proximal side of the hair pockets.

BOARD J CAPACITIES FOR CARBOHYDRATE AND LIPID FUEL UTILIZATION IN GILL OF TELEOST FISHES. ELIZABETH L. CROCKETT, MAGDALENA C. POPESCO, AND ERIN E. WILKES. DEPARTMENT OF BIOLOGICAL SCIENCES, OHIO UNIVERSITY, ATHENS OH 45701.

The gill of teleost fishes is multifunctional with low intracellular energy stores. Because gill is well-perfused, its work may be supported by a variety of circulating fuels. To evaluate which circulating fuels are preferred for energy metabolism, we determined capacities for catabolism of glucose and fatty acids in four species of teleosts representing distinct lineages. Activities of rate-limiting enzymes from pathways of energy metabolism, indicative of maximal rates of flux through glycolysis, β -oxidation, and the citric acid cycle,

were measured at 15°C. ATP yields from glucose (as measured by hexokinase activities) are 3.5-times to 30-times greater (varying with species) than ATP generation from the fatty acid fuel (as measured by carnitine palmitoyltransferase activity). A match between activities of citrate synthase (central pathway of oxidative metabolism) and hexokinase (glycolysis) (positive linear relationship: $r=0.53$; $P=0.01$) adds further support to the hypothesis that glucose is the preferred metabolic fuel in gill. Comparisons of pyruvate kinase/hexokinase ratios for gill and cardiac muscle indicate that gill, like teleost hearts, relies largely on aerobic energy metabolism. Supported by the Ohio University Research Committee, a New Investigator Award from the Mount Desert Island Biological Laboratory, and a student fellowship from the American Heart Association (Maine Affiliate).

BOARD K DIATOM GUT CONTENT OF THE AMPHIPOD *GAMMARUS FASCIATUS* AND THE LARVAL CHIRONOMID *MICROTENDIPES PEDELLUS* IN WESTERN LAKE ERIE: AN ANALYSIS OF FEEDING PREFERENCE AND RESPONSE OF TWO DOMINANT SPECIES TO ZEBRA MUSSEL INVASION. LONT J. MARR, DEPT. OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The invasion of the zebra mussel into the western basin of Lake Erie has significantly increased the abundance of the macroinvertebrates *Gammarus fasciatus* and *Microtendipes pedellus* at the study site off Put-in Bay, OH. One mechanism for this documented increase is thought to be due to a shift in energy from the pelagic to the benthic food web. Ingested diatoms from the guts of *Gammarus* and *Microtendipes* individuals and benthic diatoms collected from experimentally manipulated structures and control sites were analyzed for percent abundance. Dominant diatom taxa in the guts of both *G. fasciatus*, *M. pedellus*, and the natural periphyton community (which includes deposited mussel pseudofeces) consisted of the benthic diatoms *Amphora perpusilla*, *Achnathes plonensis*, *Cocconeis placentula*, *Fragilaria construens*, *Navicula tripunctata*, *Navicula minima*, *Nitzschia dissipata*, *Nitzschia lanceola*, *Nitzschia palea*, *Rhoicosphenia curvata* and the planktonic species *Fragilaria crotonensis*. Benthic diatoms contributed a significant portion of the gut contents of both *G. fasciatus* and *M. pedellus*, and of the periphyton samples in all treatments. No significant feeding preferences were found for the two invertebrate species. It is thought that these invertebrates are generalist feeders and are feeding on zebra mussel pseudofeces as well as benthic algae. While several other factors probably contribute to the observed density increases, the results of this study support the theory that the dominant macroinvertebrates in western Lake Erie are responding to the increased benthic algal food supplies as well as pseudofecal deposition by zebra mussel colonies.

BOARD L PRELIMINARY STUDIES ON ALGAL RESPONSES TO NUTRIENT ENRICHMENT OF LAKE ERIE WATER WITH OR WITHOUT ZEBRA MUSSELS AND *MICROCYSTIS*. CONRAD E. WICKSTROM, DALE A. CASAMATTA, XUEQING GAO AND ROBERT T. HEATH. DEPARTMENT OF BIOLOGICAL SCIENCES AND WATER RESOURCES RESEARCH INSTITUTE, KENT STATE UNIVERSITY, KENT OH 44242.

Recent studies show that western basin Lake Erie (WB-LE) phytoplankton are phosphorus-limited compared to when they were dominated by cyanobacteria and nitrogen-limited. Blooms of *Microcystis*, a toxin-producing cyanobacterium, were noted in summer 1995. These were localized in WB-LE water impacted by zebra mussel grazing. Effects of *Microcystis*-zebra mussel (MZM) activity on nutrient availability in WB-LE was tested by experimental laboratory incubations of phosphate and nitrate amendments to lake water. The experiment was factorial for all concentrations of both nutrients. Silicate additions precluded Si limitation. In vivo Chl *a* fluorescence tracked algal responses. Yields and rates of Chl *a* increases from sites with or without MZM responded positively to nitrogen additions (0, 120, 320 $\mu\text{g/L}$); phosphorus additions (0, 25, 35, 45 $\mu\text{g/L}$) yielded no trend. These and other analyses indicate that WB-LE may be shifting to nitrogen limitation once again, but the contribution of MZM to the shift is not clear. This study is preliminary and further experiments will be conducted summer 1997. This research was supported by Ohio Sea Grant R/ER-40-PD and the Lake Erie Protection Fund.

BOARD M GASTROTRICHA OF CHESAPEAKE BAY: ECOLOGY. JENNIFER L. KELLY AND WILLIAM D. HUMMON, MSES PROGRAM AND DEPT. BIOL. SCI., OHIO UNIVERSITY, ATHENS OH 45701.

We are studying the distribution and physiology of gastrotrichs as influenced by the salinity of the Chesapeake Bay estuary. Littoral and sublittoral sediments were collected from 3 clusters of 4, 4, & 5 sand beaches, along the western shore, during July & August 1996. Collections covered ca. 170 miles, from Virginia Beach to Baltimore. Salinities were: 30>15 ppt for the lower (Lo), 11>7 for the middle (Md), and 7>1.5 for the upper (Up). We found 15 genera, 9 Macrodasyida (M) and 6 Chaetonotida (C), and 30 species, 15M and 15 C. Lo had a total of 14 gen. (9 M + 5 C) with 23 spp. (14 M + 9 C). Of these, 7 gen. (6 M + 1 C) and 15 spp. did not extend into Md or Up. No spp. were restricted solely to Md, but Md shared 3 with Lo (1 M + 2 C), 1 with Up (1 M), and 5 with both Lo and Up (2 M + 3 C). Up had a total of 6 Ben. (2 M + 4 C) with

12 spp. (3 M + 9 C), of which 6 (6 C) were found only in Up. *Xenotrichula intermedia*, the most frequently encountered sp. in both Lo and Md, was the most abundant in Md, but was not present in Up. *Turbanella* sp. A, which occurred in Md, but not in Lo, was the most frequent and most abundant species in Up. Osmotic tolerance tests were performed using *Turbanella* sp. A to determine a LC_{50/24h}. Animals, acclimated 11-12 ppt, survived a range of 2-40 ppt at 24°C and 0.5-45 ppt at 12°C. This differs from the survivorship of 5-60 and 5-68 ppt for *Turbanella ocellata* from NC, and 7-63 and 5-70 ppt for *T. ambronensis* from MA, two closely related marine species.

BOARD N THE BUBBLE NEST AS AN INDICATOR OF MALE QUALITY IN THE SIAMESE FIGHTING FISH, *BETTA SPLENDENS*. TIMOTHY T. HORAN, MICHAEL J. GERST, AND BRADLEY S. NUNN, DEPARTMENT OF BIOLOGY, XAVIER UNIVERSITY, 3800 VICTORY PARKWAY, CINCINNATI OH 45207-4331.

Intraspecific animal competition in nature usually involves ritualized interactions and rarely escalates into injurious combat. During these ritualized interactions, animals assess the competitive ability and motivation of their opponents. Based upon this assessment, a decision is made whether to escalate or abandon the competition. One means by which animals determine competitive motivation of their opponent is by assessing the relative value of the resource being contested. We are examining the role that territorial bubble nests play in the assessment of rivals in the male Siamese Fighting Fish. We predict that if the bubble nest is an indicator of territory value, a male without a nest will be less willing to persist in an aggressive encounter with a rival possessing a nest. Female Siamese Fighting Fish showed a significant preference for males with a nest in their territory. While there was no statistically significant difference in aggression between males with and without a nest, there did appear to be a trend in the direction of our prediction.

BOARD O THE ORGANIZATION OF FOOD SEARCH BEHAVIOR IN CRAYFISH. CRAIG STEELE, CAROL SKINNER, KITTY STEELE, AND CANDY MATHEWSON. DEPARTMENT OF BIOLOGY AND HEALTH SERVICES, EDINBORO UNIVERSITY, EDINBORO PA 16444.

One model of crustacean food search behavior claims that chemical stimuli influence the foraging of crustaceans by preferentially activating far-field (distant) food searching. Chemical concentration may be important in relating distance to food: dilute attractant concentrations may be interpreted as originating from distant food sources. Studies on marine crustaceans, however, indicate that chemical stimuli selectively activate nearby rather than distant food search. Our study evaluated the hierarchical organization of food search behavior in *Procambarus clarkii* crayfish. Animals were presented, individually, with infusions of 10 ml of a feeding stimulant (a filtrate of 100ml of water filtered through 1g of TetraMin fish flakes). Experimental groups were presented with either the undiluted filtrate, "Max" concentration, or one of five other concentrations: 75%, 50%, 25%, 10%, or 0% (controls) of "Max". Three components of food search behavior were analyzed: detection, probing; and locomotion. Rank order of occurrence and its latency to initiation were recorded for each behavior. High concentrations ($\geq 50\%$ "Max") of the stimulant induced probing (nearby searching) prior to locomotion, while low concentrations ($< 50\%$ "Max") induced locomotion prior to or even in the absence of probing. Our results indicate that chemical stimuli preferentially activate distant food search in *P. clarkii*.

BOARD P SURVIVORSHIP OF HALOPHYTES AT A BRINE SPILL LOCATION IN SOUTHEASTERN OHIO. CAROLYN HOWES KIEFFER AND IRWIN A. UNGAR. MIAMI UNIVERSITY, DEPARTMENT OF BOTANY, MIDDLETOWN OH 45042.

An investigation was initiated to determine the survival of four halophytic species, *Suaeda calceoliformis*, *Atriplex prostrata*, *Salicornia europaea*, and *Spergularia marina* at a brine spill location in Athens County, Ohio. We wished to ascertain if seeds of these annuals, which were produced on plants transplanted into the area in the previous year, would persist and maintain populations on the brine spill site. Survival was monitored in ten 100 sqm quadrats for each of the species from May to September 1995. Survivorship curves differed among the species. Mortality was constant over the growing season in the *A. prostrata* quadrats in the low salinity habitat, while the population in the more saline site had high mortality early in the growing season and relatively high survival from June to August. *Suaeda calceoliformis* had a similar survival curve to the high salt *Atriplex* population with 70% of the plants surviving until 18 June and essentially no mortality after the latter date. *Salicornia europaea* populations had less than 10% survival by 18 June and no further mortality until the end of the growth period. *Spergularia marina* had a gradual decline in survival until 2 July and further germination occurred in these plots between 2 July and 15 August, indicating that seed germination in this species was not inhibited by high summer temperatures. It appears likely that all of the species with the exception of *Salicornia europaea* will provide persistent vegetation cover of the site until salinities decrease to the point where native plants can invade.

BOARD Q NITROGEN IMMOBILIZATION IN DECAYING RED MAPLE WOOD: THE INFLUENCE OF CONTACT WITH THE SOIL. AMY C. THOMAS AND CHARLES A. McCLAUGHERTY, MOUNT UNION COLLEGE, 1972 CLARK AVE., ALLIANCE OH 44601.

Wood represents a large portion of the biomass in forested ecosystems. In natural forests, coarse woody debris, including both snags and logs, represents a major part of the litter. Wood is very low in nutrients, including nitrogen. Therefore wood acts as a sink for nitrogen during its decomposition. We hypothesized that woody debris with ground contact (grounded wood) should immobilize more nitrogen than standing dead wood. We collected standing and grounded red maple (*Acer rubrum*) wood in a wide range of decay classes from a red maple-dominated forest at the Huston-Brumbaugh Nature Center, Stark County, Oh. The wood was analyzed for total Kjeldahl nitrogen (TKN) and bulk density. Bulk density was used as a proxy for mass loss, because wood volume had remained nearly constant. N declined from 0.07% to 0.22 % while densities declined from 0.53g/cc to 0.12g/cc. There was a strong linear correlation between TKN and density, indicating nitrogen immobilization between standing and rounded wood. This suggests that nitrogen may be the limiting element in wood decay and that decaying wood can provide an important site for long term storage of nitrogen in an ecosystem.

BOARD R SPATIAL VARIABILITY OF SOIL pH AMONG THREE PAST LAND USE AREAS IN NEW ENGLAND AND MIDWEST TEMPERATE FORESTS. KARLI J. CLARK, MOUNT UNION COLLEGE, 1972 CLARK AVE. ALLIANCE OH 44601.

Past land disturbances by humans greatly impact current forest ecosystem processes. Severe disturbances to the soil, such as plowing, may alter the spatial patterns of soil pH, thus influencing nutrient availability, which in turn affects vegetation composition and productivity. The purpose of this study was to determine and compare the spatial heterogeneity of soil pH among three land use legacies, (plowed, pastured, woodlot) in two different forest ecosystems: Harvard Forest (HF) near Petersham, Mass. and the Huston Brumbaugh Nature Center (NC) near Alliance, Ohio. From each of nine 30x50 M plots, 27 samples of mineral soil were collected every five M along rows ten M apart. The forest floor was also gathered (27 samples a each site) at the HF. Soil pH was determined by placing fresh soil in water or 0.01 M CaCl₂. The pH range (maximum and minimum values of entire plot) and statistical variability, (the distribution of values within the range) were observed. The plowed sites had the narrowest range and least variability (maximum disturbance) and the woodlot sites had the widest range and highest variability (minimum disturbance). The spatial variability (i.e. over what distance do changes in pH occur) was determined by sampling 25,50,100,200, and 400 cm away from selected points. The soil pH at the woodlot sites changed more over a shorter distance as compared to the other sites at the Harvard Forest.

BOARD C THE EFFECTS OF NUTRIENT ADDITIONS ON PHENOL LEVELS IN PLANTS OF A SUCCESSIONARY FIELD. TAMI R. McCLELLAND, DENISE E. MCKINNEY, DR. COLLEEN A. FRIED; DEPARTMENT OF CHEMISTRY, HIRAM COLLEGE; P.O. Box 67, HIRAM OH 44234.

Phenolic secondary metabolites play a significant role in dictating interactions between a plant and the biotic and abiotic factors in its environment. The purpose of this study is to determine the effects of soil nutrients and succession on the levels of these compounds within a plant. Samples of *Raphanus raphanistrum*, *Ambrosia artemisiifolia*, and *Tritolium pratense* were gathered from plots of an old corn field undergoing succession. Plots had received one of three treatments, no fertilizer, addition of a nitrate fertilizer, or addition of a nitrogen phosphate fertilizer. Phenol levels in fresh and dried samples of plants from these plots were analyzed using the Price and Butler method. Early analysis indicates that in fresh plants phenol levels are higher in control plot samples, while in dried samples, phenol levels are higher in treated plots.

BOARD T VARIABILITY IN CROSS PROTECTION EXISTS AMONG CAULIFLOWER MOSAIC VIRAL ISOLATES IN TURNIPS. JENNIFER J. BOBISH AND SCOTT M. LEISNER, THE UNIVERSITY OF TOLEDO BIOLOGY DEPT., 2801 WEST BANCROFT ST., TOLEDO OH 43606.

Cross protection, the protection of a plant from a virus by prior inoculation of that plant with another strain of the same virus, was studied with cauliflower mosaic virus (CaMV). Inoculation with CaMV isolate CM4-184 protected turnips against the D4 isolate, i.e., no D4 symptoms were observed on the protected plants. However prior inoculation of plants with D4 did not always protect turnips from CM4-184. To examine the fate of the challenge virus in greater detail, plant skeleton hybridization analyses were done to specifically detect the presence of D4 virus DNA in CM4-184-protected plants. D4 gene II could be used as a probe to specifically detect the D4 virus in doubly-infected plants since this region is missing from the CM4-184 genome. Plant skeleton hybridization analyses showed that the D4 virus propagated in the inoculated leaves of protected plants but its ability to produce a systemic

infection was impaired. The D4 virus was able to spread systemically but to a very limited extent. Prior inoculation with CM4-184 also protected turnip plants from CaMV isolates that were highly divergent from CM4-184 at the nucleotide sequence level and the mechanism of protection appeared to be the same as with the D4 virus. However, cross protection was specific to CaMV because prior inoculation of plants with CM4-184 did not protect plants against turnip mosaic potyvirus.

**POSTER SESSION
1:00 - 2:30 PM
SATURDAY, APRIL 5, 1997
OLSCAMP HALL**

BOARD A THE RELATIONSHIP BETWEEN SPEECH DISORDERS AND LEARNING STYLES. MARY M. POOL, 6845 MARIETTA ROAD SE, LANCASTER OH 43130.

Educators have continuously made efforts to improve their delivery of information to their students but due to the diversity of students they serve, not all methods are equally efficient. Special students often offer special challenges. In a study of 40 students, 20 of which were undergoing speech therapy, it was found that 70% of the experimental group were tactual learners, while only 10% were tactual learners in the control group. No effort was made to control or examine the socioeconomic factors within the experimental or control groups.

BOARD B ONCOGENE ACTIVATION IN UV-DAMAGE ASSOCIATED SKIN CANCER. STEVEN E. TUTTLE JR., 419 HINSDALE CT., WORTHINGTON OH 43085.

Oncogene activation was studied in Ultraviolet (UV) Radiation induced skin cancers. This study was undertaken because previous experiments had shown quantifiable DNA damage induced by Ultraviolet radiation. UV induced mutation in DNA can lead to oncogene activation. The purpose of this experiment was to determine whether UV related skin cancers are associated with oncogene activation. Activation of oncogenes *bcl-2* and *p53* were studied in three UV related skin cancers, basal cell carcinoma, squamous cell carcinoma, and malignant melanoma. Each case was studied using an immunohistochemical technique to identify oncogene activation in human skin cancers. Eleven cases of basal cell carcinoma, eight cases of squamous cell carcinoma, and six cases of melanoma were studied. *p53* oncogene activation was found in 100% of basal cell carcinomas, 75% of squamous cell carcinomas, and 16% of melanomas studied, while *bcl-2* oncogene activation was present in 91% of basal cell carcinomas, 25% of squamous cell carcinomas, and 100% of melanomas studied. This study suggests ultraviolet radiation induced DNA damage may be associated with oncogene activation in a large percentage of human skin cancers.

BOARD C AMPLIFICATION OF THE CYCLIN D1 GENE IN SQUAMOUS CELL CARCINOMA OF THE HEAD AND NECK. DANIEL G. STOVER, 2140 LANE RD. COLUMBUS OH 43220.

Cyclin D1, an oncogene, is a gene that is directly related to carcinogenic growth of cells. It is also essential to cell growth and must be present for any cell to enter the second phase of cell growth or reproduction. Gene expression of cyclin D1 has been hypothesized to modify the effectiveness of taxol, an experimental anti-carcinogenic drug. The purpose of this research was to determine if abnormal amplifications and increased gene expression of cyclin D1 affect the outcome of patients' responses to taxol. Using the Southern Blot method and a radioactive probe, the target DNA was isolated, thus showing the concentrations of the cyclin D1 gene. Samples 1 and 2 were treated with taxol, neither had amplification of the cyclin D1 gene. Sample 1 had a stable disease response while sample 2 had a progressive disease response. The final sample was treated with taxol, had a partial positive response, and showed amplification of cyclin D1. Based on the results, it appears that a partial positive response to taxol and gene expression of the cyclin D1 gene are directly linked. This suggested that taxol may have directly caused increased cyclin D1 gene expression. Prior amplifications of cyclin D1 cause increase gene expression. A super increase of gene expression (from taxol), causes a termination of growth, and later the cell dies. Without prior amplification, an increased gene expression would cause out of control cell growth or cancer.

BOARD D BACTERIAL RESISTANCE TO ANTIBIOTICS. LUKE T. SKIDMORE, 400 LAKE AVE, WEST MANSFIELD OH 43358.

Bacteria can develop resistance to antibiotics when they are grown in presence of antibiotics at low levels, this may occur *in vitro*, *in vivo*, or other

environments. In some cases dependence, a condition in which the bacteria cannot be grown without the presence of the antibiotic, may develop. Cross-resistance is a condition in which the bacteria are resistant to a specific antibiotic and also exhibit resistance to one or more others. *E. Coli* ATCC-2507 was placed in an environment of increasing levels of antibiotics, to produce resistant bacteria. The resistant bacteria were then tested for cross-resistance and dependence. Cross-resistance to kanamycin was observed in the streptomycin resistant strain. No dependence was recorded, which indicates that the mechanism of resistance that was developed was not a dependence phenotype. Mechanisms of resistance are currently being determined for other resistant strains. A random multi-antibiotic treatment regime was also used to study the development of antibiotic resistance in *E. Coli*. A multi-antibiotic treatment delayed or prevented the development of resistance when compared to a single antibiotic treatment regime.

BOARD E THE ISOLATION OF DNA AND SEX DETERMINATION. JOSHUA N. ROARK. 7212 Co. Rd. 47, WEST LIBERTY OH 43357.

The discovery that DNA can be recovered from ancient bone has brought up new possibilities for the study of past populations, infectious diseases, sex determination, introduction of agriculture, and animal domestication. Research on DNA from bone has dealt with both mitochondrial DNA (mtDNA) and chromosomal DNA (cDNA). Amplifying mtDNA from bone is well characterized and the high number of mtDNA in animal cells favors its survival in decayed tissues. The isolation of ancient cDNA can provide an important molecular method of sex determination from skeletal remains. The research involved isolation of chromosomal DNA from bone. The DNA isolated was run on ethidium bromide stained gels. This process may lead to Y-chromosomal-specific amplifications, through which sex determination can be made. However, the absence of the product may lead to detection of female. Though the absence of the product will not always prove beyond doubt that the individual is female. Although technical difficulties and degradation of DNA in ancient bone may limit future studies to the last few ten thousand years, this time span leaves many open doors to much more interesting research.

BOARD F THE STUDY OF THE REGENERATION OF LUMBRICULUS VARIEGATUS. ALYSON D. BRADLEY 3421 TWP. RD. 165 WEST LIBERTY OH 43357.

There has been an increasing interest in using the aquatic Oligochaeta, *Lumbriculus variegatus* for the study of regeneration. *Lumbriculus variegatus* is a fresh water, segmented worm found throughout the world. *Lumbriculus variegatus* regenerate both anteriorly and posteriorly with segmentation occurring both in the wild and in lab conditions. Most of their respiration occurs on the ventral anterior side of the body, because of thinness of body wall. Their negative retactile responses is both forward as well as reverse with a coil swim through water. *Lumbriculus variegatus* was kept in four centimeters of a mixture of aged tap and distilled water. Worms were cut with a single edged razor blade between segments. Each of the pieces were kept in 1.5 mL microcentrifuge tubes, and observed for regeneration every two to four days. Segments were counted and body length was recorded. Through this study it was found that *Lumbriculus variegatus* regenerate very well. The anterior end regenerates an eight segment head, and tail segments regenerate over 100 to 150 segments. This work has demonstrated that *Lumbriculus variegatus* may serve as an excellent model for the study of regeneration. It has laid the ground work for using *Lumbriculus variegatus* to study the molecular mechanisms associated with regeneration.

BOARD G WILL TAILS RETAIN HEAD'S KNOWLEDGE? KIM M. SATTISON, 22908 COUNTY ROAD M, WEST UNITY OH 43570.

This project's purpose was to determine if memory could be retained in regenerated animal parts. This experiment used the regenerated tail and head. The hypothesis of this project was that the regenerated planaria would learn faster than the original or parent planaria. With use of a Y-maze, the planaria were separated into two groups, left bias and right bias, based upon their turning preference. Each of the planaria were trained to go the opposite way of their bias. Training was complete when the planaria went the correct direction 80% of the time in twenty trials. The planaria were then cut in half posterior to the feeding tube. Once heads and tails were regenerated they were trained to go in the direction of the parent. The same training procedures were used with the first and second generation. The hypothesis was proven correct. The original planaria being trained to go right took 47 trials, and the average training trials for those going left was 60 trials. The average training time for the regenerated tails going to the right was 27 trials, and the heads was 20 trials. The average for the heads turning left was 20 trials and the tails took 27 trials. An ANOVA was conducted comparing the three training groups. There was a statistically significant decrease in the number of training trials from the first to the second generation ($p < .0017$). This high level of significance would indicate that regenerated animal parts can retain memory.

BOARD H DNA LIGATION AND COLONY TRANSFORMATION. JASON F. KUENLE, 1884 S. SPRINGCREST Ct., BEAVERCREEK OH 45432.

The purpose of the project was to genetically engineer *E. coli* bacteria so that it received resistance against ampicillin, kanamycin, and tetracycline. My hypothesis was that the *E. coli* would pick up the antibiotic resistance. Nutrient broth agar plates were used to grow *E. coli* bacteria. Fragments of pBR322 and pKan that contained antibiotic resistance were isolated, a ligation reaction was performed with these fragments. The *E. coli* was then transferred to vials containing calcium chloride. The vials were incubated in ice for 15 minutes, then in a 42 degree Centigrade "heat shock", next returned to the ice, and finally at 37 degrees Centigrade for 6 hours. The bacteria then grew and were analyzed. Five colonies of the transformed *E. coli* grew. The plasmids in the *E. coli* were then removed. The fragments of pBR322/pKAN and pBluescript that contained the antibiotic resistance were isolated, a ligation reaction was performed with these fragments. The *E. coli* was then transferred to vials containing calcium chloride. The vials were incubated in ice for 15 minutes, then in a 42 degree Centigrade "heat shock", next they were returned to the ice, and were finally incubated at 37 degrees Centigrade for 6 hours. The bacteria then grew and were analyzed. After the analysis it was shown that the *E. coli* had originally picked up the antibiotic resistance but that after the second transformation the resistance was lost. The conclusion of this project is that *E. coli* bacteria can be genetically engineered so that it contains ampicillin, kanamycin, and tetracycline resistance.

BOARD I A BETTER BREED OF FEED. ALISSA D. SWICK. 228 N. BOSTON St., GALION OH 44833-1701.

Rabbits have been raised for meat for hundreds of years. Rabbit producers search for a feed with ingredients that yield the best "rate of gain." Rate of gain is a ratio of the weight gained to the number of days to maturity. The best feed would include nutrients that are a source of energy and are bone- and muscle-building. This research involves comparing the rate of gain of three litters of rabbits raised on three formulas of Purina rabbit feed. To compare the nutritional value of the three feeds, the sources of nutrients necessary to rabbit growth in each of the feed formulas were analyzed. Three does were bred during similar seasons so weather conditions would not be as great a factor in the rate of gain. The ideal temperature, known as a "comfort zone," for rabbits is 60 to 65 degrees Fahrenheit. At higher or lower temperatures rabbits expend energy to maintain body temperature. The lower the temperature, the poorer the feed conversion. Weather conditions under which the three litters were raised were compared. Weights of the case study rabbits were measured and recorded weekly for fifteen weeks. The weekly and long-term rates of gain were calculated and graphed. The weekly average high and low temperatures for these weeks were recorded. Genetic characteristics that affect the growth of the case study rabbits were determined by studying the dams and sires. Taking into consideration the environmental and genetic differences among the three litters, Purina Show Formula produced rabbits with the greatest rate of gain.

BOARD J INTERPRETATION OF EMOTIONS FROM FACIAL EXPRESSIONS IN CHILDREN WITH AND WITHOUT LEARNING DISABILITIES. MARIBETH M. ELLIS 800 ALLISON ROAD, BELLEFONTAINE OH 43311.

The accuracy and time required for children with and without learning disabilities to interpret emotions when restricted to information from facial expressions, and the accuracy of those interpretations, were investigated. Forty 11-12 year old students participated. Accuracy and response time on the New Faces computer program developed by Dr. Marlin Languis were recorded for the emotion of disgust. The ANOVA statistics revealed boys with learning disabilities scored significantly higher on total false positives and spent more time identifying specific emotions than the boys without learning disabilities. Gender differences on interpretive abilities revealed boys responded with significantly more total false positives than the girls in the study. Brain topography was performed on four students. The computerized electroencephalograph and evoked potential mapping showed the students without learning disabilities were more focused, centralized, and consistent than the students with learning disabilities. Also, the control group demonstrated stronger evoked potential in the occipital, central, and parietal areas of the brain. This pattern is consistent with the hypothesis that learning disabled students are less accurate interpreters of facial expressions.

BOARD K THE SPONTANEOUS FORMATION OF AMPHIPHILIC BILAYERS SIMILAR TO THOSE OF CELL MEMBRANES. LINDA S. BOS, 6806 WINDSOR RD., HUDSON OH 44236.

It is estimated that life first appeared on this planet at least one billion years ago. These first cells must have had some sort of boundary to isolate the organism from its environment. The hypothesis of this project is that the formation of such membranes could and does appear spontaneously, thus showing that early cell membranes could have evolved with no outside influence. This will be shown with the use of detergent to form the membrane

as it is a similar molecule to that in cell membranes. The experiments centered around four main points. First, oil and water were shown not to mix. Secondly, two drops of water were shown to combine when placed in contact with each other. The same property was shown to occur in oil. Third, neither water nor food coloring has the ability to form membranes. Lastly, detergent and dye were shown not to mix. As a result of the experiments, pictures were taken that show the spontaneous formation of a bilayer. One picture shows the formation of a single layered membrane by portraying oil bubbles that are touching each other but have not joined. This shows that membranes do indeed form as the bubbles have not joined. In a second picture it is possible to see bubbles that are green both on the inside and the outside. This shows that formation of a double layer, or bilayer, as the detergent is only capable of forming bilayers with water on both sides. These experiments suggest that detergents can form membrane-like boundaries with chemical and physical properties similar to actual cell membrane.

BOARD L THE EFFECTS OF SODIUM SALTS ON THE YIELD AND GERMINATION OF THE LEGUME GLYCINE MAX. KURT FREY, #1 PICARDE COURT, BOWLING GREEN OH 43402.

The addition of salts to fertile land in many agrarian areas of the world has caused soybean development and yield to falter. The growth of soybeans is inhibited directly by their inability to take in sufficient amounts of water because of the environmental conditions of saline environments. The physiological drought brought about by these salts lessens the bean plants' ability to produce enough glucose to sustain itself. Is there a point at which the quantity of salt completely eliminates the bean's ability to develop? To determine if such a point exists, bean plants must be introduced to a varying salt concentrates in the environment. A control group of beans will be grown in a non saline environment. These conditions have determined at what concentration soybeans are unable to grow in saline environments. Results suggest that a salt content of two grams or more, distributed throughout the root environment, is sufficient to impede the bean's growth completely under ideal conditions.

BOARD M MODELING FUTURE POPULATION GROWTH AND TRENDS. ERIC M. WU, 5778 LONDONAIRY BLVD, HUDSON OH 44235.

Population growth has quickly become a global issue with the development of problems dealing with food shortage, housing, and carrying capacity among others. It took humanity perhaps 1,000,000 years to reach 1 billion people, 120 years to reach 2 billion, 30 years to reach 3 billion, 15 years to reach 4 billion, 12 years to reach 5 billion, and only 11 years to reach 6 billion. This staggering rate of growth brings about the need for predicting future population rates and totals to solve problems. A computer population model for this purpose was created using GLOBESIGHT (Global Foresight), which is a tool that helps the user reason about the future on various global issues. The model, which consists of mathematical equations, was written in FORTRAN language on a Sunworkstation. The model itself is split into three levels. The first submodel gives a rough estimate of population figures by inputting one variable, the population growth rate. The second submodel calculates the population growth rate using the two input variables of birth and death rates. Finally, the third level can calculate birth cohorts, death cohorts, population cohorts, population growth rate, and the total population using information about mortality and fertility. Using the newly created population model, the effects of changing variables on population growth rate in different regions, countries, and continents was studied. Two case studies were conducted involving the most populous country and a comparison of developing and developed regions. Perhaps the most intriguing result was the fact that India is poised to surpass China in total population. Also, barring any change in the trend of population growth rate, the developing regions will comprise an estimated 7/9 of the world's total population by 2035.

**POSTER SESSION
2:45 - 3:45 PM
SATURDAY, APRIL 5, 1997
OLSCAMP HALL**

BOARD A ALGAL EPIPHYTE DISTRIBUTION ON AQUATIC MOSSES FROM MICHIGAN AND ALASKA. GINA D. LALIBERTE, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43402 AND THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION, PELLSTON MI 49769.

The importance of aquatic mosses in aquatic ecosystems is being increasingly recognized. Aquatic mosses provide refuges for macroinvertebrates

and can increase productivity by increasing the surface area available for colonization by algal epiphytes. The locations of algal epiphytes on the leaves of aquatic mosses from northern Michigan and the Kuparuk River of Alaska were surveyed with light and scanning electron microscopy. Initial growth of epiphytes tended to occur at the tips and edges of leaves and along the costa. Distribution patterns of epiphytes tended to vary with moss species. On leaves of *Dichelyma capillaceum*, *Hygroamblystegium tenax*, and *Schistidium agassizii*, epiphytes were abundant on the adaxial surface of the leaves, while *Leptodictyum riparium* had increased numbers of epiphytes in the leaf axils. These growth patterns were similar for both the Michigan and Alaska mosses, and may indicate responses of the epiphyte community to boundary layer effects and subsequent nutrient availability from the water column, or grazing pressures.

BOARD B COMPARATIVE STUDIES OF THE GENOTOXIC PROPERTIES OF THE DNA DAMAGING AGENTS ULTRAVIOLET LIGHT, MITOMYCIN C, AND CISPLATIN IN ESCHERICHIA COLI. DENNIS J. GOLIS, JOY M. KNIGHT, TRISH E. FAIR AND DORIS J. BECK. BOWLING GREEN STATE UNIVERSITY, DEPT. OF BIOLOGICAL SCIENCES, BOWLING GREEN OH 43403.

The genotoxic properties of ultraviolet light, mitomycin C and cisplatin were determined as their ability to induce SOS repair in *E. coli* and their lethality upon exposure of these cells to UV or during a 1.5 h growth period by inclusion of chemicals in LB. Strains, PQ35 and PQ37, a *uvrA* mutant deficient in nucleotide excision repair (NER), were constructed by Quillardet and Hofnung [Mutation Research (1985) 147: 65-78]. Cells have a plasmid containing the β -galactosidase gene fused to the *sulA* promoter and thus synthesize β -galactosidase when their DNA is damaged. The SOS chromotest was carried out as described by these authors and measures DNA damage as the ratio of units β -galactosidase to units phosphatase, an enzyme which is produced constitutively in these strains. Proficiency in NER seemed to be required for resistance of bacteria to all three agents. The dosage of cisplatin which decreased survival (colony forming ability) to 37% in mutant cells was 18 μ g/ml whereas survival of wild type to equal amounts was 70%. The dosage of ultraviolet light which decreased survival to 37% was 11 seconds in the mutant cells and 24 seconds in wild type cells respectively. Cisplatin caused greater SOS induction in wild type than in the mutant cells at equal doses as did mitomycin C. Conversely, irradiation with ultraviolet light produced a greater induction in mutant than in wild type cells. This different induction may be due to a higher production of inter strand cross links by mitomycin C and cisplatin than for UV.

BOARD C CHARACTERIZATION OF A PURIFIED PREPARATION OF MITOCHONDRIAL TRANSHYDROGENASE FROM ADULT HYMENOLEPIS DIMINUTA (CESTODA). CHI FU AND CARMEN F. FIORAVANTI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The mitochondrial, inner membrane-associated NADPH \rightarrow NAD $^{+}$ transhydrogenase of adult *Hymenolepis diminuta* is crucial to this cestode in coupling the generation of NADPH, by the "malic" enzyme, with the NADH-dependent, anaerobic electron transport mechanism. We have purified the *H. diminuta* transhydrogenase to homogeneity and found that it has a monomeric molecular mass of 110 kDa as made evident by sodium dodecyl sulfate-polyacrylamide gel electrophoresis. The purified transhydrogenase requires phospholipid for maximal activity and is inhibited by 5' adenylylates. Moreover, the purified system is inhibited by dicyclohexylcarbodiimide, a known inhibitor of proton translocating systems. Antibodies, generated against the purified enzyme, were found to not only recognize the enzyme in both its membrane-associated and isolated forms but they inhibited, in a monospecific way, the activity of the transhydrogenase. We recently synthesized photoaffinity analogues of NADP $^{+}$ and NAD $^{+}$ and found that these analogues act to significantly inhibit transhydrogenase activity following photoirradiation. These data, were consistent with the supposition that the analogues interacted with the pyridine nucleotide binding sites of the enzyme and did so by covalent linkage. In addition, our preliminary results indicated that the native form of the transhydrogenase is multimeric as evidenced by chemical crosslinking and subsequent electrophoretic analyses. Supported by NIH Grant AI15597.

BOARD D INFLUENCE OF ANALOG AND DIGITAL CONSPECIFIC PLAYBACK ON VOCAL RESPONSE PATTERNS OF MALE RED-WING BLACKBIRDS (AGELAIUS PHOENICEUS). DAMIAN BEBELL^A, MICHAEL SKELLY^A, STACIE MUKINA^A, CHRISTINA KOONTZ^A, CAROL SKINNER^B, GRANT McLAREN^A. ^ADEPARTMENT OF PSYCHOLOGY AND THE ^BDEPARTMENT OF BIOLOGY AND HEALTH SERVICES, EDINBORO UNIVERSITY OF PENNSYLVANIA, EDINBORO PA 16444.

The repertoire responses of male red-wing blackbirds (*Agelaius phoeniceus*) to analog and digital conspecific playbacks were observed in this between-subjects design experiment. Free-living male red-wing blackbirds were observed within their varied habitats bordering Lake Erie in northwestern Pennsylvania and southwestern New York during May through July of 1996. In

each instance, female red-wing blackbirds were observed in the territory of the male subjects. Twelve male birds were randomly assigned to two groups. The six male subjects in Group I were exposed to a 10 min analog playback of a male conspecific song, while the additional six subjects in Group II were exposed to a 10 min digital conversion of the same analog signal. In this experiment, the vocal behavior of each subject was recorded during a 10 min baseline period to determine the pre-playback vocal pattern of each subject. Immediately following the pre-playback period, each subject was exposed to either a 10 min analog or 10 min digital playback stimulus. Following the 10 min stimulus playback period, the vocal behavior of each subject was once again recorded during a 10 min post-playback period. Therefore, the vocal behavior of each subject was recorded for thirty consecutive min during a pre-playback, playback, and post-playback period. Both the analog and digital male conspecific playback stimuli consisted of one song that was presented every 10 sec for 10 min for a total of 60 presentations during the 10 min playback period. The digital conversions of the original analog song were completed with Canary (The Cornell Bioacoustic Workstation 1.1, 1993) bioacoustic software and a Macintosh computer. The preliminary data analyses indicate that the subjects emitted a more varied repertoire of vocalizations during both the analog and digital playback periods when compared to the pre-playback period. These data will be used to further investigate the potential use of digital song conversions in understanding the significance of bird song interterritorial, social, and reproductive behavior of birds in the southern Lake Erie habitats.

BOARD E VOCALIZATION PATTERNS OF MALE RED-WINGED BLACKBIRDS (*AGELAIUS PHOENICEUS*) PRIOR TO AND FOLLOWING ARRIVAL OF FEMALE CONSPECIFICS. MICHAEL SKELLY^A, STACIE MUKINA^A, DAMIAN BEBELL^A, CHRISTINA KOONTZ^A, CAROL SKINNER^B, AND GRANT McLAREN^A. ^ADEPARTMENT OF PSYCHOLOGY AND ^BDEPARTMENT OF BIOLOGY AND HEALTH SERVICES, EDINBORO UNIVERSITY OF PENNSYLVANIA, EDINBORO PA 16444.

Diurnal vocal patterns of free living male red-winged blackbirds (*Agelaius phoeniceus*) were monitored within a 280 x 60 m wetland habitat bordering southern Lake Erie in northwestern Pennsylvania prior to (pre-female) and following the arrival of female conspecifics (post-female) within the observation habitat. Observers conducted two separate 24 hour observations initiated on April 5 (pre-female) and again on May 27 (post-female), 1996 within the same wetland habitat. No female conspecifics were observed within the habitat prior to or during the 24 hr April observation; however, females were observed in the habitat during the 24 hr May observation. Specifically, the number of male red-winged blackbirds present within the observation habitat was recorded each minute throughout each 24 hr observation period. Additionally, the occurrence of one song type (song/minute) was monitored continuously throughout the two 24 hr observation periods. The preliminary data analyses indicated that a dawn and evening vocal chorus occurred during the pre-female observation. However, data from the post-female observation did not include a dawn or evening vocal chorus, but rather a relatively consistent song pattern throughout the daylight hrs. Further analyses have indicated that the dawn and evening vocal chorus periods during the pre-female observation differed in vocal occurrence and duration. These data will be used to further investigate the potential significance of vocalization patterns in social and reproductive behavior of birds in the southern Lake Erie wetland habitats.

BOARD F COMPARATIVE CYTOLOGICAL ANALYSIS OF TUMORIGENIC AND NONTUMORIGENIC HUMAN ESOPHAGEAL CELL LINES BY IMAGE ANALYSIS AND FLOW CYTOMETRY. I. MARSHALL AND R. J. JAMASBI. BOWLING GREEN STATE UNIVERSITY, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN OH 43403.

Presently, there is no reliable method available for the diagnosis of esophageal cancer at an early stage. Therefore, the prognosis for the disease is poor. During this investigation, five human esophageal carcinoma cell lines, TE-1, TE-2, SNO, CE48T, CE81T and an immortalized, nontumorous human esophageal cell line (HET-1A) were analyzed using flow cytometry and image analysis to determine if these techniques produced similar results. It was our goal to determine whether either or both of these techniques could be employed in the prognosis and/or early diagnosis of esophageal cancer. The DNA index obtained by both techniques was compared for each of the cell lines. The results showed a good correlation between the two techniques. However, there were also some differences in the results obtained. This study demonstrated that image analysis and flow cytometry can be used in detecting abnormal DNA content of carcinoma cell lines.

BOARD G INHIBITION OF NEURITE OUTGROWTH FROM CULTURED ADRENAL CHROMAFFIN CELLS BY VINBLASTINE. R. BENJAMIN FREE, KRISTIN H. LONG AND KARL J. ROMSTEDT. BIOLOGY DEPARTMENT, CAPITAL UNIVERSITY, 2199 EAST MAIN STREET, COLUMBUS OH 43209-2394.

Adrenal chromaffin cells are post-ganglionic, sympathetic cells of the adrenal medulla which secrete epinephrine. An immortal line of rat chromaffin cells (PC-12) responds to nerve growth factor (NGF) in vitro by

producing axonal and dendritic growths. Since axons are rich in cytoskeletal microtubules, we have investigated the effect of an antimicrotubule drug, vinblastine sulfate, on neurite growth. Cells were incubated in the presence or absence of 50 ng/ml NGF for 2 days. Neurite growth of randomly selected cells was then quantified by phase contrast microscopy. In controls, neurite length/cell was found to be 58.79 ± 3.13 μ meter (average \pm SEM). NGF treatment resulted in significantly increased neurite lengths averaging 146 ± 8.14 (t-test, $p < 0.001$). Vinblastine showed half maximal inhibition (IC_{50}) of NGF-stimulated neurite growth at 4.44×10^{-10} M with 95% confidence limits ranging from 9.07×10^{-11} to 2.18×10^{-9} M. These data suggests that NGF-induced neurite growth does require functional microtubules.

BOARD H ANTHROPOGENIC POINT SOURCES OF MERCURY IN OHIO. MARCI L. COLE AND JOHAN F. GOTTGENS. DEPARTMENT OF BIOLOGY, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

Mercury is a toxic, bioaccumulative metal that can cause neuro-damage. Due to its volatility and long atmospheric residence time, local mercury emissions may have global impacts. Mercury is naturally released in trace quantities by volcanic and geologic activities. Anthropogenic sources of mercury are estimated to account for 40% to 60% of the current atmospheric mercury burden. The goal of this study was to quantify the major anthropogenic point sources of mercury in Ohio. Estimates were calculated using facility capacities, total yearly production, total yearly consumption, stack test data, and USEPA emission factors. Total mercury emissions from Ohio anthropogenic point sources were estimated to be 12,684 kg/yr. Coal and oil combustion (i.e. residences, industries and electric utilities) accounted for 84%. Incineration (i.e. sewage, medical, and hazardous waste) accounted for 4%. Manufacturing sources (i.e. lime, lamp, chlor-alkali production) and transportation fuel combustion released 8% and 4%, respectively. Ohio municipal waste incinerators, shut down as a result of regulation, once released an estimated 3,246 kg/yr of mercury. Quantifying sources of mercury pollution is necessary for developing effective control measures.

BOARD I EPIDEMIOLOGICAL SURVEY OF *PSEUDOMONAS AERUGINOSA* IN TWO NORTHWEST OHIO HOSPITALS. KATHERINE E. MORRISON AND ROUDABEH J. JAMASBI. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The present study was undertaken to examine the prevalence of serotypes O:3, O:6, and O:11 of *P.aeruginosa* in two northwest Ohio institutions (St. Rita's Medical Center and the Toledo Hospital). Monoclonal antibodies 7-2C, 11E, and 11H were produced against these serotypes and one-hundred and thirty clinical samples of *P.aeruginosa* from the two hospitals were examined using serological testing and enzyme-linked immunosorbent assay (ELISA) as the foundation of the study. Positive strains were further analyzed biochemically and morphologically. In addition, the degree of antigenic expression and susceptibility of these isolates to different antibiotics were implemented to further differentiate among the strains. Using ELISA screens, 10.7%, 21.5% and 9.3% of the isolates were typed as serotypes O:6, O:11, and O:3, respectively. Among these serotypes, none were found to possess the ability to cleave ONPG and approximately 24% were resistant to ciprofloxacin, aztreonam, or piperacillin. Morphological differences among the strains, at ultrastructural level, were not consistently observed.

BOARD J COLIFORM BACTERIA IN TEA LEAVES. SUSAN J. BERG, STUART HALL #619, P.O. Box 8804, DAYTON OH 45401-8804.

During the summer of 1995, a microbiological survey of iced tea in restaurants in the Cincinnati area conducted by the Cincinnati Health Department lead to a health advisory on preparation and handling of bulk tea leaves. In the present study, 105 samples of commercial tea leaf products were obtained and analyzed for coliforms and fecal coliforms by growth and gas production in EC Medium at 37°C and 44.5°C. While coliform organisms were found in three samples (2.9%), fecal coliforms were not recovered from any of the samples. Certain coliform organisms are known to be associated with plant material, and their presence on tea leaves is not surprising. Moreover, these organisms are not indicators of potential fecal contamination and the associated health risk. The results of this study suggest that fecal coliforms have a prevalence of less than 1% in commercial tea leaves, and that the high prevalence of coliform bacteria found in iced tea in restaurants may be a reflection of hygiene practices in the restaurants rather than contaminated tea leaves.

BOARD K NITROGENASE REDUCTASE:ROLE OF Asp39 IN MgATP HYDROLYSIS. CHRISTINA M. WHITMAN, RYAN P. SCHREINER, LAKSHMI PULAKAT AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Nitrogenase is one of the most intriguing, complex metalloenzymes. It is composed of two separate proteins designated the Fe-protein and the MoFe-protein. In order for N₂ reduction to occur, the Fe-protein must transfer

electrons to the MoFe-protein. In addition, the Fe-protein associates with the precursor of MoFe-protein, to facilitate its activation by the FeMo-cofactor. We are investigating how the Fe-protein performs two of its known functions during nitrogen fixation and biosynthesis of nitrogenase, namely (1) acting as a catalyst for ATP hydrolysis during the N₂ reduction cycle, and (2) inserting the FeMo-cofactor in the MoFe-protein. The amino acid Asp39, is conserved among 40 different Fe-proteins isolated thus far. To understand the role of Asp39 in the function of the Fe-protein we have subjected this residue to site-directed mutational analysis. Initially we have converted Asp39 into 39Asn, 39Glu, 39Ala and 39Thr and then by using reverse genetic approach we have analyzed the phenotype of the *Azotobacter* strains that synthesize these mutated proteins. A role for Asp39 in the Fe-protein mediated MgATP hydrolysis is characterized by taking biochemical and spectroscopic approaches. The results of these experiments and their implications in defining how the structural organization of the Fe-protein enables it to coordinate independent functions such as participating in FeMo-cofactor biosynthesis and insertion and inducing a conformational change in response to MgATP binding will be discussed.

BOARD L CLONING AND EXPRESSION OF HOX OPERON, ENCODING NAD-DEPENDENT BIDIRECTIONAL HYDROGENASE FROM PROCHLOROTHRIX HOLLANDICA. NATALIA MITIN AND GEORGE S. BULLERJAHN, CHEMISTRY DEPARTMENT, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The *hoxFUYH* containing genes which encode all four hydrogenase subunits was partially sequenced from *Prochlorothrix hollandica*. The sequence shows significant homology to the {Ni-Fe}-binding NAD-reducing bidirectional hydrogenase found in the cyanobacteria *Anabaena variabilis* and *Synechocystis*, and best described in eubacterium *Alcaligenes eutrophus*. The untranslated region between *hoxU* and *hoxY* genes has almost an identical DNA sequence motif as the promoter for the high-light induced *psbA1* gene from *P. hollandica* which suggests that hydrogenase production in *P. hollandica* might be light-dependent. This hypothesis is confirmed by Western blots, where there is a detectable difference in the levels of hydrogenase from dark- and light-grown cells. The antibody employed was raised against the hydrogenase enzyme from *A. eutrophus*. Furthermore we were able to monitor hydrogen evolution (1000 nmol hydrogen h⁻¹ mg protein⁻¹) from an aerobic light-grown *P. hollandica* cell culture.

BOARD M MOLECULAR ANALYSIS OF NIFM ALLELE IN KLEBSIELLA PNEUMONIAE. MARYA WOODRUFF, TIFFANY R. H. CHANDLER, EKEM T. EFUET, LAKSHMI PULAKAT AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The role of the *nifM* gene product in the maturation of the Fe-protein component of nitrogenase is obscure. The NifM-proteins from a number of nitrogen fixing organisms show relatively weak homology with the highest homology located in the C-terminal region suggesting that this portion of the protein may be responsible for its function. By using chemical mutagenic agents Brill and coworkers isolated number of *Klebsiella pneumoniae* that are defective in the NifM function. In light of our recent discovery that the NifM may be a peptidyl prolyl cis/trans isomerase we are studying its structure-function. We have obtained several of these *nifM* defective *Klebsiella pneumoniae* strains and investigating to identify the molecular basis for *nif*-phenotype in these strains. Our results reveal that some the conserved amino acid residues located at the C-terminal region of the NifM are essential for its peptidyl prolyl cis/trans isomerase activity.

BOARD N AN IN VIVO METHOD FOR CHROMOSOME COUNTING: ESTIMATION OF CHROMOSOME NUMBER IN AZOTOBACTER VINELANDII. LAKSHMI PULAKAT, SAEHONG LEE, EKEM T. EFUET AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Studies of the prokaryotic organisms in the genus *Azotobacter* and *Desulfovibrio* have produced results that indicate a very intriguing biology for prokaryotes. Based on physical estimations of the genome content per cell, reports suggest that these organisms have polyploid genomes - multiple copies of the same chromosome per cell. However genetic evidence argues against the existence of polyploidy in this bacterium. In our attempts to resolve this dilemma, we have developed a technique that we refer to as the "In vivo Method for Chromosome Counting". The salient feature of this technique is to introduce an identical genetic marker on the chromosome of the organism and also on an extra-chromosomal element (plasmid) of known copy number as an indicator. Therefore the ratio of the number of molecules carrying the genetic marker on the chromosome to the number of molecules carrying the genetic marker on the plasmid will be a reflection of the copy number of the chromosome in any DNA sample isolated from these cells. The use of this method in determining the copy number of the chromosome in *A. vinelandii* and its implications will be discussed.

BOARD O CAN ANGIOTENSIN II RECEPTOR SUBTYPE AT2 INDUCE APOPTOSIS IN XENOPUS OOCYTES? JEFFREY LEE, JASON DITTUS, NARA GAVINI AND LAKSHMI PULAKAT, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Angiotensin II (Ang II), plays an important role in the regulation of blood pressure and body fluid homeostasis. The Ang II receptor subtype AT1 is known to mediate most of the known functions of Ang II. In contrast the physiological role of the Ang II receptor subtype AT2 is unclear. It has been shown that the AT2 receptor inhibits cell proliferation and induces apoptosis in somatic cells such as R3T3 cells and PC12W cells. The granulosa cells and the theca cells of the ovary also express AT2 receptors and these receptors are implicated in the apoptosis of these cells. We are interested in analyzing whether AT2 receptor can induce apoptosis in germline cells such as oocytes. The *Xenopus* oocytes were microinjected with the mRNA encoding the AT2 receptor and exposed to Ang II for different time-periods. The expression of the receptors was monitored by binding experiments using [¹²⁵I Sar¹-Ile⁶] Angiotensin II. The onset of apoptosis was measured by isolating the DNA from these cells and analyzing for the presence of DNA fragmentation by agarose gel electrophoresis. Since Fas-ligand is known to induce apoptosis in rabbit oocytes, we also tested whether it could exert a similar effect in *Xenopus* oocytes.

BOARD P INDUCTION OF JAK/STAT PATHWAY IN XENOPUS OOCYTES BY ANGIOTENSIN II RECEPTOR SUBTYPE AT1. GREGORY M. KOSUNICK, SAMEERA AHMED, NARA GAVINI AND LAKSHMI PULAKAT, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The Angiotensin II receptor subtype AT1 is shown to induce the Jak/STAT pathway in rat aortic smooth muscle cells. These studies were carried out on the native AT1 receptors of the aortic smooth muscle cells. Since rat tissues have both AT1A and AT1B receptors, whether both these subtypes are capable of this function is unclear. Therefore, we are examining whether both the AT1 receptor subtypes are capable of stimulating Jak/STAT pathway by using *Xenopus* oocytes as an expression system. Initially uninjected *Xenopus* oocytes were analyzed for the presence of intracellular kinases Jak2 and Tyk2 and Jak substrates STAT1 and STAT2. *Xenopus* oocytes were microinjected with mRNA encoding either rat AT1A receptor or rat AT1B receptor and the expression of the receptors was monitored by binding experiments using [¹²⁵I Sar¹-Ile⁶] Angiotensin II. The tyrosine phosphorylation of intracellular kinases and their substrates in response to Ang II binding to the AT1A or AT1B receptor was monitored by immunoprecipitation with a monoclonal anti-phosphotyrosine antibody followed by Western Blot analysis using antibodies directed against Jak1, Jak2, Tyk2, STAT1, STAT2 and STAT3.

BOARD Q ACTIVATION OF ALTERNATIVE NITROGENASE SYSTEMS IN AZOTOBACTER VINELANDII. SHI LEI, LAKSHMI PULAKAT, AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Nitrogenase is an extremely complex enzyme, produced by about 20 *nif* genes. The enzyme consists of two main proteins: a dimer of a Fe-protein and a tetramer of MoFe-protein. The assembly process of a functional MoFe-protein and Fe-protein in a cell requires the participation of a large number of nitrogen fixation-specific gene products. To add to the complexity, the *A. vinelandii* cells are capable of reducing N₂ to NH₄ by using three genetically distinct nitrogenases. We have isolated a novel type of revertants that are capable of utilizing atmospheric nitrogen to support its growth in Mo-rich medium. Initially we have identified a number of colonies of *A. vinelandii* DJ54 growing on BN- plates after three days of incubation at 30°C. The frequency at which these colonies appear is approximately 1X10⁻³. The unusual thing about it is that the starting material is the strain *A. vinelandii* DJ54, which contained defined deletion in the *nifH* gene. We have investigated on the phenomenon of *nif* reversion in this strain by using a combined molecular, genetic and biochemical approach.

BOARD R INVESTIGATIONS ON THE DILEMMA OF NITROGEN FIXING CHARACTERISTICS OF AZOTOMONAS. SAEHONG LEE, LAKSHMI PULAKAT, BRYAN S. HAUSMAN, EKEM T. EFUET, SHI LEI AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The ability of *Azotomonas* to reduce atmospheric nitrogen has been an issue of controversy since this genus was included in the family Azotobacteraceae. Here we report the investigations on the nitrogen fixation characteristics of *Azotomonas fluorescens* strain ATCC13544 and show that it can grow in both liquid medium and on solid agar plates made with modified Burk nitrogen-free medium supplemented with ammonium acetate as a nitrogen source. In contrast, when ammonium acetate was omitted from this medium, the cells did not show any noticeable growth. Southern blotting analysis of the chromosome of *Azotomonas* strain ATCC13544 did not show any hybridization with a probe made of DNA sequences corresponding to the *nifH* gene of *Azotobacter vinelandii*. Based on these results, we conclude that

the *Azotomonas fluorescens* ATCC13544 does not contain the conventional genetic information on its chromosome that is needed to utilize atmospheric nitrogen as the sole source nitrogen to support its growth.

BOARD S INITIAL PURIFICATION AND CHARACTERIZATION OF ADULT *HYMENOLEPIS DIMINUTA* MITOCHONDRIAL NADH DEHYDROGENASE. XIANG JI AND CARMEN F. FIORAVANTI DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The adult cestode, *Hymenolepis diminuta*, resides in the small intestine of its mammalian host and displays a predominantly anaerobic energy metabolism. Indeed, in *H. diminuta*, as well as in other parasitic helminths, mitochondrial phosphorylation occurs anaerobically via an electron transport-coupled, Site I linked fumarate reductase. Accordingly, the mitochondrial NADH dehydrogenase complex of *H. diminuta* plays a crucial role in the physiologically anaerobic generation of ATP. Given these considerations, the isolation/characterization of the cestode's NADH dehydrogenase system is warranted. Employing isolated *H. diminuta* mitochondrial membranes as starting material, a solubilized form of NADH dehydrogenase was prepared. Solubilization was accomplished using the detergent dodecyl- β -D-maltoside on NaCl-washed mitochondrial membranes. The solubilized material retained NADH dehydrogenase activity and also displayed an NADH \rightarrow NAD⁺ transhydrogenation reaction. Thereafter, the solubilized material was subjected to DEAE-Sephacel chromatography. Assessment of the combined active fractions revealed a 12-fold purification of the dehydrogenase. In this preparation, NADH \rightarrow NAD⁺ transhydrogenation activity was apparent although the ratio of NADH dehydrogenase / NADH \rightarrow NAD⁺ transhydrogenation activity changed in favor of the dehydrogenase. As would be expected at this initial level of purification, a number of bands were noted by sodium dodecyl sulfate-polyacrylamide gel electrophoresis. However, our preliminary data suggest the occurrence of a major band with an M_r of 70 kDa. Supported by NIH Grant AI15597.

BOARD T ELECTROLYTE LEAKAGE FROM TEXAS MALE STERILE CYTOPLASM MAIZE LEAVES TREATED WITH TOXIN FROM *BIPOLARIS MAYDIS* RACE T INVOLVES HYPOXIA. M.O. GARRAWAY AND J.D. BELTRAN, DEPT. PLANT PATHOLOGY, OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

The rate (OD₆₁₀/h) of reduction of the oxidation-reduction dye 2,6-dichlorophenolindophenol (DCPIP) was comparable for mitochondrial suspensions from Texas male sterile (Tms) and Normal (N) cytoplasm maize. However, when 80ng/ml of *Bipolaris maydis* race T (BMT) toxin were added to the mitochondrial suspensions, the rate of dye reduction by Tms mitochondria was ~3x that by N mitochondria. Moreover, the rate of O₂ utilization by BMT toxin-treated Tms cytoplasm leaf segments was ~3x that by N cytoplasm leaf segments. This was correlated with a 3-fold increase in the electrolyte leakage rate from toxin-treated Tms leaf segments into, and a 3-fold increase in the O₂ depletion rate from the DW bathing solutions in which they were immersed. These responses of immersed Tms cytoplasm leaf segments to BMT toxin, were decreased by either exposing them to light or flushing the DW bathing solutions with air. Conversely they were increased by either incubating the leaf segments in the dark or flushing the bathing solutions with nitrogen. BMT toxin-induced increases in electrolyte leakage from Tms cytoplasm leaf segments immersed in DW bathing solutions might be causally linked to the toxin-induced increases in respiration and hypoxia.

POSTER SESSION 4:00 - 5:00 PM SATURDAY, APRIL 5, 1997 OLSCAMP HALL

BOARD A SEMANTIC PRIMING IN A SIMPLE TWO-LAYER NEURAL NETWORK. SEAN C. DUNCAN, ELKE M. KURZ, MARK G. RIVARDO, ROSEMARY STRASSER, AND RYAN D. TWENEY. DEPARTMENT OF PSYCHOLOGY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Kim and Myung (1995) simulated semantic priming effects with a simple, two-layer neural network. Their network incorporated a probabilistic firing function meant to represent the summation of presynaptic spikes which can lead to a post-synaptic action potential. They labeled this process "temporal summation." We replicated their results, then removed the probabilistic firing function from the network model. We still obtained the priming effects, suggesting that Kim & Myung's temporal summation mechanism was not necessary for the occurrence of the response time effects. Instead, as Kim and Myung recognized, the priming effects appear to be due to the repeated presentation of similar input patterns over time. We concluded that the addition

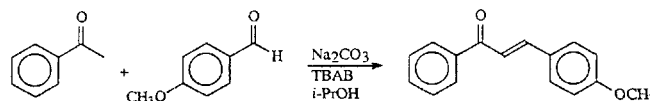
of a probabilistic aspect to the computation of the input activations does not adversely affect the emergent priming effect.

BOARD B CONTEXTUAL DISCRIMINATION LEARNING IN HIPPOCAMPAL LESIONED HOMING PIGEONS. ANTONY R. WHITE, ROSEMARY STRASSER, & VERNER P. BINGMAN. DEPARTMENT OF PSYCHOLOGY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The mammalian hippocampal formation (HF) has been shown to be involved in contextual learning (Balsalm, 1986; Hirsh, 1974). For example, rats with lesions to the HF are unable to distinguish two different environments and are thus unable to acquire a learning task dependent on contextual discrimination (Honey & Good, 1991). The purpose of this study was to determine if the avian HF, which has been shown to be functionally similar to the mammalian HF (Bingman et al. 1990), is involved in contextual discrimination learning. Eight pigeons (4 HF lesioned and 4 controls) were required to associate a uniquely colored bowl with a distinct environment. Pigeons were placed in an experimental room containing three different colored bowls. The room was surrounded either by black or white curtains. The rewarding bowl varied with the environmental context defined by the curtains. For instance, the red bowl contained food when the black curtains were present but not the white curtains. Only the red or green bowl consistently contained food for a given context and the third bowl never contained the food reward. Pigeons received 1 session a day of 5 randomized trials in each context. Criterion was reached when the bird's performance was at 80% accuracy for 3 consecutive sessions. Preliminary results reveal that lesions to the HF had no effect on pigeons' ability to learn this contextual discrimination task. These findings show that the avian HF is not imperative for this type of contextual discrimination learning. Further studies are planned to elucidate these results.

BOARD C VARIATIONS ON ALDOL CONDENSATION REACTIONS. JACK A. HUNTER, LUCAS L. CLARKE, DR. COLLEEN A. FRIED. HIRAM COLLEGE, DEPARTMENT OF CHEMISTRY, P.O. BOX 67, HIRAM OH 44234.

The aldol condensation reaction is used in the synthesis of a variety of compounds. However, the use of strong bases and ethanol as a solvent limits the functional groups which can be accommodated in the reaction. Milder conditions, including the use of weaker bases and a variety of solvents have been found. These conditions accommodate a wide variety of functional groups. The products are formed in comparable yield to a traditional aldol condensation. An example is shown below:



BOARD D UTILITY OF CAS DATABASES IN SATISFYING INFORMATION NEEDS IN THE BIOSCIENCES. HOBART G. BAKER, BIOCHEMISTRY DEPARTMENT, CHEMICAL ABSTRACTS SERVICE, COLUMBUS OH 43210.

Bionet and Sci news group archives were searched via the World-Wide Web to evaluate the chemical information needs of researchers and students in the life sciences and to assess the utility of the CAS (Chemical Abstracts Service) databases for retrieving this biochemical information. More than 350 newsgroup postings that requests information about biosubstances were collected and categorized. About half of the requests indicated a need for information or literature references about one or more aspects of generic information, such as broad classes of substances or supertaxonomic groups of organisms. The remainder indicated a need for information or references about very specific substances and circumstances. Information in greatest demand included the areas of structural and compositional biochemistry, general toxicology, environmental toxicology, immunochemistry (especially antibodies), plant biochemistry, microbial physiology, food chemistry, pharmacology, assay methodology, pollutant studies, pathobiology, carcinogenicity, agrochemistry, molecular biology, and numeric data such as LC50 values. Database searches with newsgroup-derived queries demonstrated the high utility of CAS databases in satisfying many of the information needs of life science investigators. Strategies for searching different types of life science information in the CAS databases are outlined and representative retrievals are displayed.

BOARD E EFFECTS OF LISTENERS' GENDER ON JUDGMENTS OF SPEECH INTELLIGIBILITY. LEE W. ELLIS AND DONALD J. FUCCI. THE UNIVERSITY OF TOLEDO, DEPARTMENT OF SPECIAL EDUCATION SERVICES, 2801 W. BANCROFT ST. TOLEDO OH 43606.

Effects of gender on listeners' judgments of intelligibility were investigated. Thirty subjects (15 women; 15 men) provided magnitude-estimation scaling responses and overall impressions of intelligibility of a male and female speaker's comparable versions of audio taped speech samples varying

systematically in terms of number of phonemes produced correctly. There was no significant difference between male and female subjects' magnitude estimation responses; however, their overall impressions of the intelligibility of the speakers tended to differ. Men indicated that the female speaker was more understandable, and women indicated that the male speaker was more understandable. Magnitude-estimation scaling may provide an objective means for evaluating a speaker's intelligibility. It appears to transcend gender biases associated with judgments of intelligibility.

BOARD F THE USE OF MULTIMEDIA IN THE DEVELOPMENT OF COMPUTER TUTORIALS FOR MICROBIOLOGY EDUCATION. ADAM A. LEFT, KENT STATE UNIVERSITY, TRUMBULL CAMPUS, 4314 MAHONING AVE. NW, WARREN OH 44483-1931.

The development of computer tutorials for education has been simplified in the past five years by the availability of commercial authoring systems and by faster and less expensive computer hardware. Authoring software allows persons with minimal programming knowledge to develop tutorials through the use of basic computer techniques common to other types of software (menu selections, toolbars, color palettes, etc.) and the easy incorporation of multimedia, such as digitized color graphics, sound, video, and animation. Hardware requirements include, a personal computer (100 MHz CPU, 12 MB RAM, 500 MB hard drive, graphics and sound card), color monitor, color scanner and/or digital camera. Advantages of developing tutorials and using them as a teaching aides include: self paced learning, interactive learning, incorporation of varied media types, and the ability to customize lessons to the particular needs of students. These aspects are demonstrated in a computer tutorial developed using *Multimedia Toolbook* (Asymetrix Corp., Bellevue WA) for teaching basic laboratory techniques in microbiology. The tutorial incorporates color images, sound and video to teach non-majors students the proper procedures for use of the microscope. Digitized photographs of microscope parts, actual photomicrographs of microorganisms, video clips of lens use and care, and an interactive quiz module have been incorporated. The tutorial takes students step by step through the use of the microscope, introduces them to fundamental properties of microscopy (i.e., magnification, resolution, depth of focus, etc.) and demonstrates the size and scale of microorganisms.

BOARD G *PODOPHYLLUM PELTATUM* - A MODEL PLANT FOR THE LABORATORY. JOHN L. FROLA AND DAVID J. STROUP, DEPARTMENT OF BIOLOGY, THE UNIVERSITY OF AKRON, AKRON OH 44325-3908.

A seasonal study of *Podophyllum peltatum* was completed. Observations of the shoot apices are described based on an analysis of the theories on shoot apical organization. Measurements and descriptions of apical dome height and width of the species were obtained to serve as a basis for classroom discussions concerning the changes in apical organization over a one-year period. Results of this study were used to prepare a multi-media presentation which allows students to make observations and generate hypotheses about shoot development. During classroom discussion, fundamental anatomical and morphological questions were generated to be used as the basis for student laboratory projects. This research was designed to improve identified thinking skills and our current understanding of shoot apical development.

BOARD H EFFECTS OF TLLAGE AND WEEDY VEGETATION ON SOIL MACROARTHROPOD ACTIVITY DENSITY IN SOYBEAN AGROECOSYSTEMS. DANIEL M. PAVUK, ANN L. RYPSTRA, AND SAMUEL D. MARSHALL. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 434030212,

Soil macroarthropod abundance is often observed to be greater in no-tillage than in conventional tillage agroecosystems. We conducted a study during 1994 to investigate the effects of no-tillage and weed control practices on the activity density of various soil macroarthropod taxa in soybean agroecosystems. Treatments were no-tillage with herbicides, no-tillage without herbicides, conventional tillage without herbicides, and conventional tillage with herbicides. The experimental design was a 2 x 2 factorial, randomized complete block; each treatment was replicated three times. Pitfall traps were used to sample arthropods from mid-June until early October. Ants were significantly affected positively by lack of tillage and herbicides; other arthropod taxa, such as carabid and staphylinid beetles, were not significantly impacted by the treatments. The data suggest that certain taxa may be more responsive than others to a lack of tillage and the presence of weedy vegetation in soybean agroecosystems.

BOARD I THE EFFECTS OF TIMING AND TYPE OF NUTRIENT ADDITION ON THE PLANT COMMUNITY COMPOSITION OF A 2ND-YEAR OLD-FIELD. LINDSEY A. PALMER AND MARY BENNINGER-TRUAX. BIOLOGY DEPARTMENT, HIRAM COLLEGE, HIRAM OH 44234.

This plant-community study is part of a 5-year examination of the effects of both the type and the timing of nutrient application on an old-field

ecosystem. In May of 1995, thirty 16 x 20 m plots were established in a former corn field. Six plots were treated with ammonium nitrate fertilizer (N), six plots received diammonium phosphate fertilizer (N/P), and six plots served as controls. In 1996, fertilizer was reapplied to half of the originally fertilized plots. All treated plots received 300 kg/ha nitrogen per year; N/P plots also received 768 kg/ha phosphorus per year. Above-ground plant material was harvested, dried, and weighed 3 times during the growing season from each of the 18 plots. (The remaining 12 plots will be used later in the study.) During the first growing season, fertilizer application affected species richness, species composition, and above-ground biomass. For instance, richness was significantly greater in control plots than nutrient-enriched plots, while biomass was significantly greater in N and N/P plots than controls due to the dominance of *Ambrosia artemisiifolia* and *Raphanus raphanistrum*, respectively. During the second year of the study, few differences were observed between controls and those plots which received fertilizer during the first year only. However, plots which received consecutive nutrient treatments showed increased biomass and decreased diversity relative to controls, and the composition of species was distinctly different among the three treatments. This research may lend insight into ecosystem responses to, and potential recovery from, various types of perturbations. We gratefully acknowledge support for this undergraduate research project from the Howard Hughes Medical Institute.

BOARD J A MIGRATION STUDY OF *STELIDOTA GEMINATA* (COLEOPTERA: NITIDULIDAE). ROGER N. WILLIAMS, M. SEAN ELLIS AND DAN S. FICKLE, DEPARTMENT OF ENTOMOLOGY, OARDC/OSU, 1680 MADISON AVE., WOOSTER OH 44691-4096.

The strawberry sap beetle, *Stelidota geminata* (Say), is a major pest of strawberries in the northeastern United States. They attack the fruit as it becomes ripe, chewing holes in the berries rendering them unmarketable. Further knowledge of the migratory habits of this insect pest can enhance the effectiveness of pest management strategies. This nitidulid was shown to migrate from its overwintering sites, local woodlots, to one of its primary reproductive sites, strawberry fields, in late May. A series of traps spaced approximately 25 m apart were placed in a line from the nearest woodlot to the center of a strawberry field. Whole wheat bread dough, a prime attractant for this species, served as the bait in all traps which were collected weekly. The beetle population peaked around the third week in July in the strawberry field and then gradually declined. This trend remains consistent having been tested from 1993 through 1996. Furthermore, *S. geminata* was concentrated in the transition areas surrounding the strawberry fields prior to the ripening of the fruit.

BOARD K MONITORING FLOWER THRIPS ACTIVITIES IN STRAWBERRY FIELDS AT TWO OHIO LOCATIONS. ROGER N. WILLIAMS AND M. SEAN ELLIS, DEPARTMENT OF ENTOMOLOGY, OARDC/OSU, 1680 MADISON AVE., WOOSTER OH 44691-4096.

A commercial strawberry field in each of two Ohio counties (Wayne in northeast Ohio and Warren in southwest Ohio) were monitored for the flower thrips, *Frankliniella tritici* (Fitch), in 1995 and 1996. This study was initiated after a major outbreak of flower thrips in 1994 which caused extensive damage (75% loss in some cases) to commercial strawberries in northeastern North America. It is generally accepted that the flower thrips overwinters in the South and is carried northward on frontal systems in early spring. Two trapping methods were employed in 1995, trays filled with water, glycerin, and a surfactant and yellow sticky traps (Pherocon® AM). The yellow sticky traps were deemed superior in the 1995 trial and were therefore the only traps used in 1996. Five or six (depending on the year) of each unbaited trap were placed in each field and collected weekly. Although high populations were encountered, the threshold limits were not breached in either of the years.

BOARD L FRACTAL MOVEMENTS IN FRACTAL LANDSCAPES: THE EFFECTS OF FRAGMENTATION ON ANIMAL MOVEMENT. SEAN J. CADARET, KIMBERLY A. WITH, AND CINDA DAVIS. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Habitat fragmentation disrupts dispersal among populations, enhancing isolation and extinction risk. The point at which landscapes become fragmented, and dispersal is disrupted, depends upon the abundance of habitat (p) and its spatial patterning (e.g., the fractal dimension, D). To test the effect of habitat fragmentation (habitat loss + pattern of loss) on animal movement, we studied movement pathways of crickets in fractal landscapes (5 x 5 m) consisting of sand and grass, across a gradient of habitat abundance (p=0, 20, 50 or 80% grass) and fragmentation severity (D=2.1 or 2.9; clumped and fragmented, respectively). Cricket body size significantly affected movement rate and net displacement, with larger crickets moving faster and farther per unit time than smaller ones. Habitat loss affected the rate and tortuosity of movements with crickets exhibiting faster and more linear movements as habitat abundance decreased. Habitat use was significantly greater than expected in 20% plots. Fragmentation effects were only significant for habitat

use in 20% plots; crickets spent more time in habitat cells within the fragmented landscape than in the clumped landscape. While landscape structure clearly affected animal movement, the response was essentially linear as a function of habitat loss. A critical threshold was not evident; critical thresholds thus may not be good predictors of fragmentation effects on dispersal.

BOARD M THE BEDROCK GEOLOGY OF THE MARION 30 X 60 MINUTE QUADRANGLE. DOUGLAS L. SHRAKE, O.D.N.R., DIVISION OF GEOLOGICAL SURVEY, 4383 FOUNTAIN SQUARE DR., COLUMBUS OH 43224.

The bedrock geologic map of the Marion 30 x 60-minute (scale 1:100,000) quadrangle (located in west-central Ohio) is the fourth in a series of maps to be released as part of the cooperative effort (STATEMAP Program) between the Ohio Department of Natural Resources, Division of Geological Survey and the U.S. Geological Survey. The purpose of this cooperative effort is to prepare a modern, bedrock-geologic map of Ohio. The Marion 30 x 60-minute bedrock geology map is the first Ohio map in the series produced by digital cartographic methods. The map and cross-section show the areal distribution of eight rock-stratigraphic units of Silurian and Devonian age; fault locations, the Findlay Arch, a portion of the Appalachian Basin; and possible tributaries to the ancient Teays River valley. The text discusses mapping methods, geologic setting, bedrock and economic geology, and potential geologic hazards. Open-file publications available for the Marion 30 x 60-minute quadrangle include: (1) thirty-two 1:24,000-scale bedrock-topography maps, (2) thirty-two 1:24,000-scale bedrock-geology maps, and (3) seven 1:250,000-scale and sixty-seven 1:24,000-scale computer-generated, structure-contour maps of the top of each mapped unit. The published 30 x 60-minute quadrangle, and its associated open-file products, will assist planners in properly developing and utilizing the mineral resources, ground water, and fossil fuels of west-central Ohio, and in minimizing the impact of geologic hazards.

BOARD N NEW MAP OF OHIO PHYSIOGRAPHIC REGIONS. C. SCOTT BROCKMAN, OHIO GEOLOGICAL SURVEY, 4383 FOUNTAIN SQUARE DR., COLUMBUS OH 43224.

As the result of a recent re-evaluation and remapping, Ohio has been divided into 30 physiographic regions which differ from each other in geologic and topographic characteristics. The regions introduced by Fenneman in the 1930's have been refined and subdivided. The Lake Plain has been subdivided into areas where bedrock has important geologic influence, for example, the Bellevue-Castalia Karst Plain and the Lake-plain Reefs, and into areas where Pleistocene features predominate such as the Findlay Embayment and the Paulding Clay Bottom. Similarly, the Till Plain is subdivided by the interplay of bedrock and glacial deposits into, for example, the Bellefontaine Upland, the Capital Lowland, and the Darby Plain. The Glaciated Allegheny Plateau has been divided into seven subregions including the Akron-Canton Interlobate Plateau, the Grand River Lowland, and, on the west, the Low Plateau. The unglaciated Allegheny Plateau has been subdivided into several regions on the basis of drainage character and/or topographic differences related to principal rock types. The concept of broad or "fuzzy" boundaries has been applied to transitional areas such as between the Mad River Interlobate Plain and the adjoining Southern Ohio Loamy Till Plain. The map will be useful for large-area modeling of geologic, geographic, agricultural, and ecological factors and serves as the conceptual basis for the 1996 Ecoregion Map of Ohio.

BOARD O A STUDY ON SEASONAL WATER-LEVEL VARIATIONS IN OHIO'S AQUIFERS. JOEL R. SMINCHAK AND E. SCOTT BAIR, DEPT. OF GEOLOGICAL SCIENCES, OHIO STATE UNIVERSITY, COLUMBUS OH 43210-1308.

Water-level records from a 13-year period were examined for 19 wells located throughout Ohio. Data from these wells were analyzed to determine the time of recharge initiation, duration of recharge, and amount of recharge in confined and unconfined aquifers within a given water year. The data show that the average week of recharge initiation was the third week of November in unconfined aquifers and the first week of November in confined aquifers. The duration of recharge lasted an average of 22.8 weeks in unconfined aquifers and an average of 26.8 weeks in confined aquifers. Seasonal water-level changes averaged 6.2 ft per year in unconfined aquifers and 4.5 ft per year in confined aquifers. Based on the information gained from the water-level variations, water-level recorders were installed in three closely spaced wells at a field site in Fairfield County. The site is in a region of recharge. The wells penetrate thin sand and gravel layers in a thick deposit of till and are screened at different elevations. The time delay interval between the initiation of recharge for the three wells was used in several analytical and numerical models to estimate the vertical hydraulic conductivity of the materials between the wells.

BOARD P CHARACTERISTICS OF CLASTIC CAVE SEDIMENT FROM GREAT SALTPETRE CAVE, ROCKCASTLE COUNTY KENTUCKY. DAVE MIXON, CHRIS MORTON, MICHAEL RAGSDALE, DANNETTE HELFIN, M. P.S. KREKELER, ANNETTE S. ENGEL. DEPT. OF GEOLOGY, U. OF CINCINNATI, CINCINNATI OH 452210013.

Great Saltpetre Cave, (GSPC), Kentucky has extensive exposures of a wide variety of clastic cave sediments. Samples from clay beds, sands, and gravels were taken. Grain size analysis, heavy mineral descriptions, and clay mineral analysis where conducted to assess the origin of the sediment. Clasts which occur in the sediment are dominated by sandstone and quartzite which are derived from the overlying Pennsylvanian cap rock. Sands are well sorted and consist chiefly of sub angular quartz with lesser amounts of heavy minerals. Heavy minerals include ilmenite, spinels, hematite, goethite, and lepidocrocite. Detrital clays in the <2 μ m size fraction are, in decreasing abundance: kaolinite, illite (R3 I/S), vermiculite, vermiculite/chlorite, lepidocrocite, and goethite. SEM micrographs show these minerals to have rounded and abraded edges and surfaces. These clay minerals comprise approximately 90% of the clay mineral fraction. Authigenic illite was identified on clasts and detrital clay mineral substrates and comprises less than 10% of the clay mineral fraction. The vast majority of clastic cave sediment originated from outside of the cave and not as result of condensation corrosion processes.

BOARD Q CHARACTERISTICS OF AN OUTCROP OF THE MARBLE HILL BED, NEAR BEDFORD, KENTUCKY. LEONARD A. PACE, CHRIS MORTON, EDWARD O. FREDERICK, CHAD MUSSEL, MICHAEL RAGSDALE, MARK P. S. KREKELER, DEPT. OF GEOLOGY, UNIVERSITY OF CINCINNATI, CINCINNATI OH 452210013.

The Marble Hill bed is an Upper Ordovician gastropod coquina, tidal bar / tidal channel complex which has long been recognized as an unusual lithology in southeast Indiana and north central Kentucky. A detailed description of a single outcrop of the Marble Hill bed, associated with the Rowland member and Bull Fork formation, we conducted to gain a better understanding of the depositional environment of this bed. Field descriptions reveal several lithologies exist within the Marble Hill bed. These lithologies consist of both fining upward and coarsening upward gastropod units (10-50cm thick), distinct storm beds units (5-10cm thick), bioturbated laminated units (~5cm thick) and cross bedded units (~5 cm thick) with some limited bioturbation. Dolomite and low Mg calcite cements fill gastropods, however, dolomite occasionally dominates some units whereas calcite dominates others. The wide range of lithologies within the Marble Hill bed indicate that there were different and distinct depositional environments in the tidal bar/tidal channel complex. This study interprets the coquinas as subtidal deposits and laminated and cross bedded units as intertidal beach deposits.

BOARD R SEDIMENTARY INDICATORS OF PAST BIOLOGICAL CONDITIONS. STEPHANIE M. KAPLAN AND JOHAN F. GOTTGENS, DEPARTMENT OF BIOLOGY, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

Paleolimnology routinely uses a number of physical, chemical, and biological indicators to infer historic shifts in lake trophic state. Confirming the usefulness of those stratigraphic indicators by matching a lake's sediment chronology with documented history strengthens paleolimnological work. The trophic state of Western Lake Erie has changed considerably since the turn of the century and the associated shifts in biological condition have been well documented. Two cores, taken at a depth of 9.5 m by SCUBA and dated by gamma counting (²¹⁰Pb, ¹³⁷Cs), were analyzed for changes in the assemblage of diatoms (centric vs. pennate), body size of cladoceran microfossils, total chlorophyll, and burrowing mayfly (*Hexagenia limbata*) tusk abundance. We predicted that changes in these indicators in a core profile accurately reflected the known history of this system. To test these predictions, we analyzed deposits from more than 100 years B.P. (pre-settlement), from 1950 (pre-cultural eutrophication), the 1960s, and recent deposits. Analysis of diatoms showed that during nutrient enrichment the ratio of centric to pennate frustules changed from 0.34 (pre-settlement) to 1.35 (late 1960s). The ratio decreased again to 0.34 with the recent shift to less eutrophy. This confirms past research that showed pennate diatoms were more prevalent under lower nutrient availability. Both the pre-settlement and the recent diatom community was dominated by *Fragilaria*, *Navicula*, and *Cyclotella* genera. During nutrient enrichment *Melosira* and *Tabellaria* spp. became abundant. The three other indicators are currently being analyzed. Corroboration of paleolimnological indicators with known historical conditions enforces their reliability for use in the management and restoration of other lake systems where baseline conditions and natural variability are not known.

BOARD S SPHEROIDS AND DISCUSES ARE PRECURSORS OF SOME THAILAND LAYERED TEKTITES. CLYDE S. BARNHART, 13637 ANGELL ROAD, ATHENS OH 457019617.

Thai layered tektites 10 to 30 g each are mostly angular in shape. Some, however, have a curved surface area distinct from the angular portion. The radii of these curved surfaces were measured by visually matching a best fit in a series of concentric circles. A right angle measurement to the first, always showed the parent body to be spheroidal not spherical. A few pieces are clearly from the rims of discuses. Radii of up to 10 cm were measured. This approximates the size of the largest known spheroidal splash-form tektite suggesting a common formation process. Areas of the curved surfaces are

from 1 to 6 sq cm. The angle of arc ranges from 12 to 25 deg. A few pieces having a second area of curvature at the opposite end can be fitted into an arc. The curved area is nearly always strongly fusion encrusted. Some of these surfaces have concentric curved layers beneath indicating that the discoids were shaped while softened, probably by tumbling, not by grinding. A striking feature of a few of these are stress cracks etched out by soil chemistry. These cracks follow lines of radii, are about 1 cm long and 4 or 5 deg apart. They indicate rapid chilling (producing cracks), followed by a re-heating of the crust healing the outer ends of these cracks. Heating of the layered bed and shaping of the spheroids and discuses are difficult to reconcile with sudden impact. Slower lunar volcanic processes are more strongly supported.

BOARD T SILURIAN (LLANDOVERY-WENLOCK) CONODONT CHRONOSTRATIGRAPHY AND CORRELATION OF CINCINNATI PLATFORM AND DISTAL APPALACHIAN BASIN STRATA, SOUTHERN OHIO. MARK A. KLEFFNER, DEPARTMENT OF GEOLOGICAL SCIENCES, THE OHIO STATE UNIVERSITY AT LIMA, 4240 CAMPUS DRIVE, LIMA OH 45804-3576.

The varied and complex facies relationships of southern Ohio Silurian strata and general absence or paucity of zonal fossils make it difficult to correlate the Cincinnati Platform strata of Greene and Preble Counties with the distal Appalachian Basin strata of Adams and Highland Counties. Restudy of conodont collections from those strata makes it possible to develop conodont chronostratigraphies for stratigraphic sections in those counties, thereby facilitating correlation of strata of the Cincinnati Platform with strata of the distal Appalachian Basin. The *Pterospodus amorphognathoides*, *Kockelella ranuliformis*, and lower *Ozarkodina sagitta rhenana* Chronozones are recognized in both platform (Dayton, Osgood, and Laurel Formations) and basin strata (Estill Shale, Bisher, and Lilley Formations). The Dayton and lower part of the Osgood in Greene County correlate with the middle and upper part of the Estill in Adams County. The middle part of the Osgood correlates with a disconformity separating the Estill and Bisher; the upper part of the Osgood correlates with the Bisher. The Laurel, including the Massie Shale Member, correlates with the lower, middle, and lower upper parts of the Lilley. Diagnostic conodonts are not represented in the Euphemia, Springfield, Cedarville, Lilley-Peebles transitional unit (LPTU), and Peebles, preventing a high-resolution correlation for those strata. The Euphemia likely correlates with the upper part of the Lilley and LPTU. The Springfield likely correlates with the lower part of the Peebles. The lower part of the Cedarville likely correlates with the middle and upper part of the Peebles.

BIOLOGICAL SCIENCES DIVISION

LAKE ERIE FISH BIOLOGY

9:00AM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 221

FRED L. SNYDER - PRESIDING

09:00AM ADDITION OF BURROWING MAYFLIES (EPHEMERIDAE: *HEXAGENIA* SPP.) TO THE DIETS OF THREE FORAGE FISHES IN WESTERN LAKE ERIE. KENNETH A. KRIEGER, LIBERTY A. TRISSELL, AND KEVIN G. BOGGS. WATER QUALITY LABORATORY, HEIDELBERG COLLEGE, 310 E. MARKET ST., TIFFIN OH 44883.

Burrowing mayflies (*Hexagenia* spp.) were extirpated from western Lake Erie by pollution in the 1950s. Since 1991, the mayflies have rapidly recolonized the western basin. We intended (1) to determine whether three forage fishes have begun to include *Hexagenia* in their diets, thereby reestablishing an important link between the benthic and pelagic food webs; and (2) to characterize shifts in the diets of these fishes as *Hexagenia* increases its distribution and abundance. We examined the stomach contents of spottail shiners (*Notropis hudsonius*), silver chubs (*Hybopsis storeriana*), and trout-perch (*Percopsis omiscomaycus*) collected in 1995. Spottail shiners were mostly zooplanktivorous and never fed on *Hexagenia*. Silver chubs were mostly benthivorous and occasionally fed on *Hexagenia*. Trout-perch in the western half of the western basin fed heavily on *Hexagenia*, while few *Hexagenia* were eaten in the eastern part of the basin, which corresponds with the abundance pattern of *Hexagenia* in 1995. In June 1995, 43% of trout-perch from the western part of the basin contained *Hexagenia*; in June 1996, 69% contained *Hexagenia*. A five-fold increase in the average number of *Hexagenia* in trout-perch stomachs between June 1995 and June 1996 corresponds with a 2.4-fold increase in the average density of *Hexagenia* in the entire western basin.

09:15AM AGGRESSIVE INTERACTIONS BETWEEN INTRODUCED ROUND GOBIES AND CRAYFISH: EFFECTS ON RISK OF PREDATION. JEREMY WOJDAK, ELLEN PALMER, AND JEFFREY G. MINER. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Round gobies *Neogobius melanostomus* a recent invader to the Great Lakes is increasing its range and density particularly in Lake Erie where it now ranges from the western basin to the Ohio-Pennsylvania border and reaches densities as high as 15 \cdot m². In the areas of highest concentration, round gobies appear to have replaced crayfish *Orconectes rusticus* as the dominant macrobenthivore. We hypothesized that round gobies could either be preying upon small crayfish or making all crayfish more vulnerable to other predators by evicting crayfish from common retreats. Laboratory behavioral observations reveal that round gobies do force crayfish from retreats which could make them more vulnerable to predators. In a laboratory experiment we are exposing crayfish to smallmouth bass predators in the presence and absence of round gobies, which are also vulnerable to predation. A limited number of shelters (n=12) were placed in a large pool (2.5-m diameter, 0.5-m deep) and smallmouth bass were allowed to forage for 48 hours on a group of crayfish (n=12; 17-23 mm carapace length) with or without round gobies present (n=6; 80-100 mm total length). Preliminary results suggest that predation on crayfish increases in the presence of round gobies and that this may be one of the important causal mechanisms for predicted shifts in crayfish abundance in Lake Erie.

09:30AM FISH COMMUNITY BASED ASSESSMENT OF OHIO'S LAKE ERIE NEAR SHORE AREA. ROGER F. THOMA, OHIO EPA, 1685 WESTBELT DRIVE, COLUMBUS OH 43228.

A systematic understanding of the behavior of Great Lakes near shore fish communities in relation to habitat conditions and environmental stressors has long been needed and is fast becoming critical to environmental cleanup efforts. For four years now the Ohio EPA has monitored Lake Erie near shore fish communities in an effort to understand the interplay of habitat, fish communities, and environmental disturbance. Efforts are presently underway to further refine this understanding by developing numeric expectations for fish community performance that can be used in the administrative decision making process. Results to date indicate that lake affected river mouths are the most severely degraded habitats while areas furthest from rivers are the least affected. The Maumee River and Bay area is the largest, most degraded portion of Ohio's Lake Erie near shore while the Islands and eastern Ohio shorelines are least degraded. Breakwalls have been found to have decidedly more diverse communities than beaches. While environmental quality has strong influences on fish community structure, habitat factors also exert influences, primarily detectable in the more "pristine" areas.

09:45AM PREY SELECTION AND DIET BREADTH OF YELLOW PERCH AND WHITE PERCH IN THE CENTRAL BASIN OF LAKE ERIE. PAUL J. PIRA AND EDWIN J. SKOCH PH.D. DEPARTMENT OF BIOLOGY, JOHN CARROLL UNIVERSITY, UNIVERSITY HTS. OH 44118.

With the discovery in 1985 of *Bythotrephes cederstroemi* in Lake Erie, much concern was placed on ecological impacts that this invader might have upon food webs and in particular diets of fishes. The prey selection and diet breadth of age 0, 1 and 2+ yellow perch (*Perca flavescens*) and white perch (*Morone americana*) was investigated in the central basin of Lake Erie during June through October, 1994. Age 0 yellow perch and white perch displayed diet shifts during the study and both fed upon *B. cederstroemi* by October. Age one fishes of both species exhibited gape-dependent foraging with diet breadth of the white perch being larger than the yellow perch, yet narrowing as they preyed upon *B. cederstroemi*. Yellow perch fed on *B. cederstroemi* during the summer except for August. The age 2+ fishes of both species exhibited a similar narrow diet breadth during June through October, with a diet shift to benthos during August and September. Yellow perch tended to be more specialized with narrower diet breadths than the more opportunistic white perch.

10:00AM SPORT FISHERY RESPONSES TO LAKE ERIE WALLEYE POPULATION SIZE. FRED L. SNYDER, OHIO SEA GRANT EXTENSION, CAMP PERRY, BLDG. 3, PORT CLINTON OH 43452.

Ohio's western Lake Erie walleye catch dropped from a high of 3.75 million fish in 1987 to 992,000 fish in 1994, and regional revenues derived from sportfishing declined by at least one-half. Increased water clarity during the 1990s, linked by many observers primarily to filtration by zebra mussels, caused an apparent change in walleye behavior, rendering popular fishing methods and locations less successful than in previous years. Sportfishing groups and popular media frequently attribute the lower annual catches to water clarity and hence to zebra mussels. Data on western basin walleye fishing effort and harvest show a strong relationship to walleye abundance and indicate that much of the decline occurred prior to the zebra mussel's heavy colonization of western Lake Erie in 1990. Zebra mussel effects on water clarity

have necessitated changes in fishing practices which many anglers have successfully adopted. Increased clarity also is restoring aquatic macrophytes to near shore areas, resulting in apparent increases in vegetation-oriented fish species, and suggesting greater diversity in future sportfishing opportunities. Declines in sportfishing revenues in Ohio's Lake Erie region are real, but likely are linked to lower nutrient inputs and other factors involved with trophic changes as well as zebra mussel colonization.

10:15AM FISH SPECIES AS INDICATORS OF WATER QUALITY CONDITIONS IN WESTERN LAKE ERIE. TED M. CAVENDER, MUSEUM OF ZOOLOGY, FISH DIVISION, 1315 KINNEAR RD., COLUMBUS OH 43212.

Since the 1940's, Lake Erie water quality declined over a period extending well into the 1970's. The decline was dramatically shown annually by the expanded anoxic bottom conditions in the central basin during the warm summer months. Also, water clarity decreased over that time with resulting decrease in the diversity of submerged aquatic plants. During this period almost a dozen native fish species showed significant declines in their populations. The health of some of these species was closely linked to water quality conditions. By the mid-1960's eight had become extirpated. Four others became rare and three of these were listed as endangered by the Ohio Division of Wildlife. Since 1990 four fish species have shown reversals in population decline and made substantial strides toward recovery of their status similar to that in the 1940's. Species subject to extirpation were those that had more limited distributions and became the victims of habitat loss. Recovery of two of the fish species, which are bottom feeders, may be linked to both the increase in water clarity in the 1990's and the return of their natural food, *Hexagenia* mayflies. The hypothesis that there is a strong connection between the macroinvertebrates and the population status of the two fish species was developed by an examination of the stomach contents of fish collected in the 1940's and 1950's. Confirmation of the hypothesis is awaiting the analysis of the stomachs of specimens collected in 1996.

10:30AM ARTIFICIAL REEFS IN LAKE ERIE: AN EVALUATION OF THE CLEVELAND ARTIFICIAL REEF AS A FISH CONCENTRATION DEVICE, WITH COMPARISON TO THE LORAIN ARTIFICIAL REEF. DAVID O. KELCH, THE OHIO STATE UNIVERSITY EXTENSION SEA GRANT PROGRAM, 42110 RUSSIA ROAD, ELYRIA OH 44035; FRED L. SNYDER AND JEFFREY M. REUTTER, OHIO SEA GRANT COLLEGE PROGRAM, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43212.

Artificial reefs were constructed in Lake Erie from 1984-1989 as demonstration projects by The Ohio State University's Sea Grant College Program. Evaluations were conducted to assess the effectiveness of these structures as fish concentration devices during 1992-93 at Lorain (previously reported), and 1994-95 at Cleveland. As with the Lorain evaluation, underwater VHS video was used at both the Cleveland artificial reef and an adjacent nonreef control site to identify and enumerate fish. Assessment was done monthly from May through October, weather and visibility permitting, with SCUBA divers swimming a known transect line. T-tests were used to determine seasonal differences in fish abundance between the reef and the control site. Total seasonal numbers of fish were significantly higher at the reef site than at the control site for both 1994 and 1995. Total seasonal numbers of smallmouth bass were also higher in the spring and fall than in mid-summer, suggesting seasonal preference. Comparison of research data from Cleveland (1994-95) to that of Lorain (1992-93) indicated similar patterns of fish concentration and seasonal preferences.

10:45AM RANGE EXPANSION AND DIET OF ROUND GOBY IN LAKE ERIE. CAREY T. KNIGHT, OHIO DIVISION OF WILDLIFE FAIRPORT FISHERIES RESEARCH STATION, 421 HIGH STREET FAIRPORT HARBOR OH 44077.

Round goby, *Neogobius melanostomus*, were first collected in the central basin of Lake Erie by Ohio Division of Wildlife (ODW) bottom trawl surveys in August of 1994. Since the initial discovery, round goby catch rates during ODW trawl surveys have exhibited incremental increases. Catch rates increased from 2 to 11 fish/hour during August - October surveys in 1994, from 22 to 209 fish/hour during May - October surveys in 1995, and 54 to 414 fish/hour during June - October surveys in 1996. Round gobies occupied inshore (<15 meters) rocky areas during the spring and summer months, then migrated offshore (>15 meters) following lake turnover in October. Since their initial discovery in the mouth of the Grand River in 1993, round gobies have expanded their range across the Ohio basin of Lake Erie. In 1994 goby diets consisted of 97% zebra mussels, *Dreissena polymorpha*, at 100% frequency of occurrence. Size-selective predation of gobies on zebra mussels was evident from the positive correlation between round goby total length and size of zebra mussels consumed. In 1995 and 1996, diets consisted primarily of zebra mussels in both young and adult fish, however, younger fish had a more diverse diet as invertebrates and zooplankton were also consumed. Since 1994, round gobies up to 3 years old have been collected, indicating the presence of at least 3 year classes. Growth, diet, and migration patterns of round gobies in Lake Erie and Europe are similar. Round gobies are multiple spawners that can

adapt to a variety of habitats and exhibit a rapid dispersal rate, making them a significant threat to establish throughout Lake Erie.

LAKE ERIE ECOSYSTEM STATUS AND FUTURE

1:30PM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 221

LAUREN LAMBERT - PRESIDING

01:30PM A LAKEWIDE ASSESSMENT OF 14 BENEFICIAL WATER QUALITY USES OF LAKE ERIE. L. LAMBERT, OHIO EPA-DSW-LEU, P.O. Box 1049, COLUMBUS OH 43216-1049.

The Great Lakes Water Quality Agreement (GLWQA) calls for development of Lakewide Management Plans (LaMPs) that are designed to restore, protect, and preserve the beneficial water quality uses in the Great Lakes. The Lake Erie LaMP is assessing 14 impacts to Lake Erie water quality including fish & wildlife health and habitat, dredging, beach closings, drinking water, aesthetics, costs to agriculture & industry, benthos, eutrophication, benthos, and phyto/zooplankton. Impacts were assessed in open waters, nearshore areas, embayments, river mouths, and the lake effect zone of Lake Erie tributaries. This paper will present an overview of the Lake Erie LaMP and the general results of the assessment, including the criteria/standards used and the time period assessed. It will identify locations of known impairments, the rationale for the impairment determination, and the causes/source of impairment, where known. Data gaps and additional questions that must be addressed before further assessment can be accomplished will be identified. The presentation will set the stage for more detailed presentations on beach closings, benthos, drinking water, & phyto/zooplankton assessment results.

02:00PM DRINKING WATER CONSUMPTION RESTRICTIONS/ TASTE AND ODOR PROBLEMS IN LAKE ERIE. L. THORSTENBERG, UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, WATER DIVISION, WU-17J, 77 WEST JACKSON BLVD., CHICAGO IL 60657.

Annex 2 of the Great Lakes Water Quality Agreement (GLWQA) calls for the development of Lakewide Management Plans (LaMP), designed to reduce loadings of critical pollutants in order to restore beneficial uses, for each of the Great Lakes. The Lake Erie LaMP is assessing 14 impacts to Lake Erie water quality, including consumption restrictions and taste and odor problems related to drinking water. The criteria being used to evaluate drinking water quality in Lake Erie are: 1) densities of disease-causing organisms or concentrations of hazardous/toxic chemicals that exceed human health standards; or 2) the presence of taste and odor problems. Bacteriological and chemical data, including sources and causes of contamination, were collected for Lake Erie treated drinking water from Canada (Ontario) and the United States (New York, Pennsylvania, Ohio and Michigan). In Canada, the data were collected from the Ontario Ministry of Environment and Energy, and in the United States, from State Departments of Environmental Protection, Environmental Quality, or Natural Resources. The presence and/or frequency of exceedances of treated drinking water/taste and odor criteria were studied as measured against applicable jurisdictional human health standards or guidelines, which served as the basis for declaring Lake Erie drinking water "impaired" from a human health standpoint. Based on an evaluation of the status of current water treatment plants using Lake Erie as a source, there are no impairments to drinking water consumption or due to taste and odor problems in the Lake Erie basin.

02:15PM PHYTOPLANKTON AND ZOOPLANKTON IN LAKE ERIE: ARE THEY IMPAIRED? ORA E. JOHANSSON AND E. SCOTT MILLARD, GREAT LAKES LABORATORY FOR FISHERIES AND AQUATIC SCIENCES, CANADA CENTRE FOR INLAND WATERS, PO Box 5050, BURLINGTON, ONT., L7R 4A6 CANADA

The beneficial use of plankton is considered impaired when 'community structure diverges significantly from unimpacted control sites' or bioassays confirm toxicity. The problem in assessment arises when a suitable 'unimpacted control site' does not exist. We consider alternate ways to assess the plankton using structural and functional measures. These included comparisons of biomass and production against predictive relationships, predator to prey ratios with other systems and zooplankton size structure to the criterion of Mills et al.(1987). In applying these ideas to Lake Erie, we have concluded that the phytoplankton populations in the nearshore and zooplankton in the offshore in the East basin of the lake are impaired. Zooplankton size structure further suggests that zooplankton are impaired throughout much of the east and central basins.

02:30PM EVIDENCE THAT ZEBRA MUSSELS (*DREISSNA POLYMORPHA*) CAN STIMULATE GROWTH OF *MICROCYSTIS*, A BLUE-GREEN ALGA. ROBERT T. HEATH, XUEQING GAO, CONRAD E. WICKSTROM, AND DALE CASAMATA. WATER RESOURCES RES. INST., KENT STATE UNIVERSITY, KENT OH 44242.

Microcystis sp. is a nuisance colonial blue-green alga (cyanobacterium) that can degrade water quality with noxious tastes and hepatotoxins; its growth is stimulated by high concentrations of phosphate and ammonium. Our past research indicated that zebra mussels (ZM) release large quantities of ammonium and phosphate. This study conducted a preliminary examination of the physiological status of phytoplankton in the western basin of Lake Erie (WB-LE) during development of a bloom consisting largely of *Microcystis aeruginosa* (M.a.) during late summer 1996. We found that M.a. took up phosphate and dissolved organic P compounds faster (per mg chlorophyll) and to a greater extent than other phytoplankton in the community. These findings are consistent with the view that materials released by ZM may stimulate growth of M.a. This was supported by the Lake Erie Protection Fund.

02:45PM DETERMINATION OF ALGAL METRICS FOR LAKE ERIE ESTUARIES. GERALD V. SGRO AND JEFFREY R. JOHANSEN, DEPARTMENT OF BIOLOGY, JOHN CARROLL UNIVERSITY, CLEVELAND OH 44118.

Composition of algal periphyton was resolved for Old Woman Creek, Black River, Cuyahoga River and Ashtabula River estuaries from quarterly samples collected from November, 1992 through September, 1994. Samples for this study were collected from grab samples and on glass slides. Algal community structure and water quality assessments were made on the basis of standard and consistent identification and enumeration techniques, species diversity, relative abundance, and global autecologies. Statistical and multivariate techniques were used to compare the samples and create a database of local indicator species. This study was expanded with the addition of six additional estuaries sampled in June and September of 1995 and 1996. Sample collection technique was modified by the use of glass rods instead of glass slides. A variety of metrics based on algal community structure and function are examined to identify those which provide useful information on water quality. An objective system of metrics and criteria for use in water quality assessment is the goal.

03:00PM LAKE ERIE BATHING BEACH MONITORING PROGRAM. JOHN B. WANCHICK, STEVEN BINNS, ROBERT FRENCH, J. RON GENEVIE, PETER SOMANI, MD, PHD, OHIO DEPARTMENT OF HEALTH, P.O. Box 118, COLUMBUS OH 43266-0118.

The purpose of the program is to monitor the quality of Ohio's coastal bathing beach water, and to advise local authorities of potential health risks. The list of diseases potentially transmitted by fecal-contaminated recreational water is extensive. Determination of water quality is typically based on testing for surrogates of fecal contamination: fecal coliform or *Escherichia coli*. Since the mid 1970's, the Ohio Department of Health has monitored public beaches across Lake Erie using fecal coliform as the preferred surrogate. In 1995 the Ohio EPA fecal coliform standard was exceeded 75 times, having an adverse impact on beach use and local economies. Based upon improvements in laboratory technology, the beaches sampled in 1996 were analyzed for *E.coli* content instead of fecal coliform. The standard for *E.coli* was exceeded 22 times, representing a 70.7% decrease in the identification of a surrogate of disease from the previous year. More detailed comparative studies were conducted at specific locations during 1996. One such study involved analyzing daily samples of beach water for both fecal coliform and *E.coli*. Data collected during the 1996 season will be used to determine the most practical and cost-effective combination of testing frequency and surrogate selection. Improving the predictability of health risks to swimming at bathing beaches will better protect the public's health and assist in future efforts to manage Ohio's natural water resources.

03:15PM BACTERIAL LEVELS AT LAKE ERIE BEACHES - A LAKEWIDE PERSPECTIVE (1992-1995). B. KWAVNICK¹, J. MORTIMER¹, L. LAMBERT². ¹HEALTH CANADA, GREAT LAKES HEALTH EFFECTS PROGRAM, RM 1103, MAIN BUILDING, POSTAL LOCATOR 0301A1, TUNNEY'S PASTURE, OTTAWA, ON, K1A 0K9, CANADA. ²OHIO EPA-DSW-LEU, PO Box 1049, COLUMBUS OH 43216-1049.

The Great Lakes Water Quality Agreement (GLWQA) calls for development of Lake Erie Lakewide Management Plans (LaMPs) that are designed to restore and protect beneficial water quality uses in the Great Lakes. The Lake Erie LaMP is assessing 14 impacts to Lake Erie water quality, including recreational water quality. From a human health perspective, the primary tool to evaluate beach water quality is the measurement of indicator organisms. Recreational water quality is a health issue for people who engage in activities that result in total or partial body water contact (swimming, windsurfing, water skiing, boating and fishing). *E. coli* and fecal coliform data for the years 1992-1995 were collected for Lake Erie beaches in Canada (Ontario) and the United States (New York, Pennsylvania, Ohio, and Michigan), respectively. The data also include sources and causes of microbiological contamination, as well as its limitations. In Canada, the data were collected

from Ontario Public Health units, and the Ontario Ministry of Environment and Energy and in the U.S. from State Departments of Health or Natural Resources. Geometric means of the bacterial levels were calculated, and plotted against the applicable jurisdictional health guideline. Guideline exceedances served as the basis for declaring beaches "impaired" from a human health standpoint. Exceedances of jurisdictional criteria, designed to protect human health at beaches, are occurring throughout the Lake Erie basin.

03:30PM LINKAGES AMONG LABILE SUBSTRATE POOLS, ECTOENZYME ACTIVITY, PRODUCTIVITY, AND GROWTH EFFICIENCY IN BACTERIOPLANKTON FROM THE MAUMEE RIVER, OHIO. CHRISTINE M. FOREMAN, PAULA FRANCHINI, AND ROBERT L. SINSABAUGH. DEPARTMENT OF BIOLOGY, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

In aquatic ecosystems dissolved organic carbon (DOC) is assimilated into the microbial loop through heterotrophic bacterial production; however, the relationship between various fractions of the DOC pool and bacterial productivity is not well understood. We have tried to elucidate the linkages among labile substrate pools, extra cellular enzyme activity, production, and growth efficiency for bacterioplankton collected from the Maumee River, Ohio in a series of substrate amendment studies. Water was collected, glass fiber filtered, and amended with one of the following: 20 µM ammonium, cellobiose, glucose, leucine, vanillin, or 1 mg/L starch, bovine serum albumin, or tannin. In general, the amendments stimulated respiration and productivity growth efficiency decreased with the addition of aromatic compounds, and increased as the C:N ratio of dissolved organic matter dropped. Predictions of nutrient availability were made from response patterns of ectoenzyme activities.

03:45PM EUTROPHICATION OR UNDESIRABLE ALGAE. SERGE J. L'ITALIEN, ECOSYSTEM HEALTH DIVISION, ENVIRONMENT CANADA, Box 5050, BURLINGTON, ONTARIO, L7R 4A6

Persistent water quality problems related to cultural eutrophication have been documented in Lake Erie during the 1960's. The Lake Erie LaMP has reevaluated the present trophic status of the lake. The scope of the assessment includes open lake waters, nearshore areas, river mouths, and embayments, and the lake effect zone of Lake Erie tributaries. Indicators used to identify trophic status were evaluated along with trends in open lake and nearshore nutrient concentrations, particularly phosphorus, and response in nuisance algal growth. Phosphorus and chlorophyll a concentrations in offshore waters of Lake Erie indicate oligotrophic conditions except for the Western Basin where mesotrophy prevails. Heavy *Cladophora* growth was monitored in 1995 by the OMOEE in several nearshore areas of the Eastern Basin. Although *Cladophora* fouling was evidenced along the shoreline, eutrophication was inconclusive due to limited data in assessing its persistency. Relative levels of omnivorous fish used by the Ohio EPA as indicators of trophic status in lake effect areas of Ohio tributaries exhibited mildly to highly eutrophic conditions.

04:00PM A PRELIMINARY ASSESSMENT OF THE STATUS OF IMPAIRMENT OF THE BENTHIC COMMUNITY IN LAKE ERIE. EDWARD P. IWACHEWSKI. ONTARIO MINISTRY OF NATURAL RESOURCES, 1194 DAWSON ROAD, THUNDER BAY, ONTARIO P7B 5E3.

The Great Lakes Water Quality Agreement identified the degradation of benthos as one of fourteen potential beneficial use impairments to assess in the development of a Lakewide Management Plan (LaMP). A literature review conducted for the Lake Erie LaMP shows that there have been dramatic alterations in the benthic community since the beginning of European colonization i.e. since about the 1800's. This includes well documented changes in abundance of several native species (e.g. *Hexagenia*), the extirpation of some native species and a recent shift to dominance by invading exotic species (*Dreissina* spp.). A determination of impairment is made by examining the historical perspective as well as out-of-system references, trophic models, current trends and ecosystem objectives for Lake Erie. The impact of contaminated sediments on the benthic community is also discussed.

PLANT SYSTEMATICS & HISTORY OF BOTANY

9:00AM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 206

ALLISON W. CUSICK - PRESIDING

09:00AM *CIRSIIUM HILLII* DELETED FROM THE OHIO FLORA. ALLISON W. CUSICK, DIVISION OF NATURAL AREAS AND PRESERVES, ODNR, BLDG F, FOUNTAIN SQUARE, COLUMBUS OH 43224.

Cirsium hillii (Canby) Fernald (Asteraceae) has been reported from

Ohio since 1944. Most subsequent floristic works include Ohio in the range of this species. Fisher in his 1988 volume on Ohio Asteraceae maps *Cirsium hillii* in nine counties of northeastern and southwestern Ohio. All Ohio reports of this species prove to be based upon misidentified specimens of the closely-related *Cirsium pumilum* (Nutt.) Sprengel. These two species differ in length of phyllary spines, extent of glandulosity, flower scent and type of root system. In addition, *Cirsium hillii* is a perennial and *C. pumilum* is a biennial. *Cirsium hillii* occurs in six Midwestern states: IA, IL, IN, MI, MN, WI, and Ontario. *Cirsium pumilum* is widely distributed east of the Appalachians from Me to Nc, west to Ohio. *Cirsium pumilum* has been documented from 14 counties of eastern and southwestern Ohio. *Cirsium hillii* should be deleted from the known Ohio vascular flora.

09:15AM EXAMINING GENETIC VARIATION IN CALAMAGROSTIS PORTERI SPP. INSUPERATA (SWALLEN) C. W. GREENE WITH ISOZYME, RAPD AND ISSR MARKERS. LI JIANQIANG, ELIZABETH J. ESSELMAN, DANIEL J. CRAWFORD AND JENNIFER L. WINDUS. WUHAN INSTITUTE OF BOTANY, ACADEMIA SINICA, WUHAN 430074, CHINA.

Calamagrostis porteri A. Gray ssp. *insuperata* (Swallen) C. W. Greene, commonly known as Ofer Hollow reed grass, is found in two counties in Ohio and is classified as an endangered species in the state. The species is highly rhizomatous and has low levels of seed set, suggesting that populations consist of only one or few genotypes. Molecular markers were utilized to determine genetic diversity within and between populations. Isozyme results from 149 individuals and 7 populations suggest low diversity in the species ($I=0.993$, $Ht=0.018$) and that the majority of the diversity occurs among populations ($Hs=0.0098$, $Gst=0.4412$). RAPD markers (36 individuals from 6 populations) are concordant with the isozyme results in suggesting low levels of diversity and that the greatest levels of diversity are partitioned among populations (average similarity between populations = 0.908). In contrast to isozymes which detected no within population variation RAPD markers revealed variation in two individuals from two populations. Preliminary data with ISSR (inter-simple sequence repeat) markers from 20 individuals also suggest that populations are genetically distinct from one another. In addition, ISSR's revealed more genetic variation within populations than RAPD markers. ISSR's show higher levels of variation in one of the two populations examined.

09:30AM INTERPOPULATION VARIATION IN LUPINUS PERENNIS, THE WILD LUPINE. CARRIE A. CARTWRIGHT AND HELEN J. MICHAELS. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Conservation biologists contend that small, isolated populations are characterized by reduced population viability. In the past 100 years, *Lupinus perennis*, an indicator species for oak savannahs in the Midwest, has declined in distribution and abundance. The objectives of this study were to determine 1) whether populations of lupine differ in levels of morphological variation and reproductive success, and 2) whether fitness components for each population are related to the size of the population. Seed set, fruit set, percent germination, germination rates, seed size, soil nutrients, light levels and percent bare ground were compared among fourteen populations ranging in size from 25 to 8300 individuals. As an indirect measure of genetic variation, frequencies of seed coat color morphs were also compared. Although there was no correlation between mean seed mass and population size, mean number of seeds per pod, pods per plant and seeds per plant were all positively correlated with population size. The seed coat color variation was greater in larger populations. The data suggests that the smaller populations may have lower fitness than the larger populations and that at least part of the reduced fitness may be attributed to reduced levels of genetic variation.

09:45AM INTERSPECIFIC POLLEN COMPETITION AS A REPRODUCTIVE BARRIER BETWEEN SYMPATRIC SPECIES OF HIBISCUS. ROBERT A. KLUPS, DEPARTMENT OF PLANT BIOLOGY, THE OHIO STATE UNIVERSITY AT MARION, 1465 MT. VERNON AVE, MARION OH 43302.

Because closely related plant species occurring near one another often have their flowers visited by insects carrying mixed loads of same-species and potential hybrid ("foreign") pollen, postpollination mechanisms may prevent the foreign pollen from successfully fertilizing ovules. Studies are underway to test whether interspecific pollen competition acts as a reproductive barrier between two species of rose-mallow (*Hibiscus* spp.). In a garden plot, 3-5 individuals of *H. moscheutos* and *H. laevis* from two populations were subjected to single-donor pollinations of each species separately and also to simultaneous mixed pollinations. Species-specific GPI allozymes permitted the differentiation, through protein electrophoresis, of hybrid versus same-species seeds progeny in the resulting fruits. The fruit set of hybrid-pollinated and same-species pollinated flowers both approached 100%. Seed set from hybrid pollination was markedly lower than that of same-species pollination. Of 16 *H. laevis* fruits resulting from mixed pollination, 11 had no hybrid seeds while the remaining 6 fruits had a small proportion of hybrid seeds (10 seeds/fruit were assayed). Similar results were observed for *H. moscheutos*. Future

studies will focus on confirming, by microscopic examination of styles, that pollen tube growth rates are the basis for the reduced hybrid seed set.

10:00AM BREAK

10:15AM EMANUEL D. RUDOLPH AS A BOOK REVIEWER FOR CHOICE. WILLIAM R. BURK. JOHN N. COUCH BIOLOGY LIBRARY, UNIVERSITY OF NORTH CAROLINA, CB#3280 COKER HALL, CHAPEL HILL NC 27599-3280.

Biographical accounts of Emanuel D. Rudolph (1927-1992), polar lichenologist and historian of botany, were written by Ronald L. Stuckey (The Bryologist 97: 437446. 1994; The Michigan Botanist 34: 4-23. 1996). Additional knowledge of Rudolph's scholarly endeavors is revealed through his book reviewing for *Choice*, a monthly serial devoted to the publication of book reviews, particularly to support undergraduate library collections. Following a brief history of *Choice*, Rudolph's role as a reviewer is discussed, beginning the year that *Choice* was established (1964). Important factors influencing his decision to write book reviews were: a commitment to serve colleges, an avid interest in book collecting, and an agreement with science historian George Sarton, who stated that those qualified should review books "because it was their professional duty to do so" (*Choice* 26: 1093. 1988). For 28 publications Rudolph wrote 195 book reviews of which 79 appeared in *Choice* in the disciplines of botany (58), polar science (9), history of science (6), and other biological sciences (5). His book reviews demonstrate analytical and exacting writing skills and a breadth of knowledge in these subject areas. Through his book reviews Rudolph provided collection development and teaching enrichment assistance for college librarians and faculty.

10:30AM EDWIN LINCOLN MOSELEY'S BOTANY CLASS FIELD TRIPS. Relda E. NIEDERHOFER. BGSU FIRELANDS COLLEGE, 901 RYE BEACH RD., HURON OH 44839.

In preparation for his book on *Sandusky Flora* in 1899 Edwin Lincoln Moseley (1865-1948) took many field trips with his botany classes to collect plants. Moseley had come to Sandusky in 1889 to teach all of the sciences in the High School. While he was armed with a vasculum, whistle and field glasses Moseley would require his botany class to bring money for transportation and a large well packed lunch, because he did not carry a lunch. The inter-urban street car would take them to Castalia, Milan, Berlin Heights, Oberlin, and Catawba. To go to the Erie Islands they took an excursion boat. Moseley would combine all the sciences on his field trips, when they were on Put-in-Bay they visited the caves to study geology, when they returned after dark on the boat to Sandusky they studied the constellations.

10:45AM DROUGHT IN 2037: FORECASTED BY EDWIN L. MOSELEY. RONALD L. STUCKEY, THE OHIO STATE UNIVERSITY, 1315 KINNEAR ROAD, COLUMBUS OH 43212-1192.

Edwin Lincoln Moseley (1865-1948), professor of science at Bowling Green University (1914-1948), in March 1937 first made long-range predictions of rainfall in terms of wet or dry years for the midwestern United States. His prediction of a drought occurring in 2037 was the farthest year he gave for the future. Moseley obtained data for his forecasts from (1) detailed studies of tree ring widths from over 500 tree stumps, (2) recorded water-level depths for Lake Erie, (3) published meteorological rainfall records, (4) accounts of floods along the Ohio River, and (5) the determined ages of trees on the sand ridges of Cedar Point on Lake Erie. He developed the theory that the amount of rainfall in this region repeated itself in cycles of 90.4 years, or four times the period of the magnetic sunspot cycle. His paper, read 17 March 1939 and published in the *Papers of the Michigan Academy of Science...* (1940), contained his rainfall predictions of mostly wet years until 1975. Moseley's predictions were accurate, for in general, these years were wet ones with the highest water levels known in Lake Erie. The drought predicted in 2037 is based on droughts that occurred in a series at about 90-year intervals, 1494, 1584-85, 1675-76, 1856-57, 1946-47.

**1:30PM BIOLOGICAL SCIENCES
DIVISION MEETING - RM 206**

**PLANT BIOLOGY
2:00PM SATURDAY, APRIL 5, 1997
OLSCAMP HALL ROOM 206
HELEN J. MICHAELS - PRESIDING**

02:00PM MATING SYSTEM AND POLLINATOR LIMITATION IN LUPINUS PERENNIS. HELEN J. MICHAELS. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

In the past 100 years, populations of *Lupinus perennis* (Fabaceae) have declined in distribution and abundance, leading to fragmentation as well as changes in population size and structure. The primary objective of this research is to determine the potential impact of these changes on pollination and reproduction. Specifically, experiments were conducted to answer the following questions: 1) Is *L. perennis* self-compatible? 2) Is pollinator visitation required for seed production? 3) Are selfed offspring of lower quality? 3) Is reproduction in this species pollinator limited? Flower dissections were performed to determine if floral structure and developmental timing allow for selfing. A pollinator exclusion study was conducted in a common garden to determine if floral visitors are necessary and whether the plant will set seed when manually selfed. Finally, natural pollinator servicing of plants in natural populations was supplemented with hand cross-pollinations to test for evidence of pollinator limitation. Observed patterns of flower development suggest protandry and facultative selfing. Pollinator exclusion experiments indicated that *L. perennis* is capable of selfing in the absence of pollinators, but that bagged and manually self-pollinated inflorescences have lower pod production compared to naturally pollinated plants. Number of flowers per inflorescence and distance to nearest flowering plant explained significant amounts of variation in pod production. However, pollen augmented and naturally pollinated plants did not differ in overall average pod production per inflorescence, suggesting that *L. perennis* was not pollinator-limited in this population.

02:15PM POLLINATION ECOLOGY OF PEDICULARIS IN THE CHINESE HIMALAYA. LAZARUS WALTER MACIOR. DEPARTMENT OF BIOLOGY, THE UNIVERSITY OF AKRON, AKRON OH 44325-3908.

In the summer of 1996, 20 species of *Pedicularis* (Scrophulariaceae) were located in the subalpine-alpine zone of Sichuan Province, China for investigation of their pollination ecology. Bumblebees (*Bombus* Latr.) were the only regular pollinators of the species studied. The long-tubed, rostrate, nectarless corollas of *P. cranulophya* and *P. longiflora tubiformis* were pollinated sternotribically by pollen foragers scraping pollen from anthers concealed in the galea. The nectarless, rostrate, short-tubed flowers of *P. rhinanthoides* were similarly pollinated, but similar flowers of *P. semitoria* were pollinated by pollen vibration. *P. alaschanica*, *P. kansuensis*, *P. plicata*, *P. polyodonta*, *P. stenocorys* and *P. verticillata* flowers were short-tubed, nectariferous and pollinated either nototribically by nectar foragers or sternotribically by pollen scrapers. Six *Bombus* species and two of *Psithyrus* occurred on flowers of *Pedicularis*. Flowers were either white, magenta-pink, yellow or a combination of these colors. Up to 9 *Pedicularis* species grew sympatrically and bloomed synchronously, but no putative hybrids were found. In general, pollination syndromes in this study resemble those of previous investigations, but uncorroborated reports of pollination of long-tubed species by nectarforaging lepidoterans appear incorrect. Pollinator behavior is considered a major contributor to the establishment and maintenance of reproductive isolation in *Pedicularis*.

02:30PM THE EFFECT OF NaCl, KCl, Na₂SO₄, AND K₂SO₄ ON THE GERMINATION OF ATRIPLEX PROSTRATA (CHENOPODIACEAE). TODD P. EGAN, IRWIN A. UNGAR, AND J. FORREST MEEKINS. DEPARTMENT OF ENVIRONMENTAL AND PLANT BIOLOGY, OHIO UNIVERSITY, ATHENS OH 45701-2979.

This study compared the effects of NaCl on seed germination and early growth of the halophyte *Atriplex prostrata* Boucher to other salts to determine the inhibitory effects of salinity were osmotic or due to a specific ion inhibition. Seeds of *A. prostrata* were germinated in NaCl, KCl, Na₂SO₄, and K₂SO₄ at concentrations with osmotic potentials equal to 0, -0.75, -1.0, and -1.5 MPa. Higher salt concentrations significantly ($P < 0.05$) decreased germination and seedling growth, but there was no significant ($P > 0.05$) effect among treatments on total germination. However, at -1.5 MPa the rate of germination was more inhibited by sodium salts than by potassium salts. Ungerminated seeds pretreated with salts had recovery germination percentages in distilled water that were equal to that of the freshwater controls indicating that the previous effect of these salts was due to osmotic inhibition rather than a specific ion toxicity.

02:45PM THE ANTHERIDIEN NEIGHBORHOOD OF POLYSTICHUM ACROSTICOIDES. GARY K. GREER AND BRIAN C. MCCARTHY. DEPARTMENT OF ENVIRONMENTAL AND PLANT BIOLOGY, OHIO UNIVERSITY, ATHENS OH 45701.

The radius of antheridiogen effects surrounding a source-gametophyte (i.e., antheridiogen neighborhood) was investigated using top soil from a local population of *P. acrostichoides*. Patterns of gender and morphology were generally consistent with known antheridiogen effects; percentages of male and atheristic gametophytes decreased with distance. However, the range of antheridiogen effects observed in this experiment (7.5cm) was considerably below the range previously observed on agar (25.4cm). We offer

a "hormone-pheromone" model of antheridiogen activity as a possible explanation for the small, but significant, peak in meristic-males observed at the periphery of the antheridiogen neighborhood. According to this model, antheridiogen is a hormone involved in the formation of the notch-meristem that has been coopted as a pheromone that influences the gender and morphological development of neighboring gametophytes. If the "hormone-pheromone" model is correct, the adaptive value of antheridiogen changes with distance from its source, favoring the source-gametophyte (female) at short distances and a subset of males at the periphery of the antheridiogen neighborhood. These observations emphasize the importance of using natural substrates when investigating the effects of antheridiogen on morphological development, reproduction, and fitness in gametophyte populations.

03:00PM BREAK

03:15PM THE ROLE OF CALCIUM IN THE GROWTH AND RE-GROWTH OF ARABIDOPSIS THALIANA. ROSEMARIE BIALECKI, TATYANA BIBIKOVA, AND SIMON GILROY. BIOLOGY DEPARTMENT, HIRAM COLLEGE, HIRAM OH 44234.

We believe that calcium plays an important role in the regulation of the growth of plants. Therefore an investigation was made into the role of cytoplasmic calcium concentration in the apical growth of *Arabidopsis thaliana* root hairs. It has been shown that a calcium gradient at the tip always accompanies rapidly growing root hairs. In an effort to expand our research opportunities beyond merely growing root hairs, we used a system within which we were able to study not only growing root hairs, but root hairs which had stopped growing and then went on to re-grow. First, preliminary kinetic studies were performed which enabled us to observe how the root hairs develop normally. The next stage involved kinetic studies on a growth method unique to our experiment. By applying D-Sorbitol to already growing root hairs we were able to make them stop growing for up to an hour. By removing the D-Sorbitol we were then able to stimulate normal regrowth of the root hairs. After the kinetics were analyzed, calcium images were taken of growing root hairs, root hairs which had ceased to grow, and re-growing root hairs. Our results show that a calcium gradient only accompanies root hairs that are growing and re-growing. This observation supports our hypothesis on the role of calcium in the apical growth of plants.

03:30PM THE EFFECT OF DROUGHT ON THE PHOTOSYNTHETIC RATE AND WATER POTENTIAL OF TREMBLING ASPEN (POPULUS TREMULOIDES) GROWN UNDER DIFFERENT CO₂ CONCENTRATIONS. XIANZHONG WANG, AND PETER S. CURTIS, DEPT. OF PLANT BIOLOGY, 1735 NEIL AVE., OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

We studied the photosynthetic rate and water potential of trembling aspen saplings under ambient and elevated CO₂ concentrations in a dry period in the summer of 1996. The trembling aspen saplings were grown in open-top chambers at the University of Michigan Biological station in northern lower Michigan. The trees were grown under four treatments with five replications for each: ambient (350 ppm) and elevated (700 ppm) CO₂, and low and high soil N availability. However, only saplings of two clones, 8L (late leaf senescence) and 51E (early leaf senescence), grown in high fertility soil were studied for the drought effect. Major results include: 1). Before and during the drought period, there was no difference in the photosynthetic rate of these two clones. 2). After the drought ended, however, photosynthetic rate for 51E was significantly higher than that of 8L, although neither 8L nor 51E recovered their maximum predrought photosynthetic rates. 3). Neither pre-dawn nor mid-day water potentials were affected by CO₂ treatment, but pre-dawn and mid-day water potentials of clone 8L were significantly lower than those of 51E. 4). There was no difference in stomatal conductance between clones 8L and 51E during the drought period, which indicates that clone 51E either had a more extensive root system or it could absorb soil water more efficiently than clone 8L. Results from this study suggest that intraspecific differences exist in photosynthetic responses to drought and atmospheric CO₂.

03:45PM DICARBOXYLIC ACIDS AND LIGHT DECREASE THE SENSITIVITY OF TEXAS MALE STERILE CYTOPLASM MAIZE LEAVES TO BIPOLARIS MAYDIS RACE T TOXIN. J. D. BELTRAN AND M.O. GARRAWAY, DEPT. PLANT PATHOLOGY, OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

Detached leaves from Texas male sterile (Tms) cytoplasm maize were infiltrated for 24h in the dark without or with dilute solutions (40 and 80 ng/ml) of the host-selective toxin (BMT toxin) from *Bipolaris maydis* race T, cut into 4 cm segments, then immersed in either 25ml of DW or 25ml DW containing 0.1mM (pH 6.5) of L-malate, L-oxaloacetate, α -ketoglutarate or L-aspartate. After 24 or 48 h of incubation in the dark changes in electrolyte leakage (Δ umhos/mg dry wt./24hr) of the DW solutions were measured to determine the effects of the various dicarboxylic acid solutions on the sensitivity of the Tms leaf segments to BMT toxin. Segments from toxin-treated leaves that were immersed in either DW or L-aspartate solutions, leaked up to 3x as much electrolyte as controls without toxin. In contrast, segments from toxin-treated

leaves that were immersed in L-oxalacetate, L-malate and α -ketoglutarate leaked, respectively, 2.0, 1.2 and 1.0x as much electrolyte as controls. The reduction in the sensitivity of Tms maize leaves to BMT toxin caused by dicarboxylic acids is comparable to that caused by light. Therefore, dicarboxylic acids could play a mediating role in the light-induced reduction in the sensitivity of Tms cytoplasm maize leaves to BMT toxin.

04:00PM FITNESS OF TRANSGENIC WILD-CROP HYBRIDS OF CUCURBITA PEPO: A FIELD TEST WITH WILD PLANTS. LAWRENCE J. SPENCER, ALLISON A. SNOW AND STEPHEN T. NAMETH, DEPARTMENT OF PLANT BIOLOGY, OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

When transgenic crops are grown near weedy relatives, fitness related transgenes may move into wild populations, perhaps causing them to become more invasive. To investigate this possibility, we crossed a commercial *Cucurbita pepo* cultivar genetically engineered for virus resistance with wild plants from several Arkansas populations and conducted field tests on F1 hybrid progeny in Ohio and Arkansas. These tests were designed to: 1. Compare the fitness of F1 progeny with that of wild plants; 2. Determine fitness costs to plants infected by virus; and 3. Determine the benefits (if any) for hybrids that contain the transgene. Hybrid progeny survived well, had 1.5 times as many seeds per fruit as wild plants and were less likely to show symptoms of viral infection than wild plants. Ongoing research with genetic markers will determine which hybrid plants contained the transgene and whether these plants performed better than nontransgenic hybrids. As a group, the wild-crop hybrids produced about 1/5 as many fruits per plant (1/3 as many seeds per plant) as wild plants. However, the variation in hybrid plants' fruit production was very high, with several genotypes showing fecundity as high or higher than wild plants. Also, because hybrids bloom synchronously with wild plants, it is likely that crop genes were transmitted to the next generation via pollen dispersal as well as seed set. These data suggest that, though the hybrids in this study were not more fit than wild plants, they are capable of producing progeny that will remain in contact with wild plants for further introgression.

04:15PM DIFFERENCES IN SEED PRODUCTION IN CHASMOGAMOUS AND CLEISTOGAMOUS FLOWERS IN VIOLA PUBESCENS. THERESA M. CULLEY, DEPARTMENT OF PLANT BIOLOGY, THE OHIO STATE UNIVERSITY, 1735 NEIL AVENUE, COLUMBUS OH 43210.

Many plant species produce two flower types—open (chasmogamous) flowers and closed, selfing (cleistogamous) flowers; yet the evolutionary advantages of this breeding system are still poorly understood. CH flowers are energetically expensive to produce and it is thought that this cost is compensated for by a CH fitness advantage. This study compares the mean seed mass and seed number per capsule or seeds derived from naturally-pollinated chasmogamous (CH) and cleistogamous (CL) flowers in *Viola pubescens*. *V. pubescens* is a common woodland herb found throughout Ohio, and this study focused on one population in Delaware County, Ohio. CH flowers in this species are produced in the early spring and CL flowers appear after the canopy closes. Although CH and CL capsules had similar numbers of seeds per capsule (9.6 and 9.7 respectively), CH seeds had a significantly higher mean seed mass (3.34 mg) than CL seeds (3.20 mg). However, this slight CH advantage may not be enough to offset the high CH production costs. Research is continuing to determine if this CH advantage in seed mass persists through the germination stage.

PLANT ECOLOGY

9:00AM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 224

BRENT G. DEMARS - PRESIDING

09:00PM VESICULAR-ARBUSCULAR MYCORRHIZAL DEVELOPMENT IN SPRING EPHEMERALS OF TWO OHIO FORESTS. BRENT G. DEMARS, PH.D. LAKELAND COMMUNITY COLLEGE, BIOLOGY DEPARTMENT, 7700 CLOCKTOWER DRIVE, KIRTLAND OH 44094.

Nineteen spring ephemerals (7 monocots and 12 dicots) were surveyed for vesicular-arbuscular mycorrhizae (VAM) in two Ohio forests during spring 1993 and 1994. Eleven of the nineteen species sampled displayed VAM development which was consistent between years and sites, except for *Cardamine concatenata* (Brassicaceae). Patterns of VAM occurrence primarily reflected the taxonomic classification of the sampled species. In this study, all sampled monocots were mycorrhizal, while only 25% of the dicots developed VAM relationships. The occurrence of VAM in the dicots primarily reflected their taxonomy as well. All Ranunculaceae species were mycorrhizal while those in the other five dicot families were not.

09:15PM FLORAL RESPONSES OF FOUR OAK OPENINGS FORBS TO PRESCRIBED FIRE AND MOWING. TIMOTHY L. WALTERS AND ELLIOT J. TRAMER, DEPT. OF BIOLOGY, UNIV. OF TOLEDO, TOLEDO OH 43606.

Dry sand barrens have historically been kept open by periodic fires that limit the woody vegetation and promote fire-tolerant species. This two-year study was designed to quantify the effects of burning and mowing on this rare Ohio plant community. Fall mowing and spring and fall burning treatments were performed on 3x3 meter plots (N=32) in a dry sand barren in the Oak Openings region of southwestern Lucas County, Ohio. In comparison to the untreated plots, fire and mowing reduced the number of florocane branches in *Rubus flagellaris* and spring burning reduced florocane number more than the mowing treatment. The abundance of *Vicia villosa* also decreased with fire. Fall burn decreased the number of flowers and racemes per plant in comparison to the untreated plots. *Hedeoma hispida* plants decreased with spring burn in comparison to the untreated and mowed plots, but the number of seeds per capsule increased after burning. Plant and flower abundance of *Aristida purpurascens* was not affected by the treatments. No significant differences in plant, flower, fruit or seed production were found in the second year after the treatments.

09:30PM CANOPY GAPS IN THE SECOND-GROWTH FORESTS OF WASHINGTON COUNTY, OHIO. JEREMY A. KELLER AND DAVID M. HIX, SCHOOL OF NATURAL RESOURCES, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210-1085.

Many forests may be characterized as shifting mosaics of disturbed areas in various stages of recovery. In the Central Appalachians, human activities have led to a general decline in the frequency of major disturbances, especially fire. In the absence of major disturbances, we propose that minor disturbances are playing an increasing role in stand dynamics. Canopy gaps created by the death of one or a few overstory trees appear to be the primary type of minor disturbance in southeastern Ohio. Our research seeks to determine the landscape-level characteristics of canopy gap processes in the second-growth forests of this region. We installed 24 transects on representative north- and south-facing slopes and ridgetops across the Marietta Unit of the Wayne National Forest. The gap fraction (percentage of total land area in gaps) was highest on northerly aspects (9.9%) and lowest on ridgetops (6.8%). The dominant gap-creating factor was the complete tip-up of individual canopy trees (57.9% of all gaps), except on ridgetops where multiple-tree gaps were more prevalent (60.0% of gaps).

09:45PM GPS PERFORMANCE UNDER VARYING CANOPY DENSITIES IN TEMPERATE AND TROPICAL FORESTS. C.R. ELVEY¹, K. A. PHILLIPS¹ & C. L. ABERCROMBIE². ¹DEPARTMENTS OF PSYCHOLOGY & BIOLOGY, HIRAM COLLEGE, HIRAM OH 44234; ²DEPARTMENT OF BIOLOGY, WOFFORD COLLEGE, SPARTANBURG SC 29303.

The ability to collect and plot data on the spatio-temporal distribution of resources can be accomplished through GPS and GIS technologies. By combining this with data on foraging and ranging behavior, we can analyze the influence of resource distribution on social organization and group cohesion. We investigated the capabilities of a Trimble ScoutMaster GPS unit to collect location data under varying canopy densities in both temperate and tropical forests. Eighty randomly selected points were sampled at the Hiram College J.H. Barrow Field Station's beech and maple forest; eighty opportunistically selected points also were sampled in Costa Rican and Trinidadian tropical forests. At each point we used the GPS to obtain a geographical reading, determined the speed of satellite acquisition, measured canopy density using a spherical densitometer, and noted weather conditions at time of sampling. In the temperate forest, no significant correlations were found between percent canopy cover and either the ability to obtain a reading or acquisition time. Analysis of a limited set of tropical data points show only a 33% acquisition rate and longer acquisition times. We expect to find negative correlations between the above variables in the tropical areas. The ability of GPS units to assist in this type of application for behavioral ecologists is likely to be limited for studies of Neotropical animals.

10:00AM BREAK

10:15PM INFLUENCE OF LAND-USE HISTORY ON PHOTOSYNTHESIS AND CARBON ALLOCATION IN TWO HERBACEOUS PERENNIALS. MELISSA D. KIBLER 281 WEST MAIN ST., ALLIANCE OH 44601.

Species variation in the canopy layer of the Harvard Forest, Petersham, MA may be the result of three past land-use disturbances; plowed, pastured and logged. As a result, the understory receives varying patterns and intensities of sunlight. It is hypothesized that the photosynthetic response of *Medeola virginiana* and *Trientalis borealis* will differ among sites. It is further hypothesized that photosynthetic response of reproducing herbs will be higher than that of non-reproducing herbs, because of the energy demand of the reproductive process. The final issue examined was that of carbon allocation. Biomass of reproductive structures and above and below ground biomass was examined in relation to total biomass. The LI-COR 6200 and LI-COR 6400 were used to measure photosynthesis in both field and lab. Except for a slightly

higher photosynthetic response of *T. borealis* in the plowed site, the data showed that there was not any significant difference for the photosynthetic responses of the herbs among sites. Also, both light response data and in situ photosynthetic measurements showed no influence of reproductive status. With respect to carbon allocation, the herbs displayed no relationship between C allocation and plant size, but did demonstrate a biomass threshold for the reproductive state. In conclusion, the data showed that land-use legacies had not affected the photosynthetic physiology and the carbon allocation of the two herbaceous plants.

10:30PM FINE-SCALE PLANT COMMUNITY STRUCTURE AND COMPOSITION IN OHIO AND TEXAS WETLANDS. JAMES G. KOOSER, RETTEW ASSOCIATES INC, 5010 ROVER RD STE 102, MECHANICSBURG 17055 PA; R. J. GARONO, EARTH DESIGN CONSULTANTS INC, CORVALLIS OR; B.L. KOOSER, CHESAPEAKE BAY FOUNDATION, HARRISBURG PA.

Wetland plant community structure is thought to play a role in various functions commonly ascribed to wetlands. Few methods exist for evaluating structure and composition in these plant communities. Our team developed a modified line intercept method to gather such data, and tested this method in wetlands in Ohio (n=9) and the Big Thicket National Preserve in Texas (n=6). Four 30 m long line transects were established along cardinal directions extending from a central point. At two meter intervals along each transect, we recorded the species and height (cm) of each plant part touching a PVC pole calibrated in cm. In all wetlands the sampling pole was held firm to the substrate, thus in inundated wetlands we measured water depth and vegetation heights. In forested areas we also recorded the species which appeared to be above the sampling point at 500 and 1000 cm above the ground, if present. We also noted the horizontal position (distance from the trap) and height of coarse woody debris (≤ 3 cm diameter) which intercepted the transect line. We calculated a roughness coefficient as the ratio of the length of the 60m transect line to the length of a line formed by the upper surface of the plant community. We also calculated the average "density" of plant-sampling pole intersections for each wetland. Roughness coefficients were lowest (rougher surface) in emergent wetlands in Texas, and greatest (flat upper surfaces) in floating-leaved marshes in Ohio. Average density of plant-pole intersections was greatest in graminoid fens and shrub bogs in Ohio, and least in forested sloughs in Texas.

10:45PM INSECT AND PLANT COMMUNITY STRUCTURE ALONG A RIVER TO LAKE GRADIENT AT OLD WOMAN CREEK ESTUARY. AYESHA GRAY, PENNSYLVANIA NATURAL DIVERSITY INVENTORY, DEPT. OF CONSERVATION NATURAL RESOURCES, PO Box 8552, HARRISBURG PA 17105-3444; R. J. GARONO, EARTH DESIGN CONSULTANTS INC., CORVALLIS OR; J. G. KOOSER, RETTEW ASSOCIATES INC., MECHANICSBURG PA.

Our team has been studying insect and plant community composition in Ohio wetlands since 1991. To date we have demonstrated differences in insect populations between wetland and upland insect populations, between different wetland cover types, and between natural and man-made wetlands. This study focused on wetland insect and plant community structure at Old Woman Creek National Estuarine Research Reserve. We sampled sites at lakeside near the mouth of the estuary, at mid-estuary, near the river inlet and in an upland meadow on the preserve in 1994. In 1995 and 1996 we sampled those sites named above, and an additional site at mid-estuary. We used battery operated light traps to collect insects overnight on 3 consecutive nights each year. Insects were sorted to order and counted. We also sampled plant community structure and composition using a modified line intercept method along four 30m transects centered on each light trap. We found high numbers of *Ephemeropterans* at our lakeside sites in all years. Other insect orders, notably *Diptera* and *Trichoptera*, became more abundant further upstream. The upland site was dominated by *Dipterans* and *Homopterans*. Plant communities included upland forests and meadows, floating-leaved emergent marshes and rush and sedge dominated emergent marshes. The density of *Nelumbo lutea* increased dramatically during our study. We found correlations between plant community structure and composition, and insect community composition.

1:30PM BIOLOGICAL SCIENCES DIVISION MEETING - RM206

AQUATIC ECOLOGY

2:15PM SATURDAY, APRIL 5, 1997
OLSCAMP HALL ROOM 224
REX L. LOWE - PRESIDING

02:15PM DRIVING FACTORS BEHIND WETLAND INSECT POPULATIONS: THE RELATIONSHIP BETWEEN PLANT COMMUNITY STRUCTURE AND ADULT WETLAND INSECT POPULATIONS. R. J. GARONO, EARTH DESIGN CONSULTANTS, INC., 800 NW STARKER STE 31, CORVALLIS 97330OR; J. G. KOOSER, RETTEW ASSOCIATES, INC., MECHANICSBURG PA.

The success of compensatory wetland replacement is frequently judged on the basis of percent vegetation cover. Measuring the percent cover of wetland species, or the survival of planted species, especially only 1 or 2 years after construction seems tautological. Aquatic insects have been used for many years as indicators of aquatic ecosystem integrity, and may provide an integrative mechanism by which wetland structure and function can be measured. The purpose of this study is to determine if (1) wetland insect assemblages are distinct from those of adjacent upland areas, (2) different types of wetlands can be distinguished from one another based on insect assemblages, and (3) wetland plant community structure and composition are related to insect assemblages. This study compared patterns within insect assemblages with data on plant community composition and structure at site, regional and continental scales. We used battery operated fluorescent light traps to collect insects at 20 (12 wetland and 8 adjacent upland) sites in Ohio and 10 (all wetland) in Big Thicket National Preserve, Texas. We also collected data on plant community composition and structure at each site. The 3 most abundant orders at all sites in Ohio were *Diptera* > *Ephemeroptera* > *Coleoptera*, and in Texas *Coleoptera* > *Diptera* > *Lepidoptera*. In Ohio wetlands the 3 most abundant orders were *Diptera* > *Ephemeroptera* > *Trichoptera*, and in Texas *Coleoptera* > *Diptera* > *Homoptera*. The differences in insect community composition between Texas and Ohio sites is probably due to the greater amount of coarse woody debris in the Texas wetlands.

02:30PM THE IDEAL UNIT FOR COMMUNITY EXPERIMENTS IN AQUATIC ECOLOGY? BORROW PITS MAY BE THE ANSWER. ANDREA M. KUMPE AND JEFFREY G. MINER, DEPT. OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Tests of community interaction frequently require large scale experimentation such as whole-lake manipulations. However, experiments on this scale have limitations in terms of replication and logistics. Ideal experimental units for tests of community interaction in aquatic systems should be small, closely-spaced lakes. We believe borrow pits located near highway overpasses may represent useful experimental units when whole-system manipulation is required. To test this idea, we compared the zooplankton community composition between small borrow pits (<5 ha) and a range of lakes (40-400 ha) during late spring. Three replicates were collected with tube samplers from each of six borrow pits and five lakes. In late spring comparisons of total crustacean zooplankton abundance and percentage cladocerans between lakes and ponds revealed no significant differences (t-tests, $t_9 = -1.8, -0.2$, respectively). Mean zooplankton density in three of the five lakes was <4 crustacean zooplankton $\cdot L^{-1}$, while in four of six ponds density was > 55 crustacean zooplankton $\cdot L^{-1}$. However, high among-lake variance resulted in the lack of significant differences between ponds and lakes. Cladocerans including *Daphnia* spp., *Diaphanosoma* sp., *Ceriodaphnia reticulata*, and *Bosmina longirostris*, comprised between 30-94% of the crustacean zooplankton in both ponds and lakes. The introduced daphnid *Daphnia lumholzi* was found in many of the lakes and ponds. Given the high degree of variability in zooplankton abundance among lakes, but similarity in composition between lakes and ponds, we suggest that plentiful, small borrow pits are ideal locations for whole-lake manipulations.

02:45PM MOLECULAR INVESTIGATIONS ON THE STRUCTURE AND FUNCTION OF *ChlL* FROM *Chlamydomonas*. LAURA SIGWORTH AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

In *Chlamydomonas reinhardtii* the mutants defective in *chlL* turn yellow in the dark indicating that they lack photosystem I (PSI) and cannot synthesize chlorophyll in the dark. The product of the *chlL* gene is a protochlorophyllide reductase and shares significant homology to the consensus sequence of the *nifH* gene that encodes the Fe-protein component of nitrogenase. The greatest conservation between the chlorophyll Fe-protein and the nitrogenase Fe-protein is found in the sites known to be important for binding the γ -phosphate of MgATP, for binding a [4Fe-4S] cluster, and in those postulated to have a role in catalyzing ATP hydrolysis. Our investigations are directed to understand the existence of mechanistic similarities between these two proteins. As a first step we have converted the conserved cysteine residues to serine by site-directed mutagenesis and identified that two of these cysteine residues serve as ligands for the [4Fe-4S] cluster. By taking combined molecular, genetic, biochemical and spectroscopic approach in our analysis we are investigating the structure-function of the *ChlL* protein.

03:00PM BREAK

03:15PM EFFECTS OF pH MANIPULATION ON POOR FEN ALGAL COMMUNITIES. JENNIFER L. GREENWOOD. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN, OH 43403 AND THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION, PELLSTON, MI 49679.

Ecological variables influential on bog and fen algae have been understudied. Many algal species have peak abundances correlated with acidic, low-nutrient habitats associated with bogs and poor fens, and some species require such habitats. However, no manipulative *in situ* experiments have been performed to examine mechanisms behind the correlations. Levels of pH were manipulated in enclosures in a poor fen in northern lower Michigan. Ambient pH levels of approximately 5.0 were raised to 7.0 by dosing with liquid NaOH and lowered to 4.0 by dosing with H₂SO₄. Algae were allowed colonize in the enclosures on natural substrata for three weeks. Filamentous acidophilic green algae such as *Desmidium* and *Mougeotia* were common in the acidic conditions, but were reduced in the neutral pH treatment. Neutral treatments also had increased numbers of dinoflagellate and chrysophyte algae. Increased numbers of grazing microinvertebrates were also noted in the neutral treatments.

03:30PM SEASONAL AND HYDROLOGICAL INFLUENCES ON LOTIC BENTHIC ALGAL BIOMASS ACCRUAL. STEVEN N. FRANCOEUR, BARRY J.F. BIGGS AND REX L. LOWE. BOWLING GREEN STATE UNIVERSITY, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN OH 43403.

The quantity and quality of benthic algae in streams and rivers is co-regulated by physical, chemical, and biological parameters. New Zealand provides a diverse suite of streams for testing hypotheses concerning the regulation of algal communities. To better understand the factors influencing lotic benthic algal biomass accrual, artificial nutrient-diffusing substrata were deployed in a set of 12 New Zealand streams with different hydrological characteristics over the course of a year. The rate of algal biomass accrual and the presence/magnitude of nutrient limitation was most strongly influenced by season. Flood frequency also affected these variables, but to a lesser extent. In temperate streams, algal community biomass appears to be less impacted by nutrient additions in winter. Hydrologic influences (either direct or indirect) also appear to be important in determining benthic algal biomass, especially in flood-prone streams.

03:45PM EXPOSURE OF PERIPHYTON COMMUNITIES TO TARGET CHEMICALS IN STREAM BIOASSAYS: ARE TARGET ORGANISMS WITHIN THE MAT EXPOSED? R. L. LOWE, J. L. GREENWOOD AND S. E. BELANGER, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Studies were conducted at The Procter & Gamble Company's Experimental Stream Facility (ESF) to assess the potential exposure of algal cells embedded in a periphyton mat matrix to target chemicals. Such bioassays are traditionally conducted by scraping and homogenizing algal mats, then enumerating cells without regard to their distribution in the algal matrix. Our objective in this study was to examine the fine structure of the algal mat matrix and to document patterns of algal cell distribution through the mat. Thin sections of preserved periphyton mat from the ESF were embedded in paraffin, thin sectioned, mounted on microscope slides and examined with brightfield microscopy. Additionally, portions of the material were prepared for examination with scanning electron microscopy. The top surface of algal mats supported a high density of smaller, highly-motile diatoms (species of *Nitzschia*, *Gyrosigma* and *Navicula*). The deeper and bottom portions of the mat had lower cell densities and had a greater abundance of poorly-motile or non-motile taxa such as *Cocconeis placentula*, *Melosira varians* and *Pleurosira laevis*. Investigations are continuing on environmental cues important in algal migration through the mat.

04:00PM BOTTOM-UP REGULATION OF PERIPHYTON IN A NORTHERN MICHIGAN STREAM. TROY A. KELLER. UNIVERSITY OF MICHIGAN, DEPARTMENT OF BIOLOGY, ANN ARBOR MI 48109-1048.

The relative importance of bottom-up and top-down regulation of biological communities has been hypothesized to be influenced by the environmental conditions under which the community of interest exists. Under benign conditions the top-down influence of consumers is predicted to control the biomass of lower trophic levels. This study compared the effects of (1) the removal of an abundant consumer, the crayfish *Orconectes propinquus*, and (2) the addition of both phosphorus and nitrogen on periphyton biomass during summer low-flow conditions in a cool water stream in Michigan. Three levels of nutrients (no, medium, and high) and three crayfish treatments (enclosures, enclosures, and cageless references) were arranged in all combinations at three study sites within the Maple River. The nitrogen and phosphorus mixtures were released using clay pots. Cages were made from 15cm diameter black plastic tubing, formed into a ring, and fastened to the substrate (internal area 1.75sqm). Both Chl. a and the biovolume of algae (not AFDM) increased in

response to nutrient enrichment after 40 days. Crayfish did not alter the Chl. a, AFDM, or biovolume of the algae regardless of nutrient level or the amount of time in the stream. The three study sites differed considerably in Chl. a but not biovolume. The results indicate that nutrient limitation (a bottom-up effect), not crayfish foraging (a top-down effect), controlled periphyton accrual in the Maple River during a relatively benign period.

04:15PM ENZYME ACTIVITY IN LENTIC BIOFILM COMMUNITIES. AMY J. THOMPSON AND ROBERT L. SINSABAUGH. DEPARTMENT OF BIOLOGY, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

An exopolysaccharide (EPS) matrix is a defining structural feature of biofilms. One proposed function of this matrix is the retention of extra cellular enzymes. We are investigating this function in limnetic biofilms by following the kinetics (apparent K_m and Y_{max} values) of phosphatase and aminopeptidase activities in the EPS in relation to ecto-cellular activities. Sampling units containing glass slides are suspended in an eutrophic pond allowing for biofilm colonization. Collection of the units occurs every two weeks spanning a eight month period (April-November). Apparent K_m values range from 2-11 μ M for phosphatase and 20-160 μ M for aminopeptidase. K_m values of the matrix and ecto-enzymes show seasonal differences while matrix activity ranges from 25 to 75% of the total activity and does not appear correlated with EPS concentration. Exocarbohydrate concentration ranges from 0.6-16 μ g/cm² and appears correlated with light intensity. EPS associated protein ranges from 0.35-4 μ g/cm². The data suggest that the concentration of enzymes within the matrix may contribute to the maintenance of metabolic activity within the biofilm.

MICROBIAL BIOLOGY & PHYCOLOGY 9:00AM SATURDAY, APRIL 5, 1997 OLSCAMP HALL ROOM 220 SUSAN CARTY - PRESIDING

09:00AM OPTIMAL CONDITIONS FOR THE GROWTH OF *MICROCOLEUS VAGINATUS* (VAUCH.) GOM., A FILAMENTOUS CYANOBACTERIUM OF MICROPHYTIC SOIL CRUSTS. JOSEPH M. BALCZON, CHRISTOPHER E. BRITTON, AND JEFFREY R. JOHANSEN. JOHN CARROLL UNIVERSITY, UNIVERSITY HEIGHTS OH 44118.

The presence of microphytic soil crusts in deserts enhances stability of the soil and may contribute to soil fertility. These crusts are easily damaged by fire and other physical disturbance (e.g., trampling), and may take decades to fully recover. In an attempt to stimulate recovery of disturbed soils, we are developing technology to mass-culture cyanobacteria for application to soils. We selected *Microcoleus vaginatus*, an important component of microphytic crusts for our inoculum, therefore, we wanted to determine the conditions that were optimal for growth in mass-culture. We conducted two experiments which varied nutrients and light in a fully factorial randomized design. Each experiment had two light levels and two levels of nitrogen and phosphorus. Results from both experiments indicated that light exerted a significant ($p < 0.05$) effect on chlorophyll a biomass, but nutrient levels did not significantly affect biomass. Growth rates of *M. vaginatus* were significantly higher in the low light treatment of the first experiment (150 vs. 50 μ E/m²/s photon-flux density), but in the second experiment light did not influence growth rate (50 vs. 25 μ E/m²/s photon-flux density). Our results indicate that the nutrient levels in our standard growth medium (Z-8) are sufficient for maximal yield (low nutrient treatment), and that optimum light levels are approximately 50 μ E/m²/s.

09:15AM EVALUATION OF THE EFFECT OF TRAMPLING ON THE ABUNDANCE AND DIVERSITY OF CYANOBACTERIA IN DESERT SOILS. DEBBIE A. BRADLEY, JEFFREY R. JOHANSEN, AND VALERIE R. FLECHTNER. DEPARTMENT OF BIOLOGY, JOHN CARROLL UNIVERSITY, UNIVERSITY HEIGHTS OH 44118.

Cryptogamic crusts cover extensive regions of arid and semiarid lands and are thought to be ecologically important. They are defined as water-stable aggregates of surface soil which are consolidated by algae, bacteria, fungi, lichens, and mosses. Evidence indicates that they play a role in stabilizing the soil surface and contribute to soil fertility. The purpose of this project was to quantitatively and qualitatively compare the effects of trampling on the cyanobacterial component of cryptogamic crusts. Soil samples from trampled and untrampled plots were collected from Yuma Proving Grounds, Yuma, Arizona. Cyanobacteria were quantified using the most probable number method and identified from liquid culture using standard light microscopy. A significant difference in algal density was found between the trampled and untrampled plots. The diversity of the sites will be discussed.

09:30AM A COMPARATIVE STUDY OF THE CYANOBACTERIA IN DISTURBED AND UNDISTURBED PLOTS FROM DUGWAY PROVING GROUND, UTAH. RANIER A. NG, VALERIE R. FLECHTNER, JEFFREY R. JOHANSEN. JOHN CARROLL UNIVERSITY, UNIVERSITY HEIGHTS OH 44118.

Cryptogamic crusts have numerous roles that are significant for the desert ecosystem. Perhaps the most important contribution is the stabilization of the soil surface which prevents soil erosion. The stabilization results from the soil aggregation by filamentous cyanobacteria. This study involves the quantitative and qualitative evaluation of the cyanobacteria present in experimental sites located at Dugway Proving Ground, Utah. Each site is divided into six plots which consists of 2 controlled, 2 trampled, and 2 burned plots. Within each pair, one plot received an algal inoculation and the other plot did not. Cyanobacteria were quantified using viable counts on Z-8 media and individual isolates were identified using photomicroscopes with Nomarski DIC optics. Analysis of plate count data indicated a significant difference ($p < 0.05$) in the number of algae present per gram of soil in undisturbed sites as compared to disturbed sites. The species richness of algae also is higher in undisturbed sites (> 20 taxa) than in disturbed sites (6 taxa).

09:45AM ISOLATION AND COMPARISON OF VARIOUS BACTERIODES FRAGILIS BACTERIOPHAGES. MELANIE S SCHLAUDER, MARTHA M. KORY. THE UNIVERSITY OF AKRON, DEPARTMENT OF BIOLOGY, AKRON OH 44325-3908.

Bacteriodes fragilis phages were isolated from primary effluent sewage obtained from the Akron Sewage Treatment Plant. The sewage was clarified by filtration. Each phage was enriched by growth in Brain Heart Infusion Broth (BHI-B) in the clarified sewage, with one of ten clinical strains of *Bacteriodes fragilis*. This resulted in the isolation of six phages. The phages were tested for susceptibility to chloroform and all are resistant. Each phage supernatant was stored with an addition of eight drops of chloroform. The phages were purified by three sequential single-plaque picks. The phages were amplified by growth in 1400 ml of BHI-B with their clinical host strain of *Bacteriodes fragilis*. A sodium chloride and polyethylene glycol precipitation was performed. Each phage was then purified by two to three sequential cesium chloride gradient centrifugations at 192,000 x g for 24 hours. Comparison of the purified phages via transmission electron microscopy, revealed an icosahedral capsid and attached tail. The morphologies of the phages were similar to *Bacteriodes fragilis* phages previously isolated from Nebraska and Virginia. The phages were tested for host range specificity and each revealed a unique spectrum.

10:00AM BREAK

10:15AM A NEW CYANOBACTERIAL GENUS FROM ARID SOILS. VALERIE R. FLECHTNER AND JEFFREY R. JOHANSEN. DEPARTMENT OF BIOLOGY, JOHN CARROLL UNIVERSITY, UNIVERSITY HEIGHTS OH 44118.

A new cyanobacterial genus and species is described from soils of an undisturbed, semi-arid Utah juniper community in the San Rafael Swell, Utah, U.S.A.. This genus shares characters with members of the *Scytonemataceae*, principally heterocyst formation, false branching, and presence of a sheath. However, unlike the trichomes of all previously described genera in this family, most trichomes of the new genus are tightly spiralled. The organism has been isolated only from well crusted, totally undisturbed soils.

10:30AM THE DIATOM FLORA OF FOUR PONDS FROM PRESQUE ISLE STATE PARK, PA. JULIE C. SRAY, JOSEPH M. BALCZON, JEFFREY R. JOHANSEN. JOHN CARROLL UNIVERSITY, DEPARTMENT OF BIOLOGY, UNIVERSITY HTS. OH 44118.

A chronosequence of four sandspit ponds were sampled to determine their diatom flora. Three samples were taken from each pond. One was from the epilimnion and two were epiphytic, sampled from *Myriophyllum* sp., *Vallisneria* sp., or *Nuphar* sp., depending upon which taxa were present. Forty taxa were identified from the youngest pond (Dead Pond). Niagara and Graveyard Ponds contained 39 and 37 taxa, respectively. Long Pond, the oldest of the ponds contained 40 taxa. A total of 62 different taxa were identified in this study. Principal components and cluster analyses indicated that Long Pond and Graveyard Pond were consistently similar with respect to taxonomic composition, and that the diatom communities from Dead Pond and Niagara Pond were different from the other two ponds and each other. It is likely that the differences in taxonomic composition are due, in part, to differences in water chemistry. A principal components analysis indicated that Long and Graveyard Ponds also were similar with respect to turbidity, alkalinity, dissolved oxygen and phosphate concentrations.

10:45AM EXAMINATION OF THE SUBAERIAL DIATOM NAVICULA KRASSKEI HUSTEDT IN THE SCANNING ELECTRON MICROSCOPE. JEFFREY R. JOHANSEN & JULIE C. SRAY. DEPARTMENT OF BIOLOGY, JOHN CARROLL UNIVERSITY, UNIVERSITY HEIGHTS OH 44118.

Navicula krasskei is a common subaerial diatom in Ohio, occurring on the moist sandstone ledges at Hocking Hills, South Chagrin Metropark, and Virginia Kendall Park in the Cuyahoga River National Recreation Area. It has been considered close to either the species group around *Navicula festiva* or the species associated with *N. monoculata*. Examination of *N. krasskei* in the electron microscope revealed that this species is distinct from these species as well as other *Navicula* species for which SEM micrographs are available. Type materials of *N. krasskei* were obtained and found to be similar in morphology to the specimens collected in Ohio. Its most distinctive feature is the presence of small, external costae which are present only in the axial area. Because of its unique ultrastructure, we propose the formation of a new genus for this species, *Microcostatus*.

ECOLOGY

**1:30PM SATURDAY, APRIL 5, 1997
OLSCAMP HALL ROOM 220
ARTHUR L. VORHIES - PRESIDING**

01:30PM ARRIVALS AND DEPARTURES OF TURKEY VULTURES AT THREE COMMUNAL ROOSTS: A TEST OF THE INFORMATION CENTER HYPOTHESIS. NEIL B. SABINE. DEPARTMENT OF NATURAL SCIENCES AND MATHEMATICS, INDIANA UNIVERSITY EAST, RICHMOND IN, 47374.

The Information Center Hypothesis (ICH) proposes that roosts serve to increase the foraging efficiency of its members by sharing information on the location of food. This is accomplished by having unsuccessful birds follow successful individuals from the roost to their food sources. The ICH therefore predicts that roost departures will be more synchronized (due to following) than roost arrivals. Turkey vulture arrival times and departure times were compared at three roosts in western Ohio and eastern Indiana. Most vultures arrived and departed alone. No evidence of departure synchronization was found at any roost and it appears unlikely that information transfer is an important factor in maintaining these aggregations.

01:45PM THE REPRODUCTIVE ECOLOGY AND NATURAL HISTORY OF THE NORTHERN LEOPARD FROG, RANA PIPIENS, IN A RESTORED WETLANDS IN NORTHEASTERN OHIO. ALEXANDER B. COLLIER, DEPARTMENT OF BIOLOGICAL SCIENCES, KENT STATE UNIVERSITY, KENT OH 44242.

A nine month survey of the reproductive ecology and natural history of the northern leopard frog, *Rana pipiens*, began in the spring of 1996. Spawning took place within a three week period beginning in late March when water temperatures climbed above 11°C. Egg deposition was most concentrated in shallow wetlands at an average depth of 9 cm. No masses were deposited at depths greater than 20 cm. An estimated 556,220 eggs were deposited by 203 breeding females. 67% of these masses were attached to either emergent, or non-emergent *Juncus effusus*, *Typha angustifolia* or *T. latifolia*. Juvenile frogs first metamorphosed in mid June at an average snout-vent length of 30.2 mm and a weight of 5.4 g. Mark-recapture analysis revealed a mortality rate suffered between the egg and juvenile stage of as high as 99%. Following metamorphosis, juveniles emigrated from the spawning grounds in large waves coinciding with nocturnal summer rains. However, large numbers of juveniles and adults remained in the area, utilizing an adjacent grassland as summer feeding habitat. Gut content analysis of adult leopard frogs is currently underway. Early results indicate a diet of members of the orders Coleoptera, Hymenoptera, Orthoptera and Diptera, supporting the notion that *R. pipiens* is a generalist which feeds during both night and day. The fall migration of adult and first year leopard frogs back to their overwintering sites at the bottom of a gravel quarry lake began in early October. At that time the density of frogs encountered along the shores of the lake increased dramatically. As temperatures decreased, these frogs sought refuge in the warmer lake. The last terrestrial frog was captured in the area on November 5. The population will continue to be monitored to assess the mortality rates associated with fall hibernation.

02:00PM GASTROTRICHA OF CHESAPEAKE BAY: SYSTEMATICS. WILLIAM D. HUMMOND AND JENNIFER L. KELLY, DEPT. BIOL. SCI. AND MSES PROGRAM, OHIO UNIVERSITY, ATHENS OH 45701.

We are studying species and species interactions of gastrotrichs as influenced by the salinity fluctuations of the Chesapeake Bay estuary. Sandy sediments were collected from littoral and sublittoral sites at 13 beaches along the western shore during July and August 1996. Collections ranged from Virginia Beach to Baltimore, with salinities for the 3 clusters of beaches: 30>15 ppt for the lower (Lo), 11>7 for the middle (Md), and 7>1.5 for the upper (Up). After extraction, specimens were identified using differential interference

contrast optics and recorded on SuperVHS cassette tapes via image-enhanced high-resolution video-microscopy. We found 30 species (15 Macrodasysida (M) and 15 Chaetonotida (C)) in 15 genera (9 M and 6 C). Of this total, 17 spp. (8 M + 9 C) in 8 gen. (4 M + 4 C) are new to science, though we know several of them from recent work. The new M spp. occur at Lo (7) and at Md-Up (1); the new C spp. occur at Lo-Md (1), Lo-Md-Up (2), and Up (6). New spp. in the family *Thaumastodermatidae*, include *Tetranchyroderma* (3), *Turbanella* (3), *Paraturbanella* (1), and *Mesodasys* (1). All but one of these was restricted to Lo. New spp. in the family Chaetonotida include; *Chaetollotus* (3), *Halichaetonotus* (3), *Heterolepidoderma* (2), and *Caudichthyidium* (1). All but three of these were restricted to Up. One sp. of *Chaetonotus* is a member of the fresh-water fauna; other spp. of *Caudichthyidium* are marine supralittoral.

02:15PM COMPARATIVE SOIL AND MYCORRHIZAL DYNAMICS ASSOCIATED WITH HARVESTER ANT DISTURBANCES ON RANGELAND ECOSYSTEMS IN COLORADO AND NEW MEXICO. SEASON R. SNYDER AND CARL F. FRIESE, DEPARTMENT OF BIOLOGY, THE UNIVERSITY OF DAYTON, DAYTON OH 45469-2320.

A fundamental issue in rangeland management is how to translate small-scale measurements and monitoring into effective management practices which can be applied over large areas. A comparative study was conducted on the soil dynamics associated with patch disturbances created by the harvester ant *Pogonomyrmex occidentalis* on semi-arid rangeland in Colorado and *P. rugosus* on arid rangeland in New Mexico. The project was undertaken to study whether modifications in physical properties of soil would in turn result in alterations in plant community structure and diversity as well as alterations in the soil microbial community. The physical properties of soil examined for this study were pH, moisture, organic matter, texture and available nitrogen and phosphorus. The assessment of the soil microbial community consisted of a dehydrogenase assay for microbial activity and percent root infection and total spore counts for arbuscular mycorrhizae (AM). The results showed there were substantial differences among the physical properties of the soil as well as differences in the microbial communities between disturbed and undisturbed soil at the Colorado and New Mexico sites. In addition, there were substantial differences in plant species composition and cover between disturbed and undisturbed soils at both sites. The results of this study not only provide insight into the dynamics of small-scale disturbance, but also have implications for rangeland ecosystem functioning.

02:30PM THE INFLUENCE OF ROCK WALLS ON HABITAT SELECTION BY *PEROMYSCUS* spp. IN CENTRAL NEW ENGLAND. KEVIN W. PULS, 941 CORNELL DR., ALLIANCE OH 44601.

Rock walls are a familiar sight in much of New England's landscape and have an impact on the fauna and flora that surrounds them. These walls may create a non-random species distribution. The focus of this project is to determine how the rock walls have influenced the dispersion of individuals within a population of *Peromyscus* spp. This study was performed in two second growth hardwood stands of the Prospect Hill Tract of the Harvard Forest, from mid-June to late July 1996. Both sites different in species diversity and biomass. Each of the two sites were studied successively in the same manner. Each site contained sixty four Sherman live traps arranged in eight rows of eight parallel to the wall at five meter intervals. Traps were baited with sunflower seeds and checked every morning for eighteen days. All *Peromyscus* spp. were marked as individuals and weighed upon original capture. Each capture location was noted for all individuals. Structural mapping for coarse woody debris, trees greater than 5cm dbh, stones, pits and mounds was done both in and 5m beyond the 35m square area. The results indicate that the wall had an adverse effect on habitat selection by *Peromyscus* spp.. Mice were captured in greater numbers at the trap locations farthest from the wall. 4%-6% of the total mice were captured at the most proximate trap locations to the wall and 36%-37% were captured at the farthest trap location from the wall.

02:45PM THE ACALYPTRATE DIPTERA ASSOCIATED WITH THE SPIKE-SEDGE *ELEOCHARIS SMALLII*. P.A. WALUNIS AND B.A. FOOTE, DEPT. OF BIOLOGICAL SCIENCES, KENT STATE UNIVERSITY, KENT OH 44242.

Diptera are an important component of most wetland systems, but little information exists regarding the biology and ecology of Diptera associated with wetland plants. Acalyptrate Diptera were collected biweekly from 22 May to 9 Oct., 1996 from *E. smallii* using pan traps and sweep nets. A total of 161 individuals representing 23 species, 17 genera, and 7 families were collected. Chloropidae and Sciomyzidae were the most abundant (77 and 61 individuals, respectively) and species rich (7 and 6, respectively) families. Three families (Agromyzidae, Drosophilidae, and Otitidae) were each represented by only one individual while 15 individuals (5 species) were recorded for Ephydriidae. Chloropids reached a peak between 2 Jul. and 16 Jul. ($x=25$), with low numbers before and after this period. Sciomyzid numbers varied before the peak between 28 Aug. and 9 Sept. ($x=17$), and declined to zero after 9 Sept. Shannon-Weiner species diversity of the acalyptrates varied throughout the

study with the lowest diversity recorded on 2 Jul. ($H'=0.866$) and the highest, on 16 Jul. ($H'=2.062$). We thank the Ohio Biological Survey and Water Resources Research Institute for partial funding of this research.

03:00PM GIBRALTAR ISLAND, PUT-IN-BAY, OHIO: HOT SPOT FOR TERRESTRIAL ISOPOD (ONISCOIDEA) DIVERSITY. GWYNNE S. RIFE. COLLEGE OF THE SCIENCES. UNIVERSITY OF FINDLAY. 1000 N. MAIN ST., FINDLAY OH 45840. RIFE@LUCY.FINDLAY.EDU.

Summer collections of terrestrial isopods from Ohio often yield two to three species in an area. Three collections (1990-1992) from a wood pile at the northeast area of Gibraltar Island (Putin-Bay, Ohio) found six species [*Armadillidium vulgare* (Latreille), *Cylisticus convexus* (DeGeer), *Porcellio spinicornis* Say, *Porcellionides pruinosus*(Brandt), *Trachelipus rathkei* (Brandt), and *Haplothalamus danicus* Budde-Lund] representing five families coexisting. Larger local Lake Erie Islands (Green Island, Kelleys Island) surveyed revealed one third the diversity, although different species in some cases. Ecomorphological adaptations in exoskeletal structure as well as microstructure of the isopod cuticle reveal strikingly diverse characteristics as well. Collections across the northwest Ohio mainland area never yielded the diversity or the number of less common species collected from the Erie Islands. Perhaps Lake Erie provides a buffer zone that has either isolated pre-existing species, or protects native introduced populations from environmental factors that limit their ability to prosper in other locations.

03:15PM ENVIRONMENTAL INFLUENCES ON CLUSTERING BEHAVIOR OF *CLIBANARIUS TRICOLOR* ON SAN SALVADOR, THE BAHAMAS. DAVID M. EFFRON, AMY R. FELTON. DEPARTMENT OF BIOLOGY, WITTENBERG UNIVERSITY. SPRINGFIELD OH 45501.

We investigated the effects of light, tide, and salinity on the three-colored hermit crab on San Salvador, The Bahamas. We observed during the day and night at both high and low tides. A tank with an artificial current reproduced tidal effects and covering the tank simulated night. Separate tanks were used to study the effects of decreased salinity. To measure the effects we recorded the number of hermit crabs in and out of the water at 45 minute intervals. We found that this species of hermit crab forms clusters at low tide and are more aggregated during daylight hours. We also found a tolerance to extreme low salinities in adult *Clibanarius tricolor*. However, low salinities were avoided by the crabs. Clustering in reaction to changing tides aids *C. tricolor* in the avoidance of predators and withstanding strong currents. To prevent desiccation *C. tricolor* clusters more closely during intense sunlight. *C. tricolor* escapes low salinities to aid in successful reproduction and survival of offspring. Whether *C. tricolor* clusters to escape low salinities was not observed.

03:30PM ENVIRONMENTAL INFLUENCES ON FEEDING IN *ACANTHURUS COERULEUS* OFF SAN SALVADOR, THE BAHAMAS. JEFFREY A. CULP AND CRAIG A. FAULHABER. WITTENBERG UNIVERSITY BOX 1607. P.O. BOX 6100. SPRINGFIELD OH 45501.

Herbivorous fish have been found to reduce algal biomass, increase algal productivity, and influence algal species composition and distribution on marine reefs. Compared to the amount of literature on terrestrial herbivores, relatively little research has been published concerning marine herbivores. Moreover, while most studies of herbivorous fish have concentrated on the fish's effect on the algal community, little research has been conducted on how environmental parameters impact daily feeding behavior. We studied a common herbivorous fish, *Acanthurus coeruleus*, from 4 June 1996 to 12 June 1996 in order to assess the parameters which might affect feeding frequency and number of bites per feeding episode. Our study site consisted of 3 patch reefs off San Salvador, The Bahamas. We recorded the frequency of bites and the number of bites per feeding episode and noted the tide level, cloud cover, location, and time of day. The tide level and cloud cover did not significantly impact the number nor frequency of bites. *Acanthurus coeruleus* differed in the median number ($m = 3, 2, 3$ bites/episode) and frequency ($m = 0.2011, 0.1000, 0.2534$ bites/second) of bites. Although the effects of different gene pools cannot be discounted, the observed differences may be due to variation in sizes of fish, levels of predator susceptibility, competitive grazing pressures, and the reef geography at the different sites. There was a noticeable increase in bites and frequency from morning to evening. This increase is consistent with observations of other herbivorous species.

03:45PM FACTORS INFLUENCING CORAL DAMAGE ON PATCH REEFS OF SAN SALVADOR, THE BAHAMAS. CHRISTINA A. BECK AND MARIA C. NIKOKIRAKIS. DEPARTMENT OF BIOLOGY, WITTENBERG UNIVERSITY, SPRINGFIELD OH 45501.

Coral reefs provide a high diversity and highly productive community within an oligotrophic environment. The destruction of coral colonies greatly affects this entire marine ecosystem. Since corals are fundamental to long term reef viability, their destruction, caused by environmental changes,

affects the stability of the reef community. We surveyed the amount of damage on the patch reefs of San Salvador, The Bahamas with respect to the size of the colony, geographic location, position on the reef, and species to determine which factors most influence coral damage. Quadrants were randomly selected across reefs. Coral damage was affected by colony size and species ($p < .05$) and not by geographic location or position on the reef ($p > .05$). We concluded that the present damage is directly proportional to coral size. In addition, alcyonarian (soft) corals exhibited significantly less damage than zooantharian (stony) corals. We hypothesize that the major causes of coral damage around San Salvador are sedimentation and anthropogenic disturbance.

04:00PM DIAGENESIS OF MERCURY IN LAKE CORES: A TEST CASE.
BRENDA SIMMERS AND JOHAN F. GOTTGENS. DEPARTMENT OF BIOLOGY, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

Diagenetic processes have been used as an argument against the use of sediment cores as historical records of atmospheric mercury pollution. Mercury may migrate to the sediment surface and become adsorbed on oxides and hydroxides with higher redox potential. Essentially, sediment cores should then show enriched surface sediments followed by decreasing concentrations of mercury. This hypothesis was tested by comparing stratigraphic mercury in cores of the western basin of Lake Erie taken in 1971 and 1995. The 1971 study showed a mercury enriched surface zone (0.34-1.8ppm Hg) followed by decreasing concentrations with depth (0.05-0.22ppm Hg). Cores from the same area were selected from the 1971 and 1995 study. Using radioisotopic dating techniques, the layer(s) containing sediments from 1971 were identified in the 1995 cores. Mercury concentrations in this layer will be compared with the 1971 data and with more recent deposits subject to lower mercury accumulation. Concern over the long range transport and deposition of mercury has raised questions about the suitability of various methods, such as lake cores as natural archives of accumulation. This study addresses one of those concerns.

MOLECULAR BIOLOGY

1:30PM SATURDAY, APRIL 5, 1997 OLSCAMP HALL ROOM 229 DEAN FRAGA - PRESIDING

01:30PM A MOLECULAR PHYLOGENY FOR THE DARTER SUBGENERA *ETHEOSTOMA* AND *ULOCENTRA* AS INFERRED FROM MTDNA D-LOOP SEQUENCE DATA. B.A. PORTER, T.M. CAVENDER, AND P.A. FUERST, DEPARTMENT OF ZOOLOGY, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

The twenty species of snubnose darters in the subgenus *Ulocentra* are primarily distinguished from one another by the coloration of the male during a short breeding season. The remainder of the year the males adopt cryptic colorations that are so convergent that reliable species identification is often impossible. Morphological characters have provided only minimal resolution of species relationships within *Ulocentra*, and some researchers have continued to dispute the monophyly of the subgenus. This study provides a molecular phylogeny for the twenty species of *Ulocentra* and eleven species of the sister subgenus *Etheostoma* using sequence data from the mtDNA D-loop. Both distance methods and parsimony support the monophyly of *Ulocentra* and indicate three main species groups within the subgenus. The monophyly of the subgenus *Etheostoma* is questionable, since the members of the *variatum* group are more closely related to the subgenus *Litocara*. Heteroduplex analysis was used to screen multiple individuals from each species to determine the number, frequency, and sequence of intraspecific haplotypes. This method assures that each taxa was adequately represented in the phylogeny and provides data to examine hypotheses on both the species and population level.

01:45PM THE UTILITY OF THE SMALL SUBUNIT (18S) RIBOSOMAL RNA GENE IN INFERRING INFRA-DIVISION, SUPERORDER, AND ORDER LEVEL RELATIONSHIPS IN TELEOSTEI FISHES. B.D. MARK, AND P.A. FUERST, DEPARTMENT OF ZOOLOGY, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

Teleostei are by far the most abundant and diverse group of vertebrates, alone comprising about 96% of all extant fishes. Since their original classification by Greenwood, the higher level relationships within the Teleostei have proven to be problematic. Despite the wide array of techniques available to obtain characters, many of the higher level relationships still remain unresolved. Molecular approaches are now commonly applied to taxonomic problems. The choice of which gene to study, however, is not always obvious. Because of its ubiquitous occurrence, the gene coding for the small

subunit ribosomal RNA has been examined in a wide variety of organisms. In several studies, it has been suggested that the DNA sequence of the small subunit (18S) ribosomal RNA gene evolves at a rate of approximately 1% nucleotide substitutions per site per fifty million years. We have been determining the 18S rRNA gene sequence for a variety of fish. The patterns of change within the gene, and the inferred rate of change between various taxonomic groups within the Teleostei are being studied. With a diversification of the teleostean fishes occurring over 200 million years ago, the ability of 18S rRNA gene sequences to illuminate questions at the infradivision, superorder and order level will be explored in the context of the frequency of phylogenetically informative characters. (Supported by funds from the National Science Foundation and Ohio Sea Grant.)

02:00PM USE OF MITOCHONDRIAL DNA SEQUENCES TO TRACK PHENOTYPIC CHANGES BETWEEN BLUEHOLE AND EXPERIMENTALLY TRANSPLANTED POPULATIONS OF *GAMBUSIA HUBBSI*. JULIE L. MAYBRUCK, JERRY DOWNHOWER* AND PAUL A. FUERST, DEPTS. OF MOLECULAR GENETICS AND *ZOOLOGY, THE OHIO STATE UNIVERSITY, 484 W. 12TH AVENUE, COLUMBUS OH 43210.

The mosquitofish, *Gambusia hubbsi*, is found on Andros Island, The Bahamas. It occurs in isolated blue hole populations, and in potentially continuous or semi-continuous shallow ditches and ponds. We have been studying the rapid evolution of different life history strategies in various populations. As part of these studies, populations are being transplanted from some blue hole populations into apparently unoccupied isolated bodies of water. The transplanted populations appear to show substantial changes in morphology, which would be correlated with life history traits such as age of maturation and clutch size. To confirm that the altered morphology/life history is occurring in the descendants of the original transplanted group, DNA sequences of a portion of the mitochondrial control region are being determined for a series of fish from these sites. The mt-DNA haplotypes are compared to those found in the blue hole populations which served as the source of the transplanted fish. The sequences are also compared to those which exist in other bluehole populations and in adjacent naturally occurring non-bluehole populations, to determine whether any other locality could be contributing migrant fish to the experimental sites. (Supported by funds from the National Geographic Society.)

02:15PM RANDOMLY AMPLIFIED POLYMORPHIC DNA CHARACTERIZATION OF NINGU (*LABEO VICTORIANUS*, PISCES: CYPRINIDAE) POPULATIONS OF LAKE KYOGA AND LAKE VICTORIA BASINS, EAST AFRICA. WILSON WAISMA MWANJA, LES KAUFMAN+ AND PAUL A. FUERST*, DEPTS. OF ZOOLOGY AND *MOLECULAR GENETICS, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210, AND +DEPT. OF BIOLOGY, BOSTON UNIVERSITY, BOSTON MA.

Labeo victorianus is a lacustrine Labeine cyprinidae species endemic to the Lake Victoria basin in East Africa. Overfishing has resulted in a drastic reduction of population sizes, and an apparent fragmentation of the population into isolated demes. The levels of genetic variability remaining in endangered ningu populations, and the distribution of this variation among localities have been studied. Random amplified polymorphic DNA (RAPD) markers were used to characterize the genetic population structure of the remnant surviving populations of the ningu in lakes Kyoga and Victoria. A total of 100 marker loci were generated using five RAPD primers. We found that 29% of the markers were unique to specific populations. Despite their recent reduction in size, ningu populations exhibited high levels of polymorphism with an average of 82.30% bands being polymorphic in the study. Comparison of individuals showed that there was significantly more band sharing within than between populations. Individuals within the same lake were differentiated into distinct units associated with the locality (river mouths) of capture. Despite the severe decrease in population sizes, ningu exhibited higher levels of genetic diversity than its congeners from Lake Albert. (Supported by funds from the National Science Foundation.)

02:30PM USE OF DNA MICROSATELLITE LOCI TO ESTIMATE THE EFFECTIVE POPULATION SIZE OF A CAPTIVE-BRED LAKE VICTORIA CICHLID MANAGED WITHIN THE SPECIES SURVIVAL PLAN (SSP). A. C. FIUMERA AND P. A. FUERST; DEPARTMENT OF ZOOLOGY, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

Currently, all Lake Victoria haplochromine fish species are listed as endangered due to an introduced predator and anthropogenic effects. To prevent further extinctions, a captive breeding and reintroduction program has been implemented. In order for these efforts to be successful, genetic diversity must be maintained within the captive populations. However, loss of genetic diversity due to genetic drift is unavoidable in small populations. Knowledge of the effective population size can predict the rate at which genetic diversity is lost. Variation is lost more quickly in populations with smaller effective sizes. Maximizing the effective population size is of critical importance to a successful captive breeding program. Small fin snips were taken non-destructively for

DNA analysis from approximately 20 individuals of each of several discrete generations in the captive breeding program for *Prognathochromis perrieri*. Allele frequencies were calculated for several DNA microsatellite loci. The effective sizes of the captive populations were estimated from changes in the allele frequencies between generations. This knowledge will provide valuable information concerning future management decisions of this and other endangered freshwater fish being maintained in captive situations. (Supported by funds from NSF and the Columbus Zoo).

02:45PM ASSEMBLY OF THE Fe-PROTEIN OF NITROGENASE: MOLECULAR AND GENETIC ANALYSIS OF *nifM* MUTANTS OF *KLEBSIELLA*. TIFFANY R. H. CHANDLER, EKEM T. EFUET, LAKSHMI PULAKAT AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The assembly of nitrogenase is one of the fascinating unresolved questions in bioinorganic chemistry and prokaryotic molecular biology. This multi-component enzyme not only requires the expression of genes encoding the proteins that are part of this complex enzyme, but also genes that encode proteins whose activities are required for the maturation and assembly of these subunits into the holoenzyme. *NifM* is one of these helper proteins and recently we have shown that this protein functions as a peptidyl prolyl cis/trans isomerase. In this work we have characterized some of the *nifM* point mutants of *Klebsiella pneumoniae* that were isolated by chemical mutagenesis. Initially we have cloned the *nifM* from these mutants and subjected them to nucleotide sequence analysis. This analysis not only served us as a guide-line in generating site-directed mutants of *Azotobacter vinelandii nifM* but also helped us to understand the structure-function of the NifM-protein. The results of this analysis will be presented.

03:00PM PROTEIN KINASE C ISOENZYMES EXPRESSED IN IAR20 PC1 CELLS. WEN SHENG LIU AND CAROL A. HECKMAN, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Protein kinase C (PKC) is an enzyme which is activated either by diacylglycerol (DAG) or phorbol ester tumor promoters. DAG is produced by the hydrolysis of inositol phospholipids which is in turn initiated by binding of some ligands to receptors. PKC limits the duration of signaling by lowering the ligand-receptor affinity or by reducing the number of available receptors. PKC exists as a family; so far eleven different isoenzymes: α , β 1, β 11, γ , δ , ϵ , ζ , η , θ , ι (λ) and μ have been identified by molecular cloning. PKC isoenzymes are remarkably different in number and amount in different cell lines and tissues. We tested for the isoenzymes expressed in IAR20 PC1 cells by Western blotting. We found that α , β , μ , δ , ϵ and ι (λ) were expressed when the cells were sparse (30%); α , γ , δ , ϵ and ι (λ) were expressed when cells were underconfluent (70%). When cells were confluent (100%), α , δ , ϵ and λ were expressed. Only δ , ϵ and λ were found when the cells were overconfluent. These results show that some PKC isoenzymes are only expressed when cells are subconfluent and are degraded or no longer synthesized in confluent culture. Some are expressed at all times. It is known that PKC isoenzymes can be degraded rapidly after being activated. Further work on PKC isoenzyme expression is required to determine whether activation events work to reduce the amount of α , β , and γ . The results imply that the PKC system can play different functions at cell's different stages.

03:15PM SEXING CRANES BASED WITH RAPD-PCR: A METHOD USING DNA EXTRACTED FROM FEATHERS. WENRUI DUAN AND PAUL A. FUERST*, DEPTS. OF ZOOLOGY AND *MOLECULAR GENETICS, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

Cranes form the group of the tallest flying birds in the world. Of 15 species of cranes, 7 species are on the Red List of threatened species by The World Conservation Union (IUCN). Population size of some species is very small. For examples, the total number of wild whooping crane (*Grus americana*) was about 150 individuals in 1996. There is no difference in morphology between male and female cranes, and the sex of a crane cannot be distinguished visually. In the field, researchers sex adult cranes using the unison call during breeding season. Laboratory methods to sex cranes determine the karyotype or test hormone level. Both methods require fresh tissue or blood. To obtain this blood sample, a crane has to be captured, which can be very difficult and introduces a risk of mortality. It is essential to find a easy, safe, and non-invasive method to sex cranes. We have used RAPD-PCR (Randomly Amplified Polymorphic DNA determined using the Polymerase Chain Reaction, PCR) to search for DNA sequences localized to the crane sex chromosomes, the W chromosome. Workers from the International Crane Foundation (ICF) and the Patuxent Environmental Research Center collected feathers from individuals of known sex for six species of crane: Wattled crane (*Bugeranus carunculatus*), Siberian crane (*B. leucogeranus*), Japanese crane (*Grus japonensis*), Black-necked crane (*G. nigricollis*), Hooded crane (*G. monachus*) and Sarus crane (*G. antigone*). DNA was extracted from feathers and used for RAPD-PCR. To date, thirty RAPD primers have been tested and a putative

female specific bands has been identified in the Siberian crane. The implications of this and other data will be discussed.

03:30PM EVIDENCE THAT CALMODULIN CONCENTRATION DIFFERENTIALLY REGULATES THE ACTIVITY OF CALCIUM-DEPENDENT IONIC CURRENTS IN *PARAMECIUM*. DEAN FRAGA, JUNJI YANO, MICHAEL REED, JUDY VAN HOUTEN, AND ROBERT HINRICHSSEN COLLEGE OF WOOSTER, DEPARTMENT OF BIOLOGY, WOOSTER OH 44691.

Paramecium utilize the opposing Ca^{++} /calmodulin-dependent Na^{+} and K^{+} currents to help regulate the duration of its backward swimming response to adverse stimuli. Both of these currents have been shown by genetic experiments to be regulated by calmodulin. Calmodulin is composed of two separate calcium-binding domains and a key feature of its regulation of calcium-dependent processes is that these different domains regulate different processes. By using a combination of electrophysiology and antisense oligonucleotides we have obtained evidence that calmodulin concentrations are differentially important for proper activation of these calcium-dependent ionic currents in *Paramecium*. Cells treated with AS ODN directed towards calmodulin mRNA have almost no detectable calcium-dependent Na^{+} current, whereas only a subpopulation of these treated cells will have any reduction in their calcium-dependent K^{+} current (up to 50%). Thus we conclude that the calcium-dependent Na^{+} current is more sensitive to calmodulin levels in the cell than the calcium-dependent K^{+} current. Differential effects of calmodulin based on its apparent levels in the cell have not been reported before but this aspect may not have been examined in other systems. The essential lesson from our studies is that mutations that appear to affect one of calmodulin's regulatory functions in a specific manner may actually be due to a reduced stability of the protein and thus the genetic mapping of the functional domains of calmodulin must be done with regard to this possibility.

03:45PM IDENTIFICATION OF THE O-SPECIFIC ANTIGEN BIOSYNTHETIC (RFB) GENE CLUSTER IN *AZOTOBACTER*. JEFFREY A. WILLIAMSON, LAKSHMI PULAKAT, RYAN P. SCHREINER, BRYAN S. HAUSMAN, EKEM T. EFUET AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The three formal domains of lipopolysaccharide are the O-antigen, the core region and the lipid A moiety. The O-antigen domain is presumed to be important for establishing infections in mammalian organisms. The genes required for the biosynthesis of O-antigen specific polysaccharides are identified in common pathogenic bacteria such as *Salmonella* and *Shigella*. However, the common laboratory strain *E. coli* K12 does not express the capsule or O-antigens and the antigenic features of this bacterium could not be established. Recently, it was shown that the DNA sequences corresponding to the O-specific lipopolysaccharide biosynthesis region (rfb) are present on the *E. coli* chromosome as well. *Azotobacter vinelandii* is a gram-negative, aerobic, nitrogen-fixing, non-symbiotic soil bacterium. To date there are no reports to suggest that this bacterium associates with any eukaryotic organisms in a symbiotic or parasitic manner. However, our analysis of the chromosome of *A. vinelandii* has revealed the presence of a gene cluster that is highly homologous to the rfb gene cluster of *S. typhimurium*. We are investigating the possible role of this gene cluster in a soil bacterium like *Azotobacter*. Nucleotide sequence, mutational analysis and the expression patterns of these genes will be presented.

04:00PM MOLECULAR INVESTIGATIONS ON THE STATUS OF POLYPLOIDY IN *AZOTOBACTER*. EKEM T. EFUET, MARI C. ANGUIANO, LAKSHMI PULAKAT AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The *Azotobacter vinelandii* is a soil bacterium with high metabolic activity. Previous experiments by other investigators on the DNA content of *A. vinelandii* have demonstrated that the DNA content in these cells is several folds higher than that of *E. coli*. On the basis of this observation, it was hypothesized that *A. vinelandii* has at least 40 to 80 identical chromosomes per cell. However, the gene dosage analysis in *A. vinelandii* cells suggested that many genetic operations can be performed in these cells without the constraints expected in a polyploid bacterium. In an attempt to explain this apparent discrepancy, we have done systematic analyses of the relationship between the DNA content and the cell volume of this bacterium. This result is apparently consistent with the concept that the *A. vinelandii* is a polyploid bacterium. However, our further analysis of the total nucleic acid content per cell showed that the DNA content per cell remains similar to that of *E. coli* during its growth. By contrast, the RNA content per cell of *A. vinelandii* seems to increase by about 5 fold when the culture reaches late exponential phase. Therefore, our results imply that the increase in the cell volume could be due to the high rate of transcription and translation, rather than the existence of multiple chromosomes per cell.

04:15PM YEAST TWO HYBRID ANALYSIS OF THE NITROGENASE SYSTEM OF *AZOTOBACTER VINELANDII*. KEN PARKER, SAEHONG LEE AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Nitrogenase is a complex enzymatic system in which a select group of bacteria reduce atmospheric N_2 into the biologically usable form of ammonia. The nitrogenase system utilizes over 20 nitrogenase-specific proteins in the reduction of N_2 , in the assembly and modification of its component proteins, and in the regulation of the system's expression. While some of the core proteins directly involved in the fixation of N_2 have been characterized, many of the component proteins involved in the regulation and maturation of the system proteins remain poorly understood. To analyze these proteins, we have utilized the Yeast Two Hybrid System. In this *in vivo* system, hybrid proteins are generated that comprise a fusion between the functional domains of a transcriptional activator and two proteins of interest. Direct interaction of the proteins of interest effectively reassembles the transcriptional activator, initiating the transcription of a reporter gene, thereby identifying positive interactions. Our current work seeks to utilize this analysis technique to characterize the functional role and associating partners of the NifW and NifZ proteins. At this time, our data suggests that the NifW protein interacts both with itself and the NifZ protein. We propose that these proteins form a multimeric complex that may associate with the MoFe Protein, protecting the complex from oxygen damage.

04:30PM MOLECULAR CLONING AND TRANSCRIPT ANALYSIS OF *rnpA* GENE FROM *AZOTOBACTER*. FASSIL KETEMA, MARI C. ANGUIANO, DIANA GASSER, LAKSHMI PULAKAT AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

A. vinelandii is a gram-negative soil bacterium capable of fixing nitrogen under strictly aerobic conditions. Initial investigations on the organization of the *Azotobacter* chromosome indicated that *A. vinelandii* cells may contain at least 40 chromosomes per cell. Our analysis on the DNA and RNA content per cell revealed that while the DNA content per cell remained unchanged during the growth phase, the RNA content per cell increased by about five fold. To understand the molecular basis for this increase, we are investigating on the DNA-dependent RNA polymerase that transcribes all RNA molecules in *Azotobacter*. As a first step, we have cloned a gene that encodes a subunit of DNA-dependent RNA polymerase by homology screening with heterologous probes. This gene is characterized by nucleotide sequence analysis and transcription mapping of the promoter and its regulation.

BIOCHEMISTRY & PARASITOLOGY

3:45PM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 227

REBECCA R. MCKENNA - PRESIDING

03:45PM MITOCHONDRIAL NADPH→NAD⁺ TRANSHYDROGENASE: A POTENTIAL PROTON PUMPING MECHANISM COUPLED TO ANAEROBIC PHOSPHORYLATION IN *HYMENOLEPIS DIMINUTA* (CESTODA). NANCY A. MERCER AND CARMEN F. FIORAVANTI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The adult intestinal cestode, *Hymenolepis diminuta*, is essentially anaerobic with respect to energy generation and accumulates succinate as the major end-product of glucose utilization. The mitochondrial metabolism of glycolytically derived malate, via the "malic" enzyme, by many of the parasitic helminths produces reduced pyridine nucleotide needed for anaerobic electron transport and subsequent succinate formation. In the helminths, the electron transport system requires NADH. However, in *H. diminuta* and other systems, the "malic" enzyme produces NADPH despite the electron transport requirement for NADH. To resolve this problem, *H. diminuta* employs a mitochondrial, inner membrane bound NADPH→NAD⁺ transhydrogenase that catalyzes the reaction $NADPH + NAD^+ \leftrightarrow NADP^+ + NADH$, producing NADH for electron transport. We have found that with hydride ion transfer the cestode transhydrogenase also catalyzes transmembrane proton translocation as evaluated utilizing the fluorescent probe 8-anilino-1-naphthalenesulfonic acid and submitochondrial particles (SMP) as the enzyme source. Indeed, based on initial studies, intravesicular proton accumulation by the SMP-catalyzed transhydrogenase reaction was apparent. These studies have been expanded to include evaluations of the effects of protonophores and dicyclohexylcarbodiimide, a known inhibitor of proton translocating systems. Secondly, preliminary data suggest that in its catalysis of NADPH→NAD⁺ transhydrogenation and proton translocation, *H. diminuta* mitochondria may be energized to the extent as to foster net ATP synthesis as indicated by measurements of ³²P incorporation into ATP. For the latter studies, SMP are

being employed. To this end, we will evaluate for the first time whether the *H. diminuta* NADPH→NAD⁺ transhydrogenase serves as an alternate site for anaerobic phosphorylation. Supported by NIH Grant AI15597.

04:00PM EVALUATION OF AN NADPH→NAD TRANSHYDROGENATION REACTION CATALYZED BY THE MITOCHONDRIA OF THE ADULT NEMATODE *ASCARIS SUUM*. DAVID V. UPITE AND CARMEN F. FIORAVANTI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The adult nematode *Ascaris suum* is predominantly anaerobic in terms of its physiological energetics and produces succinate and products derived from succinate as the result of glucose dissimilation. Many parasitic helminths produce cytosolic malate that, in turn, serves as the mitochondrial substrate to produce reduced pyridine nucleotides. In some of the helminths, malate metabolism by the "malic" enzyme leads to NADPH formation despite the need for NADH as the reductant for the electron transport system (ETS). In these systems, a mitochondrial NADPH→NAD transhydrogenase that catalyzes the reaction $NADPH + NAD^+ \rightarrow NADP^+ + NADH$, produces the required NADH for ETS. Apparently in *Hymenolepis diminuta* the transhydrogenase couples hydride transfer with transmembrane proton shuttling. Therefore, it is of interest that although the *A. suum* "malic" enzyme prefers NAD, these organelles exhibit an NADPH transhydrogenation reaction. Our initial characterization of the transhydrogenation reaction in *A. suum* mitochondria revealed that it is membrane-associated and stable to dialysis. Using isolated mitochondrial membranes as the enzyme source the greater transhydrogenation activity was noted under acidic conditions and the reaction was inhibited either NAD or 5' AMP. Further studies were undertaken to determine if the NADPH→NAD reaction in *A. suum* is the product of an independent pyridine nucleotide transhydrogenase or the result of another enzyme system(s). Thermal lability profiles suggested that the NADPH→NAD reaction is associated with mitochondrial lipoamide dehydrogenase. In light of these findings, the ascarid NADPH→NAD transhydrogenation will be examined in terms of enzymatic activity and Western blot analyses using antibodies generated against the *H. diminuta* lipoamide dehydrogenase and transhydrogenase. These studies will permit further characterization and allow for an evaluation of the possible physiological function of the NADPH→NAD reaction in *A. suum*. Supported by NIH Grant AI-15597.

04:15PM BOT FLY (*CUTEREBRA*) INFESTATION AS A FUNCTION OF HOST (*PEROMYSCUS*) DENSITIES. REBECCA R. MCKENNA, JOSEPH A. BRUSEO, AND STEPHEN H. VESSEY, BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Bot flies (*Cuterebra*) are common larval parasites of *P. leucopus* and *P. maniculatus*. Few studies have explored the relationship between host density and infestation rates at varying host densities. The purposes of this study were to document the relationship between host density and infestation rate and to explore the possibility of a biannual peak in infestation rate consistent with direct development of the parasite. Cuterebrid infestation rates were examined in 2 populations of *Peromyscus* spp.: one at a 2ha wood lot grid in Wood County, Ohio (SS1) and the other in deciduous woodlands of Pennsylvania (SS2), for 8 and 4 years respectively. Mice were live-trapped yearly from May-October and examined for presence of bot fly larvae. Mice were sexed, tagged and released. There was no evidence of a relationship between host density and infestation rate ($r=0.162$, $P=0.20$). A yearly secondary peak in parasite numbers was shown in most years at both sites. There was a male bias in infestation rates at SS1 ($X^2=6.575$, $P>0.01$), but not at SS2. Data strongly suggest the presence of a short and immediate pupation excluding diapause, as evidenced by the yearly secondary peak. Large deviations in population numbers and infestation rates are probably due to variation in external factors such as climate or aggregation site availability for parasites.

04:30PM MITOCHONDRIAL CYTOCHROME C PEROXIDASE ACTIVITY OF ADULT *HYMENOLEPIS DIMINUTA* (CESTODA). JEFFERY P. BELAIR, JAHMAL B. GREEN, AND CARMEN F. FIORAVANTI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The adult intestinal cestode, *Hymenolepis diminuta*, displays a predominantly anaerobic energy metabolism that is characterized by the accumulation of succinate as the major end product. Succinate accumulation is the result of the NADH-dependent, electron transport-coupled fumarate reductase system. Succinate accumulation is accompanied by a Site-I dependent, rotenone sensitive, net generation of ATP. Previous studies from our laboratory demonstrated that the *H. diminuta* mitochondrial system, when exposed to oxygen, can form peroxide. However, it appears that the *H. diminuta* system lacks catalase. By contrast we have noted that *H. diminuta* mitochondria contain small quantities of cytochrome c and display appreciable cytochrome c peroxidase activity. Therefore, it would appear that cytochrome c peroxidase may be an avenue for the removal of intermittently formed peroxide. We have evaluated cytochrome c peroxidase activity in *H. diminuta* mitochon-

dria and found that it is predominantly associated with the mitochondrial soluble fraction. As such it is differentiated from a predominantly membrane associated cytochrome oxidase activity. The cestode cytochrome c peroxidase activity appeared more optimal at pH 7.5 and, was less stable than cytochrome c oxidase when subjected to thermal denaturation. Preliminary findings indicate as well that the cytochrome c peroxidase activity of *H. diminuta* can be maintained more readily in the presence of the protease inhibitor, PMSF, and 25% glycerol. These latter data provide a frame work for initial purification studies of cytochrome c peroxidase. Supported by NIH Grant AI15597.

04:45PM THE MITOCHONDRIAL TRANSHYDROGENASES OF ADULT HYMENOLEPIS MICROSTOMA (CESTODA) AND FASCIOLA HEPATICA (TREMATODA). AARON M. WATSON AND CARMEN F. FIORAVANTI. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Mitochondria from the mouse bile duct cestode, *Hymenolepis microstoma*, exhibit a pyridine nucleotide transhydrogenase that catalyzes hydride transfer from NADPH to NAD. As such this system couples mitochondrial NADP-specific "malic" enzyme with the NADH-utilizing electron transport system. Recently, we found that the *H. microstoma* transhydrogenase acts in reversible hydride transfer, i.e., transfer from NADH to NADP. Significantly in the direction of NADP reduction, the reaction can be energy-linked, i.e., NAD reduction is markedly stimulated by either electron transport-dependent NADH utilization or ATP hydrolysis by ATPase. These data are consistent with the cestode NADH→NADP reaction being energized in response to a proton gradient. It is noteworthy that the catalysis of NADPH→NAD transhydrogenation was inhibited by N,N'-dicyclohexylcarbodiimide (DCCD), a known inhibitor of proton translocating systems. Our evaluations of the mitochondria of adult *Fasciola hepatica*, a bile duct trematode found naturally in sheep and cattle, and kept experimentally in rats, also revealed the presence of a transhydrogenase system that catalyzes hydride ion transfer between NADPH and NAD. In contrast to previous reports, the mitochondrial "malic" enzyme of *F. hepatica* preferred NADP, thereby suggesting that the transhydrogenase couples the "malic" enzyme with electron transport. As noted for *H. microstoma*, the *F. hepatica* transhydrogenase catalyzes a reversible reaction. Moreover, in its catalysis of NADP reduction, the trematode enzyme can be energy-linked with energy being derived from either NADH-utilization by the electron transport system or the ATPase-dependent hydrolysis of ATP. Taken together, these data suggest that the transhydrogenase system in helminths not only acts to couple "malic" enzyme to electron transport but may foster and respond to a proton gradient. Supported by NIH Grant AI15597.

ENVIRONMENTAL SCIENCES & RESOURCE MANAGEMENT DIVISION

9:00-9:30AM POSTER VIEWING

ENVIRONMENTAL SCIENCE
9:30AM SATURDAY, APRIL 5, 1997
OLSCAMP HALL ROOM 226
CHARLES BLECKMANN - PRESIDING

09:30AM DEVELOPMENT OF AN *IN VITRO* ASSAY WITH FISH TESTICULAR TISSUES TO MONITOR ENDOCRINE DISRUPTORS. R.E. CIERESZKO, K. DABROWSKI, A. CIERESZKO, G. TOTH, S. CHRIST, AND J. OTTOBRE. SCHOOL OF NAT. RES., DEP. ANIMAL SCI., OHIO STATE UNIV. COLUMBUS OH 43210; ENVIRONM. PROT. AGENCY, CINCINNATI OH 45268; UNIV. AGRIC. TECHNOL., POLISH ACAD. SCI, OLSZTYN, POLAND.

The first part of the project aimed to investigate the physiology of the annual reproductive cycle of male yellow perch (*Perca flavescens*). We examined dynamics of the production of major steroids in testicular fragments sampled from fish kept under different environmental conditions. Specifically, we report on the mechanisms involved in regulation of testicular function under controlled photothermal conditions. Males were maintained in four different sets of photothermal regimes. The first group was maintained on an ambient photoperiod and thermal regime whereas the second had been exposed to "shifted" (decelerated) regime by 4 months. Two other groups were either photoperiod or thermal regime "shifted" in combination with ambient photo- or thermal conditions. In the second part of this research we examined the effect

of a xenobiotic on steroid production *in vitro*. Both basal and human chorionic gonadotropin (hCG)-stimulated production of 11-ketotestosterone (11-kT) was completely shut down in fish under the shifted photothermal regime. Shifted photoperiod or temperature alone did not affect the dynamics of 11-kT production in testis. Testicular fragments of yellow perch under ambient conditions sampled in December were incubated in Cortland salt solution in the presence or absence of hCG and different concentrations of 3,3',4,4',5,5'-hexachlorobiphenyl (HCB). Inhibition of hCG-stimulated 11-kT production was inversely correlated with the dose of the toxicant. In conclusion, the deceleration of the photothermal cycle interferes with the functional development of testis in yellow perch. The xenobiotic, HCB, affects testis function in a dose-dependent fashion.

09:45AM ACID COAL MINE WATER: RESTORATION OF BIOTIC CONDITIONS FOR DAPHNIA WITH THE ZEOLITE, CLINOPTILOLITE, BUT NOT SODIUM HYDROXIDE. JAMES M. WILLARD AND LAWRENCE M. LECHKO. DEPARTMENT OF BIOLOGY, CLEVELAND STATE UNIVERSITY, EUCLID AT EAST 24TH STREET, CLEVELAND OH 44115.

Acid mine water was produced by column percolation of pyritic refuse with spring water. The acid mine water had a pH of 2.3, a soluble iron concentration of 138 ppm and sulfate concentration of 74 ppm. Static treatment of the water with 30 gm% clinoptilolite resulted in a pH of 7.1 in 10 days, no detectable soluble iron (<0.001 ppm), inorganic or organic sulfate or sulfite. Controls consisted of spring water alone and acid mine water neutralized with NaOH to pH 7.1. The NaOH control contained 24 ppm soluble iron, 64 ppm inorganic sulfate and 4 ppm organic sulfate at day 10. 14-day *Daphnia magna* chronic toxicity tests with the criteria of: 1) survival must be greater than 90%; 2) first brood appear by day 7 and 3) the cumulative neonate to adult ratio (CNAR) must be greater than 20, were conducted. Treatment with and removal of clinoptilolite encased in dialysis tubing resulted in 92% survival, brood appearance at day 8 and CNAR of 38.18. Controls of spring water alone yielded similar results; whereas treatment with NaOH resulted in death at day 7. When acid mine water was first brought to pH 4.5 with NaOH and 0.6 gm% encased clinoptilolite then added, pH 6.7 resulted at day 7 and no detectable soluble iron (<0.001 ppm), inorganic or organic sulfate or sulfite. 14-day chronic tests resulted in survival of 87%, brood appearance at day 6 and a CNAR of 24. The over-all study suggests clinoptilolite, unlike NaOH, can both neutralize and remove all soluble iron, sulfate and sulfite; agents known to be toxic for *Daphnia*. The distribution of *Thiobacillus* fermentation products are currently being examined under these conditions.

10:00AM BIODEGRADATION OF JP-8: EFFECTS OF SOIL TYPES AND NUTRIENTS. C. A. BLECKMANN, J. A. BAKER, III, C. T. TOTTEN, P. W. HOVEY, AND A. MCGOWIN. ENGINEERING AND ENVIRONMENTAL MANAGEMENT, AIR FORCE INSTITUTE OF TECHNOLOGY, 2950 P STREET, WRIGHT-PATTERSON AFB OH 45433-7765.

Biodegradation of simulated spills of the kerosene-based jet fuel, JP-8, was measured in soil microcosms with a closed-system respirometer which detected O₂ consumption and CO₂ evolution. Volatilized fuel was quantified by capture on activated carbon. Three soils, with varying clay contents, were tested. Inorganic nutrients (nitrogen and phosphorous) were added to one of the soils. Fuel concentrations of 0.1 wt % and 1.0 wt % were tested. Over the 14-day test period, O₂ consumption showed degradation of 2 to 4 % of fuel in the 1.0 wt % microcosms, and 9 to 12% of fuel in the 0.1% microcosms. Fuel volatilization in the same period was roughly 5% in the 0.1% microcosms, but was nearly 30% in the 1.0 % microcosms. CO₂ evolution lagged behind O₂ consumption for both the fuel microcosms and background soil systems. Only about 75% of the CO₂ predicted from O₂ consumption was freed into the microcosm headspace, suggesting a significant portion of O₂ bound in cell mass, nonvolatile compounds, or in inorganic complexes in the soil systems. Biodegradation extent was directly related to soil clay content; with higher clay resulting in higher net O₂ consumption. Supplemental inorganic nutrients gave variable results; O₂ consumption was stimulated in some cases and no effects were observed in others.

10:15AM INTRODUCTION OF EARTHWORMS ON A RECLAIMED MINESOIL. DAVID A. KOST AND JOHN P. VIMMERSTEDT. SCHOOL OF NATURAL RESOURCES, OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER OH 44691.

Earthworms are important agents of soil development. Deep burrowing by the night crawler (*Lumbricus terrestris* L.) may help to alleviate soil compaction produced by grading minesoils. Nightcrawler populations may develop slowly on minesoils because of distance from suitable invading populations and slow intrinsic rate of increase. In a split-plot experiment, we introduced night crawlers on a calcareous minesoil (no topsoil replaced) in Muskingum County, Ohio. The soil was graded to a rolling topography and seeded with a grass/legume mixture in 1988. In May 1990 we introduced 0 or 100 night crawlers per plot. Earthworm sampling using formalin extractant in May 1992 found no nightcrawlers and sparse populations (4/m²) of other earthworms. We reintroduced night crawlers in May 1992 (0 or 100/plot),

November 1992 (0 or 40/plot), and April 1994 (0 or 30/plot). In June 1996, density of night crawlers was 1.4/m² in plots receiving night crawlers versus 0.5/m² in Plots not receiving night crawlers. Total earthworm density averaged 124/m². Densities (no./m²) for dominant earthworm species or groups were: immature *Lumbricus* spp. (55), *Dendrobaena octaedra* Savigny (28), immature non-*Lumbricus* species (23), and *Lumbricus rubellus* Hoffmeister (12). Total earthworm ash-free dry biomass averaged 3.59 g/m². Biomasses (g/m²) for dominant species or groups were: immature *Lumbricus* spp. (1.42), *L. rubellus* (0.85), *L. terrestris* (0.44), and immature non-*Lumbricus* species (0.38). In summary, since 1992 total earthworm density increased from 4/m² to 124/m² but numbers of adult *Lumbricus terrestris* remain low (<2/m²).

10:30AM USE OF FLUE GAS DESULFURIZATION SLUDGE IN ABANDONED MINE LAND RECLAMATION. RICHARD R. NOSS, RICHARD W. CRAGO, JIM GABLE, BOB KERBER AND SHAWN MAFI, BENNETT AND WILLIAMS ENVIRONMENTAL CONSULTANTS, INC., COLUMBUS OH 43231.

Flue gas desulfurization sludge (FGD) is a waste by-product from air pollution control scrubbers. The calcium sulfite sludge from the reaction of wet lime with the sulfur oxides has several characteristics beneficial to the reclamation of former strip mines. With the assistance of AEP, FGD from the Conesville Generating Station was used in pilot applications in the summer and fall of 1995 to test its use in the reclamation of coal refuse piles. Moving from the results of the pilot study, the Ohio DNR is now implementing an FGD-based closure of the main gob pile at the Rehoboth Abandoned Mine Lands site, New Lexington, Ohio. The innovative closure design uses compacted FGD to construct a low permeability cover over the entire pile. Mixed FGD will be used for a buffer layer, and the revegetation soil layer will be mixed from on site granular soil, FGD, and composted yard waste. In addition to decreased acid mine drainage production from reduced water contact with the coal refuse, the FGD provides residual, long term acid neutralizing capacity to maintain soil moisture and runoff pH values. Overall, the use of FGD provides benefits not ordinarily achieved with soil-based closures, reduces disturbances associated with on- and off-site borrow areas, and provides a beneficial use of a material that otherwise would be landfilled.

10:45AM THE EFFECTIVENESS OF ENVIRONMENTAL POLICY IN THE PEOPLE'S REPUBLIC OF CHINA. BRIAN J. THOMAS, 551 ALBERT ST. #1, EAST LANSING MI 48823.

China is currently going through a period of rapid change and development that is bringing with it a wealth of environmental problems. The government has risen to meet these challenges by placing increasing emphasis on environmental protection. Since 1979 a series of new environmental laws and regulations have been set forth in an effort to save China's damaged environment without hindering the beneficial economic growth. The dual priorities of environmental protection and economic growth are especially evident in a large city such as Shanghai. Through a series of company, factory, and government visits this summer with Miami University's Shanghai Economic Seminar I sought to evaluate the effectiveness of China's environmental policy. It is often difficult to accurately evaluate the state of policy from reports and articles, and discussions with businessmen and government officials directly effected by these policies provided an excellent perspective on the real world effects of policy. The implementation of Chinese environmental policy is particularly affected by 1.) the relatively recent period of international openness and 2.) the new found monetary benefits of a market economy. This paper gives an overview of recent Chinese environmental policy and then evaluates how this policy has actually effected economic development.

CONTAMINANT REMOVAL

3:45PM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 226

YUNG-TSE HUNG - PRESIDING

03:45PM APPLICATION OF BIO-FILTERS IN VOLATILE ORGANIC CONTAMINANT REMOVAL. YUNG-TSE HUNG, ANNMARIE MISCO, AND MAJID ZARRINAFSAR, CIVIL ENGINEERING DEPARTMENT, CLEVELAND STATE UNIVERSITY, CLEVELAND, OHIO 44115, RUTH YU-LI YEH, CHEMICAL ENGINEERING DEPARTMENT, MING-HSIN ENGINEERING COLLEGE, HSINCHU, TAIWAN.

This paper will discuss the use of biofilters, which is one type of bioremediation method, to convert volatile organic compounds (VOCs) or dissolved organic contaminants to harmless products. It will examine the biological processes involved in degrading volatile organic compounds and the final products generated. Biofiltration has been used to remove odor in the composting process, to remove VOCs from biosolid stabilization process, and to remove toxic organic compounds from contaminated air. Several param-

eters must be controlled for proper operation of the biofiltration process. These important parameters consist of pH, moisture, filter media, and loading rate. With proper design and monitoring, biofilters has been shown to be effective in treating contaminated air. Results indicated that up to 96% NH₃, 86% VOCs, and up to 100% H₂S were removed. A pilot scale biofilter was operated for 10 months period while the bench scale biofilter was also operated for the first 6 weeks period to remove odorous gases from municipal wastewater treatment. Results indicated that more than 90% aromatic VOCs, and 99.96% H₂S were removed. Removal efficiency for chlorinated VOCs ranged from 0 to 60%. The results indicated that biofiltration may become one of the leading treatment processes for air pollutants.

04:00PM REMOVAL OF TRACE ARSENIC FROM WATER BY ADSORPTION. MING JIANG*, QI-TING JIANG** AND YUNG-TSE HUNG*, *CIVIL ENGINEERING DEPARTMENT, CLEVELAND STATE UNIVERSITY, CLEVELAND, OHIO 44115, **XIAN UNIVERSITY OF ARCHITECTURE AND TECHNOLOGY, XIAN, CHINA.

The objective of this laboratory study was to determine the characteristics of activated alumina, manganese oxides mineral and hematite as adsorbents in removing aqueous inorganic arsenic from water. A batch adsorption experiment was conducted to determine the removal efficiency of arsenic by various adsorbents. Factors affecting the adsorption efficiency including valency of arsenic and pH were investigated. An adsorption isotherm was determined. The results show that a pH of 5-7 and the resinate form are optimum for arsenic adsorption on activated alumina, and that manganese oxides mineral can act as an adsorbent and oxidant at the same time, and that the activation of hematite is a key factor for arsenic removal. Removal of arsenite with a fixed activated alumina bed was compared with a complex adsorbent bed: manganese oxides mineral followed by activated alumina. The former can treat only 226 bed volume of water while the latter 1800 bed volume of water, 8 times as large as the former, before arsenic breakthrough occurred. The study indicated that during the first 50 hours of activated alumina adsorption bed operation the arsenic removal efficiency of 100% was possible. The proposed sequential treatment process consisting of manganese oxides mineral followed by activated alumina would increase the run duration of the adsorption bed, and increase the adsorption capacity of the activated alumina.

04:15PM ANAEROBIC-ANOXIC-OXIC TREATMENT SYSTEM FOR SMALL MUNICIPAL WASTEWATER TREATMENT PLANTS. CHATCHAWAL LERSUPOCHWANICH, AND YUNG-TSE HUNG, CIVIL ENGINEERING DEPARTMENT, HOWARD H. LO, GEOLOGY DEPARTMENT, HAO-CHE HOWARD PU, COMPUTER AND INFORMATION SCIENCE DEPARTMENT, CLEVELAND STATE UNIVERSITY, CLEVELAND, OHIO 44115, RUTH YU-LI YEH, CHEMICAL ENGINEERING DEPARTMENT, MING-HSIN ENGINEERING COLLEGE, HSINCHU, TAIWAN.

This paper examines the application of an anaerobic-anoxic-oxic treatment process for municipal wastewater treatment for rural communities. Anox is an innovative activated sludge treatment process designed to remove organic matter and nitrogen with reduced energy consumption and excess sludge production. This process, which includes both non-aerated and aerated activated sludge reactors and secondary settling, produces highly settleable solids in addition to biological nutrient removal. The anaerobic-anoxic-oxic treatment system could remove 98% CBOD₅ (carbonaceous biochemical oxygen demand), 97% SS (suspended solids), 92% NH₃-N, and 76% PO₄-P in wastewater treatment plants. The plant design flow was 8 MGD (million gallons per day). The DO (dissolved oxygen) was maintained at 2 mg/L in the oxic zone and 0.8 - 1 mg/L in the anoxic zone. The return sludge ratio was 0.3 to 0.4. The sludge volume index (SVI) was 121 ml/g. The recommended operating parameters include a minimum oxic mean cell residence time (MCRT) of 12.5 days was required to attain complete nitrification at 10 C and a minimum anoxic MCRT of 2 days was required to ensure a minimum of 50% NO₃-N removal. The process was found to be resistant to plant upsets and to provide good sludge settling and good nitrogen and phosphorus removal efficiency.

04:30PM REMOVAL OF ORGANIC POLLUTANTS BY MINERAL COAGULANTS. MAJID ZARRINAFSAR, AND YUNG-TSE HUNG, CIVIL ENGINEERING DEPARTMENT, HOWARD H. LO, GEOLOGY DEPARTMENT, HAO-CHE HOWARD PU, COMPUTER AND INFORMATION SCIENCE DEPARTMENT, CLEVELAND STATE UNIVERSITY, CLEVELAND, OHIO 44115

The objective of this paper is to determine the effectiveness of mineral coagulants, including aluminum chloride, ferric chloride, iron oxide and microsand, in the removal organic pollutants and the effect of detention time on the turbidity removal. Parameters studied consisted of types of coagulants as listed above, types of organic pollutants, including Lindane, Benzopyrene, Diethylphthalate and Dibutylphthalate, size of microsand (20-100 um), dosage of organic pollutants (5 ug/L - 3 mg/L), and the dosage of coagulants (0 - 2.6 mM/L of metal cation). The adsorption isotherms obeyed Henry's law in majority of cases. The reduction in Lindane, Benzopyrene, Diethylphthalate and Dibutylphthalate were, 16%, 62%, 15% and 15% when using ferric chloride and 16%, 62%, 15% and 24% when using aluminum chloride. The addition of 1 g/L

of microsand(20-100 um) per 25 mg/L of aluminum sulphate coagulant and 0.3 mg/L of additive aqualgine, reduced the detention time for turbidity removal, from 26 min. to 8 min. The results indicated that mineral coagulants were effective in removing organic pollutants, while the microsand addition reduced the detention time required for turbidity removal.

04:45PM PHENOL WASTEWATER TREATMENT WITH SOIL ADSORPTION SUPPLEMENTED BY BIOAUGMENTATION. HOWARD H. LO, GEOLOGY DEPT., YUNG-TSE HUNG AND GANESH BALAKRISHNA, CIVIL ENGINEERING DEPT., CLEVELAND STATE UNIVERSITY, CLEVELAND OH 44115.

Phenol is a toxic organic compound present in various industrial wastewaters, which needs to be removed prior to discharge to receiving waters. The objectives of this study were to evaluate the effectiveness of treatment of phenol wastewater using soil adsorption, and to examine the effect of addition of microorganisms into soil on the removal of phenol from the wastewater. Parameters used for the investigation including types of soil adsorbents, phenolic wastewater strength, types of LLMO (live liquid microorganisms), and dosage of soil adsorbent. Types of soil adsorbents were sand, clay and sand/clay mixture. Feed strength levels of phenol wastewater were 10, 55, and 100 mg/l of TOC (total organic carbon). In this study, TOC was used as an indication of phenol concentration in the wastewater due to its rapid determination. Adsorbent dosages of 5, 10, 15, and 20 g/l were used in the experiment. A total of 30 bench-scale batch reactors were used in the study. Results showed that all three types of soil adsorbents were effective in removing phenol from the wastewater with TOC removal efficiency in the range of 60 to 70% for high strength wastewater. When soil adsorption was supplemented with LLMO bioaugmentation the TOC removal was increased to about 80%. It appeared that clay and sand when used as adsorbent materials independently had a better TOC removal efficiency. It was observed that the TOC removal efficiency increased with adsorbent dosage and with wastewater strength. S1 type LLMO had the highest TOC removal of 82% with sand as an adsorbent.

EARTH & SPACE SCIENCES AND EDUCATION DIVISIONS

**EDUCATION &
EARTH SCIENCE EDUCATION
9:00AM SATURDAY, APRIL 5, 1997
OLSCAMP HALL ROOM 217
ROBERT F. MAULDIN - PRESIDING**

09:00AM PORTAGE RIVER RATS: WATERSHED BASED EDUCATION WITH A LOT OF HELP FROM OUR FRIENDS. JUSTINE MAGSIG, 151 COLLEGE PARK OFFICE BUILD, BNGOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The Portage River Basin Council was formed to improve the water quality of the Portage River which drains 581 square miles of northwest Ohio and to call attention to the value of this hardworking river for the communities and individuals on the watershed. The Science Section of the Council addressed pollution problems. The Education Section of the Council sought to publicize the river's beauty as a community focus and also to gain a constituency for the river through involving public school students and their teachers in water quality monitoring. Ten teachers representing eight schools from the headwaters of the river in Van Buren to its entry into Lake Erie at Port Clinton joined the program. A mini-grant from the Lake Erie Protection Fund, donations from Toledo Edison Company's Davis Besse Nuclear Power Plant, and several area non-profit organizations were used to purchase equipment for biological and chemical water testing. The Ohio Environmental Protection Agency trained the teachers in the use of the equipment and riverine surveys using Qualitative Habitat Evaluation Inventory techniques. Each school was linked with a business in its vicinity that committed to replenish the chemicals used in the tests and thus keep the program alive into the future. A Student Congress in May brought more than 100 students together to share experiences.

09:15AM THE TEACHING PORTFOLIO: DEVELOPMENT, EVALUATION AND UTILIZATION BY A BIOLOGY DEPARTMENT. JOHN F. GWINN, JOHN L. FROLA, F. SCOTT ORCUTT, RONALD L. SALISBURY, BIOLOGY DEPARTMENT, THE UNIVERSITY OF AKRON, AKRON OH 44325-3908.

In 1993 our department chair determined that our long-used student evaluation of teaching (IDEA, Kansas State University), provided important but

insufficient information for the improvement of teaching, for promotion and tenure decisions, and for merit raises. Our Teaching Enhancement Committee was charged with developing a more comprehensive assessment of instruction. The most promising approach was for each faculty member to develop a teaching portfolio. Since this type of document is foreign to many science faculty there was a substantial learning phase that included departmental discussions, two half-day presentations by consultants, and readings (Seldin, *The Teaching Portfolio*). The committee developed a series of questions to be addressed for the test run in spring 1995. The great unevenness among the portfolios submitted made it difficult to evaluate them in a comparative way. Consequently the guidelines were substantially reworked and a weighted scoring sheet developed for spring 1996. Major areas and weights are Role of Course/Instructor's Philosophy (zero weight); Instructional Design and Delivery (as related to philosophy) (30%); Course Development (30%); Course Evaluation (30%); and Self-improvement (10%). Format and scoring consistency were much better. Overall the portfolio provided comprehensive, documented information for fair and balanced evaluation of teaching quality and effectiveness.

09:30AM SCIENTIFIC REASONING FOR NON-SCIENCE MAJORS. ROBERT F. MAULDIN AND LARRY W. LONNEY, DEPARTMENT OF NATURAL SCIENCES, SHAWNEE STATE UNIVERSITY, PORTSMOUTH OH 45662.

The National Science Foundation has concluded that universities have failed to give students a basic understanding of the sciences. It is the contention of the authors that this is the result of science departments offering a menu of "content-based" courses for the non-science major's general education program. Ronald Giere, in his book "Understanding Scientific Reasoning," points out that the acquisition of the intellectual skill of scientific reasoning can be accomplished over the course of a quarter (or a semester). Giere's approach is to have the students analyze press articles pertaining to experimental tests of scientific models by applying a six-step program in which the student identifies the model, the experimental setup, and the data. Then, the student is asked to formulate the prediction and reach a conclusion about the model. Two key modifications will be presented concerning Giere's approach. First, a distinction is made between one-model and two-model articles; one-model articles are covered first until the students have mastered the basics and then two-model articles are analyzed. Secondly, the concept of model development is addressed and distinguished from a crucial experiment. With model development, an old model is discussed, negative evidence is obtained for the old model, a new model (which accounts for the negative evidence) is formulated, and then a new experimental test of the new model may or may not be outlined.

09:45AM INTEGRATING TECHNOLOGY, MATHEMATICS AND SCIENCE EDUCATION IN ASSOCIATE DEGREE PROGRAMS. SHEPHERD M. ANDERSON, ROBERT A. CHANEY, FREDERICK J. THOMAS, NATIONAL CENTER OF EXCELLENCE IN ADVANCED MANUFACTURING EDUCATION, SINCLAIR COMMUNITY COLLEGE, 444 WEST THIRD STREET, DAYTON OH 45402-1460.

The National Center of Excellence in Advanced Manufacturing Education was established in 1995 at Sinclair Community College with support from the National Science Foundation's Advanced Technical Education program. Much of the Center's activity is focused on creating a seamless, integrated program from grade eleven through two years of college, which prepares students for successful careers in modern manufacturing. The program is unique in the extent to which it integrates advanced workforce skills (including those defined by the Society of Manufacturing Engineers in its *Curricula 2002*) with rigorous academic standards for mathematics and science. Instructional modules are authored by cross-functional teams that include mathematics, science and technology faculty, as well as industry representatives. The modules engage students in authentic career-related tasks, while also ensuring that students develop the broad, transferable skills and concepts required for a constantly changing work environment. An "Integrating Manufacturing Experience" provides a unifying theme throughout the post-secondary component of the students' program. The work is supported in part by the National Science Foundation, Grant DUE-9454571.

10:00AM GEOSCIENTISTS IN THE ELEMENTARY CLASSROOM. GARRY D. MCKENZIE, DOREEN GRENER, AND STEVEN HOFFMAN, GEOLOGICAL SCIENCES, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

Educational visits to schools in the Columbus area have increased under a collaborative OSU/Shell project that builds on our long history of working with elementary students. The project was designed to enable and promote graduate student and faculty contact with elementary students for the purposes of improving student knowledge of science and providing geoscientist role models for the classroom. In meeting these goals, we developed materials and presentations for the geoscientists who would visit the classrooms, piloted them in a summer program for students, and expanded our network and contacts with precollege teachers and school systems. A graduate

student advertises the programs, schedules the classroom visits, and prepares and replaces materials. As part of the TA duties, he or she also makes one or more visits to schools each week. Faculty and students usually volunteer for 2 sessions with 20-50 students, each. In each session, we have three components: 1) Earth system science (spaceship concept), 2) geoscience topic requested, and 3) life as a scientist. To assist new volunteers we have assembled guidelines for presentations that include preparing for the classroom (e.g., confirm, assess level and needs, assign), day before the visit (reconfirm, check materials), and the visit (check with office, teacher remains in room, leave address and possible assignments). The most rewarding feedback is a query seeking sources for more science.

10:15AM ESTABLISHING AN ELEMENTARY SCHOOL OUTREACH PROGRAM IN THE EARTH SCIENCES. DOREEN GRENER, STEVEN HOFFMAN, GARRY MCKENZIE, AND DALE GNIDOVEC, GEOLOGICAL SCIENCES, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210-1398.

Since the opening of Orton Geological Museum in 1894 by Dr. Edward Orton, geology professor and first president of the University, the Department of Geological Sciences has been a valuable source of information for university and precollege students and teachers. Our museum collections manager now reaches more than 4000 students per year at the museum and in Columbus classrooms. From experience with this outreach we recognized additional needs and developed a formal program with support from the Shell Foundation. This two-part program includes: 1) "Geoscientists in the Classroom", which schedules our students and faculty into 4th and 5th grade classes in the area, and 2) "Geology 101 for Kids," a week of half-day sessions during the summer for similar students. We help students to learn about the Earth as a system and to develop an enthusiastic appreciation of science. Our outreach includes many initiatives considered necessities in geoscience education, builds on the school's course of study, addresses science education standards, and makes available resources and materials for students and teachers. The next step is a workshop for the teachers who seek the information that we are providing for their students. Although our program includes an assigned Teaching Assistant, most of the effort is volunteered time; replication should be possible in other communities where there are Geoscientists, either in industry or education.

10:30AM BASICS OF GEOLOGY FOR GRADES 4 AND 5. STEVEN HOFFMAN, GARRY MCKENZIE, AND DOREEN GRENER, GEOLOGICAL SCIENCES, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210-1398.

Four topics were selected to convey the basics of geology to 4th and 5th grade students in the Columbus Metropolitan area. In partnership with Shell Foundation, we have expanded and formalized the traditional class visits of faculty and students to elementary schools. Although the staff of our Geological Museum has long provided in-school and museum programs on rocks, minerals, and fossils, we saw an opportunity to expand our efforts in this area and to help teachers introduce important geological topics. After reviewing the science standards and the science topics usually covered in elementary schools, we developed the following presentations/activities: 1) Basics of Maps and Mapping, 2) Rocks and Minerals, 3) Fossils and Earth History, and 4) Plate Tectonics, Volcanoes, and Earthquakes. Each program is elastic and fits a 40- to 60- minute time slot; hands-on activities include drawing contours, testing of mineral properties, inspection of high quality specimens of rocks, minerals, and fossils, development of a time line, arranging cut-outs of continents, acting like seismic waves, and simulation of seafloor spreading and volcanic pressure release. Other topics are covered if requested in special situations or if they are a favorite topic of the visiting geoscientist. Basics of Maps and Mapping and Rocks and Minerals are currently the most popular topics.

10:45AM IMPLEMENTATION AND EVALUATION OF AN ENVIRONMENTAL FIELD COURSE FOR BAHAMIAN TEACHERS. CAROL LANDIS, SCIENCE EDUCATION, AND GARRY MCKENZIE, GEOLOGICAL SCIENCES, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

As part of a project to increase the environmental understanding of all Bahamian students and Bahamians, we are collaborating with BREEF (Bahamian Reef Environment Educational Foundation) and the Ministry of Education and Training in Nassau to design and co-teach a field course for teachers on San Salvador Island. The first of four annual workshops will occur in July. The two-week course will include daily field studies with visits to reef, lagoon, coastal, or terrestrial environments. Activities and lectures on basic concepts of Earth system science will include: carbonate and coastal geology, environmental geology, hydrogeology, marine and terrestrial biology, agriculture, global change, and sustainability. Participants will also develop classroom projects and field activities for both primary and high school classes. The basic objective is to provide a BREEF-educated teacher in each Bahamian school by 2001. The goal is to promote sustainability in this island nation of 300,000, beginning with protection of the reefs which nourish fish, provide beach material, and attract tourists. Bahamian teachers who attended US

environmental studies workshops in the past 2 years will assist with the summer program. Evaluation of effectiveness of the workshops will involve pre- and post-workshop assessments, questionnaires and interviews, and occasional site-visits to participants' schools.

INFORMATION, COMPUTING & COMMUNICATIONS, ENGINEERING & TECHNOLOGY AND SOCIAL & BEHAVIORAL SCIENCES DIVISIONS

ENGINEERING, SOCIAL SCIENCE, TECHNOLOGY, & THEIR APPLICATIONS 1:30PM SATURDAY, APRIL 5, 1997 OLSCAMP HALL ROOM 217 JOHN K. ESTELL - PRESIDING

01:30PM AUTOMATED SOLAR CELL ANALYZING SYSTEM. RAVI NADELLA, RAYMOND HARAWAY, DIVISION OF ENGINEERING AND COMPUTER SCIENCE, WILBERFORCE UNIVERSITY, OHIO 45384.

Non-conventional energy sources like solar energy are gaining popularity due to the finite nature of the conventional energy sources and the increasing awareness about environment. Solar cells have come a long way to the present greater than 20% efficiency. To make solar energy affordable, effective solar cell testing is required. A computer controlled solar cell analyzer system has been designed and assembled to check the electrical properties of solar cells. Detailed design aspects and the working of this system will be presented at the conference.

01:45PM IMPROVEMENTS IN SPEED AND CONVERGENCE OF THE IDENTIFICATION PROCESS OF DYNAMIC SYSTEMS. TAAAN S. EL-ALI. WILBERFORCE UNIVERSITY, DIVISION OF ENGINEERING AND COMPUTER SCIENCE, WILBERFORCE OH 45384.

A system identification algorithm has been developed and tested on many plants in the electrical engineering area using a system-observer approach. This paper will show that the approach works much better in terms of speed and convergence by varying the sampling rate and updating the observer system until the true system and the observer system have similar transfer functions in which case the error between the states of the true system and the observer becomes negligible.

02:00PM A MATLAB-BASED SOFTWARE PACKAGE FOR FILTERING AND RECONSTRUCTION OF IMAGE SEQUENCES. AMJAD T. ZAIM AND JAMES B. FARISON, DEPARTMENT OF BIOENGINEERING, THE UNIVERSITY OF TOLEDO, TOLEDO OH 43606-3390.

A MATLAB-based, menu-driven software package is developed for simulation and simultaneous diagonalization (SD) transformation of linearly additive (LA) spatially invariant (SI) image sequences, as well as Karhunen-Loeve (K-L) transformation of any type of image sequence. The basic characteristics of an LA SI image sequence are that 1) features are in the same spatial position in each image, and 2) each feature contributes linearly and additively to each image in the sequence. K-L reconstruction of the original images as well as SD reconstruction of the features in the original images are facilitated in the software. Statistical analysis is applied to all images in the sequence after the reconstruction process to assess the filter performance. Data and images used by the software can be retrieved from previous sessions or stored for future work. The software employs several methods of data representation in MATLAB to handle image sequences by packing a 3-D array in a 2-D matrix. The software utilizes GUI (Graphical User Interface) capability to provide smooth and user-friendly interaction with the software through menus. Finally, display and visualization of image sequences are incorporated among the tasks achievable by the software. Because the software is designed to aid in class demonstrations and research studies, all relevant data are made accessible to the user through the software.

02:15PM MATCHED AND ORTHOGONAL PROJECTION FILTER OUTPUT PREDICTION AND COMPARISON. ANTHONY M. DELZOPPO III AND JAMES B. FARISON, DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

Deciding which of M known signals was transmitted during the time interval $(t, t+\tau)$ is a problem encountered in signal detection. The difficulty arises when noise contaminates the signal to a degree that the received signal does not resemble the transmitted signal. In this case, the receiver is utilized to make the best decision as to which signal was transmitted based on the properties of the received signal. The classical approach to solving this problem is to use statistical theory which renders the matched filter (MF). The MF minimizes the average risk of making an incorrect decision. In this study, statistical theory is employed to determine the effectiveness of an alternate filter called the orthogonal projection filter (OPF). In order to determine what conditions are advantageous for each filter, an equation which contains the a priori statistical variables is required. One equation which consists of this information is the equation for the average probability of error. This equation is obtained by deriving the decision equation, computing the probability density functions, and then applying the error function (erf). The theoretical results indicate that there are situations where the OPF outperforms the MF, and that the cross-correlation is the determining factor. This was verified through several simulations using different shaped signals with varying degrees of cross-correlation.

02:30PM COMPARISON OF THE MATCHED FILTER AND THE ORTHOGONAL PROJECTION FILTER IN THE DETECTION AND IDENTIFICATION OF OVERLAPPING SIGNALS. SALLY CHERIAN, ANTHONY M. DELZOPPO III AND JAMES B. FARISON, DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

A signal that contains the message and no additional information can be identified easily. However, in practice, the actual signals may contain the desired message as well as noise. Currently, the optimal solution to the problem of detection and identification of a message in the presence of white noise is the matched filter. This study compared the effectiveness of the Orthogonal Projection (OP) filter to that of the matched filter in detecting and identifying a specific message in a signal that contained the desired message plus an undesired message other than noise. The performance of the OP and matched filters was tested through simulations for the difficult case of two completely overlapping signals. A number of simulations were run using varying degrees of positive and negative cross-correlations of the two signals. The simulations indicated that the OP filter possessed a distinct advantage over the matched filter in cases of negative cross-correlation.

02:45PM OBTAINING SEMI-INSULATING SILICON CARBIDE. RAVI NADELLA, DOUGLAS LEACH, TIFFANY TOMLINSON, DIVISION OF ENGINEERING AND COMPUTER SCIENCE, WILBERFORCE UNIVERSITY, OHIO 45384.

Silicon carbide (SiC) is a semiconductor being pursued for high-temperature, high-power, and high-frequency applications. Semi-insulating layers in SiC are required to make electronic devices in SiC. A technique to stain semi-insulating layers in SiC has been established. This technique uses ion implantation of light ions in SiC. Detailed experimental conditions and results will be presented at the conference.

03:00PM USE OF BICYCLING IN INTRODUCTORY PHYSICS LABORATORY PROJECTS. ANOOSHIRVAN JAFARI, NATURAL SCIENCE DIVISION, WILBERFORCE UNIVERSITY, WILBERFORCE OH 45384.

While teaching introductory college physics laboratories, I have noticed that in many situations students can benefit from doing experiments outside the laboratory in a more leisurely or relaxed position. For example they can use their bicycles or make proper use of playgrounds. Recently, need for using a bicycle provided an opportunity for me to plan alternative introductory physics laboratory projects. According to *The Physics Teacher* (February 1990), Albert A. Bartlett has done similar work of this type to relate physics with skiing. In this study, results of a series of distance and time measurements during bike rides are, primarily, used to show how energy and elevation along a route like the Little Miami Scenic Trail between Xenia and Yellow Springs in Greene County, Ohio, are related. Topographical maps from U.S. Geological Survey were used to find approximate elevations for points along the bike route. It was found that a typical approximate ratio of travel times going downhill to going uphill between two points of 0.5 mile distance with the slope of 0.65 is about 0.8. Its relation with energy will be discussed.

03:15PM ENVIRONMENTAL RESEARCH: USING LIBRARY SOURCES AND THE WORLD WIDE WEB TO INCREASE AWARENESS OF ECOLOGICAL ISSUES. NANCY HAYES, SCIENCE AND TECHNOLOGY LIBRARY, THE UNIVERSITY OF AKRON, AKRON OH 44325-3907.

Conservation, ecology, and the environment continue to be increasingly important components of science education. The process of con-

ducting library research should be an integral part of promoting an awareness of ecology and environmental issues. Due to its multidisciplinary nature, educators, librarians, and information professionals experience many challenges in regard to accessing information about environmental topics. Current environmental reference sources and internet sites will be highlighted.

03:30PM PUBLICATIONS OF THE STATE ACADEMIES OF SCIENCE. J. B. HILL, UNIVERSITY OF AKRON, SCIENCE AND TECHNOLOGY LIBRARY, AKRON OH 44325-3907.

The state academies of science originated in the late 1800's and early 1900's, providing scientists at the state and local level with a means to meet and exchange ideas. One of the methods that many state academies of science employed in the promotion of regional scientific research was the publication of state academy journals and conference proceedings. Today these publications are overshadowed by the publishing efforts of the larger national professional societies. Nevertheless, an examination of content, circulation rates, indexing/abstracting practices and citation levels indicates that state academy of science publications remain an important avenue for the distribution of scientific research.

03:45PM GRADUATE STUDENTS USE OF JOURNALS: A BIBLIOMETRIC STUDY OF POLYMER SCIENCE THESES AND DISSERTATIONS. SHERRI L. EDWARDS, SCIENCE AND TECHNOLOGY LIBRARY, UNIVERSITY OF AKRON, AKRON OH 44325

Graduate students form a large percentage of the user group of most academic science libraries, utilizing journals and other library resources in support of research for the thesis requirement. However, there have been few studies made of the pattern of citations in theses or dissertations, especially in the science and engineering fields. This study explores the value of citation analysis of theses as a methodology in developing and assessing a science library's journal collection. Specifically, this study investigates the pattern of citations in masters theses and doctoral dissertations in the field of polymer science at the University of Akron during the period 1988-present. Results show that the cited polymer science literature is predominately serial in nature and that journal title dispersion is high. The study has implications for libraries that must support polymer science programs and suggests that citation analysis is a viable collection development tool for librarians.

04:00PM A NEW APPROACH TOWARD TEACHING CPU SCHEDULING ALGORITHMS. JOHN K. ESTELL, COMPUTER SCIENCE, BOX 695, BLUFFTON COLLEGE, BLUFFTON OH 45817.

The subject of CPU scheduling algorithms is not one that students in operating systems can easily comprehend in the abstract. Normally students are presented in lecture with one algorithm after another, and as the concept of a process is often new and fuzzy the students have no intuitive grasp of the material. However, there are associations between a CPU and a photocopying machine that can be used to assist in the teaching of CPU scheduling algorithms. Both devices can be used by at most one entity at a time and there is often a queue awaiting access. Students can readily relate to waiting in line to use the photocopier, and because of this familiarity the associations can be presented in a short amount of time. By introducing the concepts behind the various types of scheduling algorithms using concrete examples in this context, students are given the framework that allows them to understand how the algorithms work. When the actual scheduling algorithms are then introduced using the traditional methodology, the concepts have already been explained, and the associations allow them to remember the technical material. This paper will present several examples of associations made between CPU scheduling algorithms and photocopiers that have been successfully used in the classroom.

04:15PM RESPONDING TO DOMESTIC VIOLENCE IN A RURAL COMMUNITY. GLENN A. SHIELDS, DEPARTMENT OF SOCIAL WORK, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Violent tactics data from males court ordered into a rural community domestic violence counseling program (N=100) will be presented. Findings, based on outcomes from the Conflict Tactics Scale (Revised), indicate that male batterers perceive themselves to use negotiation and psychological aggression as primary tactics in the resolution of conflict. Domestic violence is a major social problem in both urban and rural communities. Often it is assumed, especially in the media, that violence in any form is uniquely an urban problem. Evidence, however, suggests that family violence cuts across all sectors of socioeconomic status and geographic areas. In any community effective intervention requires cooperative efforts among various community agencies including law enforcement, courts, social service agencies, and medical resources. The goals of intervention are to protect the victim and to provide treatment for the perpetrator of the abuse. Treatment activities vary and often may range from several brief counseling sessions to intervention programs that last for several months. Implications for practice and policy will be discussed.

EARTH & SPACE SCIENCES DIVISION

GENERAL GEOLOGY

9:15AM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 213

ANN GRAETSCH HARRIS - PRESIDING

09:15AM MINE SUBSIDENCE PROBLEMS IN NORTH CANTON, STARK COUNTY, OHIO. ANN G. HARRIS, DEPARTMENT OF GEOLOGY, YOUNGSTOWN STATE UNIVERSITY, UNIVERSITY PLAZA ONE, YOUNGSTOWN OH 44555-0001.

The North Canton problems began on April 4, 1988 when the driveway and corner of Patty Slutzker's home, which included her garage, sank about two feet on Grandview Avenue NE. Her next door neighbors Don & Cindy Mosser began losing their chimney and driveway on April 6th. One week later at the home of Jim & Donna Reed on Grandview Avenue NE a hole developed in their front yard. A mine tunnel could be seen at the bottom of the hole. These problems began when a construction crew uncovered old workings, while excavating for a sewer line, at the bottom of the hill. In 1992 on July 27, 1992 the weight of a garbage truck on Blitzer Street caused a cave-in over a mine. On September 26, 1996 subsidence occurred under a single story duplex at 1471-73 Ellesmere Avenue NW and damage occurred at the two neighboring duplexes as an engineering company hired by the Ohio Department of Natural Resources was drilling. The drilling was part of a \$300,000 project to prevent subsidence in the Ellesmere area. Over the past 15-20 years subsidences have been reported at the intersection of Maplecrest and South Main Street, on Hartman Street, south of Applegrove Street SW and 45th Street NE.

09:30AM OILFIELD BRINES FROM THE WHIRLPOOL SANDSTONE (SILURIAN) OF MORGAN COUNTY, OHIO; EVIDENCE FOR A DEEP FRACTURE IN PENN TOWNSHIP. STACEY HOSTETTER AND GUNTER FAURE, DEPT. OF GEOLOGICAL SCIENCES, THE OHIO STATE UNIVERSITY, COLUMBUS OH 43210.

Brines recovered from the Whirlpool Sandstone in four drill holes in Morgan Township have uniform chemical compositions with total dissolved solids (TDS) between 307,300 and 339,900 mg/L. Two additional wells that tap the Whirlpool Sandstone in Muskingum and Ashtabula Counties also produce brines whose chemical compositions are similar to those in Morgan County with TDS values of 328,400 and 310,200 mg/L, respectively. However, brine from the Whirlpool Sandstone recovered at a well in Section 11 of Penn Township in Morgan County differs significantly from all other Whirlpool brines and has TDS=346,200 mg/L. The depth of this well (4819) is very similar to that of the other wells in Morgan Township that produce from the Whirlpool Sandstone (4544 to 5075 feet). The chemical composition of the Whirlpool brine in Penn Township is similar to that of brine in sandstones of the Rose Run Formation (Cambrian) recovered in Coshocton County. However, in Morgan County the Rose Run Formation lies more than 2000 feet below the Whirlpool Sandstone. Therefore, we postulate the existence of a deep fracture that allows brine from the Rose Run Formation to enter the overlying Whirlpool Sandstone in Penn Township of Morgan County.

09:45AM GEOLOGIC CONSTRUCTION MATERIALS-THEIR HISTORIC USE IN WOOD COUNTY, OHIO. MARK J. CAMP DEPT. OF GEOLOGY, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

Wood County, Ohio is underlain by Silurian-Devonian carbonates, covered by glacial, fluvial, and lacustrine sediments. Settlers found the area a rich source of building materials. The first quarries opened along the river bottoms of the Maumee, Portage, and Toussaint providing stone for foundations and canal locks. As the land was cleared small quarries opened on the carbonate reef mounds and ridges scattered across the county. These supplied foundation stone and lime. As the county grew in population, clay for the production of tile to drain vast swampy tracts became a necessity. By 1900, most towns had their own tile-brick yard. Few commercial brick works developed in the county; instead itinerant masons made brick from local clays at each construction site. Also by 1900, quarrying centered at Fostoria, Lime City, Luckey, Milton Center, North Baltimore, Portage, Rising Sun, Stony Ridge, and West Mill grove. These quarries provided crushed stone and lime, however some Niagaran and Middle Devonian carbonates supplied small quantities of dimension stone. Stone structures in Wood County, particularly in Bowling Green and Perrysburg were mainly built of Columbus Limestone, Berea Sandstone, Salem Limestone, and glacial erratics, mainly shipped in from elsewhere.

10:00AM BREAK

10:15AM FRESH-WATER ARTHROPODS AND NEUROPTERIS PRESERVED IN IRONSTONE CONCRETIONS: A NEW LAGERSTATTE FROM THE PERMIAN OF OHIO. SHANAN E. PETERS AND KENNARD B. BORK. DEPT. OF GEOLOGY AND GEOGRAPHY, DENISON UNIVERSITY, GRANVILLE OH 43023.

An exceptionally well preserved aquatic arthropod fauna and a more abundant terrestrial flora occur within carbonate concretions found in lacustrine sediments of Lower Permian age in Monroe County, Ohio. The fossil-bearing concretions are found in three indistinct zones within an approximately 4m-thick, gray shale unit and are limited in aerial extent. The flora preserved in concretions is lightly to heavily pyritized and is composed exclusively of isolated leaflets of *Neuropteris*. In contrast to the abundant but low diversity flora, five arthropods, representing at least three taxa, comprise the fauna of the location. Fossil-bearing concretions are concentrated along regularly spaced bedding planes within the shale unit, but are not continuous over the outcrop area. Interspersed on other bedding planes are irregular, platy concretions that do not usually contain fossils. Climatically driven fluctuations in turbidity, temperature, and chemistry, and also the rate of decay of organic nuclei may have played an important role in establishing the precise conditions required for concretion formation. Stratigraphic/sedimentologic analysis of the shale unit suggests deposition in a small, chemically heterogeneous lake that formed on a low-relief alluvial plain when a coal swamp flooded. Several thin, shallowly cross-laminated sandstone beds in the upper 2m of the concretion-bearing shale unit were generated by turbidity currents associated with prograding inlet deltas. Eventually, the deltas filled the lake with sand and silt, leading to terrestrial, periodic deposition and possibly soil development. Subsequent migration of a meandering river removed much of the lake deposit.

10:30AM HISTORICAL GEOLOGY OF THE EARTH-MOON SYSTEM. ROBERT J. MALCUI, DEPT. OF GEOLOGY AND GEOGRAPHY, DENISON UNIVERSITY, GRANVILLE OH 43023.

Planet Earth has a number of special features relative to the other terrestrial planets in our solar system. It has (1) liquid water on the surface, (2) free oxygen in the atmosphere, (3) a complex biological system, (4) active plate tectonics, (5) a strong magnetic field, (6) a very large satellite relative to the size of the planet. A major question is whether or not this large satellite has led to the development of some of the special features listed above? In other words, have interactions with the Moon over geologic time had a significant effect on the evolutionary pathway of planet Earth? cursory examination of textbooks on physical and historical geology and astronomy suggests that an increase in the length of day has been the main effect and, of course, the astronomers mention the continually operating earth and ocean tides as the cause of the despinning of the Earth over geologic time. Recent work on tidal rhythmites by Sonett, et al. (1996, *Science*, v. 273, p.100) suggests that the day was about 18 hours long about 900 million years ago when the Earth-Moon distance was about 54 earth radii (compared to about 60 earth radii today). If we project the system even further back in time, the day would be shorter, the earth-moon distance would be smaller, and the resultant tides would be much higher. On the other hand, geochemical evidence published by Harper and Jacobsen (1992, *Nature*, v. 360, p. 728) and others suggest that the Earth accumulated an early, all enclosing crust early in its history (i.e., before 4.0 billion years), a crust that was apparently destroyed by recycling into the Earth's mantle about 3.9 billion years ago. Was the Moon and its associated tides involved in the destruction of the primitive crust of our planet as well as in other events (episodes) in our habitable planet's complex history?

10:45AM COMPLETION OF NEW BEDROCK-GEOLOGY MAPS OF OHIO. E. MAC SWINFORD, ODNR, DIVISION OF GEOLOGICAL SURVEY, 4383 FOUNTAIN SQUARE, DR., COLUMBUS OH 43224.

The Bedrock Geology Mapping Group at the Ohio Department of Natural Resources, Division of Geological Survey, supported by cooperative federal and state agencies, has completed a six-year effort to remap the bedrock geology of Ohio. Bedrock-geology maps have been produced for all 788 7.5-minute quadrangles covering the state. In addition, bedrock-topography maps were produced for quadrangles containing mappable thicknesses of glacial drift. Structure-contour maps for each contact appearing on any one map were generated using computer mapping software. These maps are on open file and are drawn on mylar film to allow quick reproduction and easy updating of the maps when new information becomes available. About 50 bedrock units are mapped statewide, and significant reinterpretations of the configuration of the state's bedrock topography have been completed. Currently, the Division is digitizing the bedrock-geology and bedrock-topography maps in preparation for publication of a new bedrock-geology map of the state at a scale of 1:500,000; the first wholesale updating of the bedrock geology map since publication of the Bownocker map in 1920. Digital compilations of bedrock-geology maps of western and north-central Ohio are shown. Regional and local structural features are evident in the areal distribution of the bedrock units and the orientation of buried bedrock valleys. A basement structure map, a magnetic anomaly map, and oil and gas fields maps of this area, when

compared with the new bedrock-geology and bedrock-topography maps, reveal relationships between surface geology, subsurface geology, and a deep crustal geology of the region.

1:30 PM EARTH & SPACE SCIENCES DIVISION MEETING OLSCAMP HALL ROOM 213

MAPPING TOOLS & QUATERNARY GEOLOGY 2:00PM SATURDAY, APRIL 5, 1997 OLSCAMP HALL ROOM 213 YU ZHOU - PRESIDING

02:00PM LACUSTRINE SILT IN THE LICKING RIVER VALLEY: IMPLICATIONS FOR DOWNCUTTING OF BLACKHAND GORGE, LICKING COUNTY, OHIO. MATTHEW A. PACHELL AND TOD A. FROKING, DEPT. OF GEOLOGY & GEOGRAPHY, DENISON UNIVERSITY, GRANVILLE OH 43023.

Deep valley fills and interlinked valley paths through bedrock uplands reflect a complex drainage history in the ice-marginal Appalachian Plateau region of east-central Ohio. In Licking County, the formation of Blackhand Gorge and reversal of the Licking River drainage appears to be one of the latest events in this entangled history. Cutbanks into late-Pleistocene terraces along the lower reaches of tributaries to the Licking River above Blackhand Gorge reveal dense, laminate (± 1 mm) calcareous, gray lacustrine silt overlain by 1-6 m of imbricated oxidized gravel which typically fines upward to sandy silt (Chili loam soil). The relative timing of lacustrine silt and gravel deposition is unclear as some localities reveal a clear erosional contact while one suggests a prograding deltaic/fluvial sequence. In several cores of the Licking Valley floodplain, similar lacustrine silt lies below channel and point bar gravel at depths of 5.5 to 7 m. The highest elevation of the contact between lacustrine silt and gravel is at least 248 m (813') relative to the present gorge bedrock floor of approximately 230 m (755') indicating at least 18 m of gorge incision since final lacustrine silt deposition. Textural and mineralogical analyses of lacustrine silt from the main valley, glaciated, and unglaciated tributary valleys as well as data from water and oil/gas well logs will help define glacial and non-glacial sediment source areas and the extent of lacustrine deposits.

02:15PM BURIED ORGANIC SILTS AND ORGANICS, STARK COUNTY, OHIO. JAMES R. BAUDER, 6106 ARMISTICE AVENUE N.W., CANTON OH 44718.

Preliminary site evaluation using soil and geologic data indicated that there were probably limited areas of organic materials beneath the silty surface soils in Stark County. Site characterization within the county was accomplished by over one hundred test pits in which the soil materials were characterized and presumptive bearing values were determined. Deeper soil analyses were enabled by eighteen hollow stem borings, soil samples and bearing values determined by split spoon methodologies. Organic materials were found to be much more extensive than originally estimated and within the county to be overlain by sandy terrace deposits. Site development in these areas are primarily being accomplished by surcharging.

02:30PM WISCONSINAN GLACIAL LITHOSEQUENCES FROM THE LONDON CORRECTIONAL INSTITUTE (LCI), UNION TOWNSHIP, MADISON COUNTY, OHIO. BRENDA A. LLOYD AND JOHN P. SZABO, DEPARTMENT OF GEOLOGY, UNIVERSITY OF AKRON, AKRON OH 44325-4101.

Textural analysis, fine-carbonate and clay mineral contents, and stratigraphic relationships among samples from nine test wells drilled at LCI allows differentiation of four lithosequences, A through D. The wells are located within a 2.25 km² area, average 73 m deep, and were sampled at 1.5-m intervals. Lithosequence A consists of lodgement and meltout tills and has the second-largest carbonate content. Lithosequence B contains variable lithofacies ranging from massive fines to massive diamictons and represents various glacial environments associated with a fluctuating ice margin. It has the largest total carbonate of the four lithosequences. Lithosequence C is dominated by lodgement till and contains more calcite than dolomite. Lithosequence D ranges from laminated lacustrine clays to massive gravels and reflects proglacial conditions. Wood from 74.7 m below the surface has a radiocarbon age of 28,390 \pm 330 years B.P., suggesting that the four lithosequences are Wisconsinan deposits.

02:45PM DIFFERENTIAL EROSION RATES IN GLACIAL TILLS AT PAINESVILLE-ON-THE-LAKE, OHIO. SCOTT A. DAWSON AND JAMES E. EVANS. DEPT. OF GEOLOGY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

At Painesville-on-the-Lake, coastal bluffs 16-17m tall consist of glacial tills and glacial-lacustrine sediments. Very high recession rates (180m since 1870's) have been documented here, but locally rates vary widely (0-5m/yr). This study evaluated stratigraphic changes in clay composition, till texture, consolidation, and water content. Water contents for the bluff range from 6-20% in the glacial lacustrine deposits (top 3-4m of bluff) to 10-26% in the till (lower 13m of bluff). Grain size is very coarse in the top 3-4m of the bluff consisting of coarse sand and pebble clasts loosely compacted, while the lower 13m of the bluff is >85% highly compacted clay with the remainder consisting of coarse sand and granule clasts. Problems with expansive clays can be ruled out due to work done previously in the area which states that those types of clays do not exist in the study area. The underlying cause for the wide range of erosion rates in the relatively small area at Painesville-on-the-Lake is the variation in water content from transect to transect along the coast.

03:00PM BREAK

03:15PM SUSPENDED SEDIMENT CONCENTRATION IN MAUMEE RIVER: 1950-1990. YU ZHOU. DEPARTMENT OF GEOGRAPHY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Water quality is an important component in modern hydrology. Sediment, among all surface water pollutants, is probably the most significant water quality element in terms of its quantity in rivers. The presence of stream sediment can affect water use as well as the transportation of other pollutants. Historically, sediments are naturally generated in a watershed as a result of water erosion. In the last half century, however, excessive sediment of anthropogenic origin has caused enormous environmental problems around the world. Stream sediment, therefore, constitutes an important part in water quality and human-environmental relationship studies. Using the data collected at Waterville USGS Maumee River gauging station, this presentation will discuss: (1) the seasonal variation of Maumee River's suspended sediment concentration; (2) the quantity change of suspended sediment in the past forty years (1950-1990); and (3) the relationship between suspended sediment concentration and water discharges.

03:30PM FLOOD HISTORIES RECONSTRUCTED FROM SEDIMENTARY DATA FROM TWO RESERVOIRS IN NORTHERN OHIO. JAMES E. EVANS, WILFRID M. GILL, AARON D. SULTANA, DEPT OF GEOLOGY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403; AND JOHAN F. GOTTGENS, DEPT. OF BIOLOGY, UNIVERSITY OF TOLEDO, TOLEDO OH 43606.

Reservoirs are dynamic systems that act as sediment traps for part of the sediment load of the drainage basin. The stratigraphy of reservoir sediments is a proxy for significant changes in the drainage basin, including flood histories, land use change, and climate change. Vibracores were collected from the IVEX Corp. reservoir (Chagrin River at Chagrin Falls) and Ballville reservoir (Sandusky River at Fremont). Flood horizons are fining-upward sequences up to 10 cm thick, often capped with an organic-rich horizon. These instantaneous events were matched to historical flood records using a variety of methods, including fallout isotopes. Problems encountered include: (1) disparity of flood horizons between cores, (2) evidence for reworking of flood horizons by bioturbation, (3) lack of historical flood records in part, and (4) complex reservoir histories, such as drawdown and sediment disturbance as part of management activities. Both reservoirs document a recent decline in sedimentation rates, which may indicate changing land use, or may show sediment bypassing, as the reservoir approaches fill capacity.

03:45PM MAGNETIC MAPPING OF BLACK HAND SANDSTONE IN NORTH CENTRAL OHIO. JENNIFER GRIFFITHS AND STEVEN H. EMERMAN. DEPARTMENT OF CHEMISTRY AND GEOLOGY, ASHLAND UNIVERSITY, ASHLAND OH 44805.

The Cuyahoga Formation (lower Mississippian) in central Ohio has been interpreted as a prograding delta with the upper Black Hand Sandstone Member representing the distributary mouth bar and the lower Wooster Shale Member representing the delta front and prodelta. However, the deltaic interpretation of the Black Hand Sandstone does not account for some features which are more diagnostic of a nonmarine environment such as coarse-grained texture and the inclusion of quartz pebbles and some features which are more diagnostic of a peritidal environment such as herringbone and lenticular bedding. Part of the difficulty in interpretation results from the lack of outcrops which would show the presumed gradational contact between the Black Hand and Wooster Members. The high hematite content and the presence of Liesegang rings suggests that the contrast in magnetic susceptibility between the Black Hand and the adjacent stratigraphic units may be sufficiently great enough to allow magnetic mapping of the Black Hand - Wooster boundary and a useful magnetic subdivision of the Cuyahoga Formation. Samples of the Black Hand and adjacent units have been collected in and around Mohican

State Park in Ashland County. Measurements and interpretation of magnetic susceptibility will be reported at the meeting.

04:00PM APPLICATION OF THERMAL INFRARED REMOTE SENSING TO THE MAPPING OF GROUNDWATER RESERVOIRS IN CARBONATE BEDROCK. ROBERT K. VINCENT, DEPT. OF GEOLOGY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403-0218.

Much of the Lake Erie Basin in Ohio is underlain by carbonate bedrock, covered by a thin surface layer of glacial till (usually less than 50 m). Groundwater reservoirs in the carbonate bedrock are aligned along fractures in the bedrock, where groundwater has dissolved away some of the impermeable carbonate. It is important that those fractures be identified for the protection of groundwater in this area, such that farmers can locate their stock pens away from the fractures, while drilling their water wells on them. This not only would reduce contamination of groundwater, but would increase groundwater production in the area. Examples of the use of thermal infrared scanners to locate groundwater reservoirs in Nevada and in the Union of South Africa will be shown. The South African example is for terrain that is underlain by carbonate bedrock and overlain by a few meters of windblown loess. Underground, water-filled fractures are clearly displayed as dark (cool) linear features in carbonate bedrock in a night-time thermal infrared image. These same features are not visible in a day-time, visible, aerial photo of the same area, which will also be shown. Thus, a thermal infrared study of Northwest Ohio would likely be very beneficial for groundwater quality in the region. Because the LANDSAT Thematic Mapper thermal band has coarse spatial resolution (120 m versus 30 m for the other six TM spectral bands), it is likely that airborne thermal scanners, which have spatial resolutions of 2 m or less, will be preferred.

04:15PM DISCRIMINATE ANALYSIS AS A TOOL TO MAP POROSITY DISTRIBUTION IN SANDSTONE BODIES. KENNETH A. LASOTA, DEPARTMENT OF NATURAL SCIENCES, ROBERT MORRIS COLLEGE, 600 FIFTH AVENUE, PITTSBURGH PA 15219-3099 AND J. RICHARD JONES, DEPARTMENT OF GEOLOGY, ACADIA UNIVERSITY, WOLFVILLE, NOVA SCOTIA, BOP 1X0, CANADA.

A number of primary and secondary intergranular and intragranular pore textures have been recognized in sandstone, such as moldic pores, honeycomb grained pores, elongate pores and micropores, among others. It appears that the development of these pore textures within specific sedimentary rock facies is not random. Discriminate analysis is a multivariate statistical procedure that can identify those pore textures that dominate the pore texture signature of a sandstone body. Discriminate analysis is applied here by treating all samples from a given sedimentary rock facies as a known grouping, an "a priori" classification, and the grouping's pore texture data as the discriminating variables. Discriminate analysis in essence tests which pore textures are most associated with each facies. The discriminate analysis program utilized here is the SPSSx software package which uses a Wilk's lambda step-wise selection process to characterize the porosity signature of four sandstone facies of the Venango Group (Upper Devonian) of southwestern Pennsylvania.

GENERAL GEOGRAPHY

10:00AM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 215

JOSEPH G. SPINELLI - PRESIDING

10:00AM AN EXAMINATION OF THE EFFECTS OF REFORESTATION TO MITIGATE GLOBAL WARMING USING AN ENERGY BALANCE GLOBAL CLIMATE MODEL. FRED J. STARHEIM, DEPARTMENT OF GEOGRAPHY, KENT STATE UNIVERSITY, KENT OH 44242.

The purpose of this work is to examine the effectiveness and thereby the feasibility of large-scale reforestation/afforestation efforts to mitigate projected global warming. The selected climate model is based on previous work of Pease (1987) in the *Annals of the AAG*, (77), 450-461, which has been expanded to include dimensions of time and space. The reforestation/afforestation activities are assumed to take place in the tropics where a year-round growing season, plentiful rainfall, and relatively low land development costs should provide the most economically favorable conditions for instituting such a program. The climate model simulations examined the effect of carbon absorption and sequestration in isolation, and then in a subsequent step, examined the combined effect of carbon absorption/sequestration and albedo changes attendant with increased forest cover. Results of the modeling show only small temperature benefits associated with implementation of this large-scale reforestation program.

10:15AM A PERSPECTIVE ON RURAL GROWTH IN CHINA. STEPHEN S. CHANG, DEPARTMENT OF GEOGRAPHY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

There were recent discussions generated by a World Bank report which revised downward the rate of economic growth and poverty reduction in China. With a majority of the Chinese population still in rural areas, growth in this sector is important in reducing poverty and improving standards of living. China's economic reform began in the agricultural sector, resulting in a rise in rural income and standards of living in the early 1980s. However, in the latter part of 1980s, rural income growth stalled. Income amongst people in the cities of the coastal region, however, increased as a result of investments in manufacturing. This led to an increase in income disparity between coastal and interior provinces. The reforms allowing private initiatives contributed to the rise in production and farm income. There is a limit to an increase in yield per acre, and with China's population numbers, it is difficult to increase per capita yields, which acts as a brake on the growth of rural income. Rural non-agricultural enterprises and migration of people to coastal cities for employment can help. However, a large population limits their impact.

10:30AM THE MATURING OF OHIO'S SEX COMPOSITION: 1960-1995. JOSEPH G. SPINELLI AND YU ZHOU, DEPARTMENT OF GEOGRAPHY, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

This paper compares Ohio's sex composition to the scenario for an aging, urbanizing population found in demographic theory. In 1960, Ohio was experiencing its post World War II "baby boom", reflected in a younger population and a higher sex ratio, due to a normal high sex ratio at birth. Internal migration, however, worked against the increasing maleness of the population by drawing females into larger urban centers. In population theory females usually outnumber males in short-distance, rural-to-urban migration, both among young adults and the elderly who find more amenities in the cities. By 1995, Ohio mirrored the U.S. in its percentage of urban population. The effect of high birth rates was gone and the sex ratio of counties, particularly urban counties, was below the national average for cities and towns. Ohio's highest sex ratios are found in rural counties and the non-urbanized portions of MSA counties. Agriculture usually favors males, thus, rural-farm counties tend to have higher sex ratios. This is a continuation of female short-distance out-migration from these areas to urban centers seeking employment in the service sector. Fifty-four percent of the counties of Northwest Ohio have above-the-State-average sex ratios (above 95.5); in the more rural Southeast, surprisingly, only 38 percent are above average. In Northeast Ohio, about one-third of the counties are above average, and in Southwest Ohio, 55% have above-average sex ratios. The highest sex ratios in the State are found in the Southwest, e.g., as high as 123 males per 100 females estimated in 1995 for Pickaway County.

10:45AM THE SPATIAL DIFFUSION OF BROADCAST TELEVISION: AN OHIO PERSPECTIVE. JOHN S. COLBURN, DEPARTMENT OF GEOGRAPHY, KENT STATE UNIVERSITY, KENT OH 44242.

Mass communications are a critical element of information distribution within industrialized societies. Television is the most widespread and influential form of information transmittal in the United States. Since Ohio is a large state and exercises some influence upon American society, this research examines the growth and spread of commercial broadcast television in Ohio from the 1940s through 1990. Few studies examine television from the spatial perspective, that is, where television stations are established and why they locate where they do. To that end, this study employs rank-sizing by population and year of establishment to examine the diffusion pattern of commercial broadcasting television stations and to show where stations were initially located, where they clustered, and if there is any regional influence upon television station location in Ohio. Regression techniques are employed to evaluate several socio-economic variables such as income, age, households, gender, and type of population to determine how much affect they might have upon the distribution process.

1:30 PM EARTH & SPACE SCIENCES DIVISION MEETING

**A COLLECTIVE LOOK AHEAD AT
OHIO'S FUTURE GEOGRAPHY
2:00PM SATURDAY, APRIL 5, 1997
OLSCAMP HALL ROOM 215
HENRY MOON - PRESIDING**

02:00PM A COLLECTIVE LOOK AHEAD TO OHIO'S FUTURE GEOGRAPHY. HENRY MOON, UNIVERSITY COLLEGE, THE UNIVERSITY OF TOLEDO, TOLEDO OH 43604.

In 1996 the Kent State University Press published *A Geography of Ohio*. The book, edited by geographer Leonard Peaceful, features an introduction, sixteen chapters and a conclusion presenting various aspects of Ohio's diverse human and physical geography. Chapters with a physical geography orientation include "The Land," "Climate and Weather," "Ohio Soils" and "Ohio's Mineral Resources." Chapters with a human geography orientation include "Aboriginal Cultures and Landscapes," "Ohio's Settlement Landscape," "The Development of the Economic Landscape," "Population Patterns," "Small Towns," "Energy Production and Consumption," "Agriculture," "Manufacturing," "Transportation," "Outdoor Recreation and Tourism" and "Change on the Edge of Ohio." And embedded nicely near the book's center is a composite chapter entitled "Cities in Ohio" with subsections on Columbus, Cleveland, Cincinnati, Toledo, Akron, Youngstown and the Dayton-Springfield Metropolitan Area. The text is widely recognized across Ohio and is generally accepted as the penultimate reader on the state's geography. This panel discussion features several contributing authors to *A Geography of Ohio* as well as a contemporary policy maker interested in the many dimensions of the state's physical and human geography. Panelists will not review their contributions to the book but will build on the perspectives presented there to look into the future. Each panelist will be asked to address the following questions. How will the subject of your chapter change as we move through the next century? Will the importance of your subject increase or diminish during the next 100 years? In terms of your subject, what advantages does Ohio possess that will present the state with a competitive advantage? In terms of your subject, what disadvantages does Ohio possess that will present the state with a competitive disadvantage? What are the most controversial aspects of your subject's immediate and long range future? Upon addressing each of these questions panelists will entertain questions from each other and the audience. The policy maker will provide an overview of the discussion, address selected subjects and their implications on state-level policy considerations and look ahead to Ohio's future.

DISCUSSANTS:

Prof. Nancy Bain
Dept. of Geography
Ohio University

Mr. Tim Gerber
Div. of Soil & Water Conservation
Ohio Dept. of Nat. Resources

Prof. Jeff Gordon
Dept. of Geography
Bowling Green State University

Prof. Emeritus Henry Hunker
Dept. of Geography
The Ohio State University

Dean Henry Moon
University College
The University of Toledo

Mr. Tom Nash
Cuyahoga Valley NRA
Brecksville, OH

Dr. Richard Janson
The Janson Industries

Elected Public Official
To Be Announced

**MEDICAL SCIENCES & HEALTH
TECHNOLOGIES DIVISION**

**BLOOD PRESSURE, HYPERTENSION,
LUNG VENTILATION**

9:00AM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 225

JUDY ADAMS - PRESIDING

09:00AM THE Y CHROMOSOME FROM A HYPERTENSIVE FATHER PRODUCES SODIUM SENSITIVITY IN RATS SOCIALLY INTERACTING IN A COLONY. ANN CAPLEA, GAIL DUNPHY, DARCI SMITH, DANIEL ELY. DEPT. OF BIOLOGY, UNIVERSITY OF AKRON, AKRON, OH 44325-3908

Our laboratory has shown that the Y chromosome from a spontaneously hypertensive (SHR) father when backcrossed into a normotensive Wistar Kyoto rat (WKY) contributes an increase in blood pressure (BP) of

about 15-20 mmHg. The following study was designed to test the hypothesis that the SHR Y chromosome produces Na⁺ sensitivity and higher BP than the WKY Y chromosome. Three groups of SHR/y and WKY rats (n=8-10/group, age 20-24 weeks) were implanted with an aortic telemetry device to measure BP, heart rate (HR) and activity units (Data Sciences). Group one was housed with females in a territorial colony and fed a normal Na⁺ diet (0.3%) and group two was housed the same but fed a high Na⁺ diet (3%). Group three was caged individually and fed a high Na⁺ diet (3%). BP was 15 mmHg higher in SHR/y rats in a colony on a high Na⁺ diet (HNa) as compared to the same treatment WKY colony rats (p<0.01). Both the SHR/y and WKY HNa colonies had significantly higher BP (p<0.05) than their strain matched normal Na⁺ diet (NNa) colonies. Both the SHR/y and WKY HNa colonies had significantly (p<0.05) higher BP than their strain matched HNa caged animals. BP was inversely related to HR and was not different between the two strains. Activity was higher in the colony vs cage conditions but was not different between the SHR/y and WKY. In conclusion, the Y chromosome from a hypertensive father enhanced the BP response to a high sodium diet. (Supported by HL#48072-04).

09:15AM COMPARISON OF BLOOD PRESSURE AND HEART RATE RESPONSES TO ISOMETRIC HANDGRIP EFFORTS WITH RESPONSES TO EVERYDAY TASKS. JILL M. DANSAND AND RONALD L. WILEY, Ph.D. DEPARTMENT OF ZOOLOGY, MIAMI UNIVERSITY, OXFORD OH 45056.

In research protocols, it has been shown that blood pressure is moderately elevated during brief isometric handgrip exercises, however, resting blood pressure is lowered in individuals who perform isometric handgrip exercises on a regular basis. A systematic study was conducted to determine whether a safe range of blood pressure elevation occurs during the isometric handgrip exercise as compared with elevations that many people commonly experience with everyday home or work tasks. Twelve (12) male and female normotensive subjects performed a variety of isometric, dynamic, and isometric plus dynamic exercises. Blood pressure and heart rate measurements were taken before, during and after performance of each exercise. Results of this study indicate that a safe range of blood pressure elevation occurs during the isometric handgrip exercise as compared with elevations during everyday home or work tasks. This provides information for the development of a prescribed treatment of isometric therapy for hypertensive and borderline hypertensive individuals in place of, or in conjunction with drug therapy.

09:30AM BLOOD PRESSURE EFFECTS OF HYDRALAZINE AND TESTOSTERONE IN GENETICALLY HYPERTENSIVE RATS. DARCI SMITH, REZA HAJJAFAR, GAIL DUNPHY AND DANIEL ELY. DEPT. OF BIOLOGY, UNIVERSITY OF AKRON, AKRON OH 44325-3908.

Castration before puberty has been shown to reduce blood pressure (BP) in genetically hypertensive rats. Recently, we have shown that the Y chromosome in these rats is associated with an earlier testosterone rise than in controls. The objective of this study was to test the hypothesis that testosterone raises BP by a different mechanism than through enhanced vasoconstriction. Three groups of spontaneously hypertensive rats (SHR) were used (15 weeks of age): controls, hydralazine (HYZ) treatment, and castration with testosterone implants (n=6-8/group). Blood pressure was measured weekly by tail cuff; blood was collected for plasma catecholamines (HPLC) and testosterone (RIA). At 24 weeks of age, BP in the HYZ group was significantly reduced (121 mmHg) as compared to controls (180 mmHg, p<0.01). Removal of HYZ caused an elevation of BP to 180 mmHg for 2 weeks which was again reduced to 122 mmHg when HYZ was restarted. However, the castrated-testosterone implant group on HYZ showed a significant increase in BP as compared to the HYZ only group (180 mmHg vs 122 mmHg, p<0.01). HYZ treatment did not influence plasma T levels, however it did reduce the kidney and heart pathology. In conclusion, HYZ did not prevent a testosterone induced hypertension (Supported by HL #48072-04).

09:45AM ENHANCEMENT OF Xe-133 VENTILATION LUNG SCAN IMAGE ACQUIRED AFTER Tc-99m PERFUSION SCAN. HONG LU AND JAMES B. FARISON, DEPARTMENT OF BIOENGINEERING, THE UNIVERSITY OF TOLEDO, TOLEDO OH 43606, AND MICHAEL J. DENNIS, MEDICAL COLLEGE OF OHIO, TOLEDO OH 43606.

In nuclear medicine, the match and mismatch between the images of lung perfusion and ventilation provide an important criterion to diagnose pulmonary embolism. Usually for imaging clarity, the ventilation scan using Xe-133 is performed before the perfusion scan using Tc-99m. But the inverse order is preferred clinically, since (i) if the perfusion image is normal, there is no need to do the ventilation scan, and (ii) if the perfusion image is abnormal, the ventilation image can be obtained by focusing on the perfusion abnormalities. However, the quality of ventilation image is reduced if the ventilation scan is performed after the perfusion scan, because the 140 keV photons emitted from Tc-99m will scatter into the acquisition window of Xe-133 (80 keV). The purpose of this study was to apply image processing techniques to reduce the scattering effect of Tc-99m to get a better Xe-133 ventilation image. First, an image sequence in the preferred inverse order was simulated using the images

acquired in the normal order. Image processing techniques were used to find the optimum way to reduce the scattering background in the ventilation image. Second, a real image sequence was acquired in the inverse order. Before the ventilation scan, an image of the scattered Tc-99m photons in the 80 keV Xe-133 window was also acquired. An improved ventilation image was then obtained by applying image processing techniques to this image sequence.

10:00AM COMPARISON OF BLOOD PRESSURE TECHNIQUES IN RODENTS- TELEMETRY, TAIL CUFF, TAIL ARTERY. HAMID DANESHVAR, ANN CAPLEA, GAIL DUNPHY, MONTE TURNER, DANIEL ELY, DEPT. OF BIOLOGY, UNIVERSITY OF AKRON, AKRON OH 44325-3908.

Our laboratory has been measuring blood pressure (BP) in rodents for 25 years and with the recent interest in cosegregation analysis of BP and genotypes it becomes important to examine the risks/benefits of the various techniques. Therefore, the objective of the following study was to compare simultaneous systolic BP in rats using aortic telemetry, indirect tail cuff and direct tail artery cannulation. The correlation between aortic telemetry (Data Sciences) and simultaneous tail cuff (narco Biosystems) was $r=0.832$, $p<0.001$, and between aortic telemetry and tail catheter (Micromedic) was $r=0.818$, $p=0.007$. However, several variables with each technique caused false high or low BP measures. With the tail cuff method restraint increased BP and the dimensions of the tail cuff, tail size and the thickness of the latex rubber also modified the BP. The telemetry system should be checked with regard to pulse width and offset values. Issues of cost, flexibility, accuracy/reliability, and optimal usage of each technique will be presented. Also techniques for measuring BP in preweaning age rats will be discussed. In conclusion, telemetry worked best for long term studies, tail catheter was satisfactory for acute studies and tail cuff for relative BP differences over time with large numbers of animals.

10:15AM CONTINUOUS BLOOD PRESSURE, HEART RATE AND ACTIVITY MEASUREMENTS USING TELEMETRY IN 4 WEEK OLD RATS. GAIL DUNPHY, ANN CAPLEA, DARCI SMITH, AND DANIEL ELY. DEPT. OF BIOLOGY, UNIVERSITY OF AKRON, AKRON OH 44325-3908.

In order to follow blood pressure in young rats through maturity and puberty it was necessary to verify that proper development occurred after aortic telemetry implantation. Sixteen 4 week old male rats of body weights ranging from 53 to 101 grams, mean weight 86 grams, were anesthetized and implanted with pressure transmitters (Data Sciences). The implanted males and 6 non-implanted females were placed in 1 of 2 colony living conditions which allowed territorial defense and breeding. Body weights showed that implanted animals grew at the same rate as controls. Each colony had a similar number of litters as compared to non-implanted males, showing that the large implant did not interfere with reproductive behavior or functions in the males. Plasma catecholamine levels averaged 1130 pg/ml which was not significantly different from control animals 1354 pg/ml, suggesting normal sympathetic nervous system function. In conclusion, 4 week old (53-100g) rats can be successfully implanted with a telemetry device capable of measuring continuous blood pressure, heart rate and activity. (Supported by HL #48072-04).

10:30AM IMPROVED NONINVASIVE DETERMINATION OF SHEAR RATE IN VASCULAR BLOOD FLOW USING DOPPLER ULTRASOUND. GARETT A. BEGEMAN AND JAMES B. FARISON, DEPT. OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, UNIVERSITY OF TOLEDO, TOLEDO OH 43606 AND HUGH G. BEEBE AND SERGIO X. SALLES-CUNHA, JOBST VASCULAR CENTER, THE TOLEDO HOSPITAL, TOLEDO OH 43606.

Shear rate is defined as the rate of change of the velocity of blood across the diameter of a vessel. Its importance to the medical world lies in its link to endothelial cell function, atherosclerosis, and neointimal hyperplasia. To date, the best noninvasive estimation technique for shear rate in humans has been based on the ratio of the peak systolic velocity and the radius of the vessel scaled by a bluntness factor, $n=2$. In this study, data from the superficial femoral artery (SFA) of 20 adults without clinical arterial disease were gathered using color velocity imaging with a Philips P700 ultrasound scanner. Using the MATLAB software package and simple image processing techniques, the velocity data were extracted from the images and the shear rate was calculated using the formal definition. There are no reported shear rates for the human SFA, but the calculated SFA shear rates are consistent with those reported for the common carotid. By comparing the standard estimate to the new method using the formal definition, shear rate values were roughly 1.6 times lower using the standard method. Combined with the high spatial resolution, the new noninvasive method provided a more precise, detailed description of shear rate in humans than the standard estimate.

HORMONES & METABOLISM 1:30PM SATURDAY, APRIL 5, 1997 OLSCAMP HALL ROOM 225 STEVE CHANNEL - PRESIDING

01:30PM PLASMA PORPHYRINS: DRUG INTERFERENCES IN HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC) DETERMINATION. MICHAEL R. LUST, EDWARD C. TAY AND MARTHA KREIMER-BIRNBAUM, RESEARCH DEPARTMENT, ST. VINCENT MEDICAL CENTER, 2213 CHERRY ST., TOLEDO OH 43608.

Porphyrias are inborn or acquired conditions characterized by partial deficiency in enzymes of the heme biosynthetic pathway. Such a deficiency may cause accumulation of porphyrins or precursors in tissues or excreta. Sensitive methods to detect excess porphyrins in plasma are useful in the differential diagnosis of the porphyrias. We studied six drugs whose fluorescence characteristics give them the potential to interfere with a recently described plasma porphyrin assay. Deproteinization was achieved with a mixture of trichloroacetic acid and dimethyl sulfoxide and after centrifugation the porphyrin extracts were run on a reversed phase HPLC system with fluorescence detection. Mobile phase A consisted of acetonitrile in ammonium acetate buffer, and mobile phase B consisted of acetonitrile in methanol. Under conditions of the assay, norfloxacin, ciprofloxacin, tetracycline and phenazopyridine did not seem to interfere with porphyrin quantitation. However, the antibiotic ofloxacin, whose fluorescence emission spectrum overlaps with that of porphyrins, co-eluted with the uroporphyrins. In addition, the antithrombotic dipyridamole co-eluted with coproporphyrins. Due to these interferences, porphyrin profiles may be altered. A single peak in an otherwise normal plasma due to an interfering drug may create a false positive diagnosis of porphyria, or additional peaks in an abnormal profile may contribute to an erroneous differential diagnosis. Therefore, drug interference must be excluded as a cause of elevated plasma coproporphyrins and/or uroporphyrins. [Supported in part by a grant from the F.M. Douglass Foundation.]

01:45PM DEVELOPMENTAL CHANGES IN RENAL RENIN mRNA AND BODY WEIGHT ARE ASSOCIATED WITH AUTOSOMAL ORIGIN. CHRISTIE M. PERRY, MONTE E. TURNER, DANIEL L. ELY, AMY MILSTED. UNIVERSITY OF AKRON, AKRON OH 44325-3908.

The objectives of this study were to evaluate developmental changes in renal renin mRNA, body weight and blood pressure for four rat strains: Wistar Kyoto (WKY), spontaneously hypertensive rat (SHR), SHR autosomes with WKY Y chromosome (SHR/a), and WKY autosomes with SHR Y chromosome (SHR/y), and to determine whether these changes are similar in rats with the same autosomes. Total cellular RNA was extracted from kidneys of male rats one week or four weeks old and analyzed by Northern blot, using radiolabelled rat renin cDNA. Blood pressures were measured by tail cuff sphygmomanometry (four week old rats only). Statistical significance was determined using $p=0.05$. At one week of age, body weights of SHR, SHR/y and SHR/a are significantly lower than normotensive WKY rats. Four week old SHR and SHR/a rats have body weights ($52.7 \pm 1.48g$; $56.7 \pm 1.60g$) significantly higher than WKY and SHR/y ($35.9 \pm 3.44g$; $42.8 \pm 3.29g$). The blood pressure of SHR/y is significantly lower (103.2 ± 4.70 mmHg) than WKY, SHR, and SHR/a (127.6 ± 6.80 mmHg; 123.7 ± 4.69 mmHg; 123.7 ± 5.62 mmHg). At one week of age, there are no significant differences in renal renin mRNA levels among the four strains. At four weeks of age, renal renin mRNA levels are significantly higher in WKY and SHR/y (1.751 ± 0.2048 ; 1.682 ± 0.1690) than SHR and SHR/a (0.492 ± 0.0348 ; 0.478 ± 0.0482). At four weeks of age, renal renin mRNA levels are significantly lower in SHR and SHR/a rats than in one week old SHR, SHR/a, SHR/y and WKY rats (4.111 ± 0.3060 ; 4.081 ± 0.4545 ; 3.090 ± 0.2956 ; 3.407 ± 0.1513). Renal renin mRNA levels are not significantly different in four week old WKY and SHR/y rats compared to one week old SHR, SHR/a, SHR/y and WKY rats. At four weeks of age, body weights are higher in strains possessing the hypertensive autosomal chromosomes, and renal renin mRNA levels are higher in strains with normotensive autosomal chromosomes. Renal renin mRNA levels decrease between one and four weeks only in those rats with SHR autosomal chromosomes. (Amer. Heart Assoc. GIA #95010670)

02:00PM LOW DOSE PCB EXPOSURE (1.25 AND 12.5 PPM) ALTERS THYROID HORMONE STATUS AND BIOCHEMICAL AND BEHAVIORAL NEUROLOGIC FUNCTION IN 15-25 DAY OLD RATS. B.B. PRITTS AND L.A. MESERVE. BIOLOGY DEPARTMENTS, LE MOYNE COLLEGE, SYRACUSE, NY 13214 AND BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Polychlorinated biphenyl (PCB) contamination of tributaries, sediment, and fish has been well documented in the Great Lakes and will persist because of its bioaccumulation in the food chain and the lipophilic nature of the compound. The body of knowledge regarding the potentially detrimental effects

of human exposure to this toxin remains incomplete. Research indicates that from the time of conception, transplacental, lactational, and postweaning food consumption routes of PCB exposure result in a myriad of developmental, hormonal, and neurological problems in young animals. Our previous studies examining PCB exposure have involved the administration of doses at 62.5-250 ppm. Because these levels might exceed those encountered in the environment, the present pilot study was undertaken using 15-25 day old Sprague-Dawley rats as the animal model, to determine if PCB exposure from the time of conception at concentrations of 1.25 and 12.5 ppm would result in alterations of thyroid hormone status, and biochemical and behavioral neurologic function as determined by choline acetyltransferase (ChAT) assay and Morris water maze performance. Hypothyroxemia resulted in each age group. ChAT activity was significantly altered by PCB administration, but no correlation with water maze performance was demonstrated. Twenty day old animals spent significantly more time in the water maze than controls but by twenty-five days of age there was no significant difference in maze performance between PCB and control animals. Further study is indicated to determine if the results obtained in the present study were compromised by small sample size and/or litter effect.

02:15PM THE EFFECTS OF ESTROGEN AND TESTOSTERONE ON THE DEVELOPMENT OF HYPERTENSION IN OVARIECTOMIZED FEMALE SPONTANEOUSLY HYPERTENSIVE RATS (SHRs) ON A NORMAL SODIUM DIET. BEI LIU, DANIEL L. ELY*. DEPARTMENT OF BIOLOGY, THE UNIVERSITY OF AKRON, AKRON OH 44325-3908.

Our previous study has shown that the effects of testosterone on the development of hypertension was aggregating while estrogen was preventive in ovariectomized female SHRs on a high sodium (3% Na+) diet. The aim of this study was to examine whether testosterone and estrogen have similar effects in ovariectomized female SHRs on a normal sodium (0.3% Na+) diet. Female SHRs (N=41), at five weeks of age, were assigned to five groups: i) control (n=8); ii) ovariectomized (n=8); iii) ovariectomized + testosterone implanted (n=9); iv) testosterone implanted (n=8); v) ovariectomized + estradiol & testosterone implanted (n=8). All were fed a normal rodent chow. Systolic blood pressure (Sbp) was measured weekly by tail-cuff sphygmomanometry for ten weeks. Blood samples for the tests of catecholamine, testosterone and estradiol were obtained retro-orbitally and stored in -70°C freezer for further analysis. We found that: i) A significantly greater increase in Sbp in all ovariectomized groups ($p=0.0007$) compared to that of controls; ii) Testosterone implanted animals with intact ovaries showed an obvious increase in Sbp as well, even though the differences were not statistically significant; iii) There was no significant difference between animals on either diet. These findings clearly indicate that testosterone potentiates the development of hypertension while estrogen prevents it in female SHRs regardless of the Na+ level in diet.

02:30PM URINE PORPHYRINS: DRUG INTERFERENCES IN HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC) DETERMINATION. MICHAEL R. LUST, EDWARD C. TAY AND MARTHA KREIMER-BIRNBAUM RESEARCH DEPARTMENT, ST. VINCENT MEDICAL CENTER, 2213 CHERRY ST., TOLEDO, OH, 43608.

Porphyrias are inborn or acquired conditions characterized by partial deficiency in enzymes of the heme biosynthetic pathway. Such a deficiency may cause accumulation of porphyrins or precursors in tissues or excreta. Sensitive methods to detect urine porphyrins are useful in the differential diagnosis of the porphyrias. We studied six drugs whose fluorescence characteristics give them the potential to interfere with porphyrin assays. Urine was acidified with sulfosalicylic acid, centrifuged and run on a reversed phase HPLC system with fluorescence detection. Mobile phase A consisted of distilled water, acetonitrile, acetone and methanol, modified by phosphoric acid and 2,6-lutidine, and mobile phase B consisted of acetonitrile, methanol and acetone. Under conditions of the assay, and in contrast to published reports, ofloxacin, norfloxacin, ciprofloxacin, tetracycline and phenazopyridine did not seem to interfere with porphyrin quantitation. However, the antithrombotic dipyridamole interfered by co-eluting with uroporphyrins. Apparent elevation of uroporphyrins by the drug may either create a false positive diagnosis of porphyria, or contribute to an erroneous differential diagnosis. Therefore, drug interference must be excluded as a cause of elevated urinary uroporphyrins. Supported in part by a grant from the F.M. Douglass Foundation.

02:45PM EFFECTS OF FOOD-RESTRICTION ON GLUCOSE AND UREA NITROGEN CONCENTRATION IN THE URINE OF VASOPRESSIN-CONTAINING AND VASOPRESSIN-DEFICIENT RATS. LOUISE A. AQUILA, CYRILLA H. WIDE MAN, AND HELEN M. MURPHY. DEPARTMENT OF BIOLOGY, JOHN CARROLL UNIVERSITY, 20700 NORTH PARK BLVD., CLEVELAND OH 44118.

During stress, vasopressin acts synergistically with corticotropin releasing factor (CRF) in the release of adrenocorticotropic hormone (ACTH) which, in turn, stimulates the secretion of glucocorticoids from the adrenal cortex. Previous studies indicate that, under food restriction, vasopressin-deficient, diabetes insipidus (DI) rats have a lower plasma glucose level and a

higher plasma urea nitrogen level than vasopressin-containing, Long-Evans (LE) rats. It is possible that increased quantities of glucose are being excreted in the urine, thus, producing the decreased plasma glucose levels observed in DI rats. In addition, excess urea nitrogen may be excreted with difficulty, accounting for the increased plasma urea nitrogen levels in DI animals. To test this hypothesis, urine was collected in metabolic cages for 20 male LE rats and 20 male DI rats and was assayed for glucose and urea nitrogen levels under ad-libitum and food-restricted conditions (stress). During the ad-libitum condition, the LE rats had significantly higher levels of glucose and urea nitrogen in their urine than the DI rats. The higher urine urea nitrogen level was maintained in LE rats during the stress of food restriction. In addition, during the stress of food restriction, a marginally significantly higher level of urine glucose was observed in LE rats as compared to DI rats. These findings provide evidence for the fact that vasopressin deficiency results in impairment of certain physiological processes related to glucose and urea nitrogen metabolism and/or excretion.

03:00PM EVIDENCE THAT NEONATAL SYMPATHECTOMY LOWERS PLASMA TESTOSTERONE AND SYSTOLIC BLOOD PRESSURE IN NORMOTENSIVE AND HYPERTENSIVE MALE RATS. DAVID H. WILEY AND DANIEL L. ELY, UNIVERSITY OF AKRON, DEPT. OF BIOLOGY, AKRON OH 44325-3908.

Sympathetic nervous system(SNS) activity leads to an increase in systolic blood pressure(SBP), and so by blocking the SNS, there should be a decrease in SBP. To study the effects of sympathectomy(sympx), a sympathoplegic drug, guanethidine(GD) and an antibody to nerve growth factor(anti-NGF) were administered to normotensive WKY(n=20) and hypertensive SHR/y (n=19) male rats. Subcutaneous injections of both drugs, GD(50 ug/g body weight [bw]) and anti-NGF(5.58 ng/g bw) were given the first postnatal week followed by only GD injections the second and third weeks. WKY(n=20) and SHR/y(n=18) controls received 0.9% saline for three weeks. SBP's were measured by the "tail cuff" method and blood samples collected by the "retro-orbital" method. Testosterone(T) and luteinizing hormone (LH) RIA's were run on the blood samples. Sympx in the SHR/y's caused an 83% bw reduction ($p<0.0001$), but in the WKY's no reduction. The WKY and SHR/y sympx groups showed significant decreases in SBP's of 9 mmHg($p<0.0001$) and 18 mmHg ($p<0.0001$), respectively, as compared to control groups. Plasma T levels of sympx WKY's were significantly lower($p<0.01$) than the control WKY's, and the rapid rise of T typically seen in SHR/y from week 6-8 was delayed in the sympx SHR/y's. In conclusion, these data suggest that SHR/y SBP is more dependent on the SNS than WKY. (HL # 48072-04).

03:15PM EFFECTS OF NEONATAL DIHYDROTESTOSTERONE ON BLOOD PRESSURE AND BEHAVIOR IN FEMALE SPONTANEOUSLY HYPERTENSIVE RATS (SHR). LISA A. HOGUE, RON SALISBURY AND DANIEL ELY. DEPARTMENT OF BIOLOGY, UNIVERSITY OF AKRON, AKRON OH 44325-3908.

Across most mammalian species, males have a higher blood pressure than females as adults. Both estrogen as a protector and testosterone as a promoter of high blood pressure have been implicated. Therefore, injections of 5G-dihydrotestosterone benzoate (5G-DHT-B) were given to female pups on day 3 after birth in an attempt to masculinize the pups and study the relationship on blood pressure. The critical period for masculinization of the brain is completed 5 days after birth. 5aDHT-B was used instead of testosterone since testosterone is converted to estrogen and DHT is not. The SHR strain was used for this experiment. On day 3 postpartum, half of the female pups were given injections of 50 ug per 100 g of body weight (0.05 ml of the vehicle oil) of DHT and the rest, including males were given the vehicle. In each group there were 10 animals: control males and females and steroid treated females. Collodion was used to seal the injection site. The pups were weaned at 21 days of age and were approximately 5 weeks old before blood pressure (tail cuff) and behavioral measurements (lordosis, aggression, and attacks) were made for 15 weeks. Weight gains for the rats were also monitored. Weight gains for the males, female controls and DHT females were consistent with each other. The blood pressures and behavior of the two female groups showed no differences. DHT therefore does not alter blood pressure or behavior. (Supported by HL# 48072-04).

PHYSIOLOGICAL CONTROL MECHANISMS

9:00AM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 227

LEE A. MESERVE - PRESIDING

09:00AM THE MECHANISM OF PLASMA NOREPINEPHRINE INCREASE TO CARBON DIOXIDE EXPOSURE. VICTORIA BOROVSKY, MIKE HERMAN, GAIL DUNPHY, AND DANIEL ELY. DEPT. OF BIOLOGY UNIV. OF AKRON, AKRON OH 44325-3908.

The objective of this experiment was to determine whether plasma catecholamine increase in rats exposed to carbon dioxide (CO₂) was due to adrenal gland or sympathetic nerve ending release and if it was due to hypoxia in general or specifically due to CO₂. Plasma norepinephrine (NE) as measured in hypertensive rats after: control period, after CO₂ exposure, after nitrogen exposure, after reserpine treatment for 2 weeks (1.7g/L) and then after adrenalectomy. The same rats were used throughout the experiment (n=27). There was a significant positive correlation between plasma NE content and CO₂ exposure (9 fold increase in NE and a 60 mmHg blood pressure increase in response to CO₂). The nitrogen exposure produced a significant increase in NE (90% of CO₂ response). A 2 week reserpine treatment produced a significant decrease (67%) in plasma NE after CO₂ exposure. Adrenalectomy did not reduce the NE response to CO₂. In conclusion, the increase in plasma NE after CO₂ exposure, was associated with sympathetic nerve ending release and was mostly due to hypoxia and not a reaction to CO₂.

09:15AM MULTI-SITE PHOSPHORYLATION OF GROWTH-ASSOCIATED PROTEIN GAP-43 (B-50) IN RELATION TO NEURONAL SIGNAL TRANSDUCTION. LINDA.A. DOKAS, SHUMEI TING, SHERRI. L. BOROWICZ, AND MICHAEL S. HAAS, DEPTS. OF MEDICINE AND BIOCHEMISTRY, MEDICAL COLLEGE OF OHIO, P.O. BOX 10008, TOLEDO OH 43699-0008.

During periods of axon elongation, neurons increase synthesis of the presynaptic membrane, growth-associated protein GAP-43 (B-50). Consistent with a role for this protein in signal transduction, its phosphorylation at Ser41 by protein kinase C (PKC) is stimulated by activation of receptors coupled to phosphoinositide metabolism. In order to characterize interactions of B-50 with synaptosomal proteins involved in signal transduction, chemical cross-linking with disuccinimidyl suberate has been used. In the absence of Ca²⁺, B-50 in a synaptosomal fraction can be cross-linked in a 65 kDa complex with calmodulin. In the presence of Ca²⁺, B-50 is instead crosslinked to other proteins in a complex of very high molecular weight. In contrast to PKC, casein kinase II (CKII) phosphorylates B-50 at serine and threonine residues other than Ser41 and is dependent upon the basic peptide, polylysine. Immunoblotting demonstrates both PKC and CKII in synaptic membranes, implying that phosphorylation of B-50 by either or both of these kinases could regulate its functions. These results suggest that levels of synaptosomal Ca²⁺ and phosphorylation of B-50 at multiple sites may regulate its ability to interact with other proteins involved in neuronal signal transduction. Supported by grants from NIH (NS30792) and the Alzheimer's Association.

09:30AM NEONATAL CHEMICAL SYMPATHECTOMY DECREASES SYSTOLIC BLOOD PRESSURE IN GENETICALLY HYPERTENSIVE RATS. MICHAEL M. NEEKI, MOSTAFA MIRHAIDARI, GAIL DUNPHY, DANIEL ELY, UNIVERSITY OF AKRON, DEPT. OF BIOLOGY, AKRON OH 44325-3908.

A growing body of evidence suggests that increased sympathetic nervous system (SNS) activity is an important factor for development of hypertension in genetically hypertensive rats. This study's objective was to evaluate the effect of chemical sympathectomy (SYMPX) on hypertension in two strains of rats; a normotensive Wistar-Kyoto (WKY), and a borderline hypertensive strain from a back cross of spontaneously hypertensive rats (SHR/Y). A total of 40 male one-day-old pups were divided into two groups of 10 for each strain. Control groups were injected saline; SYMPX groups were injected with a mixture of anti-nerve growth factor (ANGF) and guanethidine (GD) daily for a period of 21 days. Systolic blood pressure (SBP), plasma testosterone (T) and catecholamines were measured from weeks 5-15 bi-weekly. After 15 weeks, testis, heart, mesenteries, aorta, kidney and adrenal glands were taken and analyzed for norepinephrine (NE) by fluorescence microscopy (FM). There was a 23 mmHg (p < 0.0015) drop in SBP in the SYMPX SHR/Y group and 20 mmHg (p < 0.009) in SYMPX WKY. Plasma epinephrine and NE level dropped by 328pg/ml (p < 0.003) and 445pg/ml, respectively in SYMPX SHR/Y and 533pg/ml (p < 0.05) and 490pg/ml (p < 0.05) in SYMPX WKY as compare to their respective controls. SYMPX SHR/Y showed 0.3ng/ml drop in plasma T. FM revealed a lower concentration of NE in organs from the SYMPX group of both strains. Evidence from our study suggests that a decrease in SNS activity decreased SBP in genetically hypertensive and normotensive rats. (Supported by HL # 48072-04).

09:45AM THE INFLUENCE OF HYDRALAZINE ON COLLAGEN SYNTHESIS IN SELECTED ARTERIES OF MALE AND FEMALE BORDERLINE HYPERTENSIVE RATS. T. SEBRIGHT, G. DUNPHY, D. ELY, DEPARTMENT OF BIOLOGY, THE UNIVERSITY OF AKRON, AKRON OH 44325-3908.

The sexually dimorphic pattern of hypertension involving blood pressure (BP) and vascular morphology has been apparent for many years. The arterial collagen exoskeleton has been implicated in the sustained elevation of blood pressure. Borderline hypertensive (BHR) rats were obtained by breeding a male spontaneously hypertensive rat (SHR) with female Wistar Kyoto rats (WKY). The experiments were composed of ten females and ten males in both control, and hydralazine (Hyd) groups. Intruder stress was used

to elevate BP in both groups. Blood pressure was measured at 6, 11, and 14 weeks of age by tail sphygmomanometry. Collagen deposition was detected by electron scanning microscopy and light microscopy using Sirius red staining on the mesenteric, carotid, and abdominal arteries. Male Hyd rats had significantly lower BP, (Hyd mean=148.4 mmHg, control mean=163.4 mmHg, p<.05). Female BP (Hyd mean=154.7, control mean=154.2) showed no significant changes. Hyd males also had significantly lower plasma testosterone levels (57% decrease, p<.05) and elevated epinephrine (32% increase, p<.05) by HPLC. In conclusion, humoral factors may play an important role in collagen deposition independently of BP. (Supported by HL #48072-04).

10:00AM COMPUTER ANALYSIS OF HUMAN DEPTH EEG IN DIFFERENT SLEEP STAGES. QUN YU AND JAMES B. FARISON, DEPARTMENT OF BIOENGINEERING, UNIVERSITY OF TOLEDO, TOLEDO OH 43606; YONG S. CHOI, MICHAEL J. DENNIS AND MARK RAYPORT, MEDICAL COLLEGE OF OHIO, TOLEDO OH 43699.

This study compares delta (1-4 Hz), theta (4-8 Hz), alpha (8-12 Hz), and beta (12-20 Hz) band power during wakefulness, rapid eye movement (REM) sleep, and non-REM sleep (stages 1, 2, and 3-4) using the EEG recorded with depth electrodes in four patients with drug-resistant partial seizures. EEG frequency bands were defined traditionally. Computer analysis utilizing Fast Fourier Transforms (FFT) was performed with a program, Neurovision, written at MCO. Mean power and standard deviations were calculated for each of the frequency bands. Preliminary analysis was performed with emphasis on the presence and characteristics of theta waves in the hippocampus of the brain. Results demonstrate theta wave activity in the hippocampus, with an increase of theta activity in REM sleep as compared to non-REM sleep (stages 1 and 2).

10:15AM STEROID SULFATASE INHIBITOR DECREASES BLOOD PRESSURE IN SPONTANEOUSLY HYPERTENSIVE RATS. SHAWNNA D. VALIGORA, DEANNA S. GRAY, PUI-KAY LI*, MONTE TURNER, DANIEL ELY. DEPT. OF BIOLOGY, UNIVERSITY OF AKRON, AKRON OH 44325-3908. *(DUQUESNE UNIVERSITY, PITTSBURGH).

The objective of this study was to examine the role of steroid sulfatase (STS) in hypertension. Steroid sulfatase is known to catalyze the conversion of steroid, cholesterol and glucocorticoid sulfates to their nonconjugated forms. This active form causes the elevation of steroids in the animal, which can lead to increased blood pressure. Twelve SHR male rats were injected intraperitoneally twice a week. Six were given estrone (control group) and six were given the STS inhibitor (experimental group). Blood pressures were taken by tail cuff every week between injections. At the end of twelve weeks the body weights of the STS inhibitor rats were about 8% lower than those rats given estrone. The average systolic blood pressures of the STS inhibitor rats and estrone control rats were 143 and 158 mmHg, respectively. The weight of the heart in the STS group was 10% lower than that of the estrone group. Likewise, the right kidney (7.4%), left kidney (8%) and adrenals (25%) were all lower in the STS group. At the end of the experiment, serum testosterone and plasma corticosterone levels were measured and in both cases the STS group had lower levels. Testosterone decreased 29% and corticosterone decreased 5%. In conclusion, the newly synthesized STS inhibitor lowered two steroids potentially involved in hypertension and lowered blood pressure. (Supported by HL #48072-04).

10:30AM THE EFFECTS OF TESTOSTERONE ON CATECHOLAMINE LEVELS IN THE PERFUSED RAT KIDNEY. THOMAS J. JONES, GAIL DUNPHY, DANIEL ELY, DEPARTMENT OF BIOLOGY, THE UNIVERSITY OF AKRON, AKRON OH 44325-3908.

Autosomal chromosomes contribute to hypertension in the spontaneously hypertensive rat (SHR) model, and the sympathetic nervous system has been implicated. The objective of the study was to look at the effects of testosterone (T) on renal catecholamine levels in the perfused kidney. The study involved male SHR and a congenic strain without the hypertensive Y chromosome, SHR/a (n=6-15). Blood pressures were taken by tail cuff sphygmometry to confirm that the pressure was in the normal range for that age and strain of rat (SHR = 162 mmHg, SHR/a = 152 mmHg). Adult animals were castrated and implanted at the base of the neck with Silastic tubing (Dow Corning Midland, MI) containing testosterone propionate. Blood T levels were checked by radioimmunoassay two weeks after castration and prior to termination (BIO RAD, CA SHR 1 implant = 17.6 ng/ml, 2 implants = 38.7 ng/ml, SHR/a 1 implant = 12.6 ng/ml, 2 implants = 24.9 ng/ml). The left kidney was isolated and perfused with a constant flow of 3 concentrations of KCl to produce vasoconstriction using an oxygenated Krebs solution. Kidney pressure was monitored with a pressure transducer and physiograph. Perfusate was collected and analyzed for norepinephrine (NE) by HPLC with electrical chemical detection. Lactate dehydrogenase tests were performed in the initial stages of the study to look at potential tissue damage (0-7 u/L). Plasma NE levels were not significantly elevated between the strains. Significance was shown between the KCl treatments (p<0.0001). In conclusion the T implants appear not

to effect the release of NE from the kidney in either strain. The T implants had no effect on the autosomal chromosomes of the SHR and did not elevate NE in the kidney. (Supported by HL#48072-04).

GENETICS & MOLECULAR BIOLOGY

1:30PM SATURDAY, APRIL 5, 1997

OLSCAMP HALL ROOM 227

R. C. WOODRUFF - PRESIDING

01:30PM MUTATION RATE VS. GENETIC DAMAGE RATE: THE INFLUENCE OF PREMEIOTIC CLUSTERS OF MUTATION ON OUR VIEW OF GENETIC DAMAGE. R.C. WOODRUFF, J. N. THOMPSON, JR. AND H. HUAI. DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Genetic damage that occurs before meiosis is common in multicellular organisms. This damage gives rise to clusters of identical mutant alleles that alter important evolutionary values, such as the probability of fixation. These clusters can also cause confusion in estimating mutation rates. Because mutation rate is measured as the number of mutant gametes per total gametes sampled in a generation, rather than the number of mutational events, clusters do not change the rate of mutation. For example, a cluster of eight is counted as eight mutants and not as a single event (the genetic damage rate). Clusters only change our view of the pattern in which mutants appear in the gene pool. This is only true, however, if clusters encountered during a study are not treated as special cases, such as counting them as single events or excluding them on the assumption that they are pre-existing mutations. In these cases, the true mutation rate would be underestimated. It is also inappropriate to use the initial genetic damage events as a true measure of genetic damage rate, because many products of mutational damage are not recovered in standard mutagenesis screens. It is also inappropriate to compare mutation rates using non-parametric ranking tests, because large clusters will be given the highest, same ranking no matter their size. Examples will be discussed. Finally, the way scientists measure and compare mutations may depend on whether they are interested in evolution or mutagenesis questions. An evolutionary biologist would certainly consider all of the members of a cluster as important, whereas in chemical mutagenesis testing only the initial genetic damage events may be of interest.

01:45PM PHENOTYPIC DIFFERENCES BETWEEN GENETICALLY EQUIVALENT FEMALE RAT STRAINS. M.C. MARCELO, D.L. ELY, M.E. TURNER, AND A. MILSTED. THE UNIVERSITY OF AKRON, DEPT. OF BIOLOGY, AKRON OH 44325-3908.

The objective of this study is to determine the potential contribution of the kidney to the phenotypic differences between female SHR/y and WKY rats. Female WKY and SHR/y rats have essentially identical genotypes. Rats aged 6, 10 and 16 weeks. Groups: (1) intact, (2) ovariectomy, (OVX) at 3 weeks, OVX with testosterone (T) implants at 3 weeks. Kidney weights (KW) in SHR/y were higher at 6 and 16 weeks, but did not differ from WKY at 10 weeks. Renal renin mRNA levels did not differ between strains at 6 weeks (WKY, 0.64 ± 122 ; SHR/y, 0.643 ± 0.71). At 10 weeks, renin mRNA was reduced in WKY ($0.069 \pm .004$) compared to SHR/y (0.515 ± 0.75). Intact rats showed no significant strain differences in BP or BW at 6, 10 and 16 weeks. OVX SHR/y BP was 13% higher (182.7 ± 4.2 mmHg) than OVX WKY at 10 weeks (159.2 ± 1.8 mmHg). 16 week BP was 10% higher in OVX SHR/y (143.0 ± 3.1 mmHg) than in OVX WKY (129.4 ± 3.1 mmHg). In 16 week WKY, OVX-T (175.5 ± 7.3 mmHg) increased BP by 18% compared to OVX. In 10 week WKY, OVX increased BW by 23%, compared to intact and OVX-T. At 16 weeks, OVX increased WKY BW by 27% compared to intact and OVX-T. KW/BW ratios in WKY OVX-T were 21% higher than intact and 38% higher than OVX. KW/BW ratios in 16 week OVX were 12% higher in SHR/y than in WKY. Higher renal renin mRNA levels and KW in the SHR/y may account for the phenotypic differences between the two strains. Intact SHR/y females show higher KW and renal renin mRNA levels, which indicate potential differences in kidney function between strains. Steroid hormone manipulation revealed large differences in BP and KW at age 10 and 16 weeks.

02:00PM ALA42 OF NITROGENASE REDUCTASE: SITE-DIRECTED MUTAGENESIS AND CHARACTERIZATION. MICHELLE M. MILLER AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Biological nitrogen fixation is the reduction of atmospheric nitrogen (N_2) to a more usable compound, ammonia (NH_3). This process is carried out by an enzyme called nitrogenase. It is one of the most intriguing and complex metalloenzymes and is composed of two separate proteins, Fe-protein and MoFe-protein. For N_2 reduction to occur, the Fe-protein must transfer electrons

to the MoFe-protein. The Fe-protein, a dimer, couples the hydrolysis of two MgATP's to the transfer of electrons. The Fe-proteins of many different organisms have been sequenced. In review of these sequences, a noticeable amount of conserved residues have been recognized and noted. More specifically, the Fe-protein contains five conserved domains. The domain two spans the residues 37 - 45. In particular relevance to this work is Ala42. This residue is not conserved; however, it is in the highly conserved region of the protein. After choosing Ala42 as our starting residue, we have obtained several mutations at this site by site-directed mutagenesis. Subsequently, we have characterized these mutants in relation to nitrogen fixation.

02:15PM SER44 OF NITROGENASE REDUCTASE: CHARACTERIZATION AND MUTATIONAL ANALYSIS. BRYAN S. HAUSMAN, LAKSHMI PULAKAT, SHI LEI AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Nitrogenase is one of the most intriguing, complex metalloenzymes and is the protein that catalyzes the MgATP-dependent reduction of N_2 to ammonia. This enzyme is unusual because it is composed of two separately purified proteins; the Fe-protein and the MoFe-protein. The goal of this research is to obtain mutants, prepared by saturated site-directed mutagenesis in the "second conserved region" and to study the properties of the Fe-proteins and the MoFe-proteins of these mutants. We have determined the basis for the mutant Nif-phenotype of *A. vinelandii* UW97 (the substitution of Phe for Ser at position 44 in the Fe-protein). Interestingly, the loss of nitrogenase activity is attributable to a mutation at Ser44; however, although Ser44 is in a highly conserved region of the Fe-protein, Ser44 itself is not conserved. The structural model shows that the side chain of Ser44 is pointing away from the proposed MgATP binding site and towards the core of the subunit. Thus, the phenotype of the corresponding mutant is more likely to result from a general structural disturbance rather than a specific amino acid interaction. Finally, the implications of this finding with respect to the structure/function relationship of the Fe-protein will be discussed.

02:30PM MOLECULAR CLONING AND GENETIC COMPLEMENTATION OF LEADER PEPTIDASE I GENE FROM AZOTOBACTER VINELANDII. CARISSA A. JOCK, LAKSHMI PULAKAT, SAHONG LEE AND NARA GAVINI, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Leader peptidase I is an essential enzyme which is responsible for removing leader peptides from precursors of certain proteins. Investigations to understand the mode of activity of leader peptidase are still in a very preliminary stage. However, the genetic information that specify this enzyme has been characterized from both prokaryotic and eukaryotic sources and reported to be highly homologous. As a first step to understand the leader peptidase of *Azotobacter vinelandii* we have isolated the region of DNA coding for leader peptidase. Since the leader peptidase genes have been cloned from several organisms we have taken an approach of using heterologous probes to isolate lambda clones from the *Azotobacter vinelandii* gene library. By screening the library with non-radioactive DNA probes we have identified several positive clones and these clones were subjected to nucleotide sequencing analysis. By determining the complete nucleotide sequence and complementation of the region corresponding to leader peptidase we are trying to understand the molecular and biochemical characteristics of this protein.

02:45PM IDENTIFICATION OF PROTEINS THAT CAN INTERACT WITH ANGIOTENSIN II RECEPTOR SUBTYPE AT2. SAMEERA AHMED, GREGORY M. KOSUNICK, NARA GAVINI AND LAKSHMI PULAKAT, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

The Ang II receptor subtype AT1 is a G-protein coupled receptor and has a 7-transmembrane domain topology. The Ang II receptor subtype AT2 is also a 7-transmembrane domain-protein and shares 34% homology with the AT1 receptor. However, unlike AT1 receptor, AT2 receptor does not demonstrate the GTPγS-induced shift to a low affinity form and does not activate the Gq-protein mediated PLC pathway. To identify the proteins that participate in the AT2 receptor-mediated signal transduction, we are investigating what proteins can directly interact with AT2 receptor. To do this, we have used the yeast-based genetic assay called the "MATCHMAKER Two-Hybrid System". The intact AT2 receptor and sub-fragments of AT2 receptor were translationally fused to the GAL4-DNA binding domain by cloning them in plasmid pAS2-1 and were used as 'baits' to perform the Two-Hybrid assay. The Matchmaker Random Peptide Library contains 107 independent random peptide clones and provides a convenient source for identifying novel peptide-protein interactions in a two-hybrid screening in yeast. Each clone expresses a different 16-residue random peptide fused to the activation domain of the yeast GAL4 transcriptional activator. We have screened the Matchmaker Random Peptide Library with our 'bait' plasmids and identified a number of peptides that can interact with the AT2 receptor. The amino acid sequences of these peptides were compared to protein data-base to identify putative interacting proteins. The results and implications of these analyses will be presented.

3:00PM THE RELATIONSHIP BETWEEN THE STRUCTURE AND FUNCTION OF ANGIOTENSIN II RECEPTOR SUBTYPE AT2: THE ROLE OF THIRD INTRACELLULAR LOOP. JASON J. DITTUS, NARA GAVINI AND LAKSHMI PULAKAT, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Angiotensin II (Ang II), plays an important role in the regulation of blood pressure and body fluid homeostasis. The Ang II receptor subtype AT2 is a 7-transmembrane domain-protein and retains several amino acids that are crucial for ligand binding, G-protein coupling, and receptor activation of the Ang II receptor subtype AT1. However, unlike AT1 receptor, AT2 receptor does not demonstrate the GTPγS-induced shift to a low affinity form and does not activate the Gq-protein mediated PLC pathway. A comparison of the three intracellular loops of the AT1 and AT2 receptors has shown that the homology is lowest in the third intracellular loop (3rd ICL) of the AT2 receptor. Two other receptors, somatostatin SSTR1 and dopamine D3, are also shown to lack apparent G-protein coupling although they maintain the seven-transmembrane topology. It was also shown that the 3rd ICL of these three receptors contain a conserved 5 amino acid motif (RxxxxLKxxxxxxRxxR). To test whether the 3rd ICL of the AT2 receptor makes the AT2 receptor functionally different from the AT1 receptor, we have generated a chimeric protein (AT2:AT1A3rd ICL:AT2) in which the 3rd ICL of the rat AT2 receptor is replaced by the 3rd ICL of the rat AT1A receptor. The ligand binding and G-protein coupling properties of this chimeric receptor were analyzed by using *Xenopus* oocytes as an expression system. The results of these studies and their implications will be presented.

03:15PM THE RELATIONSHIP BETWEEN THE STRUCTURE AND FUNCTION OF ANGIOTENSIN II RECEPTOR SUBTYPE AT2: ROLE OF LYS215 IN LIGAND BINDING. AMHA S. TADESSE, NARA GAVINI AND LAKSHMI PULAKAT, DEPARTMENT OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Angiotensin II (Ang II), a potent vasoconstrictor hormone, plays an important role in pathogenic conditions such as hypertension and congestive heart failure. The Angiotensin II receptor subtype AT2 is a 7-transmembrane domain-protein and retains 34% homology with the Angiotensin II receptor subtype AT1. It also retains several amino acids that are crucial for ligand binding, G-protein coupling and receptor activation of the AT1 receptor. However, unlike AT1 receptor, AT2 receptor does not demonstrate the GTPγS-induced shift to a low affinity form and does not activate Gq-protein mediated PLC pathway. The Lys199 of the AT1 receptor is located in the 5th transmembrane domain and is essential for Ang II binding to this receptor. In the AT2 receptor, Lys215 occupies an analogous position. As a first step to understand the structure-function relationship of the AT2 receptor, we mutagenized the Lys215 of rat AT2 receptor and replaced it with Arg, Glu, Gln and Ala and analyzed the ligand-binding properties of these mutated receptors by using *Xenopus* oocytes as an expression system. Our results indicate that the features of the ligand-receptor interaction between AT2 receptor and Ang II are not similar to the ligand-receptor interaction between AT2 receptor and the partial agonist CGP42112A.

03:30PM EFFECT OF ISONIAZID ON YEAST. DONALD W. DETERS AND KRISTINA L. HUNKER, DEPT. OF BIOLOGICAL SCIENCES, BOWLING GREEN STATE UNIVERSITY, BOWLING GREEN OH 43403.

Isoniazid is a front-line drug that has been used to treat tuberculosis since the early 1950's. Current evidence suggests that the drug is converted by *Mycobacterium tuberculosis* into a toxic compound that kills the cells. We have found that isoniazid at high levels is toxic to *Saccharomyces cerevisiae* yeast cells. We have isolated several isoniazid resistant yeast mutants. When these isoniazid resistant haploid cells are crossed to sensitive haploids, the diploids are resistant; thus the resistance is dominant or semi-dominant. The isoniazid resistant haploids are cross-resistant to cycloheximide and nicotinic acid hydrazide. The dominance and the cross-resistance suggest that the drugs are being eliminated from the cells, perhaps by activation of the drug efflux system involving one or more pleiotropic drug resistance (PDR) genes. PDR1 encodes a transcriptional activator that regulates expression of several plasma membrane efflux pumps. We have isolated the PDR1 gene from two isoniazid resistant mutants and found single mutations in each case that could explain the resistant phenotype.

PRE-COLLEGE STUDENTS MORNING SESSION

**9:00AM SATURDAY, APRIL 5, 1997
OLSCAMP HALL ROOM 203
JAMES C. BROWN - PRESIDING**

09:00AM AQUEOUS STREAM BIOREMEDIATION THROUGH PHYTOEXTRACTION. SHANNON LEE MARIE BOWDREN, 827 FOX VALLEY CT., CINCINNATI OH 45230

The potential use of manganese as a replacement for lead in gasoline formulation and its consequent potential as a future pollution hazard to aqueous streams warrant present research initiatives. Mercury, a heavy metal, which already contaminates many aqueous streams as a result of industrial pollution also demands continued research to arrive at solutions for its efficient and safe removal. This study involved the transference of two terrestrial plant species, *Helianthus annuus* (Giant Greystripe Sunflower) and *Brassica rapa* (Mustard Tendergreen) into separate hydroponic nutrient mediums to remove up to 300mg per aqueous liter levels of manganese and up to 100mg per aqueous liter levels of mercury through their roots and shoots over designated periods of time. Comparison analysis of manganese and mercury recovery levels found in the ash of the roots and the ash of the shoots of the two plants was performed with an atomic absorption spectrophotometer. This was done to consider the alternate applications of harvesting the roots or harvesting the entire plant for the environmental cleanup of aqueous streams.

09:15AM THE HISTORY OF AN AMERICAN ELM: ORAL TRADITION AND DNA MARKERS. MICHAEL S. BARKER, P.O. Box 638, BELLEFONTAINE OH 43311.

Within the nursery industry and the Dutch elm disease research community, an American elm (*Ulmus americana*) cultivar known as the 'Princeton elm' has been rumored for many years to harbor a high tolerance to the Dutch elm disease pathogen, *Ophiostoma ulmi*. The tree was selected in the early 1920's for its excellent shape and growth, and in the early 1930's twenty supposed 'Princeton Elms' were planted along Washington Road, just outside of Princeton, New Jersey. The trees have survived two pandemics of Dutch elm disease with a 94% survival rate (the 6% mortality rate also represents automobile accidents and storm damage). The research involved the determination of the phylogenetic relationships among 12 of the Washington Road American elms to a possible 'Princeton Elm'. DNA was isolated from leaf samples of each tree via a hot-CTAB extraction method. The DNA was then amplified using the R.A.P.D. (Randomly Amplified Polymorphic DNA) P.C.R. (Polymerase Chain Reaction) method. Polymorphisms were scored, and entered into the phylogenetic tree construction program RAPDistance v.1.04. Some of the Washington Road American Elms were found to be genetically identical. This would coincide with the oral tradition that the DED-tolerant Washington Road American elms are clones of the 'Princeton Elm'.

09:30AM MICROBIAL GROWTH IN ANIMAL MANURE. ELIZABETH BOSTDORFF, 18745 BRIM RD. BOWLING GREEN OH 43402.

Straw, rubber mats, wood chips, and paper shavings are possible bedding choices for cattle. Price and convenience are not the only considerations. The controlled growth of larvae and other harmful organisms is important. The beddings were tested in pens of equal size, with heifers of about the same body mass, in twenty four intervals for one week. Samples of manure from the pens were placed under heat lamps for two weeks. Then, organisms were identified and counted. The data suggest that rubber is a low microbial breeding ground. Because the slippery rubber mats must be cleaned daily there is little opportunity for organism growth. However, this results in more work than the low budget straw. Another advantage of straw is that it decomposes and absorbs moisture, it may then be used as a fertilizer. Thus, in the long run, straw is the best choice among the four materials tested. Further research needs to address additional variables such as moisture, dehydration, and extended animal contact.

09:45AM TRAINING CHICKS TO DO TRICKS. MEAGAN A. CARPENTER. 60941 WARNER DRIVE, BARNESVILLE OH 43713-9662.

The purpose of this project was to determine which breed of chicken would learn tricks the fastest. The breeds taught tricks were Golden Laced Crested Polish, Black-tailed White Japanese, White Chinese Silkie, German Silver Spangled Hamburg, Belgian Porcelain D'Uccle, Asian Light Brahma, and White Faced Black Spanish. Only fully grown, non-tame roosters were tested. The chickens were tested for perching behavior by (1) learning to sit inside a hoop and be carried in the hoop, (2) perching on my shoulders, and (3) sitting quietly while taking a buggy ride. Giving them a bath determined their water tolerance. The project lasted 119 days, with at least twenty minutes a day spent on working with the chickens. Although the results varied, I concluded that some of the chickens did catch on sooner than others. The Polish was the smartest and the Japanese was the best buy.

10:15AM BACTERIA IN HUMAN DISEASE. JACQUELINE R. MALONEY. 3551 LONGWOOD DR., MEDINA OH 44256-8420.

Does covering your mouth really help prevent the spread of bacteria? Bacteria can be transported by air. If you have something in front of your mouth to block the cough, the air flow is decreased. Therefore, the spread of bacteria is decreased. I obtained forty agar plates. Until use, I stored the plates

in the refrigerator. I tested my two sisters, brother, and myself at 4:00 P.M. on December 30, 1995. I selected a room with very little air movement. The agar plates were labeled 1 foot, 2 foot, 4 foot, 6 foot, and control. They were then placed at indicated distances on a six foot table, with the control behind the cougher. The cougher stood at the end of the table at waist height, facing the plates. The helpers stood alongside the table, wearing surgical masks, and quickly removed the plate lids, except the control. The cougher immediately coughed in the direction of the plates, with the mouth uncovered. The helpers waited 30 seconds then replaced the lids. I waited a few minutes then opened up the control behind the cougher, but it was not coughed onto. We all left the room for fifteen minutes to let the bacteria dissipate, then returned and repeated the same process with new agar plates, this time with the mouth covered. This was done by four people total. The plates were incubated in a warm, moist environment. I counted the bacterial colonies at 24, 48, and 72 hours. Total colonies uncovered = 2,025, and total colonies covered = 1,163. The results supported my hypothesis. By covering your mouth, the spread of bacteria can be reduced by 43%.

10:30AM INSECTS RESPIRATORY RATES. JAMES C. BROWN, 1706 HELEN AVENUE, HAMILTON OH 45011-1840.

The purpose of this project was to test to see whether crickets and lady bugs respiration rates were affected by their size or by the temperature of the air they were breathing. Data was acquired by taking two sizes of crickets and adult lady bugs and placing them into a micro-respirator measurement device. It was hypothesized that the larger an insect, the higher the insects respiration rate and also that the warmer the air the insect breathes the higher its respiration rate. Results indicate that the larger an insect the higher its respiration rate. Also discovered was that the cooler the air the insect breathes, up to the temperature of 45°F, the insects respiration rate is higher. Therefore, the first part of the hypothesis is accepted and the second part of the hypothesis is rejected due to the fact that their respiration rate is higher the colder the air they breath.

1:00PM VIEW PRE-COLLEGE POSTER SESSION

PRE-COLLEGE AFTERNOON 2:30PM SATURDAY, APRIL 5, 1997 OLSCAMP HALL ROOM 203 JUANITO S. DURAN - PRESIDING

02:30PM POSSIBLE USES FOR INDUSTRIAL WASTES AS ALTERNATIVE THERMAL INSULATIONS. MATTHEW E. MOWRER, 67610 AIRPORT RD., ST. CLAIRSVILLE OH 43950.

The research goal is the determination for practical applications of selected industrial wastes as thermal insulation. I have chosen fly ash, the remaining ash of burnt coal; a dolomite/sulfur dioxide compound commonly called "scrubber sludge" and recycled rubber. To determine the efficiency of each, three double-walled testing chambers were built. Each chamber consists of a six-inch cube in which is suspended a four-inch cube equally spaced from all walls of larger cube. In the four-inch cube is a light bulb acting as a heat source. The cavity formed by the walls of the two cubes is then filled with the insulating material to be tested. As the heat source warms the air in the four-inch cube to a consistent thermostat-controlled temperature of 32.3 Degrees Celsius (90 Degrees Fahrenheit) the heat energy flows toward the outer wall of the chamber. The insulating material restricts this movement. The less effective the insulating material, the more time the heat source will be on, maintaining the set temperature, and using energy, which is measured in Watt-hours. The efficiency of each material is then calculated by comparing the energy used by the control chamber in a set amount of time to the energy consumed by the individual testing chamber in that same amount of time. After several test sequences, fly ash has shown to be the most efficient of the materials tested.

02:45PM THE INITIAL COLONIZATION OF NEW FRESH WATER PONDS. JENNIFER TIECHE, 4285 S. ST. RT. 605, GALENA OH. 43021

The appearance of protozoa in a new fresh water pond was investigated through soil samples and weekly water sampling. Soil samples were taken from the walls of the pond at depths of 1', 3', and 6', these samples were hydrated with distilled water and studied. Weekly water samples were taken from the top and bottom of the pond, and from the shallow end of the pond to be examined. These samples were compared against one another and the

results of another study done in 1992 in a near location. Each protozoa was drawn and information about it was entered into a log book. This project was done over a twelve week period to try to locate where the protozoans were coming from: cysts, or eggs hatching from the soil, airborne, erosional, or transported by living creatures. No evidence of life was visible for three weeks. Bacteria and Algae came the fourth week, followed by Dinoflagellates and Small Flagellates for weeks five and six. The Small Flagellates were accompanied by Paramecium, Algae, and Diatoms. In week eight the Paramecium, Algae, and diatoms remained with the addition of a copepod. Week nine and ten had a bloom of Algae so large that the color of the pond turned green. Bacteria, Small Flagellates, Algae, Volvox, Amoeba, Copepod, and eggs were found. At week eleven the copepods remained. By week twelve, Bacteria, Small Flagellates, Algae, Diatoms, Copepod and eggs were left. 34% of the pond organisms matched the soil sample, 9.8% matched the 1992 Field sample.

03:30PM THE EFFECT OF YOGURT ON CLOSTRIDIUM PERFRINGENS IN INFANTILE SUS SCROFA. ANDREA M. CHRISTENSON, 15371- 21, FAYETTE OH 43521.

Clostridium perfringens type C scours is a growing problem for Infantile *Sus scrofa* producers. Research in Sweden suggests that lactic acidified milk will help this condition in horses. Yogurt was used instead of acidified milk to treat Infantile *Sus scrofa* with *Clostridium perfringens* type C scours to slow deterioration and speed recovery. The Infantile *Sus scrofa* were divided into two groups, 1) those with 10 or more per litter and 2) those with less than 10 per litter. Observations were made every 12 hours. Infantile *Sus scrofa* in the first group were given oral dosages of yogurt in 0cc (control), 1cc, 5cc, and 10cc amounts. The scours were classified as mild, moderate, and severe. Dosages were compared within each scour severity group. Length of recovery time and weights were compared. The second group was divided into two groups. The first group was given 0cc dosage of yogurt at each observation (control). The second group was given 5cc dosage at each observation. Scours severity and weights were recorded. Results showed that group 1 Infantile *Sus scrofa* given 1cc dosages recovered faster than those given 0cc dosage (control). Those given 5cc dosage recovered faster than those given 1cc dosage.

03:15PM AN INVESTIGATION OF THE EFFECTIVENESS OF NATURAL AND SYNTHETIC INSECT REPELLENTS. SARAH E. LOHMAN, 1722 BOSTON ROAD, HINCKLEY OH 44233.

In any organic gardening book, numerous recipes can be found for "natural" insect repellents recommended for use in the garden over their synthetic counterparts. Advocates claim that these natural compounds are less damaging to the environment, leaving no toxic residues to leach into ground water. The efficacy of these kitchen-blender concoctions, was studied through testing of the hypothesis: Naturally-derived insect repellents will work as effectively as commercially-available, synthetic insect repellents. An experiment was designed in which crickets were confined in a narrow, clear plastic box and exposed to natural and synthetic insect repellents. Cornmeal bait at one end of the box was moistened only with distilled water. At the opposite end of the box, the cornmeal was moistened with distilled water and a repellent. Observations of the locations of the crickets in relation to the repellent were made every fifteen minutes for a trial period of two hours. Three separate trials were conducted for each repellent. Although the synthetic repellents, OFF! and Cutter, were found to be the most potent, the natural repellents, Onion, Osage orange, *Aloe vera*, Jalapeno pepper, Parsnip, Garlic and Orange, had observable repellent effects on the crickets' behavior. In particular, Onion was calculated to be 77.3% and Osage orange 73.5% as effective as the synthetics.

03:30PM THE MAHONING RIVER: THRIVING? SURVIVING? REVIVING? JUANITO S. DURAN, 5602 TARRYTOWN LANE, AUSTINTOWN OH 44515.

On January 17 and 19, 1996 water and sediment samples were collected from 4 sites along the Mahoning River. The first site was at the beginning of the river in Columbiana County, the second at Perkins Park in Warren, the third at the B&O Station in Youngstown, and the final in Lowellville. Four 10ml test tubes of water from each site and tested for ammonia, nitrate, nitrite, PH, hardness, chlorine, and chloramines and compared these results with tap water. Dangerous amounts of ammonia were detected in the Warren and Youngstown sites with a peak at .5 to .6 parts per milliliter. The hardness in these sites also jumped from 125 to 225 parts per milliliter. Chlorine or chloramines were not detected at any site along the river. As the river winds down to Lowellville it starts to go back to normal with the hardness falling 90 ppm and the ammonia going to 0. Aquatic life living in the first and last sites were more diversified and healthier than the remaining sites.

03:45PM USING YEAST GENETIC SYSTEMS TO SCREEN POTENTIAL ENVIRONMENTAL ESTROGENS. SMITA DE, 7955 FAWNCREEK DR., CINCINNATI OH 45249.

The feminization of the male genitalia, abnormal sperm develop-

ment, and increased uterine weight are results of specific industrial chemicals and pesticides found in the environment. The presence of these compounds in the environment and their ability to mimic estrogen qualifies them as environmental estrogens. Due to their estrogenic activity, environmental estrogens have been implicated in the development of breast cancer. We hypothesize that like estrogen, the environmental estrogens function through the estrogen receptor (ER). To test this hypothesis, we utilized two powerful yeast genetic systems to investigate if the environmental estrogens, methoxychlor, cimetidine, and kepone, induce ER dimerization and promote its transcriptional activity. The yeast two-hybrid system was used to determine ligand-dependent dimerization. Vectors containing human ER(hER)Ga14 binding domain fusion protein and hER-Ga14 transactivation domain fusion protein were cotransformed into PCY2 yeast which harbors a reporter Lac Z gene under the control of Gal4 promoter. Should any of the environmental estrogens cause ER dimerization, the Ga14 will reconstitute by bringing its two domains together resulting in the activation of the reporter activity. Transcriptional activity was measured using yeast cotransformed with hER and ERE (estrogen response element) Lac Z reporter plasmids. Binding of the receptor-ligand complex to the ERE induces Lac Z reporter gene activity. Individual yeast cultures were incubated with environmental estrogens (10^{-4} to 10^{-10} M) or estradiol- 17β (10^{-5} to 10^{-11} M) at 30°C. Growth of cultures was terminated after 18 hours and β -galactosidase activity was measured using ONPG assays. Although none of the compounds tested caused dimerization of ER, methoxychlor was able to increase ERE-Lac Z activity indicating that methoxychlor can induce transcriptional activity even in the absence of ER:ER dimer. We thus describe a simple and powerful approach to screening environmental.

04:00PM THE EFFECTS OF ACID RAIN ON SPIROGYRA . AMY M. DECKER, 101 SPLIT RAIL, BELLEFONTAINE OH 43311.

The paper determines if water that contains a pH below 7 will affect the cellular structure of *Spirogyra*. If the structure is effected, what is the common factor the starts the break up and how does this compare to the world's problem with acid rain. To determine the result a study was concluded with cultures of *Spirogyra*. Different amounts of simulated acid rain was inoculated into the growing cultures. Then the cellular structure was looked at under a microscope. After concluding that the higher levels of acid rain cultures destroyed the structure an experiment was conducted to find the common factor. A Xanthoproteic test concluded that the acid rain mainly attacks the cell membrane. The result stimulated investigation on the wide spread effects on other aquatic vegetation and possible corrective actions.

04:15PM ROLE OF THE ORNITHINE DECARBOXYLASE GENE IN THE DEVELOPMENT OF HEAD AND NECK CANCER. KRIS R. JATANA; 2235 SANDOVER ROAD, COLUMBUS OH 43220.

The ornithine decarboxylase (ODC) gene plays a critical role in the cell cycle. ODC is the first and rate limiting enzyme in the synthesis of polyamines and is required for cells to progress through the cell cycle. This investigation measured the expression of ODC in human head and neck cancer cell lines and in normal human cells. The RNA was isolated from the cells and then a reverse transcriptase reaction was used to synthesize DNA. By using polymerase chain reaction (PCR) the ODC gene was amplified, and the levels of this gene were measured. A statistically significant higher level of the ODC gene was found in head and neck cancer cells compared to normal cells; the t-test had a p-value of 0.0005. Future directions include testing wider varieties of cancer cells for ODC expression and investigating the role of ODC in the development of cancerous cells. ODC is possible target for therapeutic intervention.

04:30PM PROTECTING THE RIPARIAN CORRIDOR. ERIN M. COPE, PO Box 194 DAMASCUS OH 44619.

The project purpose is to determine the efficiency of gabions in reducing erosion to the riparian corridor. A healthy riparian corridor helps to reduce the chances of non-point source pollution. A model plywood and plastic stream bed was used to compare stream bank erosion with the presence or absence of gabions. Model gabions were constructed from fine nylon netting and aquarium stones. A stream bank was developed from potting soil, sand, and topsoil. A continuous flowing submersible pump with a plastic hose attached was the water source for the stream bed. Four rocks of different sizes were placed in the center of the stream bed. The water content of the soil was kept the same for each trial. Each 30 minute trial was administered three different times with and without gabions in place, for a total of six trials. Measurements were taken immediately after each trial to determine stream bed width. The results showed that the gabions did effectively reduce the erosion that occurred to the stream bank. An average of 14 cm of soil was lost to the stream banks during each trial without gabions. An average of 10 cm of soil was lost from the stream banks when gabions were in place.

04:45PM WHAT IS THE EFFECT OF THERMAL DEGRADATION ON VARIOUS PROPERTIES OF POLYMERS? AUSTIN C. BEEMAN; 250 NORTH RIVER RD., WATERVILLE OH 43566.

This project dealt with changes in the physical, molecular and photo-optical properties of High Density Polyethylene (HDPE) and Polypropylene (PP) as a result of recycling. The polymers were subjected to four thermal cycles on a single screw extruder with a sample being taken from the virgin polymer and each of the cycles. The samples were subjected to testing on an Instron Stress/Strain Tester, a Melt Indexer, and a Colorimeter according to ASTM procedures D 1708-84, D 1238-90b, and D 1925-70 respectively. The results showed a gradual breakdown of the polymers, but changes were distinctly non-linear. The physical property of Ultimate Stress for both polymers increased in the machine direction but decreased in the cross-machine direction. The Ultimate Elongation of HDPE was increasing higher as well in the cross-machine direction, while PP had almost no Ultimate Elongation whatsoever in that direction. The molecular Flow Rate of HDPE showed a dramatic rise while the Flow Rate for PP remained basically uniform. The photo-optical properties of Brightness rose and fell at a seemingly random rate for HDPE, while PP steadily declined. Three major changes resulted from the thermal aging: crystallization, cross-linking, and molecular shortening.

**INTERDISCIPLINARY SESSION
2:00-4:00 PM
SATURDAY, APRIL 5, 1997
OLSCAMP HALL ROOM 121
AYRES D'COSTA - PRESIDING**

**SCHEDULE OF PAPERS
TO BE ANOUNCED.
SEE HANDOUT AT REGISTRATION.**

Official Announcement

Saturday, April 5, 1997, 5:30 P.M.
Bowling Green State University, Bowling Green, Ohio
Olscamp Hall Room 123

**ANNUAL BUSINESS MEETING
FOR MEMBERS ONLY:**

There shall be an Annual Business Meeting for the membership of the Academy during the Annual Meeting. The business session shall be conducted in accordance with the most recently published edition of "*Robert's Rules of Order*".

The order of procedure shall be as follows:

- A. A Call to Order by the President.
- B. A summary of the Minutes of the previous meeting shall be read by the Secretary.
- C. Presentation of the report of the tellers of the election of officers and other positions.
- D. Voting on any proposed amendments to the *Constitution or By-Laws*. See page 50-60.
- E. Business from the floor.
- F. Adjournment.

Recommended Changes in the Constitution & By-Laws of The Ohio Academy of Science to Implement the *Unified Strategic Plan*.

*Approved on January 10, 1997
by the Governing Council for vote of the membership at
the Annual Meeting on April 5, 1997.*

These changes are intended to accomplish the following:

1. In general, **increase opportunities** for more people to be involved in affecting Academy policies and programs.
2. Bring our **governance up-to-date** with respect to national standards of governance of not-for-profit corporations.
3. **Distinguish between "Board"** or governance **related committees** (e.g. finance, personnel, nominating), operational standing committees (membership, marketing, publications), temporary or ad hoc administrative committees (e.g. Heartland Science), **and administrative committees of Councils** (e.g. specific fund raising committees or program related committees).
4. Formally **recognize** the valuable influence and insight of **students and parents** by **establishing councils** for each.
5. **Rename "objectives" to "goals"** and redefine.
6. **Rename, redefine, and expand** the Governing Council by calling it **The Board of Trustees**, and adding more at-large positions from industry, government and academia. Clarify that the **Board of Trustees** is the **ultimate legislative authority of the Academy, and define the fiduciary and stewardship responsibilities of the Board**. Specify that membership shall be based on the merit of candidates having experience in a broad array of areas related to governance. Require quarterly meetings.
7. **Redefine** the Executive Committee to include: President and Chairperson, President Elect, Treasurer, Secretary and Council Directors (Development, Sr. Academy, Jr. Academy, Student, Parent, and Industry & Business), and Journal Editor.
8. **Rename** the chief elected officer from **President to President/Board Chairperson**. This person also would chair the Executive Committee.
10. **Remove the limitation on** the number of Academy Fellows which can be elected.
11. **Strengthen, clarify, and expand** the composition of the **Junior Academy Council**.
12. **Redefine voting membership** on Junior Academy Council **to accommodate alternates** from each district able to vote if regular district councilpersons are unable to attend.
13. **Establish an attendance policy** for all deliberative bodies.
14. **Establish a policy re Academy membership requirement for serving on councils and committees**.
15. **Clarify** that all **actions** of all councils, committees and Academy groups are to be reported and considered for **ratification by the Board of Trustees** (or the Executive Committee in meetings between the times of the Board meetings).
16. **Define The Ohio Journal of Science** as publishing **peer-reviewed, refereed papers** contributing original knowledge in education, science, engineering, technology, and their applications.

PLEASE NOTE:

Deleted words indicated by ~~strikeovers~~; New words are in **BOLD CAPS**.

CONSTITUTION

ARTICLE I—NAME

This organization shall be known as The Ohio Academy of Science.

ARTICLE II—OBJECTIVES GOALS

The objectives of this Academy shall be as follows:

THE OHIO ACADEMY OF SCIENCE SHALL:

1. to stimulate interest in science, engineering, technology, and education;

2. to promote **QUALITY** scientific research;
3. to improve instruction in science, engineering, and technology;
4. to disseminate knowledge about science, engineering, and technology;
5. to encourage interaction **AND COLLABORATION** among and between scientific, engineering, technological and educational fields; and
6. to recognize high achievement in attaining these objectives.

IN EDUCATION, SCIENCE, ENGINEERING, TECHNOLOGY, AND THEIR APPLICATIONS.

ARTICLE III—MEMBERSHIP

1. CLASSIFICATION:

A. INDIVIDUAL Regular Members:

Regular Members shall be persons interested in **EDUCATION**, science, engineering, technology, or education. The Executive Committee may prescribe more detailed classes of Regular Members.

B. Corporation, Institution, or Organization Members:

Corporation, Institution, or Organization Members shall be corporations, institutions, or organizations which are interested in science, engineering, technology, and education **AND THEIR APPLICATIONS** and in the support of the Academy. Each corporation, institution, or organization may designate one representative who shall have voting privileges in the Academy.

C. Honorary Life Members:

(1) Honorary Life Members shall be active Regular Members of long standing who have rendered distinguished service to the Academy.

(2) Nomination of Honorary Life Members shall be by the Executive Committee.

(3) The ~~Governing Council~~ **BOARD OF TRUSTEES** shall vote upon the nominations. A three-fourths favorable vote shall be necessary for election.

(4) Honorary Life Members shall be entitled to all rights and privileges of Regular Members and shall be exempt from payment of dues.

(5) The number of Honorary Life Members shall not exceed one per cent of the **PAID** active membership.

D. Fellows:

~~(1) Fellows shall be or shall have been engaged in extensive productive scientific, technological or educational contributions and shall have rendered some other special service to The Ohio Academy of Science.~~

(1) FELLOWS SHALL HAVE RENDERED SOME SPECIAL SERVICE TO THE OHIO ACADEMY OF SCIENCE OR SHALL BE OR SHALL HAVE MADE EXTENSIVE, PRODUCTIVE SCIENTIFIC, TECHNOLOGICAL OR EDUCATIONAL CONTRIBUTIONS TO SOCIETY.

~~(2) Prior to nomination, Fellows shall BE have been Regular Members for a minimum of five years, Life Members or Honorary Life Members, and, IF ELECTED, shall be considered as Fellows as long as they maintain membership.~~

~~(3) Nomination of Fellows shall be made by any two Fellows. Members nominated as Fellows must have currently paid dues.~~

~~(4) Forms for the nomination of Fellows shall be provided by the Academy office upon request to Vice Presidents and Fellows. Properly completed forms shall be submitted to the Fellowship Committee.~~

~~(5) The Fellowship Committee shall forward approved Nominations to the Governing Council.~~

~~(6) Election shall be at a meeting of the Governing Council, by a three-fourths favorable vote of those members present who are Fellows.~~

~~(7) No more than five fellows may be elected in a year in which the total number of fellows exceeds ten percent of the total membership of the Academy.~~

E. Patrons:

(1) Patrons shall be persons, corporations, institutions, or organizations who have given unusual assistance or aid to the Academy.

(2) Nomination of Patrons shall be by the Executive Committee upon recommendation of the Chief Executive Officer or President.

(3) **FOR ELECTION TO THE STATUS OF PATRON, t-The Governing Council BOARD OF TRUSTEES must approve the nomination by three-fourths favorable vote of Members present.**

(4) Patrons shall be entitled to all rights and privileges of Members and at the discretion of the Executive Committee may be exempt from payment of dues.

2. ELIGIBLE VOTERS:

~~Voters shall be Regular Members and representatives designated by Corporation, Institution, or Organization Members: All PAID Members are eligible to vote at the Annual Business Meeting AND IN ALL ELECTIONS.~~

3. MEMBERS OF THE ACADEMY BOARD OF TRUSTEES AND MEMBERS OF ALL COUNCILS, COMMITTEES, AND TASK FORCES UNDER THE AUSPICES OF THE ACADEMY ARE EXPECTED TO BE MEMBERS OF THE OHIO ACADEMY OF SCIENCE.

4. IT IS EXPECTED THAT MEMBERS OF THE BOARD OF TRUSTEES AND MEMBERS OF ALL COUNCILS, COMMITTEES, AND TASK FORCES UNDER THE AUSPICES OF THE ACADEMY WILL ATTEND ALL MEETINGS. IF A MEMBER FAILS TO MEET MINIMUM ATTENDANCE OF ONE HALF OF THE MEETINGS WITHIN A CALENDAR YEAR, HIS OR HER POSITION WILL BECOME VACANT AND MAY BE FILLED BY APPOINTMENT BY THE BOARD OF TRUSTEES. AT THE DISCRETION OF THE PRESIDENT AND CHAIRPERSON OF THE BOARD OF TRUSTEES, IMPOSITION OF THIS RULE MAY BE WAIVED IN CASES OF EXTENUATING CIRCUMSTANCES.

ARTICLE IV—OFFICERS

1. PRESIDENT /CHAIRPERSON OF THE BOARD OF TRUSTEES:

A. Qualifications: The President /CHAIRPERSON OF THE BOARD OF TRUSTEES shall be a Member of long standing and a Fellow and shall have rendered signal service to the Academy, and who has achieved a recognized position in a field of scientific, engineering, technological, or educational endeavor.

B. Duties: The President /BOARD CHAIRPERSON shall discharge the duties of a presiding officer at the Executive Committee meetings, BOARD OF TRUSTEES ~~Governing Council~~ meetings, and all General Sessions of the Academy. The President /BOARD CHAIRPERSON shall keep constantly informed on the affairs of the Academy, its acts, and the acts of its officers. The President/BOARD CHAIRPERSON is authorized to name representatives of the Academy. The President/BOARD CHAIRPERSON shall cause the provisions of the *Constitution and By-Laws* to be faithfully executed. A Presidential address shall be given at the Annual Meeting of the Academy at the conclusion of the term of office. **THE PRESIDENT'S ADDRESS MAY BE PUBLISHED IN THE OHIO JOURNAL OF SCIENCE AFTER THE ANNUAL MEETING. THIS ADDRESS SHALL BE SUBMITTED AND EDITED AS ANY OTHER MANUSCRIPT SUBMITTED TO THE JOURNAL.**

C. Term of Office: The President-elect shall succeed to the office of President /CHAIRPERSON OF THE BOARD OF TRUSTEES at the adjournment of the next Annual Meeting after election and shall serve as President /CHAIRPERSON OF THE BOARD OF TRUSTEES until the conclusion of the following Annual Meeting.

D. Absence: The duties of the President /CHAIRPERSON OF THE BOARD OF TRUST-

EES, in the event of resignation, absence, disability, or death, shall be assumed for the remainder of the unexpired term by the President-elect. Should the President-elect be unavailable, the Executive Committee shall appoint a properly qualified Fellow to serve for the remainder of the term.

2. PRESIDENT-ELECT:

A. Qualifications: The President-elect shall be a Member of long standing and a Fellow and shall have rendered signal service to the Academy, and who has achieved a recognized position in a field of scientific, technological, or educational endeavor.

B. Duties: The President-elect ~~will~~ **SHALL** be a member of the ~~Governing Council~~ **BOARD OF TRUSTEES** and of the Executive Committee and may also serve *ex-officio* on any regular committee of the Academy. The President-elect shall attend meetings of the Executive Committee and have full voting privileges.

C. Term of Office: The term of office as President-elect shall commence at the adjournment of the Annual Meeting. The President-elect shall become President /CHAIRPERSON OF THE BOARD OF TRUSTEES at the adjournment of the following Annual Meeting.

D. Absence: The duties of the President-elect, in event of resignation, absence, disability, or death, shall be assumed for the remainder of the unexpired term by a properly qualified Fellow appointed by the Executive Committee.

3. SECRETARY:

A. Qualifications: The Secretary shall be a Member of long standing who is familiar with the organization and activities of the Academy. The Secretary shall be a person known for the conscientious and faithful discharge of duties appropriate to this office.

B. Duties: The Secretary shall: (1) be responsible for a complete list of the Members of the Academy with dates of their membership; the membership roster may be maintained on a current basis by the Academy Office. (2) keep the records of the proceedings of the Executive Committee, the ~~Governing Council~~ **BOARD OF TRUSTEES**, and the Academy Annual Business meeting. The Secretary shall promptly prepare and forward minutes of the Executive Committee and ~~Governing Council~~ **BOARD OF TRUSTEES** to Members of the Executive Committee.

C. Term of Office: The term of office shall commence immediately upon election and shall be for three years. In order to provide continuity in the affairs of the Academy, the Secretary shall automatically continue to serve as a member of the Executive Committee and ~~Governing Council~~ **BOARD OF TRUSTEES** for a term of one year. The terms of the Secretary and Treasurer shall not terminate in the same calendar year.

D. Absence: The duties of the Secretary, in the event of resignation, absence, disability, or death, shall be assumed for the remainder of the unexpired term by a Member appointed by the President and approved by the Executive Committee.

4. TREASURER:

A. Qualifications: The Treasurer shall be a Member of the Academy. This person shall be methodical, punctual, and a person of the highest integrity.

B. Duties:

The Treasurer **OR HIS/HER DESIGNEE** shall:

- (1) collect all monies due the Academy.
- (2) be custodian of all Academy monies and securities.
- (3) keep an account of receipts and disbursements in detail, and balance these accounts as of the first of January of each year.
- (4) with appropriate discretion, deposit monies in an appropriate financial institution in the name of "The Ohio Academy of Science, (Incorporated in the State of Ohio)".
- (5) be a member of the Executive Committee and ~~Governing Council~~ **BOARD OF TRUSTEES** and present reports regularly on the financial condition of the Academy.
- (6) read a report at the Annual Meeting of the ~~Governing Council~~ **BOARD OF TRUSTEES** outlining the progress, problems, and recommendations of the office, and thereupon shall deposit two copies of it with the Secretary.
- (7) Chair the Finance Committee.

C. Auditing: The Treasurer's accounts shall be audited as of the first of January of each year by an accountant appointed by the Executive Committee.

D. Indebtedness: No debt shall be incurred on behalf of the Academy or its officers unless provision has been made for the expenditure either in the budget or by special action of the Executive Committee. Furthermore, any officer or other Member shall obtain written authorization from the Treasurer before contracting an obligation for the Academy. The Treasurer shall not authorize any such expenditure unless sufficient funds are or will be available for payment.

E. Term of Office: The term of office shall commence on the first of July following the date of election and shall be for three years. Upon completion of the term, the Treasurer shall automatically continue to serve as a member of the Executive Committee and ~~Governing Council~~ **BOARD OF TRUSTEES** for a term of one year. The terms of the Treasurer and the Secretary shall not terminate in the same calendar year.

F. Absence: The duties of the Treasurer, in event of resignation, absence, disability, or death, shall be assumed for the remainder of the unexpired term by a member designated by the President and approved by the Executive Committee.

5. EDITOR OF THE OHIO JOURNAL OF SCIENCE:

A. Qualifications: The Editor shall be a Member who is a scientist, engineer, technologist, or educator with a distinguished publication record and who has an interest in and knowledge of editing and publishing.

B. Duties: The Editor shall:

(1) be a member of the Executive Committee, ~~Governing Council~~ **BOARD OF TRUSTEES**, Finance Committee and the Publications Committee.

(2) encourage submission of manuscripts for *The Ohio Journal of Science* and arrange for their **PEER** review and, if they qualify, for their timely publication.

(3) participate in the financial affairs of the *Journal*.

(4) receive all manuscripts submitted to the *Journal*.

(5) be responsible for ensuring that the *Journal* is published in a timely fashion, for maintaining a high quality of articles, and for securing peer review of manuscripts by competent referees.

C. Term of Office: The Editor shall be appointed by the Executive Committee. In order to provide continuity in management of the *Journal*, the Editor shall serve a five year term.

D. Absence: The duties of Editor, in the event of resignation, absence, disability, or death, shall be assumed for the remainder of the unexpired term by a person designated by the President and approved by the Executive Committee.

6. HISTORIAN-ARCHIVIST:

A. Qualifications: The Historian-Archivist shall be a Member of the Academy who has demonstrated interest in the history of science, engineering, technology, and education and the history of the Academy.

B. Duties: The Historian-Archivist shall be responsible for the collection, preservation, and maintenance of historical records of the Academy. A summarization of statistical data in reference to Academy history shall be reported at the Annual Meeting. This report shall be included in an Annual Report of the Academy. On occasion, the Historian-Archivist should publish studies bearing upon the development and accomplishments of the Academy.

C. Term of Office: The Historian-Archivist shall be ~~elected by the membership~~ **APPOINTED BY THE EXECUTIVE COMMITTEE** for a term of three years.

D. Absence: The duties of the Historian-Archivist in the event of resignation, absence, disability, or death shall be assumed for the remainder of the unexpired term by a person designated by the President and approved by the Executive Committee.

E. The Historian-Archivist shall be chairperson of the Necrology Committee.

F. The archives of the Academy shall be maintained by The Ohio Historical Society.

ARTICLE V—BOARD OF TRUSTEES AND COUNCILS

1. THE GOVERNING COUNCIL: BOARD OF TRUSTEES:

A. Membership: The ~~Governing Council~~ **BOARD OF TRUSTEES** shall be composed of the President **AND CHAIRPERSON**, President-elect, immediate Past President, Secretary, Treasurer, (when applicable, the outgoing Secretary or the outgoing Treasurer), Editor of The Ohio Journal of Science, **DIRECTORS AND ASSISTANT DIRECTORS OF ALL COUNCILS** ~~Senior Academy Director, Junior Academy Director, Director of the Industrial and Business Council, Chairperson of the Development Council, Chief Executive Officer (EX-OFFICIO, NON-VOTING)~~, Representatives to the American Association for the Advancement of Science, Representatives to the National Association of Academies of Science, Representative to the Executive Committee of the Ohio Biological Survey, Historian-Archivist, ~~the at-large members of the Executive Committee~~ **TWELVE AT-LARGE POSITIONS, FOUR EACH FROM INDUSTRY, GOVERNMENT, AND ACADEMIA FOR TWO YEAR STAGGERED TERMS EACH**, and the Chairpersons of all standing and temporary committees **WHICH REPORT DIRECTLY TO THE BOARD OF TRUSTEES. ELECTED MEMBERS OF THE BOARD OF TRUSTEES SHALL INCLUDE: PRESIDENT ELECT, PRESIDENT AND CHAIRPERSON OF THE BOARD, SECRETARY, TREASURER AND THE TWELVE AT-LARGE POSITIONS.**

B. Meetings:

(1) The ~~Governing Council~~ **BOARD OF TRUSTEES** shall meet at least ~~twice each year~~ **QUARTERLY**, once ~~on the opening day of~~ **AT** the Annual Meeting of the Academy, which shall be known as the Annual Meeting of Council, and **ON THREE OTHER DATES DURING THE YEAR** once on a date, set by the Executive Committee, at least ninety days prior to this Annual Meeting, which shall be known as the Interim Meeting.

(2) Special meetings of the ~~Governing Council~~ **BOARD OF TRUSTEES** may be called by the President **AND CHAIRPERSON OF THE BOARD** upon petition of at least three-fourths of the membership of the Executive Committee. If ten members of the ~~Governing Council~~ **BOARD OF TRUSTEES** petition the President for a special meeting of ~~Governing Council~~ **BOARD OF TRUSTEES**, the President shall call such a meeting no sooner than ten days and no longer than thirty days following receipt of the petition by registered mail.

(3) Quorum: The members of the ~~Governing Council~~ **BOARD OF TRUSTEES** present shall constitute a quorum.

(4) Duties:

(A) The ~~Governing Council~~ **BOARD OF TRUSTEES** shall be the ultimate legislative body of The Ohio Academy of Science with power to make final decisions.

(B) **ALL TRUSTEES, WHETHER ELECTED OR APPOINTED, SHALL BE VESTED WITH FIDUCIARY RESPONSIBILITIES. THEY SHALL DISCHARGE THESE RESPONSIBILITIES IN GOOD FAITH, IN A MANNER THAT EACH TRUSTEE REASONABLY BELIEVES TO BE IN THE BEST INTEREST OF THE CORPORATION, AND WITH THE CARE AN ORDINARY PRUDENT PERSON IN A LIKE POSITION WOULD EXERCISE UNDER SIMILAR CIRCUMSTANCES.**

(C) **IN ADDITION, THE BOARD OF TRUSTEES SHALL BE RESPONSIBLE FOR GENERAL STEWARDSHIP INCLUDING ALL CORPORATE OBLIGATIONS; FUND DEVELOPMENT; GENERAL POLICY MAKING INCLUDING REVIEW AND RATIFICATION OF ACTIONS OF ALL COUNCILS, COMMITTEES AND DELIBERATIVE BODIES UNDER THE AUSPICES OF THE ACADEMY; DEVELOPING A CODE OF CONDUCT INCLUDING A CONFLICT OF INTEREST POLICY AFFECTING MEMBERS OF THE BOARD OF TRUSTEES AND ALL DELIBERATIVE BODIES UNDER THE AUSPICES OF THE ACADEMY; STRATEGIC PLANNING AND SETTING OF PRIORITIES; BUDGET, FINANCIAL, AND PROGRAM OVERSIGHT; MAKING APPOINTMENTS; AND INTERACTION WITH THE COMMUNITY.**

(D) **IN THE ABSENCE OF ACTION BY SPECIFIC APPOINTING AUTHORITIES WITHIN ALL COUNCILS, COMMITTEES AND DELIBERATIVE BODIES UNDER THE AUSPICES OF THE ACADEMY, THE TRUSTEES SHALL HAVE AUTHORITY TO MAKE ANY AND ALL APPOINTMENTS TO FACILITATE THE TIMELY FUNCTIONING OF THESE GROUPS.**

(5) Agenda: ~~The Secretary, as directed by the President, shall prepare the agenda.~~ **THE AGENDA SHALL BE PREPARED IN CONSULTATION WITH THE PRESIDENT AND CHIEF EXECUTIVE OFFICER.**

(6) Voting: All **ELECTED AND APPOINTED** members of the ~~Governing Council~~ **BOARD OF TRUSTEES** shall have voting privileges. A motion shall ~~be passed~~ if a majority of those present vote favorably, except that motions to rescind actions of the Executive Committee **OR OTHER ACADEMY DELIBERATIVE BODIES** shall require a two-thirds majority vote **OF THOSE PRESENT.**

2. THE SENIOR ACADEMY COUNCIL:

The Ohio Academy of Science shall maintain a Senior Academy Council as a means of promoting and developing scientific and scholarly activities in Ohio.

A. Membership: The Senior Academy Council shall consist of a Director, Assistant Director, Secretary, and Division Coordinators who shall be Members and who shall be broadly representative of science, engineering, technology, and education in Ohio. **THE TERMS OF OFFICE OF EACH MEMBER SHALL BE THREE YEARS, WITH APPOINTMENTS STAGGERED.** Additionally, the Executive Committee shall appoint ~~six~~ **SIX ADDITIONAL** Members **SHALL BE APPOINTED**, two each from industry, government and academia, to two year staggered terms. ~~The Director, Assistant Director, Secretary, Division Coordinators and all other members shall be appointed by the Executive Committee of the Academy upon recommendation of the President. The terms of office of each member shall be three years, with appointments staggered.~~ Each member shall be subject to an annual review by the Executive Committee. **MEMBERS OF THIS COUNCIL SHALL BE APPOINTED BY THE EXECUTIVE COMMITTEE OF THE OHIO ACADEMY OF SCIENCE.**

B. Director: The Director shall be an Academy Member appointed by the Executive Committee of the Academy after consultation with the Senior Academy Council. The term of office shall be for three years. The Director of the Senior Academy Council shall be a member of the Executive Committee and of the ~~Governing Council~~ **BOARD OF TRUSTEES.**

C. Purpose and Goals:

(1) The primary purpose of the Senior Academy Council is to develop and promote scientific and scholarly activities in Ohio with regard to science, engineering, technology, and education.

(2) The Senior Academy Council shall structure programs and other activities which promote science, engineering, technology, and education in Ohio.

(3) The Senior Academy Council shall lead in planning and carrying out activities that encourage or result in productive interactions among scientific, engineering, technological, and educational fields and other activities which respond to needs of Academy Members in all the fields of interest.

(4) Three-year plans, updated annually, shall be developed by the Senior Academy Council and submitted to the Executive Committee for approval.

D. Organization AND OPERATION:

(1) The Senior Academy Director shall appoint an Annual Meeting Director, unless this function is assumed by the Assistant Director. The Annual Meeting Director shall assist the Chief Executive Officer to develop and implement plans for the annual meeting in cooperation with the local host at the site of the annual meeting and in close cooperation with the Division Coordinators.

(2) The Senior Academy Council shall meet at least three times annually, one meeting of which shall be devoted to the program evaluation, long-range planning, and goal setting of this Council.

3. THE JUNIOR ACADEMY COUNCIL:

~~The Academy shall maintain a Junior Academy COUNCIL as a means of discovering and fostering ability and interest in science and mathematics among students in grades 5-12.~~

A. Membership: The Junior Academy Council shall consist of a Director; Assistant Director; Secretary; ~~three persons from each Junior Academy District (a representative from the host institution who is selected by his or her institution and approved by the Executive Commit-~~

~~tee, a science teacher, and a pre-college student representative selected by the District Science Day Council); TWO COUNCILPERSONS 1. A HOST INSTITUTION REPRESENTATIVE AND 2. A PRE-COLLEGE TEACHER FOR EACH DISTRICT;~~ the Director of State Science Day, **THE CHAIRPERSON OF JUDGING; CHAIRPERSON OF SPONSORED AWARDS; THE DIRECTOR OF SCIENCE DAY JUDGES RECOGNITION AND CERTIFICATION; THE DIRECTOR AND ASSISTANT DIRECTOR OF THE PARENT ADVISORY COUNCIL; THE DIRECTOR AND ASSISTANT DIRECTOR OF THE STUDENT ADVISORY COUNCIL;** the Senior Academy Education Division Coordinator; and others as appointed by the Director of the Junior Academy ~~and approved by the Executive Committee.~~ **ALL MEMBERS OF THE JUNIOR ACADEMY COUNCIL SHALL BE APPROVED BY THE EXECUTIVE COMMITTEE.** The Junior Academy Assistant Director shall be appointed by the Executive Committee of the Academy after consultation with the Junior Academy Council. The term of office for the Assistant Director shall be for ~~four~~ **THREE** years, subject to annual approval by the Executive Committee. The Assistant Director shall act as Director in the Director's absence. The Junior Academy Secretary shall be appointed by the Junior Academy Director for a term of ~~one~~ **TWO** years. ~~The duties of the Secretary shall include preparation and distribution of~~ **PREPARE** the minutes of the Junior Academy Council Meetings. The terms of the Director and Assistant Director shall not terminate in the same calendar year. **THE DIRECTOR OR ASSISTANT DIRECTOR SHALL NOT SERVE CONCURRENTLY AS A DISTRICT COUNCILPERSON. IN THE EVENT THAT A VOTING DISTRICT COUNCILPERSON CANNOT ATTEND A MEETING, THEN AN ALTERNATE SELECTED BY THAT DISTRICT'S COUNCIL, DESIGNATED IN WRITING, MAY ATTEND AND SHALL BE CONSIDERED A VOTING MEMBER.**

B. Director: The Director shall be an Academy Member appointed by the Executive Committee of the Academy after consultation with the Junior Academy Council. The term of office shall be for ~~four~~ **THREE** years, subject to annual approval by the Executive Committee. The Director of the Junior Academy Council shall be a member of the Executive Committee and of the ~~Governing Council~~ **THE BOARD OF TRUSTEES.**

C. PURPOSE AND GOALS:

THE ACADEMY SHALL MAINTAIN A JUNIOR ACADEMY COUNCIL AS A MEANS OF DISCOVERING AND FOSTERING ABILITY AND INTEREST IN SCIENCE AND MATHEMATICS AMONG STUDENTS IN GRADES 5-12.

~~G. Duties:~~ D. ORGANIZATION AND OPERATION:

(1) The Junior Academy Council shall be the responsible ~~legislative~~ **PLANNING AND ADMINISTRATIVE** body of the Junior Academy.

(2) The Junior Academy Council shall ~~prepare a governing document~~ **DEVELOP GUIDELINES** and otherwise perfect the organization of the ~~Junior Academy~~ **COUNCIL.**

(3) The ~~governing document of the~~ Junior Academy **COUNCIL GUIDELINES** and amendments to them ~~IT~~ shall be approved by the Executive Committee and the ~~Governing Council~~ **BOARD OF TRUSTEES** of The Ohio Academy of Science.

4. THE INDUSTRIAL AND BUSINESS COUNCIL:

A. Membership: The Ohio Industrial and Business Council shall consist of Members ~~and non-members of the Academy~~ who are committed to the promotion and advancement of science, engineering, technology, and education **AND THEIR APPLICATIONS in Ohio.** Members of this Council shall be appointed by the ~~President~~ **EXECUTIVE COMMITTEE** of The Ohio Academy of Science. ~~The Director of this Council shall be a Member of the Academy.~~

B. Director: The Director of the Ohio Industrial and Business Council Director shall be appointed by the ~~President~~ **EXECUTIVE COMMITTEE** for a ~~two~~ **THREE** year term and shall be a member of the Executive Committee and of the ~~Governing Council~~ **BOARD OF TRUSTEES.**

C. Purpose and Goals:

(1) To facilitate linkages among government, industry, business, education, and the Academy.

(2) To facilitate continuing science, engineering, and technology education.

(3) To address the needs of industrial and business scientists, **ENGINEERS, AND TECHNOLOGISTS.**

(4) Specific **ADDITIONAL** goals of the Ohio Industrial and Business Council shall be established periodically, ~~by the Council.~~

D. Organization and Operation:

(1) Industrial and Business Forums shall be established on a regional basis.

(2) Each regional forum shall establish an Operations Committee consisting of a minimum of three persons. The chairperson of this Committee shall represent the region on the statewide The Ohio Academy of Science Industrial and Business Council.

(3) Each regional forum shall establish goals and activities to meet the needs of the region.

5. ~~THE COUNCIL OF PAST PRESIDENTS COUNCIL:~~

A. Membership: The Council of Past Presidents shall consist of all past Presidents of the Academy.

B. ~~Chairperson~~ **DIRECTOR**: The immediate Past President shall be the chairperson of this Council and shall be a member of the Executive Committee and of the ~~Governing Council~~ **BOARD OF TRUSTEES**.

C. Purpose **AND GOALS**:

To ~~meet at the call of the President for the purpose of providing~~ Eng guidance and assistance to the Academy.

D. **ORGANIZATION & OPERATION:**

THE COUNCIL SHALL MEET AT THE CALL OF THE PRESIDENT.

6. THE DEVELOPMENT COUNCIL

~~A~~ C. Purpose and goals: the purpose of the Development Council is to develop financial support for The Ohio Academy of Science ~~and thereby forward and enhance its mission by: developing and implementing policies and procedures to be adopted by the Academy's Governing Council in order to:~~

~~identify, 2. qualify, 3. cultivate, 4. solicit, and 5. recognize donors.~~ **BY 1. IDENTIFYING, 2. QUALIFYING, 3. CULTIVATING, 4. SOLICITING, AND 5. RECOGNIZING DONORS.**

~~B~~ A. Membership: the Development Council shall consist of ~~1. Chairperson~~ **DIRECTOR**; ~~2. Vice chairperson~~ **ASSISTANT DIRECTOR**; ~~3. Secretary~~; ~~4. Members of the Academy who have expertise and/or interest in seeking financial support for the Academy; and 5. The President, Treasurer, professional Development Officer (consultant or Academy staff person) and Chief Executive Officer of the Academy all of whom shall serve as ex-officio, non-voting members of the Development Council. After the initial organizational appointments~~ **THE DEVELOPMENT COUNCIL SHALL SELECT ITS OWN MEMBERS, SUBJECT ONLY TO RATIFICATION BY THE GOVERNING COUNCIL. TO BE APPROVED BY THE EXECUTIVE COMMITTEE. THE SECRETARY SHALL PREPARE MINUTES OF THE DEVELOPMENT COUNCIL AND FULFILL OTHER DUTIES AS ASSIGNED BY THE DEVELOPMENT COUNCIL. TERMS OF OFFICE FOR THE DIRECTOR, ASSISTANT DIRECTOR AND SECRETARY SHALL BE FOR ONE YEAR RENEWABLE FOR A TOTAL OF THREE YEARS. THE PROFESSIONAL DEVELOPMENT OFFICER WILL ATTEND ALL MEETINGS OF THE DEVELOPMENT COUNCIL, EXECUTIVE COMMITTEE, AND THE BOARD OF TRUSTEES AS AN EX-OFFICIO, NON-VOTING MEMBER. THE ACADEMY'S TREASURER, AND CHIEF EXECUTIVE OFFICER WILL PROVIDE THE DEVELOPMENT COUNCIL WITH REPORTS ON INCOME AND EXPENDITURES CONSISTENT WITH THE NEEDS OF THE COUNCIL AND DONORS.**

~~(1) Officers~~ **B. DIRECTOR**: the Development Council chairperson **DIRECTOR** shall be an Academy Member and shall be recommended by the members of the Development Council and be appointed by the ~~Governing Council~~ **BOARD OF TRUSTEES**. The chairperson **DIRECTOR** of the Development Council shall be a member of the Executive Committee and the ~~Governing Council~~ **BOARD OF TRUSTEES**. The vice chairperson **ASSISTANT DIRECTOR** shall act in the absence of the chairperson **DIRECTOR** and fulfill other duties as assigned by the Development Council. The secretary shall prepare minutes of the Development Council and fulfill other duties as assigned by the Development Council. Terms of office for the Chairperson, Vice Chairperson, Secretary shall be for one year renewable for a total of three years. The Treasurer and Chief Executive Officer shall provide the Development Council with reports on income and expenditures and fulfill other duties as assigned by the Development Council.

~~(2) The professional Development Officer will attend all meetings of the Development Council, Executive Committee, and Governing Council as an ex-officio, non-voting member.~~

~~(3) Treasurer, & Chief Executive Officer: the Academy's Treasurer, and Chief Executive Officer will provide the Development Council with reports on income and expenditures consistent with the need to report to donors.~~

~~G. Meeting~~ **D. ORGANIZATION AND OPERATION**: a minimum of two regular meetings ~~will~~ **SHALL** be held annually. ~~Sub-c~~ Committee and other Development Council meetings ~~will~~ **SHALL** be held as needed.

~~D. Duties~~ **C. PURPOSE AND GOALS:**

(1) Governing document: the Development Council shall prepare a governing document to be approved by the Executive Committee and ~~Governing Council~~ **BOARD OF TRUSTEES** of the Academy. The document shall include, but not be limited to, the following items:

A. Gift management policy: a gift management policy with clear guidelines for the receipt, deposit, recording, and expenditure of the funds consistent with the wishes of the donor will be developed. This document will also cover the management of funds donated in excess of the required budget and the use of income generated from such overages. It will further establish guidelines for the refusal of gifts that are not appropriate for the organization; or proposed gifts when the academy cannot fulfill the wishes of the donor. Non-cash gifts such as stocks, real estate, art and other items will also be dealt with in the policy. All fund raising and gift management of the Development Council and the Academy will be consistent with the standards of the better business bureau, the code of ethics of the National Society of Fund Raising Executives and all Ohio and Federal statutes.

B. Staffing plan: the staffing plan will define the skills and qualifications required of the paid or contract agent(s) serving as the professional development officer and any support staff. It will contain job descriptions with clear expectations.

C. Budget: the budget will identify the source and process to raise or allocate start-up funds to cover staffing costs, equipment, fund raising supplies, and materials.

D. Fund management: each contribution collected shall be solely in the name of The Ohio Academy of Science. Not later than two business days after receipt of each contribution the entire amount of the contribution shall be deposited initially in an account at a bank or other Federally insured financial institution; the account shall be in the name of The Ohio Academy of Science. The Ohio Academy of Science shall have sole control of all withdrawals from the account. Only authorized individuals, whose names are on file with the financial institution, will be given the authority to withdraw any deposited funds from the account. All expenditures must clearly be in compliance with the donor's intent. When compliance is not clear the chair **DIRECTOR** of the Development Council reserves the right to confer with the officers of The Ohio Academy of Science for approval.

E. Recruitment plan: the recruitment plan for Development Council members will be developed in order to find the right people with the interest and willingness to serve on the Development Council and to solicit funds on behalf of the Academy. It will contain a job description with clear expectations and a succession plan to insure long term stability of the development efforts.

F. Table of organization: the table of organization will establish standing ~~sub-~~ committees of the Development Council. At the discretion of the Development Council additional ~~sub-~~ committees may be established.

G. Donor profile system: the donor profile system database will consist of a giving history to the Academy, donor interests, donor giving policies or preference, donor linkage to the Academy and other pertinent information for appropriate cultivation, solicitation and recognition of individuals, corporations, foundations, organizations and government entities.

(2) Three year plan: a three year plan, updated annually, shall be developed by the Development Council and submitted to the ~~Governing Council~~ **BOARD OF TRUSTEES** for approval. The plan will be specific to the fund raising activities required to meet the budgets for each approved activity of the Academy.

(3) Feasibility review: a funding feasibility review will be conducted by the Development Council prior to the final approval of the ~~Governing Council~~ **BOARD OF TRUSTEES** of a final plan, program, project, or the program or project budget. The Development Council

will be presented with an outline of the proposed activity and the anticipated costs and will recommend to the ~~Governing Council~~ **BOARD OF TRUSTEES** the viability of funding of the project through the Development Council activities.

7. PARENT ADVISORY COUNCIL:

A. MEMBERSHIP: THE PARENT ADVISORY COUNCIL SHALL CONSIST OF MEMBERS OF THE ACADEMY WHO ARE COMMITTED TO THE PROMOTION AND ADVANCEMENT OF SCIENCE, ENGINEERING, TECHNOLOGY, EDUCATION AND THEIR APPLICATIONS. MEMBERS OF THIS COUNCIL SHALL BE APPOINTED BY THE EXECUTIVE COMMITTEE OF THE OHIO ACADEMY OF SCIENCE.

B. DIRECTOR: THE DIRECTOR OF THE PARENT ADVISORY COUNCIL SHALL BE APPOINTED BY THE EXECUTIVE COMMITTEE FOR A THREE YEAR TERM AND SHALL BE A MEMBER OF THE EXECUTIVE COMMITTEE AND OF THE BOARD OF TRUSTEES.

C. PURPOSE AND GOALS:

(1) TO FACILITATE LINKAGES AMONG PARENTS WHO ARE INTERESTED IN THE IMPROVEMENT OF EDUCATION.

(2) TO PROVIDE A FORUM FOR PARENTS TO EXCHANGE INFORMATION ABOUT EDUCATIONAL OPPORTUNITIES.

(3) TO PROVIDE THE ACADEMY WITH ADVICE ON EDUCATIONAL POLICY AND PROGRAM NEEDS.

(4) TO ESTABLISH AND ENHANCE THE ACADEMY'S VISIBILITY IN THE LOCAL COMMUNITY.

D. ORGANIZATION AND OPERATION:

(1) THE PARENT ADVISORY COUNCIL SHALL BE ORGANIZED ON A REGIONAL BASIS.

(2) EACH REGION SHALL ESTABLISH A LEADERSHIP COMMITTEE CONSISTING OF A MINIMUM OF FIVE PERSONS. THE CHAIRPERSON OF THIS COMMITTEE SHALL REPRESENT THE REGION ON THE STATEWIDE COUNCIL.

(3) EACH REGIONAL LEADERSHIP COMMITTEE SHALL ESTABLISH GOALS AND ACTIVITIES TO MEET THE NEEDS OF PARENTS.

(4) THE STATE LEVEL COUNCIL SHALL INCLUDE THE DIRECTOR, ASSISTANT DIRECTOR, SECRETARY, CHAIR AND ASSISTANT CHAIR OF EACH REGION.

(5) THE PARENT ADVISORY COUNCIL SHALL MEET AT LEAST TWICE EACH YEAR.

8. STUDENT ADVISORY COUNCIL

A. MEMBERSHIP: THE STUDENT ADVISORY COUNCIL SHALL CONSIST OF STUDENT MEMBERS (GRADES 5 THROUGH THE DOCTORAL LEVEL) OF THE ACADEMY. MEMBERS OF THIS COUNCIL SHALL BE APPOINTED BY THE EXECUTIVE COMMITTEE OF THE OHIO ACADEMY OF SCIENCE.

B. DIRECTOR: THE DIRECTOR OF THE STUDENT ADVISORY COUNCIL SHALL BE APPOINTED BY THE EXECUTIVE COMMITTEE FOR A THREE YEAR TERM AND SHALL BE A MEMBER OF THE EXECUTIVE COMMITTEE AND OF THE BOARD OF TRUSTEES.

C. PURPOSE AND GOALS:

(1) TO FACILITATE LINKAGE AND COMMUNICATION AMONG AND BETWEEN STUDENTS THROUGHOUT ALL EDUCATIONAL LEVELS.

(2) TO INFORM STUDENTS OF EDUCATIONAL AND CAREER OPPORTUNITIES.

(3) TO ADVISE THE ACADEMY ON THE NEEDS AND INTERESTS OF STUDENTS.

(4) TO ESTABLISH AND ENHANCE THE ACADEMY'S VISIBILITY AT THE LOCAL LEVEL.

D. ORGANIZATION AND OPERATION:

(1) THE STUDENT ADVISORY COUNCIL LEADERSHIP SHALL INCLUDE THE DIRECTOR, ASSISTANT DIRECTOR, AND SECRETARY.

(2) THE STUDENT ADVISORY COUNCIL SHALL MEET AT LEAST TWICE EACH YEAR.

ARTICLE VI—COMMITTEES

THE BOARD OF TRUSTEES SHALL CREATE AND MAINTAIN THE FOLLOWING COMMITTEES: EXECUTIVE COMMITTEE, PUBLICATIONS COMMITTEE, RESEARCH GRANTS COMMITTEE, NECROLOGY COMMITTEE, MEMBERSHIP COMMITTEE, NOMINATIONS AND BOARD DEVELOPMENT COMMITTEE, FELLOWSHIP COMMITTEE, PERSONNEL COMMITTEE, FINANCE COMMITTEE, AND MARKETING AND COMMUNICATIONS COMMITTEE.

1. EXECUTIVE COMMITTEE:

A. Membership: All members of the Executive Committee shall be Members of the Academy. The membership of the Executive Committee shall consist of the President, President-elect, ~~immediate Past President~~, Secretary, Treasurer, ~~(when appropriate, either the outgoing Secretary or Treasurer)~~, Director of the Senior Academy, Director of the Junior Academy, Editor of The Ohio Journal of Science, Director of the Industrial and Business Council, Chairperson of the Development Council, and six at-large positions, two each from industry, government, and academia who are elected to two-year staggered terms each by the membership. **AND DIRECTORS OF ALL COUNCILS.**

B. Chairperson: The President shall be the Chairperson of the Executive Committee. In the absence of the President, the Executive Committee shall be chaired by the President-elect.

C. Duties:

(1) New business shall be brought to the attention of the Executive Committee before being presented to ~~Governing Council~~ **THE BOARD OF TRUSTEES**. The Executive Committee shall report all substantive action to the ~~Governing Council~~ **BOARD OF TRUSTEES**.

(2) The Executive Committee ~~is the~~ **SHALL BE THE** legislative body of the Academy in intervals between meetings of the ~~Governing Council~~ **BOARD OF TRUSTEES**. The **EXECUTIVE** Committee shall report to the ~~Council~~ **BOARD OF TRUSTEES** the actions taken since the previous ~~Governing Council~~ **BOARD OF TRUSTEES** meeting. Substantive policy decisions can be reversed by a two-thirds vote of ~~Council~~ **BOARD** members present.

(3) The Executive Committee shall have power to fill any vacancies between meetings of the ~~Governing Council~~ **BOARD OF TRUSTEES**, except as provided for elsewhere in this *Constitution*.

(4) The Executive Committee shall select a candidate for each office to be filled. The **President NOMINATING AND BOARD DEVELOPMENT COMMITTEE** shall submit nominations to the Executive Committee and upon their approval, to the Academy at the regular ~~Annual Business Meeting~~ for the membership.

(5) The Executive Committee shall receive, initiate, and approve all Academy resolutions.

E. Procedures:

(1) **NOTICE OF THE MEETING HAVING BEEN DULY GIVEN**, a quorum shall consist of the ~~President, Secretary and Treasurer, or any two of them, and in addition any other three Members~~ **MEMBERS PRESENT**.

(2) A motion shall be passed if a majority of the Executive Committee members present vote favorably.

(3) The Executive Committee shall meet at least twice a year, ~~preceding each Governing Council meeting~~. The President may call a special meeting by notifying all members of the Committee at least ten days in advance of the scheduled meeting. Upon petition of at least three members, the Executive Committee must be convened.

2. PUBLICATIONS COMMITTEE:

A. Membership: The Publications Committee shall consist of the Secretary, Treasurer, and the Editor of The Ohio Journal of Science.

B. Chairperson: The Secretary shall act as Chairperson.

C. Duties: Matters relating to Academy Publications, excepting programs, may be referred to the Publications Committee by the ~~Governing Council~~ **BOARD OF TRUSTEES**. The Committee shall report recommendations for action to the Executive Committee.

3. ~~COMMITTEE ON RESEARCH GRANTS~~ COMMITTEE:

A. Membership: The ~~Committee on Research Grants~~ **COMMITTEE** shall consist of three appointed Members of the Academy each serving for a term of three years. One Member shall be appointed each year.

B. Chairperson: The Chairperson shall ordinarily be the ranking member of the Committee in terms of service on the Committee.

C. Duties: The Committee on Research Grants shall make awards to Members applying for grants-in-aid for research projects worthy of Academy support. ~~The Committee Chairperson shall file with the Secretary, at the Annual Governing Council Meeting, two copies of an annual committee report.~~

4. NECROLOGY COMMITTEE:

A. Membership: The Necrology Committee shall consist of one Member and one former Past President appointed by the Executive Committee and the Historian-Archivist. The term of office shall be a minimum of three years.

B. Chairperson: The Historian-Archivist shall be the Chairperson of the ~~Necrology Committee~~.

C. Duties: The ~~Committee on Necrology~~ **COMMITTEE** shall inform itself of deaths among Members of the Academy. It shall collect biographical data and write biographical sketches and obituaries to be deposited in the Archives of the Academy. Obituaries up to one-half page in length may be published in The Ohio Journal of Science. The Committee shall annually prepare obituaries and biographical sketches of such Members. The next of kin of the deceased member shall receive a copy of the obituary.

5. MEMBERSHIP COMMITTEE:

A. Membership: The Membership Committee shall consist of at least three Executive Committee members appointed for three year staggered terms.

B. Chairperson: The President shall designate the Chairperson of the Membership Committee.

C. Duties: The Membership Committee shall plan and implement the annual membership campaign in conjunction with the Chief Executive Officer, the Directors of the ~~Senior Academy, Junior Academy, the Ohio Industrial and Business Council~~ **ALL COUNCILS** and site-based Membership Coordinators.

6. ~~COMMITTEE ON NOMINATIONS AND BOARD DEVELOPMENT~~ COMMITTEE:

A. Membership: The ~~Committee on Nominations~~ **AND BOARD DEVELOPMENT COMMITTEE** shall consist of at least three members of the Executive Committee appointed by the President to function as a sub-committee.

B. Chairperson: The immediate Past President shall serve as chairperson.

C. Duties:

(1) The ~~Committee on Nominations~~ **AND BOARD DEVELOPMENT COMMITTEE** shall issue a call for nominations from Academy Members for the position of President-Elect and for each position to be filled on the ~~Governing Council~~ **BOARD OF TRUSTEES** and Executive Committee. ~~The call for nominations shall be submitted to the membership on or before December 31st in the year prior to the Annual Meeting.~~

(2) **THE NOMINATIONS AND BOARD DEVELOPMENT COMMITTEE SHALL RECOM-**

MENT TO THE EXECUTIVE COMMITTEE CANDIDATES FOR OFFICE WHO ARE COMMITTED TO THE ACADEMY'S VISION, MISSION, AND GOALS AND HAVE QUALIFICATIONS BEST SUITED TO THE VARIED TASKS OF GOVERNANCE INCLUDING BUT NOT LIMITED TO: POLICY; PERSONNEL; STEWARDSHIP AND FINANCING; FIDUCIARY; LEGAL; AND PLANNING.

(3) Following approval **BY THE EXECUTIVE COMMITTEE**, of the slate **SHALL CONSIST of two A MINIMUM OF THREE** nominees for each position. ~~by the Executive Committee, the Committee on Nominations shall annually conduct the election by mail ballot.~~ **THE ELECTION SHALL BE CONDUCTED BY MAIL BALLOT.**

7. FELLOWSHIP COMMITTEE:

A. Membership: The Fellowship Committee shall consist of the President, the immediate Past President, the President-elect, and three Fellows, one appointed each year for a three-year term.

B. Chairperson: The President shall serve as Chairperson.

C. Duties: The Fellowship Committee shall **FOLLOW THE PROCEDURES ESTABLISHED BY THE BOARD OF TRUSTEES** ~~establish procedures~~ for the nomination of Fellows and review those nominations submitted to it. From these nominations, the Committee shall submit a list of those to be considered ~~by the Fellows on the Governing Council~~ **TO THE BOARD OF TRUSTEES FOR THEIR APPROVAL.**

8. PERSONNEL COMMITTEE:

A. Membership: The Personnel Committee shall consist of the immediate Past President and two Members of the Academy appointed in alternate years by the President for two-year terms.

B. Chairperson: The immediate past President shall serve as Chairperson.

C. Duties:

(1) All personnel matters, including establishment of personnel policies, ~~should~~ **SHALL** be referred to this Committee for recommendation to the Executive Committee.

(2) The Personnel Committee shall conduct an annual performance and salary review of the Chief Executive Officer of the Academy ~~prior to the Executive Committee meeting preceding the Annual Meeting, at which it shall report the Committee's recommendations~~ **AND REPORT THE RESULTS AND RECOMMENDATIONS TO THE EXECUTIVE COMMITTEE FOR ACTION.**

9. FINANCE COMMITTEE:

A. Membership: The Finance Committee shall consist of the Treasurer, the President, the President-Elect, the Chief Executive Officer, Directors of the ~~Junior Academy, Senior Academy, and Industrial and Business Councils~~ **ALL COUNCILS**, and the Editor of The Ohio Journal of Science.

B. Chairperson: The Treasurer shall be the Chairperson.

C. Duties:

(1) Supervise the management of the investment portfolio of the Academy.

(2) Assist the Treasurer by providing advice and counsel on financial matters.

(3) Review the Annual Auditor's Report.

(4) Provide consultation to the Treasurer and the Chief Executive Officer in preparation of the annual budget.

(5) Recommend changes in the structure of the Academy dues and fees.

10. MARKETING AND COMMUNICATIONS COMMITTEE:

A. Membership: The Marketing and Communications Committee shall consist of a minimum

of five Members who are broadly representative of the existing and potential markets of The Ohio Academy of Science.

B. Chairperson: The President shall designate the Chairperson of the Marketing and Communications Committee.

C. Duties:

(1) To determine the needs of the scientific, engineering, technological, and educational community.

(2) To suggest ways and means of meeting these needs.

(3) To communicate to selected markets the values to be received from the products and services which can be provided by the Academy.

(4) To file a report annually by September 1 with the Executive Committee outlining needs, suggesting the ways and means of meeting these needs and describing communication strategies for positioning the Academy to meet these needs.

11. TEMPORARY COMMITTEES, TASK FORCES, AND WORK GROUPS:

A. Membership: The President may appoint Temporary or Ad Hoc Committees, **TASK FORCES, AND WORK GROUPS** as needs arise. These **GROUPS** Committees shall serve one year, but may be reappointed annually.

B. Chairperson: The President shall designate the Chairperson of each Committee, **TASK FORCES, AND WORK GROUPS**.

C. Duties: The President shall specify duties for each Committee, in writing, to the Chairperson.

12. COMMITTEES OF COUNCILS

A. FOR PURPOSES OF PLANNING AND ADMINISTRATION, COUNCIL DIRECTORS MAY APPOINT COMMITTEES, TASK FORCES, AND WORK GROUPS TO CARRY OUT THE WORK OF COUNCILS.

B. THESE GROUPS AND APPOINTMENTS ARE SUBJECT TO RATIFICATION BY THE BOARD OF TRUSTEES.

ARTICLE VII—PUBLICATIONS

1. OFFICIAL PUBLICATION:

The official publication of the Academy shall be *The Ohio Journal of Science*. **THE JOURNAL SHALL PUBLISH PEER-REVIEWED, REFEREED PAPERS CONTRIBUTING ORIGINAL KNOWLEDGE TO SCIENCE, ENGINEERING, TECHNOLOGY, EDUCATION AND THEIR APPLICATIONS.**

2. SPECIAL PUBLICATIONS:

Special papers, books, proceedings, and other publications of The Ohio Academy of Science may be published from time to time as needs arise.

ARTICLE VIII — ANNUAL MEETING

1. TIME AND PLACE:

~~A meeting of the Academy shall be held each year, which shall be known as the Annual Meeting.~~ The specific time and place **OF THE ANNUAL MEETING** shall be fixed by the Executive Committee in consultation with the Directors of the **COUNCILS AND THE HOST INSTITUTION** Junior Academy, Senior Academy and Ohio Industrial and Business Councils.

2. PRELIMINARY ANNOUNCEMENT:

A Preliminary Announcement of the Annual Meeting shall be mailed to all Members at least ninety days before the Annual Meeting, ~~but not later than January 15th.~~

3. LOCAL CHAIRPERSON:

A. Appointment: The Local Chairperson shall be appointed by the Executive Committee, acting upon suggestions from local Members and the host institution.

B. Duties: The Local Chairperson shall coordinate local preparations for the Academy Meetings and shall appoint necessary assistants and committees to arrange for details such as directional and informational signs, parking, housing, meals, the Annual Banquet, the toastmaster at the Banquet, **ON-SITE** registration, ~~the sale of banquet tickets,~~ meeting rooms, **AUDIO/visual AND TELECOMMUNICATIONS** aids equipment, publicity, and space and facilities for exhibits.

4. PROGRAM:

Details of the meeting shall be arranged by the Program Editor. An Official Program shall be distributed to each Member ~~approximately three weeks~~ preceding the Annual Meeting.

5. ANNUAL BUSINESS MEETING FOR THE MEMBERSHIP:

There shall be an Annual Business Meeting for the membership of the Academy during the Annual Meeting. The business session shall be conducted in accordance with the most recently published edition of "Robert's Rules of Order". The order of procedure shall be as follows:

A. A Call to Order by the President.

B. ~~A summary~~ **READING** of the Minutes. ~~of the previous meeting shall be read by the Secretary.~~

C. Presentation of the report of the tellers of the election of officers and other positions.

D. Voting on any proposed amendments to the *Constitution* or *By-Laws*.

E. Business from the floor.

F. Adjournment.

6. QUORUM:

The Members present shall constitute a quorum for the transaction of business.

ARTICLE IX — NOMINATIONS and ELECTIONS

1. All elections shall be determined by plurality vote, and shall be by printed ballot mailed to members of record ~~at least two months prior to the Annual Meeting. Ballots shall be received by the Academy no later than one month prior to the Annual Business Meeting for Membership.~~ No nominations shall be made from the floor at the Annual Business Meeting for Membership.

2. The ballot shall identify the names of the candidates in alphabetical order for each position. The name of each candidate may be followed by a brief statement of qualifications and biographical information in such form and content as shall be approved by the Executive Committee. The specific wording shall be approved by the nominee prior to issuing the ballot.

3. Three tellers for the election shall be appointed by the President of The Ohio Academy of Science. They shall tally the votes on the ballots and provide a written report of the results to be distributed and read at the Annual Business Meeting for Membership.

ARTICLE X — RULES OF ORDER

1. **THE BOARD OF TRUSTEES,** A all Councils, Committees and other deliberative bodies of The Ohio Academy of Science shall conduct their business according to the most recently published edition of "*Robert's Rules of Order*."

2. Unless discussion is requested, which may be facilitated by a conference call, any action which can be taken or authorized at a meeting of the ~~Governing Council~~ **BOARD OF TRUSTEES,** Executive Committee or other deliberative bodies and committees may be taken or authorized without a meeting by approval of two-thirds of the members in office by tele-

phone, fax, other electronic means, or by mail vote.

ARTICLE XI — AMENDMENTS

Amendments to the Constitution ~~may~~ **SHALL** be made as follows:

A. A proposal initiated by the Executive Committee or a petition signed by ten or more Members, stating specifically a proposed amendment, shall be filed with the Secretary not less than sixty days before a Meeting of the ~~Governing Council~~ **BOARD OF TRUSTEES**.

B. The Secretary shall send a copy of the proposed amendment to each member of the ~~Governing Council~~ **BOARD OF TRUSTEES** preceding a ~~Council~~ Meeting **OF THE BOARD**.

C. Copies of the proposed amendment shall be distributed to the membership at least thirty days prior to the Meeting at which the amendment is to be considered.

D. The action of ~~Governing Council~~ **THE BOARD OF TRUSTEES** shall be presented to the Academy **MEMBERSHIP** for its approval at its next Annual Business Meeting for Membership. A majority of those Members **PRESENT AND** voting shall constitute approval.

BY-LAWS

CHAPTER I — FINANCE

1. FISCAL YEAR:

The fiscal year of the Academy ~~and its Councils, Committees and other deliberative bodies~~ shall be from January 1 through December 31.

2. BUDGET:

A. The Treasurer, in consultation with Academy Officers and Councils, Committees and other deliberative bodies shall prepare an annual budget of income and expenditures for the new fiscal year to be considered and approved by the Finance Committee for recommendation the Executive Committee and ~~Governing Council~~ **BOARD OF TRUSTEES**.

B. The Treasurer shall present the recommended budget to the Executive Committee.

C. The Executive Committee may amend the recommended budget and shall approve a budget for final adoption by ~~Governing Council~~ **THE BOARD OF TRUSTEES** at its fall meeting. The ~~Governing Council~~ **BOARD OF TRUSTEES** may amend the budget received from the Executive Committee.

D. The Treasurer is authorized to make only those expenditures provided for in the approved annual budget.

E. Emergency-deficit appropriations shall be authorized by the approval of a majority of the members of the Executive Committee present at a meeting. All such appropriations shall be reported to ~~Governing Council~~ **THE BOARD OF TRUSTEES** at its next meeting.

F. If no annual budget for the succeeding fiscal year has been approved by December 31st, the Executive Committee shall have authority to make temporary appropriations until an annual budget is approved. All such appropriations shall be reported to ~~Governing Council~~ **THE BOARD OF TRUSTEES** at its next meeting.

3. DUES:

A. Annual dues shall be as approved by the Executive Committee and ~~Governing Council~~ **THE BOARD OF TRUSTEES**.

B. Exemption from Payment of Dues: At the discretion of the Executive Committee Honorary Members and others may be exempt from payment of dues. Upon request, Members who have retired, and who have been members of the Academy for at least fifteen years may be designated Members Emeritus. Such Members Emeritus shall be relieved from the payment of dues and will not receive *The Ohio Journal of Science*.

C. Non-Payment of Dues: Non-payment of dues **FOR THE CURRENT YEAR** ~~by September 1st~~ shall constitute a request for withdrawal of membership from the Academy.

4. INVESTMENTS:

A. Authorization: The Treasurer shall invest, dispose of investments, and reinvest monies in consultation with the Finance Committee, unless specifically prohibited from doing so by the Executive Committee or ~~Governing Council~~ **THE BOARD OF TRUSTEES**.

B. Review: All investments shall be reviewed regularly by the Executive Committee.

5. SPECIAL FUNDS:

A. The Endowment Fund is a permanently accumulating fund developed from various private and Academy sources. Only the income will be used for Academy operations.

B. As needed, additional special funds may be created by the Executive Committee.

6. INVOICES AND VOUCHERS:

A. Every creditor of the Academy must present **AN ITEMIZED INVOICE** to the Treasurer ~~an itemized invoice~~.

B. The Treasurer shall obtain verification that the goods or services have been received.

C. Before making payment, the Treasurer shall be satisfied that funds from which payment may be made have either been budgeted or authorized by special action of the Executive Committee.

D. All invoices shall be paid by check.

E. The date of payment and the check number shall be entered on each invoice paid.

F. Each invoice paid shall be retained as a voucher for use by the auditor.

~~7. THE OHIO JOURNAL OF SCIENCE:~~

~~A. The Academy shall provide annually to The Ohio Journal of Science an amount stipulated in the budget as approved by the Executive Committee and Governing Council.~~

~~B. The President's address may be published in The Ohio Journal of Science as soon as possible after the Annual Meeting, and shall not be published in another scientific publication until it has appeared in the Journal. This address shall be submitted and edited as any other manuscript submitted to the Journal.~~

~~8. JUNIOR ACADEMY OF SCIENCE:~~

~~The Director of the Junior Academy shall prepare a request for funds, which shall be included in the Treasurer's budget.~~

9 7. BOND OF TREASURER:

The Treasurer's surety bond shall be fixed and approved by the Executive Committee. The bond shall be sufficient to cover the maximum amount of monies and negotiable securities in custody.

CHAPTER II - PERSONNEL

1. EMPLOYEES:

A. The Executive Committee shall, as it deems necessary, employ persons to work for the Academy.

B. Conditions of tenure, salary, employment, duties, leave of absence, vacation and other matters pertaining to the employment and termination of employment of Academy-paid personnel shall be established and revised by the Executive Committee in the absence of specific instructions of the ~~Governing Council~~ **BOARD OF TRUSTEES**.

2. CHIEF EXECUTIVE OFFICER:

A. The Chief Executive Officer (CEO) of The Ohio Academy of Science shall be selected

and employed by the Executive Committee. The appointment will be ~~reported~~ **RECOMMENDED FOR APPROVAL** to the Academy's ~~Governing Council~~ **BOARD OF TRUSTEES**.

B. Within guidelines established by the Academy's *Constitution and Bylaws*, and by actions of the Academy's Executive Committee and/or ~~Governing Council~~ **THE BOARD OF TRUSTEES**, the CEO shall lead in fostering science, engineering, technology, education, **AND THEIR APPLICATIONS** in Ohio, as stated in the **VISION**, Mission, and Goals of the Academy. The CEO shall be responsible for general supervision of all Academy interests and functions. The CEO shall perform the duties of the office in consultation with the officers and duly appointed agents of the Academy's Councils, Committees and other deliberative bodies.

C. Prior to each Annual Meeting, the CEO shall meet with the President-Elect to set priorities for the coming year. **RECOMMENDED PRIORITIES SHALL BE CONSIDERED AND APPROVED BY THE EXECUTIVE COMMITTEE**. The President and CEO shall subsequently evaluate the priorities **AND REPORT THE STATUS OF THEIR ACHIEVEMENT** on a continuing basis **TO THE EXECUTIVE COMMITTEE AND BOARD OF TRUSTEES**.

D. The CEO shall attend all meetings of the Executive Committee, ~~Governing Council~~ **BOARD OF TRUSTEES** and the Academy Business Meeting for the membership. The CEO shall report on the status of the Academy at each of these meetings.

E. The CEO shall be responsible to the Executive Committee for all aspects of the operation of The Ohio Academy of Science central office and shall direct the day-to-day operations of the Academy.

F. The CEO, in consultation with the Academy President, shall serve as the liaison between the Academy and national, state, and local governmental bodies and offices.

G. The CEO shall assist the Treasurer in preparation of the Academy budget in consultation with the Finance Committee and shall administer the budget after approval by the Executive Committee and the ~~Governing Council~~ **BOARD OF TRUSTEES**.

H. The CEO shall be responsible for planning, promoting, and directing the Annual Meeting of the Academy in consultation with **THE DIRECTORS OF ALL COUNCILS** ~~the Annual Meeting Director, the Directors of the Senior Academy, Junior Academy, and Ohio Industrial and Business Councils.~~

I. The CEO shall facilitate and support the activities of **ALL COUNCILS** ~~the Senior Academy, Junior Academy, and Ohio Industrial and Business Councils~~ in close cooperation with their Directors.

J. The CEO shall have oversight responsibility for all research and publication activities of the Academy.

K. The CEO shall be responsible for the pursuit, coordination and support of all externally funded projects and programs.

L. The CEO shall coordinate marketing efforts, including development of a needs assessment, public relations, press liaison, and promotion activities.

M. Additional duties and responsibilities may be assigned by the President and/or the Executive Committee.

CHAPTER III — ANNUAL MEETING BANQUET

1. ~~There shall be an Annual Banquet to~~ **THE ANNUAL MEETING BANQUET SHALL** be conducted in the following order.

A. Call to order by the Toastmaster.

B. Welcome from the Host Institution.

C. Response from the Academy.

D. Presentation of new officers by the Academy President.

E. Other awards and recognitions.

F. President's Address.

G. Transfer of gavel to the new President.

Article IV — Indemnification and Insurance

Section 01: Mandatory Indemnification.

The Ohio Academy of Science shall indemnify any officer or ~~Governing Council~~ **BOARD OF TRUSTEES** member of the Ohio Academy of Science who was or is a party or is threatened to be made a party to any threatened, pending or completed action, suit, proceeding, whether civil, criminal, administrative or investigative (including, without limitation, any action threatened or instituted by or in the right of the Ohio Academy of Science), by reason of the fact that s/he is or was a ~~Governing Council~~ **BOARD OF TRUSTEES** member, officer, employee, agent or volunteer of the Ohio Academy of Science, or is or was serving at the request of the Ohio Academy of Science as a director, trustee, officer, employee, agent or volunteer of another corporation (domestic or foreign, nonprofit or for profit), partnership, joint venture, trust or other enterprise, against expenses (including, without limitation, attorneys' fees, filing fees, court reporters' fees and transcript costs), judgments, fines and amounts paid in settlement actually and reasonably incurred by her/him in connection with such action, suit or proceeding if s/he acted in good faith and in a manner s/he reasonably believed to be in or not opposed to the best interests of the Ohio Academy of Science, and with respect to any criminal action or proceeding, s/he had no reasonable cause to believe her/his conduct was unlawful. A person claiming indemnification under this section 01 shall be presumed, in respect of any act or omission giving rise to such claim for indemnification, to have acted in good faith and in a manner s/he reasonably believed to be in or not opposed to the best interests of the Ohio Academy of Science, and with respect to any criminal matter, to have had no reasonable cause to believe her/his conduct was unlawful, and the termination of any action, suit or proceeding by judgment, order, settlement or conviction, or upon a plea of nolo contendere or its equivalent, shall not, of itself, rebut such presumption.

Section 02: Court-approved Indemnification.

Anything contained in these regulations or elsewhere to the contrary notwithstanding: a) the Ohio Academy of Science shall not indemnify any officer or ~~Governing Council~~ **BOARD OF TRUSTEES** member of the Ohio Academy of Science who was a party to any completed action or suit instituted by or in the right of the Ohio Academy of Science to procure a judgment in its favor by reason of the fact that s/he is or was a ~~Governing Council~~ **BOARD OF TRUSTEES** member, officer, employee, agent or volunteer of the Ohio Academy of Science, or is or was serving at the request of the Ohio Academy of Science as a director, trustee, officer, employee, agent or volunteer of another corporation, (domestic or foreign, nonprofit or for profit), partnership, joint venture, trust or other enterprise, in respect of any claim, issue or matter asserted in such action or suit as to which s/he shall have been adjudged to be liable for acting with reckless disregard for the best interests of the Ohio Academy of Science or misconduct (other than negligence) in the performance of her/his duty to the Ohio Academy of Science unless and only to the extent that the court of common pleas of Franklin County, Ohio or the court in which such action or suit was brought shall determine upon application that, despite such adjudication of liability, and in view of all the circumstances of the case, s/he is fairly and reasonably entitled to such indemnity as such court of common pleas or such other court shall deem proper; and (b) the Ohio Academy of Science shall promptly make any such unpaid indemnification as is determined by a court to be proper as contemplated by this section 02.

Section 03: Indemnification for Expenses.

Anything contained in these regulations or elsewhere to the contrary notwithstanding, to the extent that an officer or ~~Governing Council~~ **BOARD OF TRUSTEES** member of the Ohio Academy of Science has been successful on the merits or otherwise in defense of any action, suit or proceeding referred to in section 12.01, or in defense of any claim, issue or matter therein, s/he shall be promptly indemnified by the Ohio Academy of Science against expenses (including, without limitation, attorneys' fees, filing fees, court reporters' fees and transcript costs) actually and reasonably incurred by her/him in connection therewith.

Section 04: Determination Required.

Any indemnification required under section 01 and not precluded under section 02 shall be made by the Ohio Academy of Science only upon a determination that such indemnification of the officer or ~~Governing Council~~ **BOARD OF TRUSTEES** member is proper in the circumstances because s/he has met the applicable standard of conduct set forth in section 01. Such determination may be made only (a) by a majority vote of a quorum consisting of ~~Governing Council~~ **BOARD OF TRUSTEES** members of the Ohio Academy of Science

who were not and are not parties to, or threatened with, any such action, suit or proceeding, or (b) if such a quorum is not obtainable or if a majority of a quorum of disinterested ~~Governing Council~~ **BOARD OF TRUSTEES** members so directs, in a written opinion by independent legal counsel other than an attorney, or a firm having associated with it an attorney, who has been retained by or who has performed service for the Ohio Academy of Science, or any person to be indemnified, within the past five years, or (c) by the members, or (d) by the court of common pleas of Franklin County, Ohio or (if the Ohio Academy of Science is a party thereto) the court in which such action, suit or proceeding was brought, if any; any such determination may be made by the court under division (d) of this section 04 at any time (including, without limitation, any time before, during or after the time when any such determination may be requested of, be under consideration by or have been denied or disregarded by the disinterested ~~Governing Council~~ **BOARD OF TRUSTEES** members under division (a) or by independent legal counsel under division (b) or by the members under division (c) of this section 04); and no failure for any reason to make any such determination, and no decision for any reason to deny any such determination, by the disinterested ~~Governing Council~~ **BOARD OF TRUSTEES** members under division (a) or by independent legal counsel under division (b) or by members under division (c) of this section 04 shall be evidence in rebuttal of the presumption recited in section 01. Any determination made by the disinterested ~~Governing Council~~ **BOARD OF TRUSTEES** members under division (a) or by independent legal counsel under division (b) of this section 04 to make indemnification in respect of any claim, issue or matter asserted in an action or suit threatened or brought by or in the right of the Ohio Academy of Science shall be promptly communicated to the person who threatened or brought such action or suit, and within ten (10) days after receipt of such notification such person shall have the right to petition the court of common pleas of Franklin County, Ohio or the court in which such action or suit was brought, if any, to review the reasonableness of such determination.

Section 05: Advances for Expenses.

Expenses (including, without limitation, attorneys' fees, filing fees, court reporters' fees and transcript costs) incurred in defending any action, suit or proceeding referred to in section 01 shall be paid by the Ohio Academy of Science in advance of the final disposition of such action, suit or proceeding to or on behalf of the officer or ~~Governing Council~~ **BOARD OF TRUSTEES** member promptly as such expenses are incurred by her/him, but only if such officer or ~~Governing Council~~ **BOARD OF TRUSTEES** member shall first agree, in writing, to repay all amounts so paid in respect of any claim, issue or other matter asserted in such action, suit or proceeding in defense of which s/he shall not have been successful on the merits or otherwise: (a) if it shall ultimately be determined as provided in section 04 that s/he is not entitled to be indemnified by the Ohio Academy of Science as provided under section 01; or (b) if, in respect of any claim, issue or other matter asserted by or in the right of the Ohio Academy of Science in such action or suit, s/he shall have been adjudged to be liable for acting with reckless disregard for the best interests of the Ohio Academy of Science or misconduct (other than negligence) in the performance of her/his duty to the Ohio Academy of Science, unless and only to the extent that the court of common pleas of Franklin County, Ohio or the court in which such action or suit was brought shall determine upon application that, despite such adjudication of liability, and in view of all the circumstances, s/he is fairly and reasonably entitled to all or part of such indemnification.

Section 06: Article Four Not Exclusive.

The indemnification provided by this article four shall not be exclusive of, and shall be in addition to, any other rights to which any person seeking indemnification may be entitled under the articles or these regulations or any agreement, vote of members or disinterested ~~Governing Council~~ **BOARD OF TRUSTEES** members, or otherwise, both as to action in her/his official capacity and as to action in another capacity while holding such office, and shall continue as to a person who has ceased to be an officer or ~~Governing Council~~ **BOARD OF TRUSTEES** member of the Ohio Academy of Science and shall inure to the benefit of the heirs, executor, and administrators of such a person.

Section 07: Insurance.

The Ohio Academy of Science may purchase and maintain insurance or furnish similar protection, including but not limited to trust funds, letters of credit, or self-insurance, on behalf of any person who is or was a ~~Governing Council~~ **BOARD OF TRUSTEES** member, officer, employee, agent or volunteer of the Ohio Academy of Science, or is or was serving at the request of the Ohio Academy of Science as a director, trustee, officer, employee, agent or volunteer of another corporation (domestic or foreign, nonprofit or for profit), partnership, joint venture, trust or other enterprise, against any liability asserted against her/him and incurred by her/him in any such capacity, or arising out of her/his status as such, whether or not the Ohio Academy of Science would have the obligation or the power to

indemnify her/him against such liability under the provisions of this article four. Insurance may be purchased from or maintained with a person in which the Ohio Academy of Science has a financial interest.

Section 08: Certain Definitions.

For purposes of this article four, and as examples and not by way of limitation: (a) a person claiming indemnification under this article four shall be deemed to have been successful on the merits or otherwise in defense of any action, suit or proceeding referred to in section 01, or in defense of any claim, issue or other matter therein, if such action, suit or proceeding shall be terminated as to such person, with or without prejudice, without the entry of a judgment or order against her/him, without a conviction of her/him, without the imposition of a fine upon her/him and without her/his payment or agreement to pay any amount in settlement thereof (whether or not any such termination is based upon a judicial or other determination of the lack of merit of the claims made against her/him or otherwise results in a vindication of her/him); (b) references to an "other enterprise" shall include employee benefit plans; references to a "fine" shall include any excise taxes assessed on a person with respect to an employee benefit plan; and references to "serving at the request of the Ohio Academy of Science" shall include any service as a ~~Governing Council~~ **BOARD OF TRUSTEES** member, officer, employee, agent or volunteer of the Ohio Academy of Science which imposes duties on, or involves services by, such ~~Governing Council~~ **BOARD OF TRUSTEES** member, officer, employee, agent or volunteer with respect to an employee benefit plan, its participants or beneficiaries; and a person who acted in good faith and in a manner s/he reasonably believed to be in the best interests of the participants and beneficiaries of an employee benefit plan shall be deemed to have acted in a manner "not opposed to the best interests of the Ohio Academy of Science" within the meaning of that term as used in this article four; (c) the term "volunteer" shall mean a ~~Governing Council~~ **BOARD OF TRUSTEES** member, officer or agent of the Ohio Academy of Science, or another person associated with the Ohio Academy of Science, who (i) performs services for or on behalf of, and under the authority or auspices of, the Ohio Academy of Science, and (ii) does not receive compensation, either directly or indirectly, for performing those services. Compensation does not include (i) actual and necessary expenses that are incurred by the volunteer in connection with the services performed for the Ohio Academy of Science and that are reimbursed to the volunteer or otherwise paid; (ii) insurance premiums paid on behalf of the volunteer and amounts paid, advanced or reimbursed pursuant to this article four, section 1702.12 (e) of the Ohio revised code or any indemnification agreement, resolution or similar arrangement; or (iii) modest perquisites.

Section 09: Venue.

Any action, suit or proceeding to determine a claim for indemnification under this article four may be maintained by the person claiming such indemnification, or by the Ohio Academy of Science, in the court of common pleas of Franklin County, Ohio. The Ohio Academy of Science and (by claiming such indemnification) each such person consent to the exercise of jurisdiction over its or her/his person by the court of common pleas of Franklin County, Ohio in any such action, suit or proceeding.

CHAPTER V — AMENDMENTS

These By-Laws may be amended by either of the following methods:

- A. By the same procedure as that stipulated for amendment of the *Constitution*.
- B. By approval of amendments by the Executive Committee and the ~~Governing Council~~ **BOARD OF TRUSTEES**; such amendments become effective immediately.

- END - END - END - END -

**Motions to be made from the floor to amend
the above document are expected to be submitted
in writing (25 copies) to the Academy Secretary
in advance of the meeting.**