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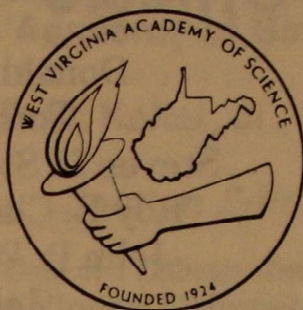
## 1991



Abstracts of papers of  
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# Abstracts for the Sixty-Sixth Meeting

# Biology

JOHN HENRY and MICHAEL KOTARSKI Department of Biology, West Virginia University, Morgantown, West Virginia 26506. Molecular analysis of asteroid mutations of *Drosophila melanogaster*.

The asteroid gene is necessary for the proper development of the hexagonal close-packed array of more than 800 ommatidia that compose the *Drosophila* compound eye. DNA from the region of the asteroid gene has been cloned. In order to verify that this DNA is from the asteroid gene, a transposable element was mobilized to transpose out of the asteroid mutant, ast1117-2. Transposition of the element produced revertant (wild-type) and extreme asteroid eye mutations. Southern blot analysis of these mutations reveal that the revertants are precise excisions of the element and that the extreme mutations are caused by DNA lesions associated with the transposition event. These data indicate that there is a correlation between lesions in the DNA that has been cloned and the asteroid mutant phenotype and that lesions in a particular region severely disrupt asteroid gene function. This region may contain asteroid gene coding sequences.

RAYMOND C. DERK and MICHAEL KOTARSKI Department of Biology, West Virginia University, Morgantown, West Virginia 26506. Cloning of the asteroid gene of *Drosophila melanogaster*.

The asteroid gene plays a central role in the development of *Drosophila melanogaster*. Its proper expression is essential for the development of many of the adult structures, most notably, the compound eye. To study the role of the asteroid gene in development, we have cloned the asteroid gene region. P transposable elements were mobilized and integrated into the asteroid gene producing 24 recessive asteroid mutations. Lambda phage-*Drosophila* recombinant DNA libraries were constructed from three mutant strains and clones containing P element sequences were identified and isolated using a full-length P element probe. DNA Purified from these clones were tested in situ to *Drosophila* salivary chromosomes squashes. The clone, ast1027-2.3, hybridized to salivary region 21E1-2, the location of the asteroid gene. This indicated that this clone may contain asteroid gene sequences. The clone was restriction mapped and DNA probes derived from it were used to verify that the DNA of the asteroid gene had been cloned.

TERENCE O. LILLIS and GARY K. BISSENETTE,  
Division of Plant and Soil Sciences, West  
Virginia University, Morgantown, West Virginia  
26506-6057.

Detection of filterable groundwater bacteria.

Three untreated, rural groundwater supplies used as drinking water sources were extensively examined for the presence of miniaturized or filterable heterotrophic bacteria, i.e. bacteria which escape entrapment on standard 0.45  $\mu$ m pore size membrane filters. Water samples were processed through a specially designed membrane filter tower consisting of an upper filter of standard pore size (0.45 $\mu$ m) followed by a second filter of smaller porosity (0.22  $\mu$ m). Substantial numbers of miniaturized bacteria passed through the larger, standard porosity filter and were detected on the 0.22  $\mu$ m filter. Nutrient dilute R2A agar, in combination with a 28°C incubation temperature and an extended incubation time of 7 days, provided optimal recovery of miniaturized bacteria as compared to nutrient-rich media and other incubation temperatures.

BARBARA MCBRIDE, JACK THATCHER AND  
KAREN KATULA, Dept. of Biology, West Virginia  
University, Morgantown, West Virginia 26506.  
Analysis of Cyclin B 5' Upstream Sequences.

Cyclin B is one of the key regulatory proteins of the cell cycle. It has been shown to be continuously accumulated during the cell cycle and then abruptly destroyed by proteolysis during mitosis. Cyclin B is known to complex with the protein kinase, p34. The p34-cyclin complex then initiates a series of events which are believed to include chromosome condensation and nuclear envelope breakdown. Destruction of the cyclin leads to inactivation of the p34 kinase and is required for exit from mitosis. Because of the importance of cyclin B in the cell cycle we decided to analyze the transcriptional regulation of this gene in the sea urchin, *S. purpuratus*. A clone of the *S. purpuratus* cyclin B gene was obtained from Tim Hunt (University of Cambridge). Subclones of the 5' upstream region were generated and sequenced. The sequence of the cyclin B was analyzed for known sites of protein binding and compared to the upstream sequences of an actin gene displaying a similar pattern of expression. No obvious sequence homologies except for a TATA box were observed between the two genes indicating these genes do not share transcription factors and must be regulated by distinct mechanisms. The only common protein binding motifs identified in the cyclin B upstream region included those for Ap1, PIT1 and TFIID. DNAase I footprinting assays were conducted to identify actual sites of protein binding. Four clearly protected regions were observed covering the sequences +36 to -6, -16 to -30, -42 to -94 and -144 to -169. The larger protected regions most likely contain multiple and possibly overlapping sites of protein binding. Nuclear protein extracts were fractionated on heparin-agarose columns and each fraction assayed by DNAase I footprinting. Using this approach we were able to separate some of the cyclin B specific transcription factors and define more clearly their sites of binding.

VAUGHNDA S. LARSON, Div. of Science/Math,  
West Virginia Northern Community College,  
Wheeling, West Virginia 26003 and  
GARY E. LARSON, Dept. of Biology, Bethany  
College, Bethany, West Virginia 26032.  
Autorhythmometry in a Teenage Population.

As part of the National Science Foundation Young Scholars Program at Bethany College during the summer of 1990, seventeen young people from the ages of fifteen to eighteen participated in a study to measure circadian rhythms within their own bodies (autorhythmometry). Every three hours for a period of twenty-four hours each teenager took his/her own oral temperature, pulse rate and blood pressure. They also performed two tests to determine the degree of eye-hand coordination and measured their peak expiratory flow and grip strength. The students graphed their own results to see individual circadian rhythms. The peaks, troughs and the amplitude were noted. Mean data for males and females were calculated and compared.

Temperature, pulse rate and one of the eye-hand coordination tests showed marked circadian rhythms. The mean peak temperature, although approximately the same (37.3 degrees Celsius for boys and 37.2 degrees Celsius for girls) showed a 3 hour phase difference (at 1730 for boys and at 2030 for girls). The mean low temperature (36.7 degrees Celsius for boys and 36.4 degrees Celsius for girls) also differed in phase (at 0230 for boys and 0530 for girls). The mean pulse rate had a broad peak during the day and a low level during the night. No significant difference between boys and girls in the pulse rate was evident. Eye-hand coordination, as determined by the speed of putting 30 beans into a jar through a small metal tube, showed a rhythm. The fastest mean time for boys was at 1730 and for girls was at 2030. The slowest mean time for both occurred at 0530. Overall the girls performed this task faster than the boys. Various reasons may exist for the students not finding rhythms in blood pressure, the other eye-hand coordination test, peak expiratory flow and grip strength. Inexperience using a sphygmomanometer may account for lack of rhythm in the blood pressure data. Additionally, the exhaustion of the subjects may have impaired their ability to make measurements properly.

Knowledge of the existence of rhythms in one's own body was a new fact of life for many of the students participating. The implications of these cycles in health and athletics remains to be appreciated.

HYACINTH PAUL, RONALD WINFREY AND  
KAREN KATULA, Dept. of Biology, West Virginia  
University, Morgantown, West Virginia. Partial  
purification and characterization of proteins binding  
to the upstream region of the sea urchin  
cytoskeletal actin gene. Cyl.

The *Cyl* actin gene of the sea urchin, *S. purpuratus*, is regulated both temporally and spatially during embryogenesis. We are attempting to elucidate the molecular mechanisms involved in the *Cyl* pattern of expression. Our present goal is to clone and characterize the genes for

some of the *Cyl* specific transcription factors. Affinity columns were prepared using synthesized oligonucleotides representing five of the *Cyl* transcription factor recognition sequences. These columns were used to partially purify the specific binding proteins from embryonic nuclear protein extract. Fractions containing specific binding protein were identified by gel shift analysis and these samples were then fractionated by SDS-PAGE. Southwestern blot analysis was used to identify which of the protein bands were binding to the DNA probes. We found that each affinity column did, indeed, enrich for a particular protein or proteins. The various proteins differed in molecular weight and in affinity for their recognition sequence. Some of the recognition sequences appeared to be bound by more than one protein species. In conjunction with these studies we have used methylation interference to exactly identify which of the bases in the recognition sequence are required for protein binding.

S. CRAIG STAMM and E. C. KELLER, Jr., Dept. of Biology, West Virginia University, Morgantown, West Virginia, 26506. Genetic diversity of *Bdellovibrio* isolates from the upper Monongahela River basin.

Two polygenic traits (lytic expression time and survivability) were examined in *Bdellovibrio* isolates from the upper Monongahela River basin through the use of heritability studies based on the analysis of variance models (ANOVA) of classical quantitative genetics. In all, eleven isolates from Shinnston (W7 site) and twelve isolates from Monongah (W3) on the Westfork River, as well as two isolates from Westover (M7) on the Monongahela River and one isolate from south Fairmont (T2) on the Tygart River were utilized. *Bd* 109 a proven *Bdellovibrio* isolate originating from Davis, California served as the control organism for these studies. Also, host range analysis using five Gram-negative bacteria with proven susceptibility to *Bdellovibrio* was performed on the river isolates. For lytic expression time, the minimum/maximum site values (in hours) were: 28.77/55.50 for W7; 26.67/56.57 for W3; 31.14/41.03 for M7; 55.36/57.91 for T2; and 42.33/43.85 for the *Bd* 109 control cultures. For survivability, the minimum/maximum site values (number of plaques per 0.5 ml adjusted to the  $10^{-7}$  dilution) were: 4/950 for W7; 2/308 for W3; 12.8/95 for M7;  $1.4 \times 10^{-4}$ / $2.3 \times 10^{-4}$  for T2; and 1.43/2.21 for *Bd* 109. The ANOVA indicated significant variation for the lytic expression time trait between both the isolates among sites and the isolates within sites. However, for the survivability trait, significant variation was found to exist only for the isolates within sites. The heritability estimates for the two traits ranged from 0.51 to 0.56 for lytic expression time, and from 0.91 to 0.95 for survivability. Host range analysis on the *Bdellovibrio* river isolates indicated six different bacteriolytic patterns, including a majority of isolates being restricted to *Pseudomonads* similar to the limited host range of *Bdellovibrio starrii*. The findings here support earlier studies into the heterogeneous nature of *Bdellovibrio* isolates from the environment in general, and contribute to our knowledge of their variation within a river system.

TRENT REDMAN, TODD FIJEWSKI, and MICHAEL KOTARSKI  
Department of Biology, West Virginia University,  
Morgantown, West Virginia 26506. Characterization  
of dominant Star mutations at the asteroid gene of  
*Drosophila melanogaster*.

Star is a dominant mutation that produces eye defects when present in a single copy in the genome of *Drosophila*. Homozygous Star individuals die in early embryogenesis due to developmental defects. Many independent Star mutations have been produced over the past forty-five years and each of these mutations is associated with a chromosome aberration. Star mutations interact with asteroid mutations in a complex manner and were thought to be defects within a gene with similar, but distinct developmental function. However, Southern blot analysis of several Star mutations, using DNA probes from the region of the asteroid gene, indicate that Star mutations are alleles of asteroid. Several Star mutations have been characterized at the DNA level and are deletions of the asteroid gene or are associated with translocation breakpoints that disrupt the asteroid gene. These data suggest that the dominant Star mutations are the result of the complete absence of asteroid gene function, while recessive asteroid mutations are the result of a decrease in gene function. The location of the Star lesions pinpoint regions of the asteroid gene that are essential for its proper function.

# Botany

Theresa M. Wolfe, Robert K. Riley, William J. Vail, Biology Department, Frostburg State University, Frostburg, Maryland 21532 and Margaret L. Linthicum, University Of Georgia, Athens, Georgia 30602. A Study Of Mycorrhizae With Tomato Plants From The NASA Space Seed Program.

A study was carried out to compare mycorrhizae formation of space-exposed tomato seeds (var. Rutgers) from the NASA space seed project with those of control seeds stored on the earth. The seeds were placed in orbit on April 7, 1984 and returned to earth on January 12, 1990. These seeds experienced weightlessness and were exposed to cosmic radiation for longer than any other space seed experiment. The seeds were obtained from NASA in April 1990, and the experiments were carried out from September 1990 through January 1991. Garden soil from Mineral County, West Virginia was pasturized under 80 C° steam heat and used as the potting soil in 2X2X2 inch pots. The soil was inoculated with spores of Glomus interadices or Gigaspora heterogama. All roots were analyzed for percentage of roots infected with mycorrhiza and the intensity of mycorrhiza in each infected root. Results show no difference in percent germination or endomycorrhizae formation between space seeds and earth bound controls. G. interadices showed a slightly higher percent of infection and greater intensity of infection than G. heterogama in both space seeds and earth-bound controls.

HAROLD S. ADAMS, Div. of Arts and Sciences, Dabney S. Lancaster Community College, Clifton Forge, Virginia 24422 and STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, West Virginia 26554. Northern white cedar in the mid-Appalachians.

Northern white cedar (Thuja occidentalis L.), a species with a distinctly northern distribution in North America, extends southward along the Appalachian Mountains to Tennessee and North Carolina. In West Virginia, white cedar has been reported from eleven counties, whereas the species is known from twenty counties in Virginia. However, relatively pure stands of mature white cedar are found at only a few localities. Stands at three such localities--two in West Virginia (near Circleville in Pendleton County and at the mouth of Second Creek in Greenbrier County) and one in Virginia (along Cascades Creek in Bath County)--were sampled in the present study. White walnut (Juglans cinerea L.) is the only other canopy species present at the Second Creek locality, but at Circleville and Cascades Creek white cedar shares dominance with nine and ten species, respectively. Density (N/ha) of trees ( $\geq 10$  cm DBH) ranged from 230 (Second Creek) to 620 (Circleville), whereas basal area (m<sup>2</sup>/ha) ranged from 21.6 (Cascades Creek) to 33.5 (Second Creek). Cored white cedar trees averaged  $160 \pm 11.5$  rings at Second Creek,  $137 \pm 11.4$  rings at Cascades Creek, and  $61 \pm 5.6$  rings at Circleville. Patterns of growth for these trees did not display the persistent recent decline reported for certain other conifers (e.g., red spruce) in eastern North America.

JOHN C. LANDOLT, Div. of Science and Mathematics, Shepherd College, Shepherdstown, West Virginia 25443, STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, West Virginia 26554 and CRAIG STIHLER, West Virginia Dept. of Natural Resources, Elkins, West Virginia 26241. Cellular slime molds from West Virginia caves III. Notes on the occurrence and distribution of *Dictyostelium rosarium*.

The majority of the 20 or so species of cellular slime molds (CSM) described from North America are both widespread and rather common, but some species are relatively uncommon and a few of these seem to have rather restricted distributions. For example, previous reports of the occurrence and distribution of *Dictyostelium rosarium* would suggest that this species is most commonly associated with moderately dry or saline soils in arid habitats. However, in an ongoing survey of CSM in West Virginia, the only isolates of *D. rosarium* have been made from cave environments. During the past three years, soils from nine caves have been examined for the presence of CSM, and in three of these caves (My Cave in Pocahontas County, Cave Mountain Cave in Pendleton County, and the Arbogast portion of the Arbogast-Cave Hollow cave system in Tucker County), *D. rosarium* has been the single most important species present. The fact that all three caves are known to harbor bats at least suggests an association with bat biology, but such an association has yet to be demonstrated. It may be that *D. rosarium* has a particular adaptation that allows it to exploit the cave environment to a greater extent than other CSM species.

HONGGANG LIU and DAN K. EVANS, Herbarium, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Vegetation of Greenbottom Swamp, Cabell County, West Virginia.

Greenbottom Swamp is located in Cabell County, West Virginia. The approximate north latitude is 38°35' with an approximate west longitude of 82°15'. It is a small wetland system connected to the Ohio River. Seven community types are recognized in the swamp. Four wetland forest community types are the *Salix nigra*-*Acer saccharinum* community, the *Salix nigra*-*Plantanus occidentalis* community, the *Acer saccharinum*-*Plantanus occidentalis* community and the *Acer saccharinum*-*Salix nigra* community. Three wetland shrub and herbaceous community types are the *Typha latifolia*-*Saururus cernuus* community, the *Cephalanthus occidentalis* community and the *Leersia virginica* community. Water depth is the main factor determining community types. Clustering and ordination techniques were employed in plant community classification. The vegetation map was drawn from aerial photographs.

DAN K. EVANS, Herbarium, Marshall University, (MUHW) and Pontificio Universidad Catolica de Ecuador (QCA). Medicinal *Cyperus* (Cyperaceae) among the Shuar and Achuar of Southeastern Ecuador.

The Shuar and Achuar, formerly the Jivaro, are the most numerous of indigenous people living in lowland, southeastern Ecuador. Due to their isolation much of their culture remains intact including the

use of plants in traditional medicine. Two distinct species of sedges, Cyperus articulatus L. and C. prolixus H.B.K. are important medicinal plants in the culture. Herbarium collections from six widespread indigenous communities revealed 11 medicinal types referable to the two taxa. Piripri, the Jivorian classification for medicinal Cyperus, is further divided into medicinal types according to remedial use: for liver problems, snakebite, heart pain, to promote growth and muscle development in women, anemia in children, as a contraceptive, to shorten the menstrual cycle, to promote early walking in children, and given to dogs to develop good hunting skills. In all cases the fresh rhizome is grated, the juice mixed with water and taken in amounts and with frequencies according to the remedial purpose. Within the two distinct species, morphological forms corresponding to remedial use could not be readily distinguished by the author. However, women responsible for cultivating gardens, were quite capable of making the distinctions and took pride in having large clumps of each type nearby for home use. Most forms do not produce fully developed inflorescence. Rather, the florets remain in compacted panicles of spikelets within the involucre and are infected with the fungus Fusarium. Mold is also obvious on lower leaf sheaths and on the scales of the rhizome. Considering the morphological similarity among medicinal types within a species, remedial effectiveness might be attributable to variation in the infecting fungus.

WM. HOMER DUPPSTADT, Department of Biology, West Virginia University, PO Box 6057, Morgantown, WV 25506-6507. Updates on the Vascular Flora of West Virginia. VII.

As recorded at the West Virginia University Herbarium, the following species of vascular plants have been recognized as new or noteworthy additions to the flora of West Virginia during the past year: Echinochloa muricata (Beauv.) Fern., Scirpus ancistrochaetus Schuyler, Carex rugosperma Mackenzie, Ampelopsis brevipedunculata (Maxim.) Trautv., Hypericum dissimulatum Bickn. and Solidago gracillima Torr. & Gray.

L. S. FERRARA, Dept. of Biology, West Virginia Institute of Technology, Montgomery, WV 25136. Shoot and seedling population dynamics of Polygala paucifolia, a temperate forest herb.

P. paucifolia reproduces sexually through the production of cleistogamous (selfing) and chasmogamous (outcrossing) flowers and asexually through the growth of rhizomes. To trace populations dynamics of shoots and seedlings through 3 growing seasons, 8-10 0.25 m<sup>2</sup> plots were established in New Jersey populations located in wet, dry, and intermediate moisture habitats. In the fourth year, 4 permanent

plots were excavated to determine the extent of both rhizomatous reproduction and the interconnectedness of shoots. Shoot population dynamics differed greatly among populations in all three years. Shoot density increased with increasing light intensity received by the permanent plots during May. Neither shoot density nor mean shoot size was related to light received. Self-thinning appeared to occur only in plots with very high density of shoots. Flexibility in rhizome architecture allows the genet to both maintain its space in the original location and exploit habitats previously uncolonized by Polygala. Seedling emergence, distribution, and survivorship was highly variable among populations and between years. Mortality was high, indicating that the establishment of new genets within the population is a rare event in this species.

CHANNARAYAPPA<sup>1</sup>, G. SHIVASHANKAR<sup>1</sup>, V. MUNIYAPPA<sup>1</sup>,  
D. SCHWEGLER-BERRY<sup>2</sup> AND E. C. KELLER<sup>3</sup>. <sup>1</sup>University of  
Agricultural Sciences, Bangalore, India. <sup>2</sup>Pathology Section,  
ALOSH, Morgantown. <sup>3</sup>Biology Department, West Virginia  
University, Morgantown, WV, USA. Electron Microscopic  
Studies of Tomato Leaf Infected with Tomato Leaf Curl Virus  
(TLCV).

Examination by transmission electron microscopy of tomato leaf tissue infected with tomato leaf curl virus (TLCV) and healthy plant material revealed no cytological modifications in control samples. Conversely, specific alterations were present in the phloem bundle cells from naturally and artificially infected plants. The ultrastructural modifications included hypertrophy of both the nucleus and nucleolus, segregation of nucleolar components into discrete granular and fibrillar regions, appearance of electron dense condensed fibrillar rings, and the presence of virus-like particles either as loosely compacted or hexagonally close-packed symmetrical arrays. The virus-like particles were isometric, about 15-18 nm in diameter, which were characteristic of gemini virus. In the lumen of sieve elements, virus-like particles occasionally formed aggregates having cylindrical arrangements occurring in pairs. Among the organelles other than the nucleus, virus-like particles were found in the plastids of sieve elements. In the chloroplasts of TLCV infected cells, considerable disturbances in the internal organization was observed. In the most severe form of degeneration, the thylakoid system was fragmented and disorganized. In some chloroplasts starch grains were abnormally large. Excessive accumulation of osmiophilic bodies in degenerating chloroplasts and sieve elements were observed.

# Chemistry/Biochemistry/ Molecular

GARY J. SIKO and DEBORAH A. LEONARD, Dept. of Biology, West Virginia University, Morgantown, West Virginia 26506. Use of a cholesterol auxotroph to study the role of cholesterol in plasma membrane structure and function in mammalian cells.

As a major constituent of the plasma membrane, cholesterol is required for cell proliferation and differentiation. Changes in sterol composition in mammalian cells and their effects on cell proliferation were studied through the use of a well-defined cholesterol auxotroph, AR45. The AR45 mutant is a Chinese hamster ovary (CHO) cell lacking detectable lanosterol 14- $\alpha$  methyl demethylase activity. The mutant is characterized by the accumulation of lanosterol and dihydrolanosterol, precursors to cholesterol, when grown in sterol-free media. Under these conditions, cell growth stops and the cells eventually die. Given an exogenous source of cholesterol, the AR45 cells grow normally. The growth kinetics of both AR45 and wild type cell lines grown in the presence of varying amounts of exogenous cholesterol were measured to determine the minimum amount of cholesterol required for cell growth. Thin layer chromatography was used to provide a quantitative and qualitative analysis of plasma membrane phospholipid composition in cells grown under various levels of cholesterol supplementation and depletion. The effects of changes in membrane lipid composition on plasma membrane function were assayed by measurements of cell adhesion, pinocytosis, and 5'nucleotidase activity.

DANIEL G. TODD, GARY L. WRIGHT and VERNON E. REICHENBECHER, Dept. of Biomedical Sciences, Marshall University School of Medicine, Huntington, WV 25704-2901. Identification and partial purification of a putative precursor to hypertensive factor (HF) by monoclonal anti-HF antibodies.

Hypertensive factor (HF), a low molecular weight peptide isolated from the erythrocytes and various tissues of rats, has been shown to be a powerful stimulator of lanthanum-resistant calcium uptake in aortic tissue and can induce prolonged blood pressure elevation when injected into normotensive rats. An HF- ovalbumin conjugate was used as an immunogen in BALB/C mice. Hybridomas producing the anti-HF antibodies were generated and identified by ELISA assays. Monoclonal IgG antibodies produced in mouse ascites tumors were purified by protein-A affinity chromatography. Soluble proteins from various tissues of Sprague-Dawley, Wistar-Kyoto and spontaneously hypertensive rats were extracted and separated by SDS-polyacrylamide gel electrophoresis under reducing conditions. Western blot assays performed on these proteins revealed a single band which migrated at a molecular weight of approximately

23kD. The anti-HF antibody recognized the 23kD protein band in rat heart, brain, kidney and liver, but failed to detect the band in lung, testes or plasma. Similar experiments using bovine heart also revealed an immunoreactive 23kD protein. A highly enriched preparation of the bovine 23kD protein has been prepared by the following purification scheme: tissue extraction, ammonium sulfate precipitation, molecular sieve chromatography and SDS- polyacrylamide gel electrophoresis. The results suggest that the 23kD protein contains a region identical or highly similar to the amino acid sequence of HF and may represent a precursor molecule to hypertensive factor which is conserved between species. (Supported by NSF EPSCoR grant # R11-8922106).

WILLIAM T. SEAMAN and TERRY W. FENGER,  
Dept. of Biomedical Sciences, Marshall  
University School of Medicine, Huntington,  
West Virginia 25704-2901. Functional  
expression of Human Immunodeficiency Virus  
env gene product in CD4<sup>+</sup> Hela cells.

Human Immunodeficiency Virus (HIV) is the etiological agent of Acquired Immune Deficiency Syndrome (AIDS), a fatal disease marked by an inability to mount an immune response against opportunistic infections. This virus preferentially infects CD4<sup>+</sup> lymphoid and non lymphoid cells via the binding of the envelope protein (env) of the virus with the CD4 antigen located on the cell surface. The env gene product is initially synthesized as a 160 kD glycoprotein (gp160) that is proteolytically cleaved to produce noncovalently linked subunits; a 120 kD protein (gp120) that binds CD4 and a 41 kD protein (gp41) that fuses the viral lipid envelope with the plasma membrane of the uninfected cell thus initiating the infection. Similarly an infected cell expressing gp120/gp41 on its surface can bind to and fuse with an uninfected cell expressing CD4 on its surface resulting in the formation of a syncytium thus increasing the ability of the infection to spread. Strategies designed to prevent HIV infection have focused on preventing the interaction of gp120/gp41 with CD4 and the plasma membrane. Thus, structural information on this interaction at the molecular level is essential in preventing infection. Using recombinant DNA technology, we have constructed a plasmid that contains the entire env coding sequence under the transcriptional control of the HIV long terminal repeat (LTR). Transfection of Hela CD4<sup>+</sup> cells with this construct results in the formation of syncytia not present in cells transfected with a control plasmid. To determine if syncytia formation was due to the production of gp120/gp41, proteins from transfected cells were labeled with S<sup>35</sup>-Methionine and immunoprecipitated with antibody directed against gp160 and analyzed by SDS-polyacrylamide gel electrophoresis. These results suggest that env is produced in these cells and provides a system for the functional analysis of the interaction between gp120/gp41 and CD4.

KELLY W BEERS and GARY O RANKIN, Dept. of Pharmacology, Marshall University School of Medicine, Huntington, West Virginia 25755. Effect of N-(3,5-dichlorophenyl)succinimide (NDPS) on renal blood flow and glomerular filtration in Fischer 344 rats.

The experimental agricultural fungicide N-(3,5-dichlorophenyl)succinimide (NDPS) is a nephrotoxicant in the Fischer 344 rat. NDPS is biotransformed by the P-450 monooxygenase system to N-(3,5-dichlorophenyl)-2-hydroxy-succinimide (NDHS), a more potent nephrotoxicant, causing diuresis within 3 hrs. Research in our laboratory indicates that NDPS may alter renal hemodynamics to enhance toxicity. However, it is not known how NDPS affects renal glomerular or tubular function, or renal plasma flow in the anesthetized rat. In this study male Fischer 344 rats (260-310 g), anesthetized with sodium pentobarbital (50 mg/kg, i.p.), were prepared for renal function experiments. Renal plasma flow (RPF), glomerular filtration rate (GFR), urine volume (V), and fraction of GFR excreted as urine (V/GFR) were determined during seven 30 min intervals following NDPS (0.8 mmol/kg, i.p.) treatment. Although NDPS did not alter V, RPF, or GFR, the fraction of GFR excreted as urine was increased significantly compared to vehicle-treated controls. Results of the study indicate that NDPS alters renal function by reducing the tubular fraction of glomerular filtrate that is reabsorbed. However, since pentobarbital is also metabolized by the P-450 system and was given 150 min prior to NDPS, it is possible the conversion of NDPS to the more toxic NDHS was attenuated.

Gary O. Rankin, Vonda J. Teets, Derek W. Nicoll and Patrick I. Brown, Marshall University School of Medicine, Huntington, West Virginia, 25755-9310. Combination of nephrotoxicants at subtoxic and toxic doses.

Previous studies in our laboratory and by others have demonstrated that combined exposure to two or more nephrotoxicants can enhance or attenuate the actions of the individual nephrotoxicants. In our laboratory we have shown that the nephrotoxic antimicrobial agent cephaloridine can markedly attenuate the nephrotoxicity induced by the agricultural fungicide N-(3,5-dichlorophenyl)succinimide (NDPS). In these studies cephaloridine was administered in a nonnephrotoxic dose 1 hr before NDPS administration. The purpose of the present study was to determine if nonnephrotoxic doses of two nephrotoxicants, hexachloro-1,3-butadiene (HCB) and mercuric chloride (MC) could potentiate or attenuate NDPS-induced nephrotoxicity. For these studies male Fischer 344 rats (4 rats/group) were administered a single intraperitoneal (i.p.) injection of HCB (50 mg/kg), MC (0.2  $\mu$ mol) or the appropriate vehicle 1 hr before NDPS (0.2 or 0.4 mmol/kg, i.p.) or NDPS vehicle. Renal function was monitored at 24 hr intervals for 48 hr post-NDPS or NDPS vehicle. HCB pretreatment had little effect on NDPS-induced renal effects. MC pretreatment increased BUN concentration, kidney weight and proteinuria following NDPS (0.2 mmol/kg), but did not alter the pattern

of NDPS (0.4 mmol/kg)-induced renal effects. These results suggest that nonnephrotoxic doses of HCBd or MC have either no effect or weakly potentiate NDPS nephrotoxicity. (Supported by NIH grant DK 31210).

B. DasSarma, Department of Chemistry, West Virginia State College, Institute, West Virginia 25112. Inhalation cancer risk from ambient air in the Kanawha Valley with special reference to Institute.

Urban population living in close proximity to chemical industry in the Kanawha Valley has always been concerned about additional cancer risk posed by routine emission of suspected carcinogens. The assessed risk estimated in the Kanawha Valley Toxics Screening Study (EPA, July 1987) and the Report on Ambient Exposures to Volatile Organic Compounds in the Kanawha Valley (Nancy Sullivan et al, Harvard University, January 1989) will be reviewed in the light of measured data (B. DasSarma, Proc. 1989 EPA/A&WMA International Symposium, 733-743) and industrial emission inventory.

Upper bound individual lifetime cancer risk at Institute campus estimated in the three reports will be presented as loss of average life span. Wide variation in these estimates will be reviewed as a reminder to pitfalls in the current practice of health risk assessment (Dennis J. Paustenbach et al, J. Air & Waste Management Assoc., 40, 1620, 1990).

TIFFANY A. COOK and DEBORAH A. LEONARD,  
Dept. of Biology, West Virginia University,  
Morgantown, West Virginia 26506. Quantitation in oxysterol resistant cell lines of a DNA binding protein specific for the HMG-CoA reductase promoter.

HMG-CoA reductase catalyzes the rate-limiting step in the biosynthesis of cholesterol. It has been shown that transcription of the HMG-CoA reductase gene is repressed by oxysterols, yet the details of this regulation are not complete. One protein which may be involved in oxysterol-mediated regulation is CNBP (cellular nucleic acid binding protein). This DNA-binding protein, found in nuclear extracts of human liver cells, recognizes a specific sequence in the promoter region of HMG-CoA reductase which has been shown to be necessary and sufficient for oxysterol regulation of transcription. When cells are grown in the presence of oxysterols the level of CNBP increases. Oxysterol-resistant Chinese hamster ovary (CHO) cell lines are being used to study the mechanism of oxysterol regulation of HMG-CoA reductase. If the resistance is a result of a mutation affecting CNBP regulation, altered binding of this protein to the HMG-CoA reductase promoter would be expected. To measure the levels of

CNBP, nuclear proteins extracted from cells cultured in the presence or absence of oxysterols are separated by SDS-PAGE, transferred to nitrocellulose, and probed with a [ $^{32}$ P]-labelled sequence from the HMG-CoA reductase promoter region specific for CNBP binding.

PHILIP D. YIN and DEBORAH A. LEONARD, Dept. of Biology, West Virginia University, Morgantown, West Virginia 26506. The role of phosphorylation in regulating degradation of 3-hydroxy-3-methylglutaryl coenzyme A reductase.

HMG-CoA reductase is the rate limiting enzyme for the biosynthesis of cholesterol in mammalian cells. The enzyme is quantitatively regulated by alterations in the rates of synthesis and degradation. Qualitative regulation can occur by reversible phosphorylation of HMG-CoA reductase, which inactivates the enzyme. The role of phosphorylation state in enzyme regulation is controversial, but it has been proposed that phosphorylation plays a role in targeting reductase for degradation. An *in vitro* permeabilized cell system for studying the role of phosphorylation in reductase degradation has been developed. In digitonin-permeabilized CHO cells, the reductase enzyme remains intact and associated with the endoplasmic reticulum. Addition of physiological concentrations of ATP results in the rapid, irreversible loss of enzymatic activity, followed by proteolytic cleavage of the reductase enzyme. The inability of alkaline phosphatase to reactivate ATP-inactivated reductase in permeabilized cells suggests that this inactivation is not equivalent to the reversible phosphorylation which occurs *in vivo*. Detection of Immunoprecipitable [ $^{32}$ P]phosphoreductase after incubation of permeabilized cells with [ $\gamma^{32}$ P]ATP indicates that the enzyme is being phosphorylated. Permeabilized cells were then labelled with [ $^{32}$ P]ATP followed by alkaline phosphatase treatment. Measurement of [ $^{32}$ P]phosphoreductase was used to determine whether loss of enzyme activity is due to irreversible phosphorylation or a subsequent inactivation step.

MELINDA S. SHOCKLEY and DEBORAH A. LEONARD, Dept. of Biology, West Virginia University, Morgantown, West Virginia 26506. Characterization of an oxysterol-resistant Chinese hamster ovary (CHO) cell line.

Oxysterols, oxygenated precursors or metabolites of cholesterol, have been implicated as the regulatory molecules in the cholesterol biosynthetic pathway through the feedback inhibition of the rate limiting enzyme HMG-CoA reductase. Sterol-mediated control of the activity of HMG-CoA reductase is exerted at several levels including transcription, translation, and protein degradation. To study the molecular basis of oxysterol control of HMG-CoA reductase, mutant Chinese hamster ovary (CHO) cell lines resistant to the effects of the oxysterol

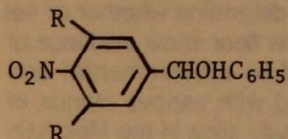
25-hydroxycholesterol have been isolated. One of these cell lines, C1, has been characterized in an attempt to determine the molecular basis for resistance. Plating efficiencies were used to compare C1 and wild type cell growth in the presence of 25-hydroxycholesterol. At concentrations of 25-hydroxycholesterol which inhibit enzyme activity in wild-type cells by 95%, enzyme activity in C1 cells is inhibited by less than 50%. Oxysterol inhibition of HMG-CoA reductase synthesis and degradation rates in C1 and wild type cells was also compared. Previous studies of the effects of 25-hydroxycholesterol on cells grown in serum-free media have indicated that this oxysterol acts at many regulatory levels. Characterization of this oxysterol-resistant mutant provides insight to the possible mechanisms for oxysterol regulation of cholesterol biosynthesis.

JAGAN V. VALLURI, H. W. ELMORE and DOUGLAS B. CHAMBERS, Department of Biological Sciences, Marshall University, Huntington, WV 25755. Salt-induced changes in protein patterns of Sandalwood (*Santalum album* L) callus.

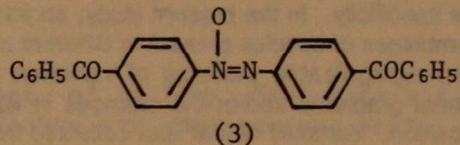
The decline in plant productivity due to salinity necessitates the development of stress tolerant plants. Of the various approaches, cell culture selection of mutants has received increasing attention in recent years. A knowledge of the molecular responses such as gene expression during cellular adaptation to stress would be helpful and might lead to the identification of the altered putative genes. Sandalwood callus was maintained on Murashige and Skoog medium supplemented with 2,4-D and two different kinds of cytokinins viz. kinetin and benzyladenine. Callus formation was profuse on 2,4-D (1 mg/L) and BA (1 mg/L) compared with callus growing on 2,4-D (1 mg/L) and Kn (1 mg/L). Protein changes induced by salinity stress in sandalwood were investigated using SDS-polyacrylamide gels. Rapidly growing sandal callus was exposed to varying concentrations of NaCl ranging from 10, 16, 20 and 25 gm/L. After 24 to 48 h of exposure to salt stress a 20 to 30% reduction in callus volume was observed. SDS-polyacrylamide gels revealed both qualitative and quantitative reductions in protein synthesis. Several low and high molecular weight proteins showed enhancement in response to moderate levels of salt stress. Protein synthesis was completely inhibited at higher salt concentrations.

DANIEL B. FOWLER, JOSEPH M. FUSCALDO, JANICE M. KILDUFF, CHESTER W. MUTH, and KEVIN L. STICKLER, Dept. of Chem., West Virginia University, Morgantown, WV 26506-6045, Hydroxide-Promoted Redox Reactions of  $\alpha$ -Substituted Nitrobenzyl Alcohols

$\alpha$ -Phenyl-4-nitrobenzyl alcohol (1) has been found to undergo reaction with 1 M NaOH to yield several products including azoxy 3 in 25% yield (based on weights only); in contrast  $\alpha$ -phenyl-3,5-dimethyl-4-nitrobenzyl alcohol (2) did not undergo reaction with 1 M NaOH. A mechanism involving steric inhibition of resonance for an anticipated intermediate from 2 will be presented to explain the



1, R = H  
2, R = CH<sub>3</sub>



difference in behaviors of alcohols 1 and 2.

Nitrobenzyl alcohols with the  $\alpha$ -substituent as 4-pyridyl and 4-pyridyl N-oxide have been treated with sodium hydroxide to study the extent and pathways for this type of reaction.

# Ecology

STEVEN L. STEPHENSON, LISA V. MCCUE, DENISE E. BINION,  
and KATHRYN D. SHAVER, Dept. of Biology, Fairmont State  
College, Fairmont, West Virginia 26554. Myxomycetes associated  
with the litter microhabitat in temperate forests.

The litter microhabitat in a temperate forest is characterized by a considerable degree of spatial heterogeneity and, as a consequence of the decomposition process, its physical, chemical, and biological properties change through time. The data already available from previous studies indicate that (1) the litter microhabitat supports a distinct assemblage of Myxomycetes and (2) particular species of litter-inhabiting Myxomycetes show evidence of substrate specificity. In the present study, an effort is being made to determine whether or not the assemblages of species present at different microsites on the forest floor show evidence of exhibiting recognizable patterns of variation that can be related to environmental and vegetational gradients and/or the changes in litter quality associated with various stages of decomposition. Samples of leaf litter collected from seven different study sites in the Mountain Lake area of southwestern Virginia were used to prepare a total of 700 moist chamber cultures, with each study site represented by the same number of cultures. Seventy-eight percent of these cultures yielded Myxomycetes (either fruiting bodies, plasmodia, or sclerotia). Arcyria cinerea was the single most abundant species and occurred in approximately 10% of all cultures. Among the other more common species of litter-inhabiting Myxomycetes were Diderma effusum, Physarum bivalve, Lamproderma scintillans, Cribraria microcarpa, Diderma testaceum, and Didymium iridis. (Supported by a grant from the National Science Foundation.)

DAVID ELDRIDGE AND CHRIS WILLIAMS, students  
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Jefferson High School  
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Acid Rain Project

The Jefferson Acid Rain Program was a month long program which enlisted 102 high school science volunteers from Chemistry and Physics classes at Jefferson High School to assess the pH of the rainfall in Jefferson County. The county was divided into thirteen five-minute by five-minute quadrants by latitude and longitude and all volunteer students who lived in these quadrants collected acid rain samples. One student in each quadrant collected rainfall data with a rain gauge. The purpose of the quadrants was simply to localize the data for students in each quadrant, so they could make comparisons with each other.

A jar lined with a ziplock bag and rubber band was used to collect the rainfall. All data was collected out of the rain shadow of the home or trees and was three feet off the ground. Low lying areas and those close to rivers and streams were avoided. Each morning at 6:30 A.M. wet depositions were collected and subsequently tested with appropriate hydrion paper. Spot checks on the student data with a pocket pH meters accurate to the nearest .2 pH unit were used to check student reliability. The 10 % spot check showed highly reliable data.

The month of November showed an average pH of 4.55 +/- .2 pH unit. This value is consistent with the pH values found during two other testing periods and the values attributed to the area in large scale general maps. The rainfall was slight in this

time period compared to the previous two time periods this type of data was taken. The rainfall for the month of November averaged 0.06 inches.

During the month of December, the effects of acid rain on pea plants was measured using genetically pure peas for three traits, one of which was height. Samples of pea plants were treated with pH 3.0, 4.0, 5.0, 6.0, and 7.0. After a short time, the pH 3.0 and 4.0 treated plants died. Those at pH 5.0 that survived were dwarfed and died part way through the project. Those treated at 6.0 and 7.0 survived with the greatest growth for those treated at pH 6.0. Fifty-six days after the start of the project flowers, appeared on several plants.

TARA DUBEY, Dept. of Biology, West Virginia  
Institute of Technology, Montgomery, West  
Virginia 25136.

A Study of the Colonization of Submerged Leaves  
of Birch, Oak, and Pine by Water-Borne  
Hyphomycetes in the Kanawha River, West Virginia.

An investigation of the aquatic fungi [Primarily Ingoldian Hyphomycetes] that colonize decaying submerged leaves was carried out during November and December of 1990. In this study dead leaves of birch (Betula sp.), oak (Quercus sp.), and pine (Pinus sp.) were confined in the fine mesh fibreglass screen cloth bags, submerged in the Kanawha River for six weeks and then returned to the laboratory and examined microscopically for aquatic fungi. Some bags contained only leaves of just one type, whereas, others contained mixtures of all three types. Twenty-three different fungal taxa were encountered with the number recorded for birch higher (21) than those recorded for either oak (4) or pine (3). Eleven taxa were recorded from the bags of mixed leaves. Both frequency of occurrence and abundance of conidia per unit area of leaf surface were higher for birch.

Anguillospora crassa and Tetrachaetum elegans were recorded as dominant forms colonizing all leaf bags. The relative abundance of Ingoldian Hyphomycetes on birch leaves is apparently correlated with a faster rate of degradation by these fungi due to a certain degree of substrate specificity. Colonization of pine needles by aquatic hyphomycetes occurred to a greater extent than would have been anticipated based on the observations of previous research.

PAMELA J. EDWARDS and JAMES N. KOCHENDERFER,  
USDA Forest Service, Timber and Watershed  
Laboratory, Parsons, West Virginia 26287.  
Artificial watershed acidification on the  
Fernow Experimental Forest.

An artificial watershed acidification study was initiated on the Fernow Experimental Forest in May 1988. To induce acidification, ammonium sulfate fertilizer is applied aerially

three times per year at an annual rate approximately double ambient N and S inputs. Stream water chemistry, principally during storm events, soil leachate chemistry, and soil chemistry are monitored intensively to determine if acidification can be induced and to examine some of the biogeochemical factors involved in the acidification process. To date, six applications have been made, with at least one more year of treatment planned. Other West Virginia researchers are examining the effects of acidification on terrestrial salamander populations, aquatic shredder communities, and aquatic bryophytes. These latter investigations may indicate whether certain organisms can be used as early indicators of ecosystem perturbation. (Supported in part by funds provided by the United States Environmental Protection Agency.)

SUDHA GUPTA, Prof. of Botany Govt. M-H-College of Home Sci. and Sci. for Women JABALPUR (MP) INDIA and TARA DUBEY, Adj. Research Asso. Dept. of Biology, West Virginia Institute of Technology, Montgomery, West Virginia 25136. Effect of water pollutants on the rate of oxygen uptake of three aquatic fungi from India.

This investigation was concerned with the effect of certain types of pollutants such as detergent, DDT, sewage and high chlorine on oxygen uptake in selected species of fungi, viz., Catenaria anguillulae, Pythium tenue and Phytophthora erythroseptica. These pollutants and fungi are common in bodies of water in the Jabalpur area.

Manometric techniques were followed by using a Braun Warburg apparatus. All three fungal taxa exhibited an increased rate of oxygen uptake in the presence of sewage water which coincides with their capability to withstand and compete with bacteria in polluted water. Water with DDT also increased the respiratory rate of the three fungi, thus supporting their role in the accumulation and degradation of DDT, reducing its aftereffect on nontarget biota. There was a gradual decline in the rate of oxygen uptake of C. anguillulae in the presence of water containing detergent and water containing excess chlorine both, but this fungus was far more sensitive to detergent than chlorine. This demonstrates the extreme sensitivity of member of the order Blastocladales [C. anguillulae] to detergent. Members of the order Peronosporales like P. tenue and P. erythroseptica displayed minimum rates of oxygen uptake in the presence of excess chlorine.

STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, West Virginia 26554. Ecosystems of East Africa.

East Africa (Kenya and Tanzania) is a region of considerable biological and ecological interest. The vegetation is exceedingly diverse and ranges from arid grasslands and savanna woodlands over much of the interior plains and highlands to alpine moorlands above treeline on the highest mountains. Among the distinctive plants of the alpine moorlands of these equatorial mountains are giant senecios and lobelias that are quite unlike anything found in alpine areas of the temperate zone. East Africa is characterized by the greatest and most spectacular concentration of large animals found anywhere on earth. Elephants, giraffes, rhinoceroses, buffaloes, lions, zebras, and a variety of different types of antelopes thrive in such protected

areas as Serengeti National Park, Lake Manyara National Park, the Ngorongoro Crater Conservation Area, and Mount Kenya National Park. The Serengeti, the largest and best known of these protected areas, extends over more than 14,500 km<sup>2</sup>. Olduvai Gorge in northern Tanzania is of particular interest for yet another reason. This site has yielded some of the oldest known fossils of early hominids.

STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, West Virginia 26554, SUSAN M. STUDLAR, Dept. of Botany and Microbiology, Oklahoma State University, Stillwater, Oklahoma 74078, PAMELA J. EDWARDS, USDA Forest Service, Timber and Watershed Laboratory, Parsons, West Virginia 26287, and KIMBERLY K. RUGGLES, West Virginia Dept. of Natural Resources, St. Albans, West Virginia 25177. The possible effect of acidification on stream bryophyte communities.

Various species of bryophytes (mosses and liverworts) are the major primary producers in many mountain streams, which are often virtually free of higher plants. Five first-order streams located on or near the Fernow Experimental Forest in Tucker County, West Virginia, were sampled during 1989 and 1990 to obtain preliminary data on the structure and composition of the bryophyte communities present. Water pH averaged >5.5 in two of the streams, whereas the others were relatively more acidic (average pH = 4.2, 4.0 and 3.2). At least 26 species of bryophytes (20 mosses and 6 liverworts) were encountered in the transects used to sample the five streams. Based on values calculated for relative frequency and relative cover, Scapania nemorosa was the single most important species. A number of other studies have demonstrated that species distribution patterns for stream-associated bryophytes are strongly influenced by water pH. In the present study, the general pattern was for bryophyte species richness to decrease with decreasing pH, and no bryophytes were recorded from Finley Run, the most acidic of the five streams. (Supported in part by funds provided by the USDA Forest Service.)

TARA DUBEY, Dept. of Biology, West Virginia Institute of Technology, Montgomery, West Virginia 25136, STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, West Virginia 26554, and PAMELA J. EDWARDS, USDA Forest Service, Timber and Watershed Laboratory, Parsons, West Virginia 26287. A preliminary study of the possible effects of acidification on the mycoflora of West Virginia mountain streams.

The fungi that occur in freshwater streams belong to two major taxonomic groups--the Phycomycetes (chytrids and water molds) and the Hyphomycetes (imperfect fungi). Aquatic Phycomycetes are common inhabitants of freshwater streams, where they occur as saprophytes or parasites on a wide variety of substrates, including algae, other aquatic fungi, aquatic plants, plant detritus, and microscopic aquatic animals. Aquatic Hyphomycetes play an important role in increasing the palatability and nutritional quality of plant detritus for invertebrate grazers, while at the same time enzymatically degrading the detritus. The role of aquatic Hyphomycetes is especially important because many aquatic invertebrate grazers which are unable to digest cellulose and lignin are able to consume fungal biomass generated by detritus-decomposing fungi. Fungal activity appears to be most important during the initial stages of decomposition. The aquatic fungi occurring in five first-order streams located on or near the Fernow Experimental Forest in Tucker County, West Virginia, were sampled during September and October of 1990 to obtain some preliminary data on the distribution and occurrence of these organisms. Water pH averaged >5.5 in two of the streams, whereas the others were relatively more acidic (average pH = 4.2, 4.0 and 3.2). The total number of taxa recorded from all five streams was 62 (30 Phycomycetes, 20 non-Ingoldian Hyphomycetes, and 12 Ingoldian Hyphomycetes). The number found in a particular stream ranged from 12 to 34, with the lowest number present in Finley Run, the most acidic stream sampled. (Supported in part by funds provided by the USDA Forest Service.)

FRANK S. GILLIAM, Dept. of Biological Sciences,  
Marshall University, Huntington, WV 25755.  
Old-growth longleaf pine forest stand structure  
and longleaf regeneration under chronic fire  
exclusion.

Whereas many studies on the fire ecology of longleaf pine have been carried out in areas where fire has occurred frequently enough to allow successful regeneration, fewer investigations have documented the effects of fire on longleaf regeneration when fire is re-introduced to an area which has experienced long-term fire exclusion. Furthermore, as a result of widespread disturbance among longleaf pine ecosystems, still fewer of those studies have been carried out in old-growth forests. This paper presents preliminary data on stand structure and longleaf pine regeneration in a 66-ha old-growth forest in the Sandhills of North Carolina. Data were taken by sampling all stems  $> 2.5$  cm DBH within 0.04-ha circular plots located randomly, but stratified to two site types: unslope mesic areas and downslope xeric areas. Numbers of all longleaf seedlings were noted in each plot. Overstory vegetation in mesic plots was predominantly black oak, hickory species, and large, sparse longleaf pine stems, more typical of Piedmont forests. Xeric plots had high density of smaller turkey oak stems, as well as the large longleaf pines, typical of Sandhills vegetation. Longleaf pine regeneration was minimal on both mesic and xeric areas, often with no seedlings in sample plots regardless of site types. Data from a nearby longleaf stand (with a similar stand history, but where fire has been re-introduced by biennial burns over the last 15 years) show contrasting high seedling densities. These preliminary data suggest that long-term fire exclusion in longleaf pine forests greatly alters stand structure by decreasing longleaf pine regeneration, and that this pattern is independent of site type.

STEVEN L. STEPHENSON, Dept. of Biology, Fairmont State College, Fairmont, West Virginia 26554 and GARY A. LAURSEN, Dept. of Biology and Wildlife, University of Alaska-Fairbanks, Fairbanks, Alaska 99775. Myxomycetes in high-latitude and high-elevation ecosystems of western North America.

Most studies of the distribution and ecology of Myxomycetes (plasmodial slime molds) in terrestrial ecosystems have been carried out in temperate forests, where these organisms are particularly abundant. Studies of Myxomycetes in other types of ecosystems, including those found at higher elevations and latitudes, are relatively few in number. Based upon a preliminary study carried out during the 1989 field season, Myxomycetes do not appear to represent a conspicuous element of the mycoflora associated with subarctic alpine and Arctic tundra ecosystems of central and northern Alaska. However, at least a few species are not uncommon in certain types of microhabitats. For example, aethalia and active plasmodia of Mucilago crustacea are sometimes surprisingly abundant in Arctic tundra. A number of species of Myxomycetes are characteristically found in association with melting snowbanks in alpine areas at somewhat lower latitudes. Based upon a series of collections made during the 1985 field season from an alpine basin located near timberline in the Swan Mountains of northwestern Montana, Diderma niveum, Prototrichia metallica, Acryria versicolor, Comatricha alpina, and Lamproderma sauteri are the most conspicuous and consistently abundant of the Myxomycetes that occupy this rather special and very limited (both spatially and temporally) habitat. The "snowbank" Myxomycetes certainly constitute a distinct ecological group, since they produce fruiting bodies only during the relatively brief period of time (late spring and early summer) when

the special microenvironmental conditions apparently required for their growth and fruiting do exist. During the remainder of the summer, the species of Myxomycetes found in these alpine areas are very much the same as those collected at lower elevations in the same regions. (Supported in part by a grant from the National Geographic Society.)

TARA DUBEY, Dept. of Biology, West Virginia  
Institute of Technology, Montgomery, West  
Virginia 25136. "Aquatic Phycomycetes of the  
Kanawha River, West Virginia"

The Kanawha River along with its tributaries forms the largest northwardly flowing drainage system entirely within the United States. The water molds from this river were collected on 14 different substrata during the one year period from January 1990 to December 1990. Twelve monthly collections yielded twenty-one species in 15 genera, 9 families and 6 orders of aquatic Phycomycetes. Correlation of frequency presence of the species reported with physical and chemical characteristics of the river water showed that the number of species collected increased with an increase in water temperature and pH during November to May reaching a stable peak during March to May. Achlya americana (100 percent frequency), Pythium debaryanum (91 percent frequency), Nowakowskiella elegans (83 percent frequency), Phytophthora sp. (83 percent frequency) and Saprolegnia eccentrica (75 percent frequency) were the most common species found on more different substrata than any others. High temperature from June to August seems to be responsible for the poor occurrence of fungal taxa during that period.

RONNIE D. JEWELL and THOMAS K. PAULEY, Dept. of  
Biological Sciences, Marshall University,  
Huntington, WV 25755. Natural history of the  
ravine salamander (Plethodon richmondi) in north-  
western West Virginia.

Some aspects of the natural history of Plethodon richmondi were studied from April 1990 through January 1991 at North Bend State Park in Ritchie County, West Virginia. Natural history topics considered included seasonal activity, movement patterns, age classes, and cover objects. To determine seasonal activity, microclimatic factors such as soil temperature, air temperature, and air relative humidity were recorded. Daily high/low temperatures and precipitation recorded at North Bend State Park by the National Climatic Center were used as indicators of the general climate. Six 25 m<sup>2</sup> quadrats were used to study movement patterns and age classes. Each salamander observed in the quadrats was toe clipped, measured (snout/vent length), and sexed. Also, its position within the quadrat was recorded. Seasonal activity studies showed that first-year juveniles appeared to be more

active during the warmer summer months. Conversely, adult P. richmondi were more active during fall and winter when air and soil temperatures were cooler. Air relative humidity did not appear to be an important environmental regulating factor. Thirty-two specimens were toe-clipped and 5 were recaptured. Of these 5, the maximum distance any one specimen moved was 6 meters. Of the specimens observed, females made up 46.9%, males 28.1%, and juveniles 25.0%. Nearly 97.0% of all specimens observed were found under cover objects; 62.5% under rocks, 31.3% under leaves, and 3.2% under logs.

BETH A. HOLMES and THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Male reproductive cycle of *Plethodon cinereus* in West Virginia.

*Plethodon cinereus* is the most common woodland salamander in north-eastern United States, as well as in West Virginia. The male reproductive cycle has been determined in several states, but not in West Virginia. Some studies have suggested that spermatophores are produced in spring and fall and, therefore, mating may occur in both seasons. To determine the male reproductive cycle of *P. cinereus* in West Virginia, 69 adult males collected from February through November were examined. The spermatogenic wave, i.e., the migration of sperm through the male reproductive system, revealed spermatozoa started in the posterior end of the testes in July, migrated through the anterior end before passing through the anterior section of the vasa deferentia to the posterior section in September. Spermatozoa were stored in the posterior section of the vasa deferentia until time of mating.

RONALD A. CANTERBURY, THOMAS K. PAULEY, and RONNIE D. JEWELL, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Time of mating and egg deposition of West Virginia populations of the green salamander, *Aneides aeneus*.

Field and laboratory studies were conducted to determine the time of mating and egg deposition of *Aneides aeneus* in West Virginia. Spermatogenic wave studies indicated that mating occurs in the spring (late May and early June) and possibly fall (September or October). Ovarian egg analysis and field observations indicated that eggs are deposited in June. Examination of ovarian eggs and observations of non-brooding females disclosed that there is a biennial egg-laying cycle.

ROBIN L. KING and THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Male reproductive cycle of *Desmognathus ochrophaeus* in West Virginia.

*Desmognathus ochrophaeus* (mountain dusky salamander) is a common salamander in seeps and terrestrial areas of mixed deciduous forests in West Virginia. It is the smallest and most terrestrial of this genus in the state. While the male reproductive cycle has been studied in surrounding states, it is not known in West Virginia. To ascertain when spermatozoa are mature, the spermatogenic wave was determined by examining 50 adult males. In the spermatogenic wave, spermatozoa start in the posterior end of the testes and migrate to the anterior end, through the anterior section of the vasa deferentia to the posterior section prior to mating. In *D. ochrophaeus* from West Virginia, spermatozoa were in the posterior end of the testes in August, migrated from the anterior end in September and October, to the posterior end of the vasa deferentia by May. Since spermatozoa were not found in June specimens, it was hypothesized that mating occurs in May and/or early June.

TIMOTHY W. LONGBINE, TODD W. REULBACH, and THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Range of *Ambystoma texanum* and *Ambystoma barbouri* in West Virginia.

Kraus and Petranks (1989) described a new sibling species of *Ambystoma texanum*, *A. barbouri*, from central Kentucky and adjacent Ohio, Indiana, and West Virginia. This split into two sibling species was based upon morphological and ecological differences. In West Virginia, the known range of *Ambystoma texanum/barbouri* is along the western border from Wayne County in the south to Wood County in the north. Kraus and Petranks only examined the Wayne County populations in West Virginia, which they identified as *A. barbouri*. The major morphological difference between the two species is the shape of maxillary and premaxillary teeth. *Ambystoma barbouri* has broad, short lingual cusps and *A. texanum* has long-cusped teeth. To determine where populations of each species occur in West Virginia, tooth morphology of 32 specimens from Wayne, Mason, and Wood counties was examined. Results revealed that specimens from Wayne County are *A. barbouri* (as described by Kraus and Petranks) and those from Mason and Wood counties are *A. texanum*.

JEFFREY BAILEY and THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. The range and distribution of the Cumberland Plateau salamander, *Plethodon kentucki* (Mittleman), in West Virginia.

*Plethodon kentucki* is one of three species of the *Plethodon glutinosus* complex in West Virginia. Two species, *Plethodon kentucki* and *P. cylindraceus*, have restricted ranges while *P. glutinosus* is found throughout most of the state. Field surveys and museum records show that with the exception of populations in Mason County, the range of *P. kentucki* in West Virginia is restricted to counties west of Kanawha and New Rivers. Within its range, it is known to occur in 12 counties. It will be the purpose of this paper to discuss the range and distribution of *P. kentucki* and possible factors that limit its distribution.

MEEGAN C. CASTO and THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Spermatogenic wave of *Desmognathus m. monticola* in West Virginia.

*Desmognathus m. monticola*, Appalachian seal salamander, is a large creek-dwelling salamander that occurs throughout most of West Virginia. The reproductive cycle of this species has not been described for West Virginia specimens. To determine the spermatogenic wave, testes and vasa deferentia of adults collected from July through November were examined. In the spermatogenic wave, spermatozoa start development in the posterior end of the testes and move through the anterior end to the anterior section of the vasa deferentia before passing through the posterior section to the cloaca. Results indicated that spermatophores are ready to be deposited from July through October.

THOMAS K. PAULEY and RONALD A. CANTERBURY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Status of the genus *Desmognathus* in West Virginia.

Five species of the salamander genus *Desmognathus* are known to occur in West Virginia. Three species have a relatively wide distribution in the state. *Desmognathus f. fuscus* (northern dusky salamander) is found in most creeks throughout West Virginia; *Desmognathus ochrophaeus* (mountain dusky salamander) is common in seeps and mixed deciduous forest in the eastern counties; and *D. m. monticola* is found in creeks in most counties except for a few along the Ohio River. Two species have somewhat limited ranges within the state.

One of these, Desmognathus welteri (Black Mountain dusky salamander), was added to the herpetofauna of West Virginia in 1988. Its range is restricted in the state to the southern counties of Wyoming, Logan, McDowell, and Mingo. Desmognathus quadramaculatus (blackbelly salamander) reaches the most northern point of its range in a small creek west of Kanawha River 0.8 miles south of Gauley Bridge in Fayette County. Until herpetological surveys were conducted in the New River Gorge in 1989 and 1990, the distribution of this species in West Virginia was not known. During these two years, D. quadramaculatus was found in 9 creeks. Historical records suggest that it is considerably less common now than in the past. Since it was more abundant in the headwaters than at the mouths of the nine creeks where it was observed in 1989 and 1990, it is possible that heavy collecting for use as fish bait has reduced its number.

RONALD A. CANTERBURY and THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Gut analysis of the green salamander (*Aneides aeneus*) in West Virginia.

Ninety-six specimens from the West Virginia Biological Survey representing populations throughout the state and every month except November and December were examined for prey items. Of these 96 specimens, 39 were devoid of food and 24 of these contained fragments of digested food in the large intestine. All age classes were examined and showed considerable variations in body size, but not in the size of food items consumed. Insects constituted 92.1% of all food items recovered and were found in all specimens containing food. Spiders and mites made up the other 7.9%. Hymenopterans and coleopterans were the major food items making up 83.9% of all prey consumed. Of hymenopterans consumed, 82.5% were ants. Orthopterans, dipterans, hemipterans, and lepidopterans comprised the remaining 16.1% of insects consumed.

THOMAS K. PAULEY, JON BROWNING, TODD MILLER, and JEFFREY FULKS, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. Amphibians and reptiles of Greenbottom Wildlife Management Area, Cabell County, West Virginia.

Amphibian and reptile surveys were conducted at Greenbottom Wildlife Management Area from February 1989 to December 1990. Survey techniques included aquatic funnel traps, pitfall traps with drift fences, frog call census, and day and night searches. Twelve amphibian species were observed including 4 species of salamanders, one species of toad, and 7 species of frogs. Reptiles observed included 2 species of turtles and 3 species of snakes. The most common amphibians included Notophthalmus v. viridescens, Pseudacris c. crucifer, Rana sylvatica, R. pipiens, and R. clamitans melanota; the most common reptiles were Chrysemys picta marginata and Thamnophis s. sirtalis. Two observa-

tions were of particular interest. First, there was a large population of R. pipiens (a species with a limited distribution in West Virginia) that is sympatric with R. palustris. Second, there were few Ambystoma in what appeared to be excellent habitat.

RONNIE D. JEWELL and THOMAS K. PAULEY, Dept. of Biological Sciences, Marshall University, Huntington, WV 25755. The effects of the Ice Age on the distribution of the redback salamander (Plethodon cinereus) and the ravine salamander (Plethodon richmondi) in West Virginia.

The distribution of Plethodon cinereus and P. richmondi has been of interest to herpetologists for many years. Plethodon cinereus is found throughout the state except in the western part of the Allegheny Plateau Province where P. richmondi occurs. The effects of the Ice Age may have influenced this present distribution of P. cinereus and P. richmondi in West Virginia. There were three periods of glaciation during the Ice Age that produced ponds in the area known as the Teays Valley. The first ponding extended over an area almost 6,000 square miles and each succeeding ponding was somewhat smaller. Also, during the second period another lake, Glacial Lake Monongahela, was formed in the northern panhandle. This lake was almost 200 miles long and 100 miles wide, and occupied all land below 1,100 feet. The major outlet for this lake was along the Harrison-Doddridge County line near Salem, West Virginia, an area where the ranges of P. richmondi and P. cinereus meet. Highton and Larson (1979) proposed that the P. cinereus group separated from the other eastern lineage 2.5 million years ago and a burst of speciation occurred from 2.5 to 0.5 million years ago to produce the presently recognized species. This burst of speciation occurred during the same period as the ponding in West Virginia. Highton (personal communication 1990) intends to separate P. richmondi into two species based on electrophoretic analyses. He states that all populations east of the Kanawha River (formally the Teays River) are different than populations west of the river, and there might be a contact zone between the two populations in the Teays Valley area.

It is possible that the northern and southern populations of P. richmondi were isolated long enough for speciation to occur, and once the glaciers retreated back to Canada the separated populations moved back into the Teays Valley thus becoming sympatric. In the north, Glacial Lake Monongahela probably restricted the range of P. cinereus to the mountains above 1,100 feet east of the lake for a long period of time and only recently has P. cinereus returned into the Allegheny Plateau Province now occupied by P. richmondi.

# Mathematics/Physics/ Geology

SHENG SHEN, Graduate Program in Control Systems Engineering, West Virginia Institute of Technology, Montgomery, West Virginia 25136. Propagation of electromagnetic waves in periodically loaded rectangular waveguide.

The author considers propagation in rectangular waveguide in which a block of dielectric (of dielectric constant  $K > 1$ ) fills a section of the guide of length  $B$ , and is adjacent to an empty section of length  $D$ : the whole configuration being repeated (period  $L = B + D$ ) along the whole infinite guide. Let  $K = \omega/c = 2\pi f/c$  be the usual wave number. Let  $k_0$  be the cut-off wave number (of an arbitrary but fixed TE mode) in uniform empty guide, and  $k_1$  the cut-off wave number for the guide if uniformly filled with the dielectric (of constant  $K > 1$ ). It is well-known that  $k_1 < k_0$ . Then, for the periodic guide, there are three possibilities: (i)  $k < k_1$ , (ii)  $k_1 < K < k_0$ , and (iii)  $k > k_0$ . It is found that in case (i) propagation is completely cut off, while in case (ii), there are (in general) a finite number of stop- and pass-bands. (Case (iii) has already been discussed in the literature.)

BRIAN J. KARCZEWSKI and JOHN C. SENCINDIVER, Div. of Plant and Soil Sciences, West Virginia University, Morgantown, West Virginia 26506-6108. Comparison of Estimated and Measured Saturated Hydraulic Conductivity Values for Five Soil Series.

Saturated hydraulic conductivity ( $K_{sat}$ ) was measured in the field and laboratory for five soil series located in the three-county region of West Virginia known as the Eastern Panhandle. Fifteen sites were chosen for the study, three sites for each soil series. The soils were Hagerstown and Chilhowie (fine, mixed, mesic Typic Hapludalfs) developed on limestone, Berks (loamy-skeletal, mixed, mesic Typic Dystrichrepts) and Blairton (fine-loamy mixed, mesic Aquic Hapludults) developed on shale, and Monongahela (fine-loamy, mixed, mesic Typic Fragiudults) developed in alluvium on stream terraces. Field  $K_{sat}$  was measured using the Guelph Permeameter, while a constant head, dual flow permeameter was used with core samples for the laboratory analysis. Hydraulic conductivity was also estimated by using a standard Soil Survey guide for predicting hydraulic conductivity. Laboratory data were more variable than field data for all series except Hagerstown. Also, laboratory  $K_{sat}$  readings were consistently higher than those taken in the field. Estimations of  $K_{sat}$  for the Berks, Monongahela and

Chilhowie series agreed with laboratory data, but these estimations were higher than field data. Estimations for the Hagerstown and Blairton series were slightly higher than laboratory results and slightly lower than field results.

HERBERT H. SNYDER, Dept. of Mathematics, West Virginia Institute of Technology, Montgomery, West Virginia 25136. A nonlinear ordinary differential equation in electron beam dynamics.

The differential equation in question is  $y'' + \alpha(1 + \cos 2x)y = 2\alpha Ky^{-3} + \beta y^{-1}$  ( $\alpha, \beta, K = \text{const.} > 0$ ). It arises in the theory of periodic magnetic focusing of cylindrical electron beams of high average charge density, and reduces to Mathieu's equation when nonlinear terms may be neglected. Work on this equation (mostly in the microwave electronics literature) is of rather mixed quality, tending to be supported by physically plausible arguments which, however, cannot be directly verified. The author applies rigorous mathematical arguments which (a) establish existence and uniqueness of solutions; (b) show that certain physically "unreasonable" solutions cannot occur; (c) correct errors in earlier linearizations of the equation; and (d) suggest efficient iterative methods of approximate solution.

ALPHA E. WILSON, Dept. of Physics, West Virginia Institute of Technology, Montgomery, WV 25136. Coriolis acceleration on the earth's surface by way of a rotating disk.

Coriolis acceleration, the effects of which are seen daily on TV weather shows, is one of the least developed topics in physics or physical science below the advanced mechanics level. This presentation shows how to derive the Coriolis acceleration equation for motion on the earth's surface in a simple way by first considering motion on a rotating disk.

THOMAS THOMPSON (STUDENT), J. JOSEPH FULLER, AND DON. J. SMITH, Dept. of Computer Science, West Virginia Institute of Technology, Montgomery, WV 25136. Landscape Generation Using Principles of Non-Linear Dynamic Modelling

The principles of Non-linear Dynamic Modelling were applied to the generation of landscapes for display by the means of Computer Graphics. The subdivision rules and recurrence relations necessary to generate the height fields in the image are discussed. The shading techniques and affine transformations used to render the images are discussed also. Methods used to construct the images are compared and contrasted to other widely used methods. Results of the computer programs written to validate the approach are given.

# Natural History

CHAD BUCKLEW AND KEITH GARBUTT, Dept of Biology  
West Virginia University, Morgantown, West  
Virginia 26505. The Effect of Age and Acidity  
on the Community structure of Volunteer Wetlands  
in Northern West Virginia.

During the summer of 1990 a survey was conducted of 15 volunteer wetland associated with abandoned or reclaimed surface mines in Monongalia and Preston counties, West Virginia. The wetlands were classified by age five were less than six years old, five were 10-12 years old and five were 20-25 years old. Within each age class there was a range of pH's from pH 3-PH 7. At each wetland six transects were run and estimates obtained of community composition and cover.

Analysis of the wetlands showed that the overriding influence on community parameters, such as dominance, diversity and equability, was the age of the wetland. While pH did have an effect on composition and community structure it did so in a complex manner and on clear patterns seemed to emerge.

THOMAS E. WEAKS and DONALD R. NASH, Dept. of  
Biological Sciences, Marshall University, Hunting-  
ton, WV 25755 and PAUL J. HARMON, West Virginia  
Natural Heritage Program. P.O. Box 67, Elkins, WV  
26241. Bryophytes of Upper Shaver's Fork Basin,  
West Virginia.

Bryophyte populations were studied at diverse sites of the Upper Shaver's Fork area of Randolph County, West Virginia. Nineteen different habitats types were sampled during the summer season of 1990. Moss and hepatic populations from areas that had been disturbed by human activities were compared with those of relatively undisturbed areas. In addition, growth forms and substrate preferences were analyzed in an effort to establish the order of recolonization of sites that had been disturbed by strip-mining or the clear-cutting of timber. Most bryophytes were terrestrial species growing on various substrata such as tree trunks, fallen logs, rocks, and moist soil. On disturbed sites, members of the mosses were frequently pioneers on freshly exposed, bare soil surfaces, where they are of importance in thwarting incipient erosion. Species richness was far greater for the mosses than that for the hepatics in the majority of both disturbed and undisturbed sites. While it was anticipated that species richness would be higher for the disturbed sites than for the undisturbed sites, the opposite was found to be the case. The dominant mosses of the northern forest and spruce forest habitat types were perennial species. These included Thuidium delicatulum, Hypnum sp., and Dicranum sp. All of these mosses are slow-growing species that form increasingly dense mats each year on a given substratum. Harvesting these species is predicted to exert long-term damaging effects on their populations.

MARY ETTA HIGHT, Dept. of Biological Sciences, Marshall University, Huntington, West Virginia 25755.  
Distribution and taxonomic status of the Pygmy Shrew, *Sorex hoyi*, in West Virginia.

Taxonomy and distribution in the eastern part of the range of the Pygmy Shrew, *Sorex hoyi*, have been questionable owing to a shortage of specimens and lack of records from West Virginia. Two eastern subspecies are presently recognized: *S. h. thompsoni*, a large northern form, and *S. h. winnemana*, a smaller southern form. The species was first reported as part of the West Virginia fauna in 1986 from Canaan Valley, Tucker County, elevation 3200 ft. (Michael, 1986, Proc. W. Va. Acad. Sci. 58:37). On the basis of size, this specimen was tentatively assigned to *winnemana*. The record lay at considerable distance from the known ranges of *S. hoyi thompsoni* in Pennsylvania, and *S. hoyi winnemana* in Maryland and Virginia.

Subsequently twenty-three additional specimens of the Pygmy Shrew have been captured in West Virginia from 1986 to 1990. These new records represent 10 localities in 7 counties (Berkeley, Fayette, Kanawha, Monongalia, Pocahontas, Raleigh, and Tucker) and span the gap between known distribution of the two subspecies.

I compared cranial measurements of West Virginia specimens with published data for *winnemana* from Maryland and Virginia and *thompsoni* from Pennsylvania. Measurements of West Virginia specimens fall between and overlap those of the presently accepted subspecies. Other distinctions must be sought to warrant continued recognition of these two subspecies.

Pygmy shrews were collected in a variety of habitats including wetlands, a narrow floodplain, mixed spruce-northern hardwoods forest and xeric oak-hickory-pine forest. Elevations ranged from 700 to 4300 feet. It appears that the species is ecologically more tolerant than was previously thought.

WILLIAM JAMES ARNOLD, Four Pole Scientific Services, Huntington, West Virginia 25705-3613.  
Native Tarantulas in West Virginia (Araneae, Mygalomorphae).

Tarantula-like spiders and their relatives are uncommon or rare in the eastern United States and attract far less scrutiny than spectacular desert and tropical forms. Heretofore only two species had been found in West Virginia, *Antrodiaetus unicolor* (southern and mountain counties) and *A. robustus* (Ohio Co.), from the Antrodiaetidae, folding-door trap-door spiders, reported by F.A. Coyle (Bull. Mus. Comp. Zool., 141:269-402, 1971). Current collections extend the range of *A. unicolor* to include Fayette, Gilmer, and Cabell counties, but have located no more *robustus*. A purse-web spider, *Sphodros niger*, family Atypidae, known before from Ohio, Pennsylvania, and Virginia, has been found in Fayette County, WVa. Two other *Sphodros* species, *atlanticus* and *rufipes* are known from Maryland and Virginia but not from West Virginia.

Trap-door spiders of the family Ctenizidae are considered rare in the East. West Virginia specimens representing two genera of cork trap-door spiders are reported initially here. A single adult male *Ummidia* was captured in a river bottom field in Wyoming County; previously, *Ummidia* was known in the East from Florida north only to Virginia. A number of male *Myrmekiaphila* have been taken in pit traps at upland and river

bottom forest sites in Fayette and Raleigh Counties. The genus had been known before to occur only from Florida to Tennessee and North Carolina. Identification of WVa Ummidia and Myrmekeiaphila awaits the outcome of a revision of the Ctenizidae currently underway by W.J. Gertsch and N.I. Platnick; several species have yet to be described in each genus.

Sphodros niger, Antrodiaetus unicolor, and the Myrmekeiaphila species have been found at localities recently acquired by the National Park Service in the New River Gorge National River. The Ummidia species is known presently in WVa only from the Wildlife Area at the Corps of Engineers Bailey Dam Project.

The observed incidence of mygalomorph spiders in West Virginia is much richer than might be expected from the literature and has been extended from two to five species. These represent genera from each of two families of the "atypical" tarantulas, folding-door trap-door spiders, and purse-web spiders. The more "typical" cork trap-door tarantulas are represented by two species which may be undescribed members of two genera. All are medium to small in stature and are members of groups which elsewhere inhabit silk-lined burrows in sand, soft soil, or duff in forested localities.

PAUL J. HARMON, Natural Heritage Program, Division of Natural Resources, P.O. Box 67, Elkins, WV 26241. The Status of *Trifolium stoloniferum* (Running Buffalo Clover) in West Virginia: Five New Population Discovered.

To better enable the West Virginia Natural Heritage Program to locate populations of Running Buffalo Clover in the state, data from a 1989 library search of historical references to bison, elk, or native american trails in West Virginia was used to plan a systematic search for *Trifolium stoloniferum* Muhl. ex A. Eaton in West Virginia. Contract botanists searched seven major regions of the state for this endangered species. Five new populations of *T. stoloniferum* were found, all from Randolph County, West Virginia. Each new population site is discussed, as well as implications for future searches and the status of this species in our state. The status of three other sites for *T. stoloniferum* in West Virginia is also discussed as well as information shared by other Natural Heritage Program botanists from Indiana, Ohio, and Kentucky.

BRIAN R. MCDONALD, Natural Heritage Program, Division of Natural Resources, P.O. Box 67, Elkins, WV 26241 A Multidisiplinary Natural History Survey of the Upper Shavers Fork Watershed.

In 1987 the U.S. Forest Service purchased approximately 40,000 acres of the upper Shavers Fork watershed between Cheat and Back Allegheny mountains. This area comprises one of the highest elevation river valleys in the central Appalachian region. Because of the high elevation, and vegetation characterized by northern hardwood and spruce forests, the West Virginia Natural Heritage Program and the West Virginia chapter of The Nature Conservancy lobbied to have the areas biodiversity surveyed so that the U.S. Forest Service could plan development and

use of the area that would not impact the regions rare species. Lobbying was successful and \$130,000 were made available. Surveys were conducted in 1988, 1989 and 1990. Disciplines included in the surveys were: small mammals, fish, breeding birds, reptiles and amphibians, vascular plants, lichens, bryophytes, and fungi. Results of the survey efforts were outstanding. The endangered Northern Flying Squirrel was located at eleven areas on the tract and the threatened Cheat Mountain salamander was found at 12 locations. Numbers of species considered rare included five small mammals, one fish, 17 plants, three birds and one salamander. In addition several plant species never previously recorded in West Virginia were found. Results have been turned over to the U.S. Forest Service and will be used in their land use planning process.

# Psychology/Education

JAMES L. SPENCER, Dept. of Psychology, West Virginia State College, Institute, WV 25112.  
Scientific Literacy of West Virginia State College Students.

Ninety-four West Virginia State College students were asked to complete a two part exercise concerning their knowledge and views towards science. The first portion of the assignment was the completion of a 50 question test of their scientific literacy. Questions were drawn from biology, chemistry, physics, and general science. Half of the questions were true - false, the other half four option multiple choice. The second part of the exercise was to assess student opinion. Twenty questions about various scientific issues were evaluated on a five point Likert scale ranging from "strongly agree" to "strongly disagree". Respondents also reported various demographic information, including gender, major, class standing, number of science courses previously taken, and amount of exposure to science outside of the classroom, as measured by their frequency of reading scientifically oriented television shows. Average score on the literacy test was approximately 70% correct (range 48 - 94). Attitudes varied considerably from issue to issue; only three showed any sort of consensus. Literacy was found to be correlated with a number of variable, including gender, class standing, age and number of science courses completed. Results reaffirm conclusions of similar studies at other institutions and in other contexts of the necessity for greater emphasis on scientific literacy amongst the general population.

JAMES L. SPENCER, PAUL L. CRAWFORD & DIANA M. ALFERINK, Dept. of Psychology, West Virginia State College, Institute, WV 25112. Prediction of College Grade Point Average in West Virginia State College Students: A Comparison of Two Models.

Two models for predicting college success of West Virginia State College students were compared. In the first, American College Test (ACT) scores were utilized as the sole predictor variable of college success, as measured by each student's college grade point average (CGPA). In the second, ACT scores were coupled with each student's high school grade point average (HSGPA). The second model yielded significantly better predictive efficiency than did the first. When comparing the predicted CGPA for each student to that actually achieved, postdiction differences were found by gender and by race for both models. Both models tended to overpostdict male, but underpostdict female CGPA's and both somewhat overpostdicted black student CGPA's. Results suggest the statistical efficacy of using multiple regression models, as opposed to the currently preferred single factor models for predicting college success. Also raised is the tentatively substantiated idea that ACT scores' predictive validity may be biased by gender and by race.

RANDALL T. CHEW III and MARK SHORE, Science Division, Potomac State College, Keyser, WV 26726, and CHARLES WIMER, Mineral County School District, Keyser, WV 26726. ENLIST-Micros -- teachers gaining confidence using microcomputers

Potomac State College is a Regional Training Center for the ENLIST-Micros project, a BSCS project that helps science teachers in K-12 use microcomputers. The participant broadens his horizons and is able to use his new skills to help others in a peer-coaching setting. Operations, this year, have been in the Mineral County School District. Expansion into two more districts is anticipated next year.

Achievement of project goals is a process, not an event, and requires several years. A Stages of Concern questionnaire assesses feelings towards the use of computers in teaching. Typical beginning participants in the course have Awareness that computers could increase their effectiveness, interest in learning about them and the requirements for their use (Informational), and considerable uncertainty about the demands of computer use (Personal).

Those who complete the course reduce their earlier high concerns and begin to have increased concerns about the computer-using task and the use of information about computers (Management), coordination and cooperation with others (Collaboration), and, to some extent, exploration of more universal benefits for himself and his fellow teachers (Refocusing).

Results from a pre-and post-questionnaire indicate that participants increase in personal and student computer use and that computer use is more appropriate and effective. Tests also show that participants increase in their ability to use microcomputers, but do not increase their belief that students can use computers to improve science learning. The last expectancy typically improves slowly only after the teacher has had consistent success with computer usage.

MICHAEL J. DEMCHIK, Jefferson High School,  
Shenandoah Junction, WV 25442. A Statistical  
Method for Determining STS Activities in Science  
Classes.

During the 1988-89 school year, a successful program called Global Issues Chemistry produced statistical results at the 95th percentile on the Comprehensive Tests of Basic Skills, (CTBS), subsection: Science, form 4T. At the end of the school year, the Global Issues Survey (GIS) was administered as a post test item. Based on the growth that occurred from pre to post and both the CTBS and GIS, validity was established in our situation.

This instrument was utilized as a pre test for Chemistry II and Chemistry I students. Chemistry I students were used as a control to determine if there was a difference in the knowledge and placement of global issues. Spearman Rank Order Coefficient and a follow up "t" test was used to determine if there was a difference in students knowledge and placement of global issues in terms of priority. Ratings by both students correlated highly  $r = .714$  and  $t = 3.16$ ,  $p < .001$  for global issues.

In order to determine if the knowledge and priority placement between the students who had the Global Issues Chemistry course, and the current Chemistry II students were the same, priority ratings were compared. A correlation,  $r = .31$ ,  $p > .10$  and  $t = 1.18$ ,  $p > .05$  indicated that the priority ratings were not correlated. Because of the low correlation between the two classes, the listing of all the STS materials supplied to the Global Issues Chemistry class were assigned to the current class at the same rate of 20%. It would appear that a reliability factor could be generated and on subsequent testing of the statistical model, amounts and levels of the STS activities to be used might be determined. It would appear that this initial work may lay the foundation for further investigation.

INES LOPEZ and JOHN H. HULL, Dept. of Psychology,  
Bethany College, Bethany, West Virginia 26032.  
The effect of hindsight on subjects' judgments  
of blameworthiness and suggested length of  
criminal sentence.

Subjects (28 female, 28 male) read descriptions of a homeowner who surprised, then shot and killed, an unknown intruder in his home. Descriptions varied in terms of intruder gender and intruder criminal record, neither of which were known to the homeowner at the time of the shooting. Analyses of variance showed significant hindsight effects; subjects rated the householder significantly more blameworthy for the shooting, and liable to a significantly longer prison sentence, if the intruder did not have a criminal record. Subjects rated the homeowner significantly least blameworthy in the shooting of a female with a criminal record.

NORMA J. VENABLE, West Virginia University  
Extension Service, Morgantown, West Virginia  
26506. Simple Science Sells.

The West Virginia University Extension Service develops and delivers educational programs and materials in several areas of public concern including conservation education and environmental stewardship. Initiated in 1983 with federal funding from the Renewable Resources Extension Act, the Natural Resources program is an Extension program effort supporting broad spectrum environmental programming by providing non-technical information on West Virginia's natural resources to educators, teachers, youth, conservation and related client groups. To date, 11 publications on wildlife, including mammals, birds, and insects, and vegetation, including trees, ferns, and aquatic plants, have been written. Another series of booklets on West Virginia's natural areas is ongoing with publications on Canaan Valley, Dolly Sods, and Cathedral Park. Accompanying programs, workshops, and seminars are also available. This paper describes the Natural Resources Program, its educational goals, and the marketing of non-technical science programs to a diversity of academic and non-academic groups. (The Natural Resources publications series will be available for review.)

MARY URBANSKI, Dept. of Nursing, West Virginia Institute of  
Technology, Montgomery, West Virginia 25136.

Program Evaluation of a Prefreshman Minority Advanced  
Placement Program for Health-Related Professions in a  
Major Research University.

Since the 1960's the United States has become more ethnically and racially diverse. Prior to this period most immigrants came to the United States from Europe. Today, most of them are coming from Latin America and Asia. The non-white population of the United States is growing at a much faster rate than the white population. Banks (1987) reports that between 1970 and 1980, the Asian population in the United States increased 141 percent, the Mexican-American 93 percent, and the African-American 18 percent. The white population increased only 6 percent between these years. Ethnic minorities comprise the majority of the school population in twenty-five of the largest cities in the United States. Minorities will constitute majorities in fifty major U.S. cities by the year 2000 (p. 13). Astin (1982) and others report, definitively, that minority students do not access college rates comparable to non-minorities nor do they complete college in comparable numbers. "Despite the nation's efforts to remedy its record of racial discrimination . . . today's minority groups continue to be underrepresented in the system as a whole and especially in the fields that prepare students for positions of leadership and status in American society" (p. 2). The overall purpose of this study was to evaluate the Minority Advanced Placement Program (MAPP) for high school junior minority students interested in health-related careers. The study was designed to determine:

- (1) if there is a relationship between students participating in the special MAPP summer program and their subsequent enrollment in college;
- (2) if students were satisfied with the MAPP program; and

- (3) if there is a relationship between African-American Penn State students who participated in the MAPP summer program and their subsequent academic achievement and retention in college, by comparing them with a matched sample of African-American Penn State students who were not enrolled in the MAPP program.

Part One presented data on subsequent enrollment figures. Part Two presented the demographic data of the MAPP alumni population and the results of the program satisfaction telephone survey. Part Three presented the conclusions of the statistical comparisons of academic achievement and retention between the sample of African-American Penn State MAPP alumni and the matched sample of African-American Penn State students who were not MAPP alumni.

Overall data analysis was performed utilizing descriptive and t-test methodologies. Of the 233 MAPP alumni, 207 were surveyed by telephone, yielding a response rate of 89.25 percent. Data analysis indicated the following conclusions.

- (1) that MAPP students are more likely to attend college than minority students in general. Of the 207 MAPP alumni surveyed, 91.3 percent indicated enrollment in college following high school graduation;
- (2) that MAPP alumni rated their overall MAPP program satisfaction highly. There were no apparent differences between race/ethnic variations or gender differences;
- (3) that comparisons of academic achievement indicated no significant differences regarding cumulative grade-point-averages on a per semester basis; and
- (4) that the retention rates for African-American Penn State MAPP alumni were significantly higher than a matched sample of minority students enrolled at Penn State University.

STEVE BECKELHIMER

West Virginia Department of Education  
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Trends in Science Standardized Test Scores in  
West Virginia

The West Virginia Department of Education administers a norm-referenced standardized achievement test to all students at grades 3, 6, 9 and 11 as part of the State-County Testing Program.

Since 1984 the State-County Testing Program has utilized the Comprehensive Tests of Basic Skills, Form U to assist educators and parents in identifying strengths and weaknesses in student learning. One report of results, the item analysis, is particularly beneficial in illuminating concepts that may need increased emphasis in the instruction.

The item analysis report from the science portion of the test has been examined over a number of years to determine trends in state-level strengths and weaknesses.

# Zoology

MINDY M. YEAGER, DONALD C. TARTER, MIKE L. LITTLE and MIKE E. SEIDEL, Department of Biological Sciences, Marshall University, Huntington, WV 25755. An analysis of variation in a disjunct population of the central mudminnow, *Umbra limi* (Kirtland), in the Greenbottom Wildlife Management Area, West Virginia.

A disjunct population of the central mudminnow, *Umbra limi* (Kirtland), was compared with congeneric populations. Morphometric and electrophoretic characters were used to determine the amount of intra-specific and interspecific variation. The disjunct population in Greenbottom Wildlife Management Area (Cabell County, West Virginia) is located 110 km from the nearest population in Hocking County, Ohio. The distribution of mudminnows is said to have been effected by the Wisconsin glaciation stage. Except for a few population that have slightly extended their range in Ohio, the West Virginia population is the only one existing beyond the terminal moraine of the glacier. This population may have been introduced by flooding or it may be a relict population which has survived unnoticed since the recession of the Wisconsin glacier. In either case variation, both morphometric and molecular, would be expected due to either the founder effect, or to longevity of isolation. The mudminnows from West Virginia were compared with populations from central and northern Ohio. Two populations of *Umbra pygmaea*, were also included in the analysis. Standard morphometrics, meristics and the Truss network measurements were utilized for morphometric comparisons. General protein analysis was carried out using SDS-PAGE and isozymes were compared using starch gel electrophoresis. Morphometric and molecular variation will be discussed along with possible routes of dispersal for this disjunct population.

FRANK BORSUK and DONALD C. TARTER, Dept. of Biological Science, Marshall University, Huntington, West Virginia 25755. Age and growth of the bluegill, *Lepomis macrochirus* (Rafinesque), in a stratified and destratified lake in southwestern West Virginia.

An age and growth study was conducted between the bluegill sunfish, *Lepomis macrochirus* (Rafinesque) at Beech Fork and East Lynn Lakes, West Virginia, from April 1989 to September 1989. The body-scale relationship of bluegills was found to be 1.07 for both lakes. The length-weight relationships of bluegills were found to be  $\log W = -0.87 + 1.25 \log L$  and  $\log W = 1.18 + 1.43 \log L$ , Beech Fork Lake and East Lynn Lake, respectively. Coefficient of condition values were significantly higher (0.05 confidence level) for bluegills up to 119 mm in Beech Fork Lake, while values became significantly higher (0.05 confidence level) in bluegills 130-159 mm in East Lynn Lake. Overall, the bluegill population from Beech Fork Lake, a destratified reservoir, showed increased growth rates during the first two years of life.

KIMBERLY RUGGLES and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, West Virginia 25755. Ecological life history of *Peltoperla tarteri* Stark and Kondratieff from Big Hollow of Paint Creek, Fayette County, West Virginia (Plecoptera: Peltoperlidae).

An ecological life history investigation was conducted on *Peltoperla tarteri* from Big Hollow, Fayette County, West Virginia, from November 1988 to October 1989. A total of 281 naiads was collected with the highest relative abundance occurring in June 1989. Mature naiads were consistently found feeding on leaf packs located in flowing areas of the stream while the young naiads were found on the submerged surfaces of rocks. Naiadal exuviae were recovered from May 28 to June 23 (13.5 to 16.0 C); the largest number of exuvia (48) were taken on June 3, 1989. Length frequency distributions indicate a univoltine life cycle with adult emergence beginning in late May and continuing to late June. The greatest percentage (58.2) of naiadal growth occurred between June and July. A sex ratio of 1:1 was observed in *P. tarteri* naiads. Monthly foregut analysis indicates that naiads are detritivores with 81.8% of their diet consisting of plant detritus. The diet was also composed of mineral detritus (17.7%) and diatoms (0.47%). Direct egg counts ranged from 50 to 249 eggs/female with a mean of 138. A correlation coefficient of 0.84 was calculated for female body length versus fecundity. Mean egg measurements were 0.29mm in length and 0.28 mm in width.

MINDY YEAGER, TOM JONES, and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, West Virginia 25755. Reproductive biology of a disjunct population of the central mudminnow, *Umbra limi* (Kirtland), in the Greenbottom Wildlife Management Area, Cabell County, West Virginia.

A disjunct population of the central mudminnow, *Umbra limi* (Kirtland), inhabits the Greenbottom Wildlife Management Area, Cabell County, West Virginia. This population represents the only record of the central mudminnow in West Virginia, and the only southern Ohio River drainage record east of the main channel Tennessee River. A proposed habitat alteration at the Greenbottom site has prompted an extensive study on the reproductive biology of the central mudminnow. Monthly collections (October 1989 to September 1990) were preserved for laboratory analysis. Mature egg counts ranged from 228 to 540 ( $\bar{X} = 333$ ), and were only weakly correlated with standard length ( $r = 0.65$ ) and body weight ( $r = 0.54$ ). Egg diameters ranged from 0.73-1.93 mm: the mean was 1.21 mm. The monthly mean gonosomatic index (GSI) ranged from 7.394 to 0.172, March and May, respectively. Spawning occurred in March in shallow, vegetated, flooded areas when the water temperature was 50-55 C. Fry were observed in early April and growth was monitored until they joined the adult population in late May. Mudminnows appear to utilize several reproductive strategies depending on environmental conditions (e.g. flooding, drought). Based on a t-test (0.05 confidence level), nine dimorphic characters were found in the population. This study concludes that habitat alterations will have no ill effects on this population providing seasonal conditions within the swamp are maintained. These conditions give the central mudminnow an advantage over competitors and allow their continued survival.

LISA BURGESS and DONALD TARTER, Dept. of Biological Science, Marshall University, Huntington, WV 25755. Ecological life history of *Anthopotamus distinctus* (Traver) from Indian Creek, Monroe County, West Virginia (Ephemeroptera: Potamanthidae).

An ecological life history study was conducted on the mayfly *Anthopotamus distinctus* (Traver) from Indian Creek, Monroe County, West Virginia, from October 1988 through September 1989. One hundred and ninety-six naiads were found in the soft, sandy substrate where they are crevice dwellers. Monthly foregut analysis showed that the naiads are detritivores, with 96 percent of the diet being composed of plant and mineral detritus. Filamentous alga and diatoms are minor components of the diet. Length-frequency distributions and a population range diagrams suggested a univoltine life cycle with no egg diapause. Naiads with dark wing pads were collected only in May and June. Emergence peaked in June-July at a temperature of 21 C. An estimate of 12 instars was determined using the Janetschek method. Chi-square analysis showed adherence to the expected 1:1 sexual ratio.

HUMBERT ZAPPIA, DEAN ADKINS, ROBERT NORMAN, and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, West Virginia 25755. Effects of first and second year artificial lake destratification on benthic macro-invertebrate population in Beech Fork Lake, Wayne County, West Virginia.

During 1987 and 1988, benthic macroinvertebrate populations were investigated at Beech Fork Lake, Wayne County, West Virginia, to determine the effects of first and second year operation of thermal destratification fans compared to pre-destratification (1985). Analysis of the benthic macroinvertebrate populations showed significant increases have occurred during the summer seasons based on MANOVA ( $p < 0.05$ ), and step-wise discriminant analysis ( $p < 0.01$ ). These increases have occurred in total numbers, diversity, and the number of taxa. Statistical analysis of the fall season data shows no overall significant increase in total numbers, diversity, or number of taxa. There were significant increases in the fall season of first year destratification. Although there is no significant statistical difference in water quality parameters (summer or fall), the mean dissolved oxygen increased to its highest level in 1988 (summer and fall). Increased oxygen at depths below 5 ft may account for shifts from predator species to resident detritivores.

DONALD TARTER, Dept. of Biological Sciences,  
Marshall University, Huntington, West Virginia  
25755. Effects of temperature and pH on the  
oxygen consumption rates of larval alderflies,  
Sialis aequalis Banks, from Camp Creek, an acid  
mine stream, Wayne County, West Virginia.

The effects of temperature (24 and 4 C) and pH (3.2 and 7.6) on the oxygen consumption rates of larval alderflies, Sialis aequalis Banks, were measured with a Gilson Differential Respirometer and oxygen consumption compared to body weight by regression analysis. Respiration varied with temperature and body weight of larval sialids. Larval S. aequalis populations appear to be broadly adapted to oxygen consumption rates for a wide range of pH values and seasonal temperatures. Individual weight and oxygen consumption of larval sialids were negatively correlated. Mean oxygen consumption rates at 4 C were significantly different between pH 3.2 and 7.6 but not significantly different at 24 C between pHs 3.2 and 7.6. At both temperatures, the two regression lines for pH (3.2 and 7.6) were significantly different (0.05 confidence level). This suggests a significant difference between the body weight and oxygen consumption relationship at the two different pH's. Comparisons of oxygen consumption rates at various temperatures were made with larval S. californica Banks, S. occidentis Ross, and S. rotunda Banks.

DONALD TARTER, Dept. of Biological Sciences,  
Marshall University, Huntington, WV 25755 and DIANE  
NELSON, Dept. of Biological Sciences, East  
Tennessee State University, Johnson City,  
Tennessee 37614. Tardigrade fauna (Phylum:  
Tardigrada) in mosses and liverworts from Seneca  
Rocks in the Monongahela National Forest, Pendle-  
ton County, West Virginia.

Nine species of tardigrades, including one new species, were collected in mosses and liverworts from Seneca Rocks, a 1,000-foot quartzite formation located in the Monongahela National Forest in northeastern West Virginia. The quartzite rises above the North Fork Valley at the Mouth of Seneca. The following species of tardigrades, including the state record Diphascon oculatum Murray, were found in mosses and liverworts on the ground, rocks and trees: Diphascon n. sp., Hypsibius convergens (Urbanowicz), H. dujardini (Doyere), Isohypsibius macrodactylus (Maucci), Macrobiotus hufelandi Schultze, M. richtersi Murray, Milnesium tardigradum Doyere, and Minibiotus intermedius (Plate).

TOM JONES, MARY YEAGER, and DONALD TARTER, Dept. of Biological Sciences, Marshall University, Huntington, West Virginia 25755. Preliminary observations on the summer food habits of the grass pickerel, *Esox americanus vermiculatus*, in the Greenbottom Wildlife Management Area, Cabell County, West Virginia.

The grass pickerel is mentioned on the Vertebrate Species of Concern List in West Virginia. The reason for the West Virginia status of the grass pickerel is that the lentic, vegetated spawning areas are limited to the state. Recently, we found a population in the Greenbottom Wildlife Management Area (GWMA) in southwestern West Virginia. Personnel at the U.S. Army Corps of Engineers are planning to add new marshland by building dykes at the downstream end of the property. This study will establish a baseline for summer food habits of the grass pickerel prior to habitat disturbance, and will help provide information for the management of food habits of fishes in the GWMA. Grass pickerel (12/month), ranging in total length from 57-206 mm, were collected from May to August 1990 by seining the vegetated, littoral zones of the wetland habitat. In the laboratory, quality and quantity of the monthly stomach contents were determined using the following calculations: (1) percentage frequency of occurrence, (2) average of volume percentages, (3) average number of individuals, and (4) percentage of total volume by weight. Additionally, food preference studies were conducted in the laboratory using the grass pickerel, central mudminnow, green sunfish, and selected benthic macroinvertebrates (e.g. odonates).

DONALD TARTER, Dept. of Biological Sciences, Marshall University, RALPH KIRCHNER, 5960 E. Pea Ridge, Huntington, West Virginia and BORIS KONDRATIEFF, Colorado State University, Fort Collins, CO. Range extension of caddisflies (Trichoptera) into West Virginia.

Two species of caddisflies found in West Virginia are added to the previously known fauna of the state. One widespread species, *Micrasema wataga* Ross, is not an unexpected record to the state fauna considering its wide range (AK, NH, KY, MA, MN, SC, TN, VA, WI, PQ). Adults (1 male, 1 female) were collected along the Bluestone River, Mercer County, on 16 May 1990. *Lepidostoma reosum* Denning, a relatively rare species (MA, ME, NB), represents an important southern range extension into West Virginia. Adult males (11) were collected from the headwater of Seneca Creek, Pendleton County, on 15 May 1990. Female, larva, case and habitat of this species are unknown. Larvae may inhabit bog areas where adults have been collected. The number of caddisfly species now known from West Virginia is 187. Additional species of caddisflies expected to be found in the state will be discussed.

**PROCEEDINGS OF THE WEST VIRGINIA  
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**INSTRUCTIONS TO AUTHORS  
Revised February 1982**

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