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PROGRAM ABSTRACTS

104TH SESSION

IOWA ACADEMY OF SCIENCE

April 24-25, 1992
The University of Northern Iowa

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GENERAL SESSIONS

I. The Second Decade of AIDS. JUNE E. OSBORN, M.D.,
Dean, School of Public Health, The University of
Michigan, Ann Arbor, MI

Discussion of current policy issues with respect to the
AIDS epidemic, and a current status report.

II. Observing High-Speed Motions with Electronic
Flash. LOREN M. WINTERS, North Carolina School
of Science and Mathematics, Durham, NC

The brief burst of light from an electronic flash
unit can be used to "stop" high-speed motions so
that one can see what is happening. With an
automatic trigger, the flash unit can be discharged at
selected instants, effectively dissecting the motion
into thin "slices of time". "Slices" of events such
as the burst of a balloon, the smash of a ball dropped
on a table, and the passage of a high-speed projectile
through water will be demonstrated. A computer-driven
bank of flash units for producing multi-colored images
in rapid sequence will also be demonstrated. Slides
of a variety of high-speed processes will be shown,
and information will be available for those interested
in doing high-speed photography on their own.

III. Yellowstone after the fire. DONALD G.
DESPAIN, Research Biologist, Box 160, Yellowstone
National Park, Wyoming

Vegetation response to the fires varied according
to the environmental conditions of the site. Areas
of grassland that burned showed very little
response aside from a flowering enhancement.
Sagebrush bushes did not survive the fires, but
there are numerous seedlings from the seedbank in
the soil already repopulating the sites. It will
probably take 20 to 30 years for the sagebrush to
get as large as they were before the fire. A
seedbank study has shown that many seeds of several
species survive in the soil even in the hot burns.
There seem to be enough seeds that survive the fire
that there is little problem with seeds getting
back into the burned areas. Aside from seeds,
there are other means of plant propagation.
Rhizomes, bulbs, corms and root crowns also
survived the fires and began the immediate process
of revegetation.

Lodgepole pine seeds survived the crown fires in
the cones. Seed densities in the fall of 1988
ranged between 50,000 and one million seeds per
acre. Seedlings now range between 300 and 100,000
per acre. There seems to be no lack of new
lodgepole pines especially where a sizeable seed
crop existed in the crowns before the fire.
Seedlings that germinated in 1991 even appeared in
large areas of intense crown burn. There were two
surprises from the 1988 fires. Aspen seedlings
began showing up in suitable sites in all the
burned areas. Establishment of aspen by seed is
considered very rare in the Rocky Mountains. The
second was a profusion of Bicknell's geranium.
This species had been collected in the park earlier
but was so rare before the fires that it was not
recognized by the current park botanists. It is a
biennial plant. In 1989 there were many flat

rosettes of geranium leaves. In 1990 these all
bolted to 2 to 3 feet tall, produced small white
flowers and seeds. By 1991 they were again
extremely rare. The seeds must be in the soil
waiting for the next fire which could be 200 to 300
years from now.

The most important factors affecting revegetation
are soil moisture and nutrients and the associated
plant community that existed before the fire.
Fertile soils with good water holding capacity had
a dense diverse vegetation before the fire and
responded immediately with a wide variety of
species and a nearly complete plant cover following
the fire. Poor, dry soils had less vegetation
before the fire and show a slower response. A
secondary factor is elevation. The lower
elevations have a longer warmer growing season that
allowed a rapid response whereas communities in the
higher elevations were slower to respond but are
showing similar responses of vegetation density and
species. Fire intensity in the crowns seems to
have had little or no effect on the revegetation
response. Areas that now have dense vegetation had
a more diverse and dense plant cover before the
fire. Those areas that had little vegetation
prefire still have little vegetation.

SECTION PROGRAMS

AGRICULTURAL SCIENCES

1. Iowa Weed Disease Survey

A. H. Epstein, A. C. Wagner

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A survey to determine the diseases present on
weeds in Iowa was initiated in 1991.
Emphasis was placed on the major agricultural
weeds, however, all weeds were sampled
where diseases appeared on them. In addition
to a data base on diseased weeds we have also
started a collection of disease organisms
isolated from the specimens collected.

A total of 123 fungal isolates have been
collected, of these there are 43 which appear
to have some potential as biological agents of
weed control.

2. Some associations between VAM fungi and oats.

A. C. WAGNER AND A. H. EPSTEIN

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Vesicular-arbuscular mycorrhizal (VAM) fungi have been shown to be involved in the up-take of water and nutrients in many terrestrial plants including oats.

Two varieties of cultivated oats were grown in pot culture using field soil as the source for VAM fungal inoculum. Plant growth and VAM fungal colonization are discussed.

The possible production of a germination-inducing volatile substance by the actinomycete *Streptomyces orientalis* is also discussed.

3. Components contributing to rate-reducing resistance in a plant virus pathosystem.

Forrest W. Nutter, Jr

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It has been shown in fungal pathosystems that rate-reducing resistance can be separated into components to mechanistically explain why epidemics are fast or slow, as affected by host genotype. Components of resistance to plant viruses may be quantified in a similar fashion but with several subcomponents added to account for alternative weed hosts and/or infected volunteers that are of primary importance to initiate epidemics and for vectors which are essential for transmission. Epidemiological principles and operational definitions were developed and utilized to identify and quantify components contributing to rate-reducing resistance in the *Capsicum annuum* L./weed hosts/tobacco etch virus (TEV)/aphid pathosystem. Pepper genotypes which could be infected with TEV, but delayed symptom appearance and slowed the rate of virus antigen accumulation over time, were also found to have a rate-reducing effect on TEV epidemics in the field compared to fully susceptible genotypes. Rate-reducing genotypes were found to have lower receptivities, represent smaller lesions (epidemiologically), had longer latent periods, and produced fewer viruliferous aphids over time, compared to susceptible pepper genotypes. Insect vector(s) and weed hosts were found to be important subcomponents of the pathosystem and these have also been quantified and related to the development of TEV epidemics in time and space. Substantial yield benefits were realized when rate-reducing resistance was deployed to control TEV. The use of resistant cultivars to reduce the apparent infection rate should increase the effectiveness of disease control tactics that reduce initial inoculum.

4. Seasonal occurrence of alfalfa foliar pathogens in Iowa.

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Although alfalfa is susceptible to a number of foliar pathogens in Iowa, virtually nothing is known about the pathogens responsible for injury, their seasonal occurrence and the damage they cause to alfalfa production. The seasonality of foliar pathogens was determined by establishing research plots at 4 locations in Iowa: Ames, Ankeny, Chariton and Knoxville. Leaf samples containing at least 25 lesions or blotches were sampled at 7-day intervals from each of four replications per site beginning in early May and ending in late September. To facilitate pathogen identification, samples were incubated at 23°C for 48 hours to induce sporulation. The frequency of pathogens was then recorded and expressed as a percentage of total number of lesions sampled. Nine fungal pathogens and one bacterial pathogen were found. These were:

Phoma medicaginis, *Stemphylium botryosum*, *Pseudopeziza medicaginis*, *Leptotrichia medicaginis*, *Cercospora medicaginis*, *Leptosphaerulina briosiana*, *Colletotrichum dematium*, *Stagonospora meliloti* and *Uromyces striatus* and *Xanthomonas campestris*. *Phoma* was predominant early in the season; *Leptosphaerulina*, *Pseudopeziza* and *Cercospora* in the mid- and late- season samplings while *Stagonospora* and *Uromyces* predominated late in the season. Yield reductions due to foliar diseases ranged from 17 to 31 percent.

5. Impact of Rose Rosette Disease on Multiflora rose

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Rosa Multiflora (Multiflora rose) a thorny shrub introduced from Japan has naturalized and is now a widespread pest on over 2 million acres of non-tilled land in Iowa. The Rose rosette disease has been shown to be lethal to the rose and research to elucidate the causal agent and its mode of action is now under way.

This paper describes the changes in food reserves that occur in the plant following infection as well as the deviations in the plant's growth patterns that eventually result in the plants death.

6. Unreduced gametes in an interspecific *Impatiens* hybrid

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Two 24-chromosome interspecific hybrids, 'Tangeglow' (*I. aurantiaca* x *platypetala*) and '7851-1' (*I. hawkeri* x *platypetala*), were used as parents. The F₁ offspring had chromosome numbers ranging from 28 to 36. Furthermore, only 4 *Celebes* chromosomes were found in somatic cells of the F₁ offspring, indicating that 'Tangeglow', the female parent, had undergone a normal meiosis. These results indicated that '7851-1' was producing both partly and completely unreduced gametes.

Potential applications of unreduced gametes in *Impatiens* breeding programs will be discussed.

7. A rapid protocol for isolating DNA from lyophilized tissue of two Cuphea species

W. Chen, W.W. Roath and B. Nikolau

Graduate Research Associate, Agronomy Department; USDA-Agricultural Research Service North Central Regional Plant Introduction Station; and Biochemistry and Biophysics Department, ISU, Ames, 50011

Cuphea viscosissima Jacq. and C. lanceolata Aiton possess seed oils with predominately medium-chain length fatty acids which are used in the soap and detergent, and food industries. At present these fatty acids are obtained from imported tropical seed oils or from petroleum. DNA must be isolated from many plants so as to define molecular markers used in genetic studies and evaluation of Cuphea germplasm. Several protocols for isolating plant DNA have been reported previously in the literature. Extracting Cuphea DNA with one of these protocols usually took more than a day. The key changes made to improve this protocol are: (1) the concentration of hexadecyltrimethylammonium bromide (CTAB) was increased from 0.5 percent to 4 percent; and (2) several steps were omitted. Isolating Cuphea DNA with this modified procedure required only a half day.

8. Molecular marker analysis of second-generation European corn borer resistance in maize

M. J. BRINKMAN, M. LEE, W. L. WOODMAN AND W. D. GUTHRIE

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Polygenic inheritance is characterized by continuous distribution of phenotypic classes. Conversely, phenotypic classes of traits affected by single genes are discrete, and more amenable to manipulation by conventional breeding methods. Restriction fragment length polymorphism (RFLP) analysis permits maize breeders to map and resolve complex traits into individual genetic components. In this study, RFLP analysis was used to map genes for European corn borer resistance using 90 probes on a sample of 150 F_{2:3} lines developed from a B73/DE811 population. Experiments were performed in three environments. Interval mapping detected significant effects on seven chromosomal regions representing six chromosomes.

9. Evaluation of photosensitive-maize populations, their testcrosses and backcrosses.

CAMPBELL, M.R., and L.M. POLLAK.

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Maize germplasm of tropical origin remains largely ignored since adequate variability for agronomic traits exists within Corn-Belt germplasm. In addition, photosensitivity often prohibits the evaluation of these populations in temperate environments.

The purpose of this study was to compare methods for evaluating a photoperiod sensitive collection of maize populations in temperate locations. Materials included were chosen from more than 600 racial collections on the basis of agronomic traits and pest resistance. Populations and their testcrosses to Corn-Belt testers were evaluated for flowering and vegetative traits during 1984-85. Populations backcrossed to testers were evaluated at two locations in 1991.

Testcrossing of populations significantly reduced time to flowering, however a slow dry down rate did not allow for effective yield evaluation. Backcrosses to Corn-Belt testers further reduced time to flowering and improved dry down sufficiently for yield determination.

10. Evaluation of agronomic and composition traits for Caribbean corn populations

Y. WU AND L. M. POLLAK

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Caribbean maize germplasm can be a promising source of diversity, increased productivity, and increased quality for breeding populations used for U.S. corn hybrid development. Seventy-three caribbean population testcrosses to sister-line hybrids of the Lancaster and Stiff Stalk heterotic patterns were evaluated in three locations in Iowa in 1990 and 1991. Although average yield of both the crosses and checks was lower than normal, and crosses were very tall and late maturity, 10 crosses had higher yields than a commercial check in B14 x B73 test-cross experiment in both years. Average yield was lower than checks in the Oh43 x Mo17 experiment, but three crosses still had higher yields than B73 x Mo17 in the 1990 experiment. There were significant differences among the 73 testcrosses within a heterotic pattern for composition traits. Protein contents were 1.65% higher than the checks and oil content increased 0.8% compared with those of the checks. There was a wide range of results for diseases and insect resistance.

11. Performance of adapted tropical maize germplasm

A. R. HALLAUER AND L. A. MICHELINI

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Seven tropical varieties that are important in tropical maize breeding programs were selected for adaptation to temperate environments. The objective of study was to determine the relative performance of the adapted tropical varieties in crosses with BS13 (improved strain of Iowa Stiff Stalk Synthetic) and BS26 (improved strain of Lancaster Sure Crop). BS13 and BS26 represent the important heterotic groups used in the U.S. Corn Belt. Evaluations of crosses, reciprocal backcrosses, and parental varieties were made in 7 Iowa environments. The crosses of Suwan 1 by BS13, Tuxpeno by BS13, and Suwan 1 by BS26 had greater yields compared with crosses of other exotic varieties. Overall BS13 combined better with the exotic varieties than did BS26. It seems the heterotic pattern of Suwan 1 by Tuxpeno is promising to increase the genetic base of U.S. Corn Belt breeding programs.

12. Broadening the corn germplasm base in the Corn Belt

L. M. POLLAK

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For the past six years an international project involving the U.S. and 11 Latin American countries has been evaluating, exchanging, and using native germplasm. High-yielding selections from the temperate locations have been evaluated in the field in Iowa and Georgia. Several of the selections have potential for Iowa either to improve yield quality or specialty traits of Corn Belt hybrids. Results of evaluations that have been conducted and their implications for the Corn Belt will be discussed.

ANTHROPOLOGY

13. Bioturbational size sorting as an archaeological site formation process

J. A. Artz

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Studies of intensively bioturbated soils in California suggest that bioturbation, resulting in the upward movement of small particles and the subsidence of large particles, is most intense in the upper 20-30 cm of the soil, the depth interval in which pocket gophers and other burrowing fauna typically forage. Artifact depth distributions from archaeological sites in Iowa provide evidence for the upward dispersion of small artifacts, but provide little evidence for the subsidence of large particles. Patterns in small-artifact depth distributions suggest that, under conditions of pedogenic upbuilding, archaeological deposits are most intensely bioturbated in the early phases of upbuilding, when the deposit is entirely within the 20-30 cm thick foraging zone. The intensity of bioturbation, measured archaeologically by the upward displacement of small particles, falls off (in some cases quite abruptly) once the foraging zone no longer penetrates the archaeological deposit.

14. Climate and the development of cosmology in the New World Tropics.

S.R. SNOW

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This paper will examine the role of climatological phenomena in the development of cosmology in the New World tropics. It will discuss the hypothesis that rainfall patterns, cloud patterns, storms, etc. helped to shape the patterns that dominate the world-view systems of various cultures within the New World tropics. Climatological phenomena form a set of patterns that are readily visible to

people throughout the tropics and offer a number of dominant patterns from which to model general cosmological systems. Using ethnohistoric, ethnographic and archaeological data this paper will show how these phenomena are modelled within different cultures with similar and dissimilar results.

15. The Gipe Vessel

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The purpose of this report is to provide a comprehensive look at the Gipe vessel, to confirm a hypothesized date of Late Woodland period and to determine the function of the vessel by means of analysis of its size shape, and construction through the use of comparative data.

The Gipe vessel was found in association with skeletal remains and is virtually complete. A relative date of 1350 B.P. is suggested.

16. The Bonaker phase: Emergent Mississippian culture on Cahokia's near periphery

J. M. Collins and D. R. Henning

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Excavations at the Bonaker phase type site are reviewed to contrast coeval settlement patterns of the Ozark Rim, Crescent Hills locality, and those of the American Bottom. The Bonaker phase, radio-carbon dated to AD 1050, exhibits an admixture of American Bottom Emergent Mississippian and indigenous Late Woodland traits. Domestic site structure is similar to American Bottom Emergent Mississippian communities, particularly those of the Prairie Lake locality. However, stone box graves arranged in circumscribed cemeteries are a conspicuous component of the phase, predating the introduction of stone box cemeteries to the American Bottom by more than a century.

17. Chenopodium utilization in Mill Creek subsistence

D. W. Jones

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The Iowa Statewide Archaeobotanical Survey recorded the presence of Chenopodium spp. remains from five Mill Creek sites located in northwestern Iowa. Two of these sites, Chan-Ya-Ta and Brewster, each produced over 1000 carbonized Chenopodium seeds from cultural features. New research techniques utilizing Scanning Electron Microscopy (SEM) examination of a sample of seeds from each site has provided information on two critical areas of interest: 1) the classification to a species level, and 2) the question of domestication. With this information, an evaluation of Chenopodium utilization at each of the sites and in Mill Creek Culture subsistence patterns is attempted.

18. Results of an investigation of a woman's paddle from Irian Jaya

J.L. Stoffer

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Department of Sociology and Anthropology
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An artifact from Irian Jaya came into possession of an American soldier during World War II. Eventually, the artifact was donated to the University of Northern Iowa and identified as a soup stirrer. As part of an undergraduate project, it was re-identified as a woman's paddle decorated with the s-shaped design distinctive of the Lake Sentani Region.

19. A potential prehistoric fish trap in Greene County, Iowa; or, What the hell is that thing?!

M. L. ANDERSON

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During a 1991 Iowa Department of Transportation sponsored archaeological survey along Old Highway 30 in Greene County a local resident relayed an interesting tale. During his youth he had fished along Hardin Creek and was always curious about a structure across the stream. It was a low U-shaped wall of relatively uniform sized rocks forming a dam across the creek. He surmized that it must be a prehistoric fish trap, maybe like the one he had heard about near Amana. Upon visiting the site it was noted that not only did this structure exist upstream of a county road bridge but another rock structure spanning the creek existed south of the bridge. Interviews with several local residents only clouded the issue. Therefore, this research project was initiated with the hopes of clarifying and not muddying the waters regarding the a potential prehistoric fish trap in Greene County, Iowa.

20. Identification and significance of local brick-making sites in historical archaeology: an example from Iowa

F. A. Finney

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Local brick-making sites are poorly known in the Midwest, particularly the facilities for small scale production of soft mud bricks. Such facilities are typically found at or near the construction site. Scove kiln and clamp brick-making sites exist until at least the 1880s and are potentially significant to the nineteenth century architectural and economic history of the immediate vicinity. Because of the non-permanent or transient nature of small brick making operations, most sites are destroyed or dismantled soon after completion of the desired buildings. In some cases, these sites were destroyed by the continuing use of the brickyard.

This paper will discuss the identification of archaeological debris that can be derived from scove kiln and clamp sites. One example from Iowa is presented. Small-scale brick making concerns, such as that represented by site 13WA76 were crucial to the economic development and the architectural character of the City of Indianola. There is no record of this brickyard in the Iowa Industrial Censuses, county histories, county atlases, or other written records.

21. Gladbrook Pressed Brick and Tile Company (1898-1938)

VOGT, MICHAEL W.

Department of Sociology and Anthropology
University of Northern Iowa
Cedar Falls, Ia 50613

The paper concerns the remains of the brickyard located in the Northeast quarter of section 8, Spring Creek township, Tama County, Iowa. Through field surveys the following questions will be addressed. 1. What type(s) of activity took place at the site? 2. How long was the site occupied? 3. What were the beginning and ending dates of occupation? 4. How many people were required to perform the activities? 5. Why was the site abandoned? The archaeological evidence I would expect to find during excavation will also be discussed.

Historical sources on the site exist and will be used to check the inferences made concerning the above questions.

BOTANY

22. The effects of interspecific competition on plant growth and seed production

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Competition often plays a major role in plant survival and reproduction. Increasing plant density or decreasing available resources generally increases the effects of competition. We investigated the effect of interspecific competition on garden peas (*Pisum sativum*) by manipulating the density of competitor species. We planted 3 garden peas in each of 48 three-gallon pots in a greenhouse. Varying densities (0, 3, 6, and 12 seeds) of each of the 3 competitor species were added to these pots. Results showed that increased competition generally reduced both vegetative growth and reproductive output of the garden peas. The peas showed a differential response to the varying levels of competition among the 3 species. We hypothesized that there would be a certain level of competition that significantly reduced pea growth and reproduction. This level, which should vary with different crop species, may be used by agronomists to determine the density when it would be necessary to apply pesticides for the control of competing weedy species.

23. Community ecology of native grasslands in the Loess Hills of western Iowa

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Community samples of native grasslands in the Loess Hills were measured during 1990 and 1991. Samples represent the vegetation observed in 2 by 5 meter sampling areas located along transects that originate on peaks or ridgelines and run directly down adjacent slopes. All transects with a common origin comprise a site. Within each 2 by 5 meter sampling area, 40 subsamples, each 25 by 25 cm, were randomly selected. Species were assigned one of four categorical indices (0 to 3), based on their abundance in each subsample. A species' abundance in the community sample is the sum of its indices. Additional provisions were made to measure the importance of woody vegetation over one meter tall. Samples number 240, and were collected at 23 sites from 8 locations.

Initial results suggest that variation in the native grassland communities occurs on three scales. Latitudinal variation occurs at the largest scale, which likely results from climatic differences and plant geography. Variation arising from present and past land use patterns is important at a smaller scale (e.g., locations in the same county). At a finer scale, topographic and edaphic variation has an important influence on community composition (e.g., sites within a location with the same anthropogenic history).

24. The natural history of Lespedeza leptostachya in Iowa

D.D. Smith and S.C. Zager, Biology Department, University of Northern Iowa, Cedar Falls, IA 50614-0421

The Prairie bush clover is a federal and state "Threatened species" endemic to dry-mesic prairies in the midwest, but occurs most often in Iowa. Natural history studies began in 1988, when 16 extant populations were relocated to record associate species and note ecological parameters. Searches were conducted on 126 prairies resulting in four new extant sites. It was mostly found on north-facing slopes, in relatively mesic microhabitats on loamy soils. An extensive soil survey was conducted at 3 extant sites, but no clear relationship was discerned between local plant distribution and soil type. Prairie vegetation dominated extant sites, but habitat quality varied from highly diverse preserves to depauperate, eroded, overgrazed pastures. Associate species tended to be those commonly found throughout Iowa and known to increase following habitat disturbances. Apparently, moderate grazing or fire management has maintained some populations. Long term monitoring plots have been established where demographic data suggest a maturing population with few seedlings. A 3 year study indicates that plants in burned plots remain vigorous while others diminished in unburned, ungrazed plots. Seedling recruitment was observed in grazed plots.

25. An unusual leaf spot fungus (Beniowskia sphaeroidea) on switchgrass (Panicum virgatum) in Iowa

B. L. HANSEN MCKINSTRY AND L.H. TIFFANY

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In July 1990 an unusual leaf spot was observed on non-native switchgrass in a moist semi-shaded area in a sewer line planting at Iowa Lakeside Laboratory. In August 1990, the same fungus was found on a similar planting along a bicycle trail on the east side of Lake Okoboji. Both sites had been planted by a local landscape company in 1985 with seed from the same source. The causal fungus, Beniowskia sphaeroidea, produces elliptical tufts of mycelium, conidiophores and conidia erupting in chlorotic areas on both surfaces of the switchgrass leaves. It has not previously been observed in Iowa. The fungus has been monitored for survival and spread since its discovery. It has developed each summer in the areas where it was initially observed with some local spread. It has not been found on native switchgrass plants in an adjacent prairie at Lakeside.

In June 1991, black tar spot like ascostromata, asci and ascospores of an unknown ascomycete were observed on overwintered leaves from the Lakeside Laboratory site. Connections between the ascomycete and B. sphaeroidea have not been established. Studies of the life cycle of B. sphaeroidea and of the disease it encites on switchgrass are continuing.

26. Field observations on kernel smut of big bluestem in Iowa

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Dept. of Botany, Iowa State University, Ames, IA 50011 and Dept. of Plant Pathology, University of Georgia, Athens, GA 30606

Kernel smut of big bluestem (Andropogon gerardii) caused by Sphacelotheca occidentalis results from the invasion of individual immature florets by systemic mycelium with development of teliospore-containing galls. Since we first observed the disease at Cayler Prairie in Dickinson County in August 1978, we have found it each year in native prairies in northwest Iowa and in planted prairies in other areas of the state. We have also monitored other prairies in the state to check for potential spread of the fungus.

Diseased plants may produce drastically stunted culms and typically decline rapidly in vigor. Diseased big bluestem populations in restored prairies may deviate from this symptomology.

Growth and decline of individual big bluestem plants in field situations is difficult to ascertain. We are obtaining data in specific populations by recording the number of diseased and healthy culms in August each year along transects in permanent plots established in Cayler Prairie in 1987.

27. Unusual epidermal structures in Polygonum (Polygonaceae) leaves

N. R. LERSTEN AND J. D. CURTIS

Department of Botany, Iowa State University, Ames, IA 50011 and Biology Department, University of Wisconsin, Stevens Point, WI 54481

A survey of leaf anatomy of 153 of the 300 or so species of Polygonum was made from cleared leaf samples of herbarium specimens and ten locally available species, supplemented by SEM and resin sections of selected species. Among our sample, several unusual or unique features were revealed in the epidermis and will be described: shrublike or brushlike clusters of simple trichomes, spheroidal glands restricted to one section, modified epidermal parenchyma that range from enlarged cells to deeply invaginated cells to deeply penetrating cells subdivided into an outer and an inner cell, and epidermal nodules and resin cups, found in only one species each. We also describe extrafloral nectaries of two local species, a forgotten epidermal feature not mentioned since 1909. Polygonum is surprisingly rich in its epidermal variation, which is of potential significance for the as yet unsettled taxonomy of this group as well as of intrinsic anatomical interest.

28. Unusual internal structures in Polygonum (Polygonaceae) leaves

J. D. CURTIS AND N. R. LERSTEN

Biology Department, University of Wisconsin, Stevens Point, WI 54481 and Department of Botany, Iowa State University, Ames, IA 50011

A survey of leaf anatomy of 153 of the 300 or so species of Polygonum was made from cleared leaf samples of herbarium specimens and ten locally available species, supplemented by SEM and resin sections of selected species. Among our sample, several unusual or unique features were found internally and will be described: cavities of epidermal and subepidermal origin, hypodermal fibers, internal nodules, enlarged crystal cells confined to the paraveinal layer, and perhaps the most unusual feature, a system of elongate cells that occur above veins and extend horizontally into the mesophyll, often traversing an entire areole, and have dense contents and large pit fields. These cells, restricted to 12 of 17 species surveyed in one section, have some unique characteristics but we call them laticifer-like because in their gross appearance they resemble a system of laticifers. These internal anatomical features have both taxonomic and intrinsic anatomical significance.

29. A quantitative study of nuclear and cellular changes in normal and Texas cytoplasmic male sterile corn tapetal cells during microsporogenesis

HARRY T. HORNER

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Tapetal cells in anthers from normal (N) and Texas cytoplasmic male sterile (Tcms) lines vary significantly in several ways during their development. In Tcms anthers,

the tapetal cells degenerate about the microspore stage leading to abortion of the male cells. Tapetal cells from both lines contain either one nucleus or two nuclei per cell. The ratio of two nuclei to one nucleus per cell is much greater in the Tcms line at all stages. During development, all of the Tcms tapetal cells undergo changes in size that are much greater than their N counterparts. At the microspore stage Tcms tapetal cells are maximally enlarged. Changes in the sizes of the single nucleus or two nuclei per cell are less pronounced but do vary between lines. These data, along with data derived from flow cytometry and electron microscopy, suggest that there may be a nuclear-cytoplasmic interaction, in addition to the mitochondrial abnormality, that leads to cytoplasmic male sterility in Tcms corn.

Poster

30. Patterns of ^{14}C -photosynthate movement during early ovule and embryo development in *Glycine max* (L.) Merr.

M.A. CHAMBERLIN, H.T. HORNER AND R.G. PALMER

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In rapid development of zygote to heart-shaped embryo, nutritional requirements of ovular tissues are high. Utilizing $^{14}\text{CO}_2$, via photosynthesis and autoradiographic (AR) techniques, we show that flow of labelled carbon into ovular tissues and embryo of soybean is temporally and spatially regulated. From zygote through globular stages of embryo development, labelled carbon accumulates in a bipolar manner in integumentary tissue opposite micropylar and chalazal poles of embryo sac. As zygote and endosperm subsequently divide, labelled carbon accumulates within young embryo and cellular endosperm. At heart-shaped embryo stage greatest accumulation of label still is at chalazal and micropylar ends of embryo sac, but it is no longer exclusive to these poles. ^{14}C is now abundant along interface between embryo sac and integuments indicating that this lateral region is also a site for carbon movement into embryo sac. AR evidence for carbon flow into embryo sac can be directly correlated with ultrastructural and morphological changes in ovular and endosperm tissues enclosing embryo.

31. Identification and characterization of a *Drosophila* lozenge allele.

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The *Drosophila* eye consists of 700-800 well-organized ommatidia. A fly with a disorganized ommatidia phenotype was isolated during a F₁ screen after treatment with the mutagen diepoxybutane. A line of flies carrying the mutation was analyzed using genetics and the scanning electron microscope (SEM). The mutant allele is recessive and it resides on the X chromosome. A search of the *Drosophila* literature suggested that the mutation was in the lozenge gene. Fly lines carrying described lozenge alleles were obtained from stock centers. Comparisons of the ommatidia using the SEM showed that the putative lozenge allele and the known alleles generate similar phenotypes. Complementation tests between the putative and known lozenge alleles prove that the mutation is in lozenge.

32. An investigation of the protein product and regulation of a *Drosophila* accessory gland gene.

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The nucleotide sequence of a gene expressed solely in the *Drosophila* accessory gland has been determined. The predicted polypeptide demonstrates characteristics that suggest a secretory protein and a gene bank search has been conducted. A ten base-pair consensus sequence found three times in the promoter region has been found upstream of accessory gland genes analyzed previously. Deletion analysis experiments are planned which will clarify whether or not this sequence is important in the transcriptional regulation of the gene.

33. A characterization of Anatid herpesvirus DNA J. C. JOHNSON AND R. GARDNER

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A plaque-purified isolate of the Holland strain of Anatid herpesvirus (AHV-ppc3) was propagated and purified by differential and buoyant density means. The virus was found to have a buoyant density of 1.215 g/cm³. AHV-ppc3 DNA was analyzed by sedimentation velocity in neutral or alkaline sucrose gradients. Based upon a comparison with T4 DNA, AHV-ppc3 DNA was found to have S = 59.7 and M_r of 1.19 x 10⁸d or about 10% larger than for Marek's disease DNA. In alkaline gradients, AHV-ppc3 DNA fragments with the largest of the most abundant species having S = 69 and M_r of 6.0 x 10⁷d. The buoyant density of AHV DNA in cesium chloride was 1.723 g/cm³ with a % G+C content of 64.3. This finding was supported by thermal melts of the DNA in SSC/10 in which the T_m was 82.7 C. The data support a model for AHV in which the viral duplex

DNA is linear, without covalently closed termini or significant base modifications, but with single strand nicks or gaps. The % G+C content of AHV DNA is the highest reported for any avian herpesvirus and further serves to categorize this virus into the group of avian viruses which are cytolytic, loosely cell-associated and non-tumorigenic.

34. Efferent projections of the rat area postrema examined using the PHA-L anterograde tracing method.

S.M. Cibula, A.M. Zardetto-Smith, A.K. Johnson and D. Erkenbrack

Biology Dept., Central College, Pella, IA 50219 and the Dept. of Psychology, Univ. of Iowa, Iowa City, IA 52242

The area postrema (AP) is a circumventricular organ within the brainstem that not only receives input from visceral receptors (such as those sensing blood pressure) but also has the potential for being sensitive to blood-borne circulating hormones important in fluid balance and cardiovascular control (e.g., angiotensin). In this study, the ascending projections of AP neurons were examined using the sensitive anterograde tracing technique *Phaseolus vulgaris* leucoagglutinin (PHA-L). Injections of PHA-L were placed within the AP of male Long-Evans rats (n=8). Brain sections were processed for visualization of PHA-L using avidinbiotin immunoperoxidase. In 4 cases, calcitonin gene related peptide (CGRP) and neurotensin (NT)-containing neurons within the brainstem were visualized using glucose-oxidase immunocytochemistry. In agreement with previous studies utilizing other tracing techniques, PHA-L fibers were not observed rostral to the parabrachial nucleus, indicating AP neurons do not project directly to forebrain autonomic nuclei. The lateral parabrachial nucleus (LPBN) received a moderately dense, topographically organized innervation from the AP. PHA-L labeled fibers and terminals (brown) were observed in close apposition to CGRP and NT neurons (blue) within particular LPBN subnuclei known to project to forebrain areas involved in fluid balance/cardiovascular regulation. Thus, CGRP and NT cells in the LPBN may be important in relaying afferent information from AP neurons to the forebrain.

35. Activation of serotonin 1-A (5-HT_{1A}) receptors by methoxy derivatives of aporphine

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Serotonergic and dopaminergic receptors are believed to be similar in structure, and thus to have agonists/antagonists of similar structure. Consequently, methoxy derivatives of aporphine were examined in biological systems in order to identify pharmacological properties of the derivatives on 5-HT_{1A} receptors.

The paramethoxy derivative of aporphine was found to be antagonistic to 5-HT_{1A} receptors because it both increased *in vivo* heart rate/blood pressure in the rat and inhibited 8-OH DPAT [(R)-8-hydroxy-2-(dipropylamino)tetralin], a known agonist to 5-HT_{1A} receptors. Also, 8-OH DPAT was inhibited in *in vitro* preparations of electrically stimulated guinea pig ilea. The monomethoxy derivative was similar to acetylcholine/methacholine in their effects on guinea pig ilea. Atropine, an inhibitor of acetylcholine/methacholine, inhibited the action of the monomethoxy derivative of aporphine also. Further characterization of 5-HT_{1A} agonists/antagonists is needed to fully understand the mechanisms of action of this important and widespread neurotransmitter.

36. Detection of cryptic peanut lectin receptors on embryonic chick tissues.

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Previous work from our laboratory has used fluorescent lectins to examine the distribution of sugars in various tissues of 40 hr chicken embryos. Almost all tissues were stained by wheat germ agglutinin (WGA), while a subset of tissues (somites and neural ectoderm) were stained by peanut lectin (PNA). Asparagus pea lectin was always negative. In this study, several enzymes were used to determine whether particular lectin receptors were absent or masked on the tissues not stained. Treatment of sections with neuraminidase to remove sialic acid never exposed fucose residues to asparagus pea lectin, but galactose moieties on additional tissues now were stained with PNA. The borders of most cells stained with alcin blue, suggesting that glycosaminoglycans (GAGs) might be the material stained by lectins. Experiments with keratanase to remove keratan sulfate GAGs also enhanced the staining of additional tissues by PNA, but reduced staining of somites and dorsal ectoderm with WGA. Thus, peanut lectin receptors appear to be masked by other sugars or glycosaminoglycans, rather than absent from several tissues of the chick embryo.

37. A semiotic study of serotonergic receptor at the molecular level

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A reductionistic approach to learning and memory offers that the key to understanding these mechanisms rests at the molecular levels of brain functioning. A more comprehensive approach suggests that there is a unity within the order of brain functions and that a theory of signs permeates such functions while maintaining the unity.

This paper will apply the sign theory of Charles S. Peirce (typically used in linguistics) to neurotransmitter activity (particularly serotonin) to theorize how information and meaning are processed between neurons.

38. The effects of lead on the enzyme glucose-6-phosphate dehydrogenase in cultured murine erythroleukemia cells.

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50219

The effect of lead poisoning on the pentose phosphate pathway was investigated in respect to the rate limiting enzyme Glucose-6-Phosphate Dehydrogenase (E.C.1.1.1.49) in the continuous cell line BB88 derived from a murine splenic tumor. Cells were grown for three days in culture media containing graded concentrations of lead (35-550 uM) and at confluency were harvested for enzyme extraction. Preparative starch gel electrophoresis and an enzymatic rate assay using fluorescence spectroscopy were

performed on fractionated extracts containing the cytosolic enzyme G-6-PDH in order to determine the cytosolic concentration and the catalytic activity in cells grown at the various lead concentrations.

Results indicated a somewhat surprising increase in enzyme activity in cultured cells grown in media containing 90 uM concentrations of lead which was followed by a rapid loss of activity above lead concentrations of 180 uM.

39. Cuticular wax biosynthesis in plants

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S. HEINEN¹, Y. XIA³, AND B. J. NIKOLAU²

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Cuticular waxes are a plant's first barrier to the environment, and therefore play an important role in survival. In addition, because these waxes have novel lipid compositions, this biosynthetic pathway is of interest in relation to the current effort to genetically engineering crops with altered lipid compositions. We are taking advantage of the unique features offered by maize (*Zea mays*) and *Arabidopsis thaliana* to clone and characterize the genes and gene products involved in this pathway. In maize, 17 loci are involved in cuticular wax biosynthesis. Four of these genes have been tagged with *Mu* transposons. We are currently cloning these genes using the cloned *Mu* sequences as molecular probes. In *Arabidopsis*, the *cer* mutants elaborate altered cuticular waxes. We are in the process of isolating one of these genes, *cer2*, via chromosome walking. Ultimately, the complementary findings from maize and *Arabidopsis* will expand our understanding of the biochemical mechanisms involved in the synthesis of these unique and biologically significant lipids.

40. Comparison of QTL for Plant Height Between
Selfed and Random Mated Populations of Maize

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M. Lee

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Johnston, IA 50131 and Department of Agronomy,
Iowa State University, Ames, IA 50010

Quantitative Trait Loci (QTL) for plant height were identified in two related populations of maize. One, termed SYN0, was composed of 100 F2-derived F3 families from the cross B73 x Mo17. The second, termed SYN5, was composed of 100 families derived from the same original cross. The SYN5 families were made by random mating 250 plants for 5 generations, bulking the resultant seed and choosing 100 seed for the next generation of random mating. This process was repeated 5 times followed by a selfing step. Several unexpected results were obtained. A few regions of the RFLP map showed little expansion during the random mating generations, although most of the genome behaved as expected. QTL identified in the SYN5 included both ones seen in the SYN0 as well as new ones. In addition, some QTL identified in the SYN0 were not seen in the SYN5.

41. **Phase-Synchronization of Random Motion
Through Off-Resonant rf Excitation**

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Ion detection in Fourier transform ion cyclotron resonance is dependant upon the ability to create a coherent packet of ions from an initially random group of ions. Creation of a "coherent" ion packet prior to ion detection is achieved in FT-ICR through ion acceleration with a linearly polarized alternating electric field. Until recently, only the impact of resonant frequencies on energy gain and coherence were considered. Computer simulations using the program SIMION indicates that phase synchronization and energy gain can both be done using non-resonant excitation. Different excitation techniques were studied and the impact of the non-resonant excitation on spatial distribution of the ions at maximum coherence was examined. The theoretical basis for a new excitation technique designed to obtain better resolution for high mass molecules was developed.

42. Determination of sulfur forms in coal by ASTM procedures

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Alternate ASTM procedures for determining pyritic sulfatic, and total sulfur in two geographically diverse coals were studied to determine whether the alternate procedures give comparable results. For one coal, variations in the procedure for dissolving pyrite (FeS_2) did not significantly affect pyritic sulfur values. However, for the other coal, procedural variations may have had a slight effect on the pyritic sulfur results.

Total sulfur values obtained by two separate ASTM procedures were slightly different for both coals. Since organic sulfur is calculated as the difference between the total sulfur and the sum of the pyritic and sulfatic sulfur, the slight discrepancy in the total sulfur resulted in a slight discrepancy in the organic sulfur values. However, because of factors such as coal inhomogeneity and particle size, as well as inherent experimental and analytical errors, the magnitude of the discrepancies may not be statistically significant.

43. **Conformational Studies of Biomolecules
Using 2-Dimensional Time-Of-Flight Mass
Spectrometry**

C. L. JUST, A. PANEC, R. SINES, C. D. HANSON

Department of Chemistry, University of
Northern Iowa, Cedar Falls, IA

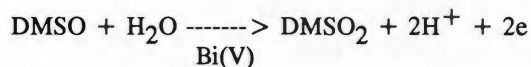
Time of flight (TOF) mass spectrometry has been demonstrated to have enormous potential for high mass analysis with extremely high sensitivity. However, the inability to provide linked scans or daughter spectra limits its utility for biomolecule analysis. Although kinetic energy focusing with a reflectron permits the observation of metastable fragments (daughter ions), such information is only structurally significant when correlated with the parent ion. Use of a ion repeller as a broad band kinetic energy analyzer permits a ms/ms correlation experiment to be achieved with high sensitivity. A 2-D time of flight experiment permits parent-daughter correlation while maintaining both the sensitivity and mass range required for biomolecule analysis.

44. The quartz crystal microbalance: a tool for electrochemists

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The Electrochemical Quartz Crystal Microbalance (EQCM) has been proven to be a useful probe of the electrode/solution interface. As such, it is being used to study the electrodeposition process of lead dioxide films and the catalytic properties of these films doped with various metallic and anionic species. To demonstrate the utility of the EQCM, the work presented will concentrate on two topics (1) the formation of oxygen-deficient oxides formed early in the deposition process and (2) the interaction of the catalysts and analytes in anodic oxygen-transfer reactions at these electrodes. The model reaction for this work,



Other electrochemical processes and current applications of the EQCM also will be discussed.

45. Biochemical applications of High Performance Liquid Chromatography with Pulsed Electrochemical Detection (HPLC-PED).

W. R. LaCOURSE and D. C. JOHNSON

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Anodic electrocatalytic reaction mechanisms are observed at noble metal electrodes with the application of potential-

time waveforms. These waveforms combine amperometric detection with alternated anodic and cathodic polarizations, which maintain uniform electrode activity. PED exploits this phenomenon to detect polar aliphatic organic compounds, which have little or no chromophore, fluorophore, and/or constant applied potential electrophore. HPLC-PED has been applied to the direct, sensitive, and reproducible detection of alcohols, carbohydrates, oligosaccharides, alkanolamines, amino acids, and a variety of sulfur compounds.

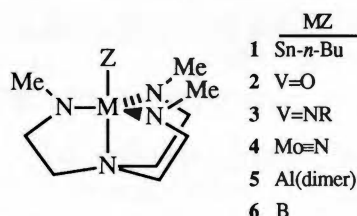
Biochemical applications will be used to highlight a discussion of the theory and operation of PED.

46. Synthetic routes to azametallatranes

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Metal amides have drawn considerable interest as potential CVD precursors to metal nitride films. Here we report the synthesis of azametallatranes, **1-5**, the first five-coordinate tricyclic members of the metal amide class. Whereas **1, 5** and **6** are formed in transamination reactions, this approach fails for **2-4**.



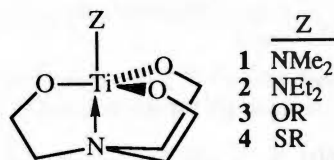
However, **2-4** are synthesized in novel transmetalation reactions using **1** as a reagent. Compounds **1-5** possess a five-coordinate metal structure which **5** achieves via dimerization. Such dimerization can be prevented by utilizing bulky Me₃Si groups instead of Me groups. Compound **6** contains four-coordinate boron.

47. Titanatranes: structures and reactivities

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Titanatranes **1** and **2** react cleanly with a variety of alcohols and thiols to give compounds of type **3** and **4**



in high yields. Interestingly, **2** reacts faster than **1** with these reagents even though **2** contains the more bulky leaving group. Evidence will be presented for an initial protonation step in the reaction pathway,

followed by nucleophilic displacement. In the solid state, **1** is dimeric as shown by X-ray crystallography. Titanatranes in solution, however, display more complicated behavior as shown by VT NMR spectroscopy and by molecular weight measurements.

48. Removal of Vanadium, Nickel, and Sulfur from Orinoco Basin bitumen

S. SCHMITT, S. S. AKHTAR, AND C. D. CHRISWELL

Ames Laboratory, Iowa State University, 111 Metals Development Building, Ames, IA. 50011

The reserves of bitumen from the Orinoco Basin of Venezuela constitute the largest single source of hydrocarbons in the world. They are greater than the conventional petroleum reserves of Saudi Arabia. Despite the abundance of this resource in a politically stable area, it remains essentially unexploited.

A major impediment to the use of bitumen is that it contains relatively high concentrations of S, V, and Ni. V and Ni are present in bitumen in the form of porphyrin complexes. These metals both poison refining catalysts used during cracking and desulfurization.

In the present work, separate attempts were made to remove V and Ni from bitumen by leaching with hydrogen peroxide, sulfuric acid, perchloric acid, phosphoric acid, and molten sodium hydroxide. Of these, only leaching with phosphoric acid appeared to yield significant reductions in levels of V and Ni. Based upon semi-quantitative XRF analysis, leaching with phosphoric acid for 30 minutes at 100°C appeared to lead to reductions of 100% in Ni, 70% in V and 80% in S.

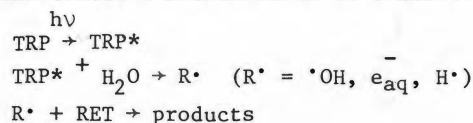
49. UV-induced photodegradation of bacteriorhodopsin

J.E. HAFEMEISTER, J.T. KOFRON, and M.B. MASTHAY

Department of Chemistry, Drake University Des Moines, IA 50311

Bacteriorhodopsin (bR) is a photoactivated energy-transducing protein from *Halobacterium halobium* which is widely used as a model visual pigment due to its structural similarity to the human visual pigment rhodopsin.

Recent findings in our laboratory indicate that the retinal chromophore (RET) of bR is photostable under visible actinic illumination but that it rapidly degrades ($\tau_{1/2} = 35$ min) when tryptophan residues (TRP) in the protein backbone are photo-excited with the 254 nm line from a 100 W Hg lamp. One possible reaction mechanism is as follows:



A variety of other possible mechanisms as well as their potential relationship to the age-related deterioration of human vision will be discussed.

50. Longer incubation periods needed to obtain stable calculated total cholesterol values with Sigma Procedure No. 352

F.W. KOLKHORST AND I.M. SIMET

School of HPELS, University of Northern Iowa, Cedar Falls, IA 50614

Sigma Procedure No. 352 (Sigma Chemical Co., St. Louis, MO) for determination of total plasma or serum cholesterol (TC) prescribes an incubation period of 10 min at 25-30°C after mixing the sample and reagent; absorbance readings are to be completed within 30 min following incubation. Plasma from six subjects was prepared in duplicate according to Sigma procedures. Following mixing, each cuvet was allowed to stand at 26-28°C, with absorbances read every 15 min for 195 min. Each sample, control, or calibrator reached a peak absorbance between 150 and 180 min after mixing, suggesting that the reactions were not complete within the recommended measurement period. Also, TC values calculated from these absorbances were stable only after 30-45 min. These results may be explained by low peroxidase content and/or lack of solubilizing agent in the Sigma reagent.

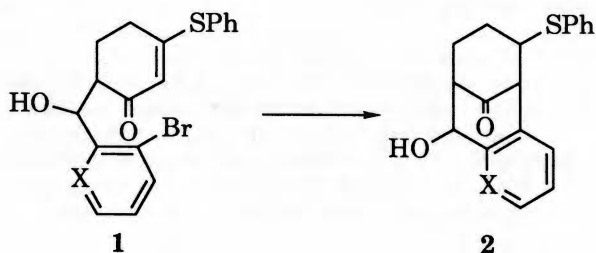
ORGANIC AND BIOLOGICAL CHEMISTRY

51. A Direct Approach to Huperzine A

D. VINES AND G. A. KRAUS

Department of Chemistry, Iowa State University, Ames, IA 50011

Huperzine A has become a promising lead for the control of Alzheimer's disease. We have developed a route based on the intramolecular cyclization of an aryl bromide. The synthesis of sulfide **1** and reactions designed to permit cyclization to **2** will be discussed.



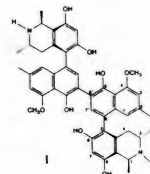
52. NOVEL alkaloids from the tropical plant Ancistrocladus abbreviatus

K.P. MANFREDI, M.R. BOYD, J.W. BLUNT AND J.B. MCMAHON

Department of Chemistry, University of Northern Iowa, Cedar Falls, Iowa 50614-0423

In a recent publication the National Cancer Institute (NCI) reported the isolation and characterization of dimeric naphthelene-tetrahydro isoquinoline alkaloids **1** from basic extracts of the tropical plant Ancistrocladus abbreviatus. These unique compounds have been shown to inhibit cell killing by HIV-I and HIV-II and are currently in pre-clinical development.

Details on the isolation, structure elucidation and biological activity will be presented. The isolation of a number of novel inactive monomeric compounds will be discussed.



53. Characterization of a chromium pyrophosphate series with an ion exchange column

W.A. EDENS, D.C. SPECKHARD AND W.W. CLELAND

Department of Chemistry, Loras College, Dubuque, Iowa 52001, USA

Enzyme catalyzed hydrolysis of the polyphosphate moiety of ATP accompanied by the liberation of energy plays a key role in the energy metabolism of biological systems. Enzymes which catalyze phosphate hydrolysis typically require at least one metal ion for activity. Magnesium is one of the most common of these metal ion activators. While the various coordination isomers of Mg ATP undergo rapid interconversion, trivalent chromium forms inert complexes thus providing sufficient stability for separation, characterization, and in some cases crystallization of the complexes.

This research deals with ten related Chromium pyrophosphate coordination complexes, $[\text{Cr}(\text{H}_2\text{O})_n(\text{NH}_3)_{4-n}\text{H}_2\text{P}_2\text{O}_7]^+$ as n goes from 4 to 0, which are models for the corresponding metal-nucleotide complexes. Chromium pyrophosphate complexes, exhibit octahedral coordination with two sites occupied by the pyrophosphate and the ammonia and water ligands occupying the remaining coordination sites. The separation and characterization of these compounds with the use of a Mono "S" HR 16/10 Pharmacia ion exchange FPLC column will be discussed.

54. **N⁶-Cyclosubstituted C-2 functionalized adenosines: Highly selective agonists for the adenosine A₁ receptor.**

V. NAIR* AND A. J. FASBENDER

Department of Chemistry, The University of Iowa, Iowa City, Iowa 52242

A number of recent studies have revealed that the biological activities of adenosine may be mediated through the involvement of extracellular purinergic receptors, termed A₁ and A₂, which appear to be distributed in a wide variety of

tissues in the human system. There is considerable interest in the development of adenosine analogs and derivatives that mimic the pharmacological properties of adenosine but with much higher A_1 receptor specificity and with resistance toward rapid metabolic degradation. This paper will report on the synthesis of novel, stable adenosine analogs with potent A_1 agonist activity and high A_2/A_1 receptor selectivity. Details of representative syntheses and relevant spectroscopic information will be presented. Agonist activity data for selected compounds will be reported. Structure-activity correlations will be discussed.

55. Synthesis of a contiguous tricyclic purine system: Entry to unique nucleosides.

V. NAIR* AND D. E. PURDY

Department of Chemistry, The University of Iowa
Iowa City, Iowa 52242

In the search for new antiviral compounds, there has been considerable effort extended towards the design and synthesis of hypermodified nucleosides that are unique analogues of their natural counterparts. While many biologically interesting acyclic and carbocyclic purine nucleoside systems as well as base-extended nucleosides have been reported, there is little known about hypermodified nucleosides where the carbohydrate moiety is fused in a contiguous arrangement with the purine base. This communication reports on the design and synthesis of such unique nucleosides. Entry to these molecular systems and their derivatives are of interest, not only in terms of their potential for antiviral activity, but also as structurally defined biological probes for specific mammalian or viral enzyme-catalyzed reactions.

56. The roles of AMPS lyase and AMP deaminase in the antiviral activity of dideoxyinosine.

V. NAIR* AND T. B. SELLS

Department of Chemistry, The University of Iowa
Iowa City, Iowa 52242.

Since the initial findings of the anti-HIV activity of 2',3'-dideoxyinosine (ddI), a number of studies have focused attention on the metabolic pathway for the conversion of ddI to its antivirally active cellular derivative, 2',3'-dideoxyadenosine 5'-triphosphate (ddATP). Although a few of the steps for the conversion of ddI to ddATP have been the subject of study, little is known about the behavior of a key enzyme in this pathway, adenylosuccinate lyase (AMPS lyase), towards antivirally important dideoxynucleotides. This paper will report on the synthesis of selected 2',3'-dideoxynucleotides and their enzymology with AMPS lyase. As ddAMP and derivatives produced by the action of AMPS lyase may be hydrolytically deaminated by adenylic acid deaminase (AMP deaminase), results on the behavior of this catabolic enzyme towards selected dideoxynucleotides will also be presented.

57. Inhibition of copper and iron induced oxidation of human low density lipoprotein by ketoconazole.

G.B. MEYER, AND R.C. SEXTON

College of Pharmacy, Drake University
Des Moines, IA 50311

Human low density lipoprotein (h-LDL), which is oxidatively modified by cells in the arterial wall, may be atherogenic. The oxidative process is initiated through a free radical attack on the unsaturated fatty acids esterified to LDL phospholipids and cholesterol. Both copper and iron are known to initiate free radical oxidation of

LDL which can be monitored by determining increases in fatty acid diene formation as measured by their absorbance at 234 nm. In the present study, pro- and antioxidant conditions for CuSO_4 and FeCl_3 catalyzed oxidation of h-LDL (160 μg protein/ml) in different buffers were examined. Metal ion at 5 μM induced oxidation best at pH 7.4 in 50 mM buffers of Tris-saline > Phosphate-saline >> Bis-Tris Propane. Treatment of Tris-saline buffer with Chelex 100, a metal binding resin, reduced autooxidation of h-LDL. In Chelex treated Tris-saline buffer, the lag phase of LDL oxidation induced by added metal ions (5 μM) was significantly increased by the addition of ketoconazole (20 μM) demonstrating a new antioxidant property for this drug.

58. Effect of ketoconazole on the oxidation of human low density lipoprotein (LDL) and linoleic acid solution by soy bean 15-lipoxygenase.

M.A. JACOBY AND R.C. SEXTON

College of Pharmacy, Drake University
Des Moines, IA 50311

Lipid peroxidation of human low density lipoprotein (160 μg protein/ml) was catalyzed by purified soy bean 15-lipoxygenase (SLO, 10^4 units/ml) in chelexed treated 50 mM Tris-buffered saline, pH 7.4. LDL oxidation was monitored as a change in diene absorbance at 234 nm, over a 2-6h period at 37°C. Ketoconazole (KC) added to the buffer inhibited SLO mediated oxidation of LDL in a concentration dependent fashion. Maximum inhibition (75%) occurred at 25 μM KC. LDL oxidation by SLO was also inhibited 100% by pre-treatment of LDL with 100 mM KC followed by dialysis to remove unbound KC. Oxidation of linoleic acid (357 μM) was catalyzed by SLO (166 units/ml) at 25°C in 0.2 M borate buffer, pH 9. The change in A234 nm/min due to 30 μM of the following drugs was examined: KC, nordihydroguaiaretic acid (NDGA), U18666A, AY9944, miconazole, and triarimol. Only NDGA and triarimol inhibited (30%) linoleic acid oxidation by SLO. Thus, inhibition of LDL oxidation by KC may be due to a stabilization of the LDL phospholipid shell rather than by inhibiting SLO activity. Inhibition of linoleic acid oxidation by triarimol will be discussed.

59. Effect of ketoconazole on the oxidation of human LDL by bovine aortic smooth muscle (BASM) cells.

E.C. ZENTRICH AND R.C. SEXTON

College of Pharmacy, Drake University
Des Moines, IA 50311

BASM cells in culture have been shown to oxidatively modify human low density lipoprotein (LDL). Such oxidized LDL appears to be a significant factor in the etiology of atherosclerosis. This work shows that the azole antifungal drug ketoconazole when added to the culture medium of BASM cells inhibits LDL oxidation. BASM cells were grown to confluency in 60 mm dishes in F-12/DMEM medium supplemented with 5% fetal calf serum. On day 5, the cells were fed 1 ml F-12/DMEM containing LDL (320 μg protein). The cells over a 24h period caused a 2x increase in LDL oxidation as measured by an increase in thiobarbituric acid reactive substances (TABARS). Copper at 5 μM enhanced by 2x the oxidation of LDL by BASM cells.

Addition of ketoconazole to the cell medium caused a concentration dependant inhibition of LDL oxidation by BASM cells. Maximum inhibition of LDL oxidation was achieved at 20 μ M, but was also observed to be slightly toxic to BASM cells as measured by a decrease in protein content per dish.

60. Oxidation of human low density lipoprotein (LDL) by rabbit and bovine aortic endothelial cells and its inhibition by ketoconazole.

C.J. HERTZ, AND R.C. SEXTON

College of Pharmacy, Drake University
Des Moines, IA 50311

Rabbit aortic endothelial (RAE) cells are known to oxidize LDL. Oxidized LDL may contribute to the formation of atherosclerosis. The focus of this work was to demonstrate that bovine aortic endothelial (BAE) cells are also capable of oxidizing LDL and to examine the effects of ketoconazole (KC), an inhibitor of cytochrome P-450 dependent monooxygenases, on cell mediated oxidation of LDL. Confluent cells in 60 mm dishes were incubated for 24-48 hours in medium containing LDL (300 μ g protein/ml). Two BAE cell lines were found capable of oxidizing LDL, as evidenced by an increase in TBAR values and relative electrophoretic mobility of medium LDL. The oxidation of LDL by RAE cells was inhibited by 5 μ M KC in the medium. Pretreatment of RAE cells with KC (20-60 μ M) failed to prevent cell oxidation of LDL. Pretreatment of LDL with 100 μ M KC completely prevented RAE cell mediated oxidation of LDL. These results indicate KC may stabilize the phospholipid shell of LDL against cell mediated lipid peroxidation.

61. Separation & Characterization of New Peroxidase from Tobacco Pith.

J. EGGERS, M. ALLISON, T. SCHUMACHER, T. DAY, L. FREKKING, J. DUNN, L. HASENWINKEL, P. SINGER, AND R. WARNET

Departments of Biology and Chemistry,
Simpson College, 701 North C St., Indianola, IA 50125

The separation and characterization of a series of apparently new peroxidases will be discussed. These peroxidase, isolated from tobacco pith catalyze phenolic coupling reactions, require H_2O_2 , but they are not detectable by standard colorimetric peroxidase assays and in some cases, they lack the soret band (absorbance at 420 nm) which is characteristic of conventional peroxidases. Evidence will be presented which show that these new peroxidase are substrate specific and may be stereospecific.

CONSERVATION

62. The role of biological and economic science in the Endangered Species Act (ESA)

M.C. BACH

Office of Policy Analysis, U.S. Department of the Interior,
Washington, D.C. 20240

The Endangered Species Act of 1973 strengthened provisions of previous legislation of 1966. The ESA established categories of "threatened" and "endangered" species and for the first time included plants and all classes of invertebrates. In the eighteen sections, the role of biological "science" has various functions; it is critical to the listing process, it forms the basis of habitat designation and is fundamental to the preparation of recovery plans for conservation and survival of endangered and threatened species. The Act was amended in 1978, 1982, and 1988 and will be considered again 1992. The 1978 amendment allowed Federal agencies to undertake an action that would jeopardize listed species, if it were exempted by a special cabinet-level committee. Essentially, the process provides that after the biological issues have been considered through consultation, applicants may seek an exemption based on economic reasons. There have been six applications for exemption. A September 1991 Bureau of Land Management filing for an exemption from section 7 of the ESA would permit timber sales on 44 tracts remaining in its 1991 sales program in Oregon. This recent incident illustrates the relative roles of these two fields of science, noting upcoming discussions on possible effect on reauthorization of the Act.

63. DeSoto NWR demonstration and education project

M. BUSKE, T. ROOT, G. GUGE, G. GAGE, C. THOMPSON

Extension Area Crop Production Spec., S.W. Area Extension Center, POB 460, Atlantic, IA 50022

ISUE and USFWS recently completed a four-year study of low-input crop production practices at DeSoto NWR. A key objective was to monitor ground and surface water for pesticides and nitrates within the refuge. Nitrate concentrations in soil pore water and shallow groundwater were compared between low-input and conventionally managed crop rotations. Groundwater nitrate averaged less than 1 mg/L under both crop rotations. However, soil pore water nitrate was considerably higher, with the conventional rotation significantly greater than the low-input rotation. Alachlor, atrazine, bentazon, cyanazine, EPTC, metolachlor, metribuzin, and trifluralin were detected in DeSoto Lake, groundwater and/or drainages emptying into the lake. Groundwater detections were infrequent, with atrazine and cyanazine the most common. Concentrations were >1 μ g/L. All herbicides detected, except EPTC and trifluralin, are not used on refuge cropland. Detections and concentrations in drainages were highest following rainfall events. Atrazine and cyanazine were detected in lake water samples throughout the year. Atrazine periodically exceeded the aquatic population advisory level.

M.C. Bach

Office of Policy Analysis, U.S. Department of the Interior, Washington, D.C. 20240

The Intergovernmental Negotiating Committee for a Convention on Biological Diversity of the United Nations Environment Programme (UNEP) has recently completed its third session of negotiating. It is the objective of the convention to conserve the maximum possible biological diversity for the benefit of future generations and for its intrinsic values. Included in the discussions, thus far, are provisions for fair and equitable sharing of the benefits of biotechnology research as it relates to the overall gene pool potentially conserved through the intent of the convention. Noting that, according to the views of some countries, existing international arrangements do not cover all aspects of biological resources, the speaker will discuss and contrast previous international agreements with the proposed convention and its impact on U.S. activities.

65. Atrazine degradation in Roberts Creek, Clayton County, Iowa

D. W. KOLPIN, AND S.J. KALKHOFF

U.S. Geological Survey - Water Resources Division
400 South Clinton Street
Iowa City, Iowa 52244

A water-quality study was conducted during the 1990 growing season through about an 11-kilometer reach of Roberts Creek, a small stream in northeastern Iowa, to determine the fate of atrazine in a surface-water environment. The entire reach under investigation has no surface-water or ground-water contributions to streamflow which leads to a simplified mass balance for chemical constituents in this segment of the stream. Time of travel was determined in the study reach by conducting two dye-tracing tests at medium- and low-flows to establish the sample collection strategy on a Lagrangian model of stream flow. A parcel of water was tracked through the study reach by using the time of travel results to compute collection time at each of the sampling sites. Water samples were collected during base-flow conditions about monthly within the study reach and analyzed for atrazine and its two biotic degradation products, desethylatrazine and deisopropylatrazine. Atrazine concentrations substantially decreased (24 to 60 percent) in concentration downstream through the study reach during four of the seven sampling periods collected from April through November. During these same four sampling periods, the concentrations of the two biotic atrazine degradation products were constant or decreasing downstream. Three lines of evidence suggest that abiotic degradation, in the form of photolysis, may be the driving process degrading atrazine in this type of environment. First, the decrease of atrazine concentrations do not correspond to an increase in the concentrations of the biotic atrazine degradation products. Second, atrazine degradation, as indicated by the half-life, had no significant correlation with stream water temperature, an indirect measurement of biotic activity. Third, atrazine half-life had a significant negative correlation with the daylight length, an indirect measurement of photolytic activity.

66. Management Systems Evaluation Area:
A Midwest Water Quality Initiative

S.L. OBERLE

214 National Soil Tilth Lab, Iowa State University, Ames, IA 50011

The Midwest is one of the most extensive agricultural areas in the country, producing about two-thirds of all U.S. corn and soybeans. While the development of commercial fertilizers and pesticides has led to substantial increases in corn and soybean productivity in the region, over-application and improper management of these agrichemicals has increasingly resulted in negative environmental impacts, particularly nitrate and pesticide contamination of surface and ground water.

The Management Systems Evaluation Area (MSEA) project was launched in 1990 as one element of the President's Water Quality Initiative. Research and extension programming is jointly administered and conducted by the U.S. Department of Agriculture, the U.S. Environmental Protection Agency, and the U.S. Geological Survey. Five states including Iowa, Minnesota, Missouri, Nebraska, and Ohio were selected as centers for MSEA research and extension programming.

My overall intent is to outline the general objectives of the MSEA project, and to give a broad overview of MSEA research and education activities to date.

67. The effect of simulated herbivory on cottonwood and subsequent herbivore preference

S. J. KELLER and S. J. Stein

Department of Biology, Central College, Pella, IA 50219

Herbivores may often play an important role in plant growth and reproduction. We attempted to identify whether herbivores prefer previously browsed or unbrowsed cottonwoods (*Populus nigra*). We also compared two different initial growth methods of cottonwoods and determined which was preferred by herbivores. Cuttings were propagated individually in .8 L containers in the first method and groups of 10 cuttings were propagated in 11.4 L containers in the second method. All plants were transplanted 24 days later to individual 11.4 L containers. Herbivory was simulated by clipping the ends of shoots. The growth of individually propagated plants was slightly greater than the growth of plants propagated in groups. Herbivores showed a slight preference for plants propagated in groups over plants propagated individually. Herbivores strongly preferred cottonwoods that were previously experimentally browsed over unbrowsed plants. Forty-nine percent of the leaves of experimental plants were damaged compared to only 29 percent in the control plants. This research suggests that previous herbivory on plants may be a significant factor predicting future herbivore attack. This may amplify the impact of herbivores on the dynamics of certain plant populations and on community development.

68. Growth and survival of browsed forest tree seedlings

K. T. DeLONG

Department of Biology, Grinnell College, Grinnell, Iowa 50112

Seedlings of eight species of trees in a mature forest dominated by white oak were examined for two years both inside and outside deer-proof exclosures to determine if browsing differentially affects the growth and survival of seedlings.

White oak was not preferentially browsed but the survival of browsed white oak seedlings was significantly lower than that of browsed seedlings of other species, and significantly lower than the survival of unbrowsed white oak seedlings.

69. The effects of color and inflorescence on butterfly pollination and subsequent seed set

L. A. SPENCER and S. J. STEIN

Department of Biology, Central College, Pella, IA 50219

Plants and pollinators have been involved in extensive coevolution since the radiation of the early angiosperms. Today, cross pollination by insects is necessary for the reproduction of many plant species. In this study we investigated the effects of flower color and inflorescence on pollination by butterflies. Nine flower beds were cultivated with 17 different species of annual flowering plants in the summer of 1991. We recorded butterfly visitations to 6 colors of flowers spread through the visible spectrum and to the flowers of 7 different plant species. Thirty percent of butterfly visits were to pink flowers. Both ends of the spectrum, violet and red, received only 3.9 and 2 percent of the visitations respectively. Flowers with a flat corolla were visited more than those with long floral tubes. We also compared the percent of visitations to each flower to the number of viable seeds produced. Light pink zinnias were visited twice as often as two darker shades of pink zinnias, but the number of viable seeds produced did not differ. Visitation was greater to pink than to orange zinnias, but the number of viable seeds produced in pink zinnias was only half as many as in orange zinnias. Hesperids selected yellow and orange flowers more than any other color, and Pierids selected blue and pink flowers most often.

70. Applications of a Geographic Information System (GIS) to the study of populations of rare prairie butterflies

G. L. SELBY and D.C. Glenn-Lewin

Dept. of Botany, Iowa State Univ., Ames, IA 50011

A four-year study of rare prairie butterflies was conducted at Prairie Coteau in Pipestone County, Minnesota. Distributional data for butterflies, plant community data, nectar plant abundance data, and management data were collected at a 10 m² scale along transects. These data were analyzed in relation to each other and to data from soils maps, topographic maps, and infrared aerial photos using a Geographic Information System (GIS).

The primary factors influencing the spatial distribution of each butterfly species were examined, and these data were used to predict the distribution patterns of the butterflies throughout the site. The effects of prescribed burning were also examined by comparing population data for similar quadrats in burned and unburned survey units.

This study demonstrates the utility of a GIS for studying butterfly populations, identifying and evaluating potential sites, and setting up appropriate management units based on the predicted distribution of the butterflies within the sites.

71. Distributional status of the plains pocket mouse, *Perognathus flavescens*, in Iowa

J.B. BOWLES, G.M. WILSON, J.W. VAN ZEE

Dept. of Biology, Central College, Pella, IA 50219
Dept. of Biology, Fort Hays State Univ., Hays, KS 67601
Dept. of Biology, New Mexico State Univ., Las Cruces, NM 88003

The plains pocket mouse, *Perognathus flavescens*, was first reported from Greene County, Iowa in 1914. By the late 1960's, individuals had been taken in several counties as far east as Linn County. Due primarily to paucity of records, the plains pocket

mouse was placed on the state endangered list in 1977. Since the 1960's, this species has been reported only from scattered sites in the loess hills of western Iowa (Harrison, Monona, and Plymouth counties) and from single locations in central and eastern counties (Benton and Louisa, respectively). More data on the biology of the plains pocket mouse in Iowa needs to be collected from these extant populations.

Poster

72. Soluble Organics and Available Nitrogen in Paired Prairie and Cultivated Soils

T.H. DELUCA AND D.R. KEENEY

Department of Agronomy and Leopold Center for Sustainable Agriculture, Iowa State University, 126 Soil Tilth Building, Ames, IA 50011.

The internal nitrogen (N) cycle in soils of native and established prairie is highly conservative of N. Prairie soils were thus studied as an ideal system in paired comparison with cultivated soils to determine the effect of farming on soluble organic matter in soil as it relates to available N.

Soils collected from 11 adjacent prairie and cultivated sites were analyzed for K₂SO₄-soluble C and carbohydrate, KCl-soluble amino-N, NH₄⁺, and NO₃⁻, total C and N, and microbial biomass.

Prairie soils were consistently higher in all parameters except soluble C and inorganic N. Soluble C was inconsistent between sites. Cultivated soils accumulate NO₃⁻ in excess of extractable NH₄⁺ and appear to lack sufficient available C to immobilize inorganic N. This condition may represent a perturbed internal N cycle.

ELEMENTARY SCIENCE TEACHING

73. Environmentalistics - integration of environmental education into all aspects of curriculum and school/classroom environment.

M. L. NORTON

This presentation includes literature, music, and environmental education reference integration: A REAP funded video and accompanying guide supporting "environmentalistics" through knowledge of relative habitats and issues will be shared that has just been produced by Mary and Jay Norton.

74. Abstract Not Available.

75. The Newspaper - Play It Again Sam

M. I. LYDA AND C. S. TOMPKINS

Longfellow Elementary, 233 Edwards Street,
Waterloo, IA 50703

Classroom activities incorporating the use of
newspapers. Make and take for participants.

76. Abstract Not Available

77. Long-duration space travel with 25 eleven-year
olds: Are we there yet, teacher?

M. SADEGHPOUR

Lincoln Elementary School, Mechanicsville, Ia 52306

Based on a two-week workshop attended on-site at
Johnson Space Center in Houston, an STS module was
developed for upper elementary students. It
utilizes student ownership for self-motivated,
self-directed learning about space travel. Student
questions lead into such interest areas as reasons
for needing or wanting to make such trips, the
mechanics, physics, and history of rocketry, the
solar system and beyond through which the 5th grade
"space cadets" pass, and the enclosed life-support
systems for long-duration space travel and for
extra-terrestrial living. Important parallels are
drawn between the closed systems of Space Station
Lincoln and Planet Earth. NASA provides extensive
resources for teachers and students, and hands-on
activities range from mosquito rockets to a life-
size model of the space shuttle flight deck, and
finally, student planned and constructed models of
permanent "other-planetary" stations.

78. Scientific investigations using practical
problems

DOWNS, G. E. AND FOGLE, D.

Curriculum and Instruction Department, Iowa State
University, N131E Lagomarcino Hall, Ames, IA 50011

Scientific investigations using practical problems
in the life and physical science areas will be
addressed. In the life science area scientific
type problems dealing with plants will be the
major focus, and in the physical science area
scientific type problems dealing with motion will
be the major focus. Hands-on activities using a
"process" approach will be used to address the
science content and problem solving tasks
performed.

79. Changing pre-service preparation for
elementary science teachers

C. A. LEE

Biology Department, University of Northern Iowa,
Cedar Falls, IA 50614-0421

Now in its fourth year, the Preparation of
Elementary Mathematics and Science Teacher (PEMST)
project has experience in changing the teacher
education programs for elementary mathematics and
science teachers. Content courses in both science
and mathematics have been tailored to the needs of
elementary classes. Special pedagogical foci
are problem solving and manipulatives in mathemat-
ics and the learning cycle and activity-based
courses in science.

Student teaching experiences have been made
stronger through special training of cooperating
teachers. Special support is being developed for
the induction years, the first two years of
teaching.

Preliminary evaluations indicate successful course
development and cooperating teacher training. It
is hoped that the market for elementary teachers
with such strengths in mathematics and science
will increase.

ENGINEERING

80. Finite analytic numerical simulation of two-
dimensional sea breeze on a regular grid

R. A. Bernatz

Department of Mathematics
Luther College
Decorah, IA 52101-1045

The sea breeze circulation is a natural convection
flow created by a surface temperature difference
between land and sea. The transient circulation of
the sea breeze is modeled by the unsteady,
turbulent, two-dimensional, ensemble-averaged
Navier-Stokes and energy equations. Turbulent
Reynolds stresses are given by a $k-\epsilon$ model. The
finite analytic (FA) method is used to numerically
integrate the governing equations on a
non-staggered (regular) grid using the momentum
weighted interpolation method (MWIM). The
simulated flow results show good agreement with
many characteristics found in observational data.

81. Visualization of Topology of Separated
Flow Over a Semi-Elliptic Wing at Incidence
Intersecting a Plane Wall

T. A. Johnson and V. C. Patel

Iowa Institute of Hydraulic Research
The University of Iowa, Iowa City, Iowa 52242

Three flow-visualization techniques, surface
oil flow, dye injection, and the smoke wire
method, are applied to study the flow around a
12:6:1 semi-ellipsoid wing intersecting a
plane wall. The results are used to describe
the surface shear-stress patterns on the wing

and wall in terms of their topological structure. This is done for two chord Reynolds numbers, 2.5×10^5 and 7.5×10^5 , with a wall Reynolds number three times that of the chord. The angle of attack of the wing is varied from 0° to 25° . Based on the occurrence of two major bifurcations around 10° and 20° this range is divided into four categories: symmetry, low, intermediate, and high incidences. The topology of each range is presented in detail and the evolution of the primary separation lines are traced. A wide variety of flow phenomena, including both open and closed separations, are seen to occur. The results indicate high sensitivity of the separation pattern and type to small changes in geometry.

82. Fuel-jet effects on flame flicker frequencies

K.-T. PAHNG AND L.-D. CHEN

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The flame flicker frequency of methane and propane jet diffusion flames was measured. The experiments involved with a vertical fuel tube, surrounded by coflowing, low-velocity annular air. The flicker frequency was determined by a laser deflection technique. In general, single predominant flicker frequencies are measured. The flicker frequency is typically in the range 10 to 20 Hz. Unlike that the flame flicker frequency was considered to be independent of the fuel jet velocity in the literature, the present work shows that the flicker frequency can be substantially varied by the fuel jet velocity. This condition only occurs at annular air being maintained near the transition conditions. At transition, a sharp (or discontinuous) increase of the flicker frequency was reported when the annular-air velocity was increased, i.e., bifurcation of the flicker frequency. The fuel jet also exerts similar effects. The bifurcation results in two incommensurate frequencies in the spectrum of the jet diffusion flames studied.

83. Optimal Control of a Multi-zone Thermal System

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The optimal control of a representative heating, ventilating, and air-conditioning system is investigated. Previously, optimal and traditional control methods were compared for a once-through system consisting of a single zone and heat exchanger. The zone temperature was controlled using a single variable. Optimal control was then applied to a system with multiple control variables that included variable airflow rates and recirculation. The use of multiple control variables was found to improve thermal comfort and reduce system operating costs. The current study focuses on the application of optimal control methodologies to an extended model that includes multiple zones, heat exchangers, and fans.

The optimal control problem consists of system governing equations and a cost function to be minimized. The governing equations are formulated to account for transient effects in the system. Cost functions typically consist of terms representing the energy use of components within the system and penalty terms used to maintain system variables near setpoint values. Comfort conditions in a zone can be enforced by including penalty terms in the cost function that require the temperature and airflow rates be maintained at or near some desired set values. These conditions can be tied to the indoor air quality in the zone and, if not satisfied, to a loss of productivity of humans using the zone. Optimal temporal responses for the control variables are solved using a nonlinear optimization technique.

84. Foam Flow

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Liquid foams consist of small gas bubbles separated by thin liquid films. They are of practical use in a wide variety of applications including manufacturing and chemical processes, oil well operations, and fire fighting. Although considerable information is available concerning the properties and nature of foams, little research has been done toward understanding the properties of foam flow.

The purpose of this paper is to discuss how foam behaves as a fluid. Results of experiments illustrating the non-Newtonian behavior of foam flow will be presented. A better understanding of foam flow properties will allow better utilization of foams for a variety of applications.

85. Application of a Three-Dimensional Radiative Transfer Model to Nonhomogeneous Clouds

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An understanding of weather and climate ultimately depends on accurate precipitation data. In many cases, satellite remote sensing techniques are required to obtain these data. In order to sense a volume of atmosphere and translate measurements into rainfall rates, an accurate description of radiative transfer through the atmosphere is necessary. A realistic description of radiative transfer through a cloudy atmosphere must consider the spatial variability of the clouds and the effect of this variability on radiative processes. A general purpose, multi-dimensional, radiative transfer model based on the discrete-ordinates method has been developed to account for anisotropic scattering, incoming collimated beams at any angle, transparent walls, and nongray, nonhomogeneous media. The model has been successfully benchmarked against results from other studies in one, two, and three dimensions. Application of the radiative transfer model for a three-dimensional cloudy atmosphere will be presented. The atmospheric constituents absorb, emit and scatter radiation. Effects of cloud particle composition, cloud height and size, and ground albedo will be discussed.

86. Permeability changes of an expansible nylon fabric

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Air bags have proven to be an effective safety technology capable of reducing injuries and deaths from automobile accidents. In order to be effective an air bag must inflate almost instantaneously. Then the gases, which produced the inflation, must adsorb the energy of bodily impact by viscous dissipation as they are released through the porous fabric. This paper presents the results of a study which was designed to quantify the permeability characteristics of a commercial air bag fabric immediately after the bag has been inflated. Two general questions influenced the design of the experimental study: (1) How does the permeability of the nylon fabric change once it is inflated and in a stretched state?, and (2) How does the expansibility and hence the fabric's permeability change as the environmental temperature is varied?

The permeability of commercial textile fabrics is always measured at very low pressure drops (5 inches of water) according to ASTM procedures. This is done in order to avoid the large variations which can be encountered from fiber elongation and fabric expansion at higher pressure drops. In this instance, the higher pressures encountered during an actual bag inflation process was modeled by using biaxial stress fields induced through

bubble inflation techniques applied to actual fabric samples. The empirical relationship between room temperature, fabric permeability and the bubble inflation pressure was thereby established. The rupture stress of the fabric as a function of strain (inflation) rate was also documented by this technique. Repetition of the procedure at different isotherms yielded the temperature-performance characteristics of the commercial nylon 66 air bag fabric.

The permeability was found to be a nearly linear function of pressure drop for a range of 0 to 10 psig. Increasingly higher inflation pressures led to nonlinearities. The stress at rupture and the temperature effects were found to correlate with the thermal response behavior of the nylon fiber used in the fabric. The implications of the results of this study, and their application to the continued development of highly reliable automobile safety air bags will be discussed.

87. Utilization of sulfur dioxide

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Sulfur dioxide is a by-product of various ore smelting operations and can be recovered from the combustion products produced by burning coal and other fuels containing sulfur. It is a surplus commodity which causes serious environmental pollution problems. Although some sulfur dioxide is converted into sulfuric acid, the market for this product is saturated in many locations. Therefore, the conversion of sulfur dioxide into other products is being studied. A product which could consume a large amount of sulfur dioxide in its manufacture is sodium sulfate. Preliminary experiments have shown that sulfur dioxide can be reacted with sodium chloride in a fluidized bed reactor at high temperature to produce sodium sulfate. However, the rate of reaction is slow and there is a tendency for the particles to sinter which interferes with fluidization. Various attempts to solve these problems will be discussed.

88. Selective aggregation of coal particles

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Various methods have been proposed for cleaning coal fines by selective aggregation of the fines in an aqueous suspension followed by screening or sedimentation. These methods include coagulation, flocculation, and agglomeration. The first method can be the result of hydrophobic bonding since some types of coal are very hydrophobic. The second method depends on the application of a flocculant in the form of a very long chain soluble polymer to bond the particles together. The third method utilizes an oil to bond the particles. The problem is to find a combination of conditions which will aggregate the coal without aggregating its accompanying mineral particles.

The results of investigating different coagulation and flocculation conditions will be discussed. The effects of pH, temperature, and specific flocculants will be addressed. In addition, the results of separating coal and kaolinite by selective flocculation will be presented.

89. AOP and air stripping; remedial technology for contaminated water

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When it occurs, leakage from underground storage tanks has been a serious environmental problem. Liquid hydrocarbon fuels, for example, have traditionally been stored underground as a safety precaution. However, leakage from such damaged or corroded storage tanks can contaminate and compromise the quality of the groundwater beneath the storage tank. This paper discusses the use of an Advanced Oxidation Process (AOP), in combination with air stripping, as a means for remediation of water contaminated with hydrocarbons or other organic compounds.

The goal of the research effort was to reduce the TOC content of a waste process water stream from 2500 ppm to 250 ppm. At least nine partially oxygenated organic contaminants were identified in a sample of the waste water by GC/MS. The AOP which was used consisted of the injection of 30% by weight of hydrogen-peroxide into the contaminated water. A series of experimental tests demonstrated that the desired 90% reduction in TOC was possible only at a processing temperature of 180 C (10 bar). Moreover, GC/MS analyses indicated that formic and acetic acids were formed during the oxidation phase of the process. Unlike carbon dioxide these simple acids cannot be easily air stripped and remain quite persistent and stable.

This paper discusses the implications of the combined AOP and air stripping technology to water remediation problems. Costs estimates and comparisons with other available technologies are presented.

90. Oxidation of hazardous waste in supercritical water

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In supercritical water oxidation, dilute aqueous organic wastes are oxidized at temperatures and pressures above the critical point of water. Recent experiments at Sandia National Laboratories conducted in conjunction with MODEC Corporation have demonstrated successful clean-up of contaminated water in a supercritical water reactor. Modeling and experimental results are presented for a surrogate waste containing 98% water, 2% methanol. Experimental data are available for inlet and outlet conditions (composition, flow rate, temperature), and axial temperature profiles along the outside reactor wall. The purpose of this model is to study the chemical and physical processes inside the reactor. The parameters that control the location of the reaction zone are of particular interest. The reactor is modeled as a plug-flow reactor with a specified temperature profile. The chemistry in this model has been corrected by changing the reaction rates of unimolecular reactions to their high-pressure limits. Results indicate that the decomposition step of H_2O_2 into the OH radical is the dominant reaction step controlling the destruction of methanol under supercritical conditions. This corrected chemistry model is used to calculate the characteristic destruction times of methanol as a function of reactor inlet conditions.

91. Structure and Properties of New Chalcogenide Glasses

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Although oxide glasses based on the glass formers SiO_2 , B_2O_3 and GeO_2 have been known for more than 2000 years, almost nothing is known of glasses based upon the next chalcogenide element S. In our research at ISU, we have been examining the structure and properties of glasses based upon SiS_2 , B_2S_3 and GeS_2 . In this talk, we will summarize the structure and properties of $\text{Na}_2\text{S} + \text{B}_2\text{S}_3$ glasses. Emphasis will be placed upon the comparative structures and properties to those of the corresponding oxide glass system $\text{Na}_2\text{O} + \text{B}_2\text{O}_3$.

92. An experimental study of convection and solid movement during multicomponent solidification

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An experimental study of solidification of ammonium chloride-water solutions in a two-dimensional enclosure cooled from all sides is reported. The convective processes and movement of the solid phase for various conditions are studied using shadowgraph images and normal photography as well as temperature measurements.

It is found that the cooling rate influences the relative amounts of thermal and solutal convection in the melt, which, in turn, influences the solid movement and microstructure formation within the enclosure.

The experiments represent a foundation for further studies in which the actual origination of the solid phase can be studied.

93. Simulation of columnar dendritic solidification of lead-tin alloys

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This study reports on simulations of columnar dendritic solidification of lead-tin (Pb-Sn) alloys in a rectangular cavity cooled from a side. The governing equations for the α -solid, γ -solid and the liquid phases are derived using the technique of volume averaging. Stationary solid phases, local thermal equilibrium, and complete local mixing of the solute in the liquid are assumed. Noteworthy features of the model include the coupling of convection to microstructural characteristics (e.g., anisotropy of the dendrites), full accounting for the temperature/solute coupling at the solid/liquid interface, incorporation of microsegregation, fully temperature and concentration dependent enthalpies and densities, flow due to solid/liquid density differences as well as thermal and solutal buoyancy forces, and realistic modeling of remelting and the eutectic reaction.

The model predictions differ in important ways from previous models not containing one or more of the above features. The effects of

convection on the resulting solid structure and on macrosegregation are investigated in detail. The predictions also serve as a first step toward more accurate comparisons with simultaneous experiments performed in the authors' laboratory.

94. A systematic approach to industrial technology transfer: implications for Iowa

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The need for Industrial Technology Transfer cannot be overemphasized. A review of related literature shows that the transfer of technology from institutions of higher education to the private sector has not been totally effective. This partial ineffectiveness is a result of inadequate motivational impetus or medium to make the transfer effective.

The State of Iowa needs to encourage and focus more attention on the Industrial Transfer of Technology and the exchange of academic and commercially viable technologies. A systematic approach to the Industrial Technology Transfer should be used (e.g. technical assistance, consulting services, continuance of a mutual relationship with higher education and the public sector, an active engagement in applied technical research and the development of grants. The need to develop effective partnerships among the institutions of higher education in the State of Iowa should be of paramount importance. It must be focused on compelling business, industrial, public and private sector needs.

GEOLOGY

95. Preliminary investigations of a Pleistocene Age mammal site near Vinton, Iowa.

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Located several miles north of Vinton, Iowa, this particular paleontological deposit of probable late Wisconsinan Age, contains the partial skeleton of the North American Mastodon, (*M. americanum*), along with the remains of several other large ungulates. The upcoming proposed investigation of the mammalian remains, and the complex sediments in which they are held, has the potential of providing us with an increased understanding of the glacial age chronology and environment during the close of the last glacial advance in Iowa.

96. Rates of ocean sediment accumulation: a mathematical model and real data

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Rates of ocean sediment accumulation were analyzed from a theoretical perspective and from real sediment samples from three sites off the Washington state coast. The rate model is a steady-state system dependent on downward accumulation, particle mixing, and particle reactions. Real rates were extrapolated by measuring the activity of lead-210 at discrete depth intervals in sediment cores.

The fit of the model to the data depended on the initial assumptions. The experimental rates were as little as 30% of rates found in previous studies, although, as expected, the rates decreased from the shelf region to the canyon region.

Theoretical and practical concerns with the procedure will be discussed.

97. Sedimentary petrography of the Lithograph City Formation

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The Cedar Valley Group of Northern Iowa is made up of cyclic deposits, each consisting of a basal transgressive marine unit and an upper regressive carbonate unit. Although the regional stratigraphy of these deposits has been summarized, few petrographic studies have been undertaken of Devonian formations in northern Iowa.

This undergraduate-research study proposes to complete a petrographic study of the Lithograph City Formation from the Aureola Hills section, Maxon, Quarry, Floyd County. Additional samples were studied from Floyd Quarry.

Where possible, original depositional textures will be interpreted as well as the preferential dolomitization of some beds in this formation. Ultraviolet fluorescence microscopy will be used to help in recognizing relict textures.

98. Silurian-Devonian unconformity, Loomis Quarry, near Denver, Iowa

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Results are presented of an undergraduate-research study of the Silurian-Devonian unconformity exposed near Denver, Iowa. A stratigraphic description will be presented, as well as petrographic and size-grade analyses of several lithologies found adjacent to the unconformity. Results of the study are discussed including a description of selected lithologies and their depositional environment.

99. Chemostratigraphy of a Middle Devonian T-R Cycle: Original chemistry vs. porosity-controlled diagenesis

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The Cedar Valley Gp in Iowa is subdivided into four formations each representing successive transgressive-regressive (T-R) sea-level events. The Coralville Fm (Givetian), consists of open marine units overlain by peritidal deposits punctuated by subaerial exposure surfaces. Stable isotopic data on nonluminescent brachiopods (NLB) from the Coralville were collected through the sequence to monitor marine calcite compositions. Data were collected from two genera to evaluate vital effects. Data were collected on micrites (M) to contrast with brachiopod chemistry. NLB's below subaerial exposure surfaces are depleted by 4 ‰ in $\delta^{13}\text{C}$ and 3 ‰ in $\delta^{18}\text{O}$ compared to data lower in the cycle. Isotopic data from M generally are more depleted than brachiopods, but exhibit depletion in the upper intervals, nearer exposure surfaces, and progressive enrichment in lower portions of the cycle. Trace elemental data on NLB, luminescent brachiopods (LB) and M show that Fe and Mn contents of M mimic stable isotopic signatures, with progressively lower concentrations approaching subaerial unconformities, suggesting stabilization in oxidizing environments overlying intervals stabilized in reducing environments. Data indicates that NLB are the least-altered components in each interval, followed by LB, with M interpreted as the most diagenetically altered. Although NLB are the least altered components, data indicate partial alteration. Simultaneous stratigraphic inflections in isotopic and trace elemental data in lower portions of the cycle can be interpreted as either reflecting changes in original sea water chemistry, or preferential diagenetic alterations under varying water/rock ratios. Preliminary fluid flow modeling suggests that differences in original sediment porosity could have exerted a primary control on fluid flow rates, fluid compositions, and resulting rock compositions.

100. THE MANSON IMPACT STRUCTURE CORE-DRILLING PROJECT: AN EXCITING LOOK INTO IOWA'S CRETACEOUS-TERTIARY IMPACT STRUCTURE

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In 1991 the first of a series of core holes were completed, sponsored by the Geological Survey Bureau and U.S.G.S., and dedicated to investigating the Manson Impact Structure. The M-1 core sampled rocks on the edge of the central peak, and the M-2 core penetrated the rocks of the crater moat. Preliminary investigation of these cores has already provided valuable insight into the formation of this well-preserved, complex crater. The current model begins with the impact of a stony asteroid into the center of North America at the end of the Cretaceous Period, 65.7 million years ago. The asteroid, about 2 km in diameter and traveling about 20 km/sec, exploded with the energy equivalent of 750,000 megatons of TNT, vaporizing the asteroid and 7 km³ of Earth materials, melting 37 km³ of rocks, ejecting 617 km³ of solid materials, and displacing 1047 km³ of materials downward, forcing the rim of the crater to be uplifted at least .5 km above pre-impact surface 25 seconds after impact. The uplifted rim then collapsed as a sequence of large blocks, forcing the central peak upward to a temporary height approximating the rim. At this time, several minutes after impact, large volumes of crater rim and ejecta materials slumped into the crater and moved as a high-velocity debris flow, across the crater floor and up onto the central peak. Within weeks the region had stabilized and a lake began to form in the crater moat. Eventually the lake was filled with sediment and the moat area was covered by a sequence of fanglomerates that prograded inward from the crater rim. An extended period of erosion and burial of the area by till from a number of continental ice sheets in the Pleistocene produced the Manson Impact Structure as we observe it today.

101. Analysis of the ground-water flow system, geochemistry, and underseepage in the vicinity of the Red Rock Dam near Pella, IA

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The Red Rock Dam, constructed and operated by the U.S. Army Corps of Engineers, is located on the Des Moines River in Marion County, Iowa. There has been extensive collection of hydrologic data to monitor seepage conditions, because soluble evaporites are present in the bedrock foundation of the dam. Analysis of water-level measurements in observation wells, hydrogeologic mapping, geochemical analysis, and chloride tracer data indicate underseepage of reservoir water on the northeast side of the dam occurs through the evaporite zone of the bedrock and through glacial sands of the valley bluff. Potential exists for dissolution of evaporite material in the bedrock foundation, because reservoir water and shallow ground water in the vicinity of the dam are undersaturated with respect to gypsum and anhydrite.

102. Relation between stream water-quality and geology in Roberts Creek watershed, Clayton County, Iowa

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In Clayton County, Iowa, the relation between gaining and losing stream reaches and the underlying geology in a karst area is well known, but the relation between changes in stream quality and the underlying geology are not fully understood. Low-flow investigations on Roberts Creek watershed, Clayton County, Iowa, during the summers of 1988-90 were conducted to determine the relation between the underlying geology and stream-water quality. Discharge measurements were made and water samples collected for analyses of nitrate and atrazine in 20 subbasins along the mainstem and tributaries of Roberts Creek. The water temperature, specific conductance, and pH were measured concurrently with sample collection. The areal extent of rock units subcropping in each subbasin was quantified using a Geological Information System. Roberts Creek generally gained water in subbasins having a greater percentage of impermeable Maquoketa formation bedrock and lost water in subbasins that had a greater percentage of karstic Galena carbonates. Water-quality measurements and analyses indicate that there was a statistically-significant relation between water temperature, pH, and nitrate concentration and the geology underlying the subbasins. The water temperature and pH were lower and nitrate concentration higher in subbasins that were underlain by a greater percentage of impermeable Maquoketa formation than in subbasins underlain by the Galena carbonates. The ground-water inflow in gaining reaches may explain the differences in stream-water quality. Greater pH values and decreased nitrate concentrations in losing reaches may be due to biological activity in the stream. There was no significant relation between atrazine concentrations and the geology.

103. Assessment of groundwater contamination in the Mississippian aquifer beneath the Walnut Creek Basin near Kelley, Iowa.

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Groundwater contamination by agricultural chemicals is of serious concern in Iowa. A research site in central Iowa along Walnut Creek is being studied by the USDA Management System Evaluation Area (MSEA) Program to determine the processes of groundwater contamination. The purpose of this study is to assess the contamination potential of the confined Mississippian aquifer. Based on estimates of vertical groundwater velocities at the Till Hydrology Site to the northwest of the study area, it is unlikely that agricultural chemicals have yet reached the aquifer.

The Mississippian aquifer consists of the Burlington-Keokuk Formation (limestone) and the St. Louis Formation (sandstone and limestone). The aquifer is overlain and confined by Pre-Illinoian till, Wisconsin loess, and late Wisconsin till of the Des Moines Lobe. Till thickness is generally greater than 50 feet. In most of the study area, Pennsylvanian sandstone and shale units also overlie the Mississippian aquifer. Bedrock topography slopes towards the South Skunk River. Groundwater from both formations is used for domestic supply. The Burlington-Keokuk Formation yields 5 to 35 gallons per minute, and the St. Louis Formation yields 3 to 20 gallons per minute. Samples for atrazine, alachlor, metolachlor, metribuzin, $\text{NO}_3\text{-N}$, $\text{NH}_3\text{-N}$, and sulfate will be taken from wells this spring to determine the extent of contamination in this system. Tritium samples will be collected from wells to determine the age of the groundwater.

104. Riparian buffer strips and the influence of hydrogeology on the water quality of Bear Creek, central Iowa.

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There is concern for the pollution of Iowa's surface waters by agricultural runoff. Riparian buffer strips (RBS) offer the potential to restrain runoff and process vadose water. The groundwater/surface water interaction along a 700 meter section of Bear Creek, a tributary of the Skunk River in central Iowa, is being investigated to determine the capacity of an RBS to improve surface water quality.

Bear Creek is a gaining stream, its channel incised in late-Wisconsin till of the Des Moines Lobe. Beneath the till, and immediately underlying the creek, lies the St. Louis Fm., a sandy limestone aquifer. Nested piezometers to a depth of 70 meters are positioned over the 16 ha tract. These provide access for chemical monitoring and the measurement of hydraulic head to define the groundwater flow system. The head data suggest that both the surficial aquifer and the Mississippian aquifer influence the creek's discharge. We are attempting to distinguish and quantify groundwater contributions to the creek from both the surficial and regional aquifers using water chemistry and hydrological information. We hypothesize that discharge from the confined aquifer will bypass the RBS and affect water quality. Dilution of creek water must be considered when assessing the effectiveness of the RBS.

LINGUISTICS

105. Political institutions and the development of a literary vernacular: the use of binary formulas in medieval Aragonese prose

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During the 14th century, the Spanish kingdom of Aragon witnessed the emergence of a serious vernacular literary language. The earliest works in this language were Aragonese translations of classical Graeco-Roman and Semitic texts. The translators of these works were almost exclusively members of the royal chancery or court. Their literary prose reveals a distinctive use of synonymic pairs or binary formulas in the translation process. Through systematic comparison of an original Old French text and its Aragonese translation, I will show that this characteristic can be attributed to the influence of the highly formulaic Latinate language typical of royal government prose.

106. A top-down model for Russian sentence structure

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I propose a top-down learning/teaching model for Russian sentence structure, which begins with the concept of a language idea, and then proceeds first to the selection of one of three sentence types, theme/rheme identification, the addition of optional time, place, and circumstantial elements, and the ultimate expression of these elements in Russian. The process is sensitive to the concepts of communicative sentence perspective, ideational completeness and elipsis, word order, inter-utterance cohesion, the natural semantic categories implied by the interrogative categories of Russian, as well as the grammatical categories Russian elects on morphological bases, such as gender, number, person, mood, aspect, case, tense, etc.

107. Computer-assisted vs. videotaped training in teaching sign vocabulary to normal-hearing adults

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The present study was designed to examine receptive learning of 30 American Sign Language (ASL) signs using two teaching modes. Subjects were 28 college students with normal hearing, naive to sign language, who were trained either under computer-assisted instruction (CAI), using the Micro-Interpreter II Program: "Computerized Animated Vocabulary of American Sign Language," (CAV) or through videotaped presentation (VT). Subjects viewed 15 signs under each condition, being first exposed to either CAI or VT training. Contrary to investigators' speculations, results indicated significantly ($p < .01$) higher scores under the VT condition when sign learning and retention were probed 3 and 10 days after training. Thus, in spite of the appeal CAI might hold as an efficient alternative source of training, the image of the human presenter appears to be preferable to the animated figure presenting signs in CAV-ASL. The present investigation yielded significant information relative to the receptive learning of sign vocabulary under state-of-the art conditions.

108. Iconicity and sign vocabulary acquisition: Linguistic considerations

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This investigation was concerned with learning and retention of isolated sign vocabulary as a function of sign classification. Thirty American Sign Language (ASL) signs were selected on the basis of their availability in a computerized program of animated signs. Six experienced signers designated

the signs as iconic (similar to its referent), opaque, or abstract. Twenty-eight hearing college students, naive to sign vocabulary, comprised the subject population. Subjects were exposed to one of two sets of 15 signs under videotaped or computer-assisted instruction. Performance scores were consistently higher for iconic signs, in support of previous research. Nevertheless, we posit that if beginning learners are exposed primarily to iconic signs because of acquisition ease, it will delay facile use of sign, since opaque and abstract signs often represent functional signs and glosses.

109. Code-switching or interference? An analysis of the speech of Italian immigrants in Argentina

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Code-switching, defined as the alternating or switching of two different languages at the word, phrase, clause, or sentence level (Valdes 1981:95), usually adheres to certain "constraints" or rules as to the types of switches that are acceptable. Interference, on the other hand, refers to the importation of a linguistic structure from one language directly into another, and operates most clearly on a phonological level. This preliminary study looks at the speech of Italian immigrants with these two linguistic phenomena as points of reference to determine what is taking place in the linguistic manifestations of this particular group. Examples from the speech of case studies, varying in socio-economic status, as well as in social and psychological distance from the target language group, will be presented as evidence for either code-switching or interference.

Poster

110. Laryngeal compensation and linguistic stress in children with velopharyngeal incompetence

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Velopharyngeal incompetence (VPI) may be defined as the inability to use the velum and/or pharyngeal muscles to achieve closure between the oral and nasal cavities. The purpose of this study was to determine if children with VPI exhibited differences in linguistic stress patterns (frequency, intensity, and durational values of syllables), as compared to normal-speaking peers. Differences would suggest compensation at the laryngeal level for a deficiency at the velar level. Subjects were six hypernasal children, ranging in age from 5 to 8 years, and a control group of normal-speaking peers. Durational and frequency values were obtained by use of MacSpeech Lab II software, and frequency values by means of a VisiPitch. Results revealed that both groups used an increase in frequency and intensity when producing primary stressed syllables. The hypernasal group also used a significant increase in duration for primary stressed syllables, compared to the control group, suggesting a form of laryngeal compensation for the VPI.

PHYSICS

117. Spacecraft Observations of Terrestrial Radio and Plasma Wave Phenomena

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Our knowledge of Earth as an emitter of radio and plasma waves in the kilohertz to megahertz frequency range has grown steadily over the last twenty-five years. Many kinds of naturally occurring plasma waves, Earth-based transmitter signals, and spacecraft-induced interference effects have been detected by satellite-borne low frequency radio receivers. In this paper we describe some of the findings, primarily from the Galileo spacecraft, which flew by Earth on December 8, 1990. Phenomena observed include auroral kilometric radiation, whistler-mode noise, lower hybrid and upper hybrid plasma waves, VLF radio transmitters, and several different types of spacecraft-induced interference. The causes of some of these phenomena are still poorly understood.

118. Highly Structured Langmuir Wave Emissions Observed Upstream of the Earth's Bow Shock

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Highly structured Langmuir waves produced by energetic electrons streaming into the solar wind from the Earth's bow shock have been captured using wideband electric field measurements on the Galileo spacecraft during the flyby of Earth on December 8, 1990. The wideband sampling system on Galileo provides digital electric field waveform measurements at sampling rates up to 201,600 samples per second. These data provide higher resolution measurements than any previous instrument of this type. The main Langmuir wave emission occurs near the local electron plasma frequency, which was about 45 kHz. The Langmuir wave bursts are highly structured. Many intense bursts were observed on time scales as short as one millisecond, corresponding to spatial scales of a few tens of Debye lengths. Large downshifts in the emission frequency are also observed, sometimes by as much as 50 percent. Some of the highly structured emissions are suggestive of the formation of soliton-like wave packets, such as have been predicted by various theories dealing with the nonlinear stabilization of Langmuir waves.

119. An Explanation of Asymmetrical Auroral Hiss Events

D. D. MORGAN and D. A. GURNETT

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Auroral hiss, a whistler-mode radio noise often observed over the auroral zone typically has a symmetrical funnel-shaped frequency-time structure when viewed on a spectrogram. However, sometimes only the side of the funnel over the polar cap is seen, the side extending

equatorward from the auroral zone being attenuated close to the source region. We are in the process of investigating this asymmetry. The investigation is proceeding in several steps: (1) determine the path along which the whistler mode waves propagate, (2) compute the value of the growth rate at several points along the ray path, and (3) integrate the growth rate divided by the group velocity along the ray paths. So far we have only completed step 2. Results of our calculations show that the waves are damped much more quickly on the equatorward side of the auroral zone than on the poleward side.

120. Electron Density Fluctuations in the Earth's Magnetosphere

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The Combined Release and Radiation Effects Satellite (CRRES) has observed large electron density fluctuations in Earth's magnetosphere. CRRES has a highly elliptical, nearly equatorial orbit with an inclination of 18° and an apogee of $6.3 R_E$. Electron density values are calculated from electromagnetic emissions at the upper hybrid resonance frequency. These emissions are observed by the Sweep Frequency Receiver, which provides high time-resolution measurements of electric field fluctuations, producing one spectrum per eight seconds from 6.4 kHz to 400 kHz. As the spacecraft approaches the plasmopause, rapidly varying electron density fluctuations are often observed. These fluctuations have periods ranging from a few seconds to a few minutes and amplitudes, $\Delta N/N$, varying from 10 percent to 100 percent. Temporal and spatial variation in the fluctuations are being studied using power spectral analysis. The dependence of the amplitude and frequency of the fluctuations on radial distance from Earth and on magnetic storm activity are also being studied. Models of several possible source mechanisms are being tested in attempts to understand the origin of the fluctuations.

121. A Study of Langmuir Waves Upstream from Uranus' Bow Shock

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Department of Physics and Astronomy, University of Iowa, Iowa City, IA 52242; *Bartol Res. Inst., Newark, DE 19716

During the Voyager 2 flyby of Uranus on 23-26 January 1986, strong electron plasma oscillations (Langmuir waves) were detected by the plasma wave instrument near 1.78 kHz prior to the inbound bow shock crossing. The Langmuir waves occurred in sporadic bursts for about one day until the spacecraft eventually crossed the bow shock at 0730 on 24 January 1986. The regions of space upstream of the shock can be divided into the undisturbed solar wind, the electron foreshock populated by energetic electrons, and the ion foreshock populated by energetic ions. The distance of the spacecraft upstream from the electron foreshock boundary can be calculated using the measured magnetic field and the spacecraft position together with a nominal shock model. This distance is called Diff. Using Langmuir wave bursts, changes in Diff, and low frequency magnetic field fluctuations, intervals have been identified when Voyager 2 was in the solar wind, electron foreshock, and the ion foreshock. These data are used to investigate the consistency of the standard model for Langmuir wave generation, as well as the implications of the observations for the position, shape, and motion of the bow shock.

122. Revisions of calculus-level introductory physics course syllabus using computer courseware

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Loras College is completing a three part revision of the curriculum for the calculus based introductory physics course.* The lecture syllabus incorporates spreadsheet based exercises, computer simulations and tutorials. Coordinated use of computer tools for data gathering and analysis and the preparation of formal reports is introduced in the laboratory section. Aspects of the Workshop Physics Project and industry level computer interfacing are being incorporated in the laboratory.

Detailed courseware lessons have been written to introduce contemporary topics and assist students with guided time-at-task exercises. A new *Physics Laboratory Manual*** incorporates the use of Microsoft Works™, CA-Cricket Graph™, and LabVIEW™. Courseware lessons utilize *Physics Simulations*® for the Macintosh and A.A.P.T. software. *Spreadsheet Physics Study Units*** [John Wiley & Sons (1991)] is used to supplement a standard textbook.

Sample syllabi will be presented showing how the lessons replace standard assignments and selected laboratory units. Results of student use, evaluations and reactions will be discussed.

*Work supported by NSF grant USE 9052038

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123. A study of Helmholtz resonators excited by an air jet

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An earlier study by Khosropour and Millet investigated the internal spectra of several air-jet excited Helmholtz resonators. In particular, an exploration was made of the dependence of frequency and amplitude of the Helmholtz mode on jet speed and jet width. [R. Khosropour and P. Millet, J. Acoust. Soc. Am. **88**, 1211-1221, (1990)] Additional measurements made on a variety of resonators show general agreement with this earlier study, but additional results have been obtained regarding the nonlinear dependence on jet speed and jet width of the amplitude of the Helmholtz mode.

124. Radiative Muon Capture on hydrogen

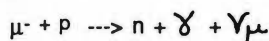
E. BEHRENS AND A. J. LARABEE

Buena Vista College, Storm Lake, IA 50588

In ordinary muon capture (OMC), the capture of a muon (μ^-) by a proton results in the production of a neutron and neutrino.



Sometimes, however, the capture also produces a high-energy gamma ray.



This is referred to as radiative muon capture (RMC). The branching ratio of RMC to OMC is sensitive to the value of the induced pseudo-scalar coupling constant, g_p . This constant is one of the fundamental constants determining the behavior of the weak nuclear force. A measurement is currently in progress at TRIUMF (an accelerator facility in Vancouver, B.C.) to measure the RMC rate on a liquid hydrogen target using a 69 MeV/c muon beam. A cylindrical drift chamber is used to detect the gamma ray given off in the RMC decay. The detector array will be discussed and the current results of the measurement will be presented.

125. The constitution of the universe

A. J. DEANS

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In the unified quantum field theories of modern physics the precise mathematical form of the fundamental laws of nature is found in the Lagrangian of the Superstring and the N=1 Supergravity theories. In Maharishi's Vedic Science, these same fundamental laws - the constitution of the universe - are found in the eternal self-referral dynamics of consciousness knowing itself. This eternal dynamics is embodied in the very structure of the sounds of the Rik Ved, the most fundamental aspect of the Vedic literature.

We present the structure of the Rik Ved Samhita as brought to light by Maharishi's Apaurusheya Bhashya of the Ved and the Langrangian of both the D=10 and D=4 Heterotic Superstring.

PHYSIOLOGY

126. The effects of time and temperature after blood withdrawal from turkeys upon the determination of plasma potassium concentration

W. O. Reece

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Clot formation and its retraction are unduly delayed when blood is withdrawn from turkeys because birds lack the intrinsic mechanism for blood coagulation. Accordingly, serum is not appropriate for the determination of potassium concentration in the avian species. If an anticoagulant is used for collection so that plasma can be harvested, the sample must be immediately centrifuged. The nucleated erythrocytes of birds remain metabolically active after their withdrawal and the erythrocyte Na^+ - K^+ ATPase continues to pump Na^+ out and K^+ into the cells. For samples not immediately centrifuged, this causes the plasma concentration of potassium to decrease with increasing time from withdrawal. The magnitude of decrease with time from withdrawal is reduced with decreased ambient temperature.

127. Unilateral isokinetic strength training as a means of producing cross-transfer effects in contralateral homologous musculature.

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Departments of Physical Therapy and Physiology/Pharmacology, University of Osteopathic Medicine & Health Sciences, Des Moines, IA 50312.

This study was to examine the cross-transfer effect of a unilateral isokinetic elbow flexor strength training program on the contralateral elbow flexor musculature. Twenty healthy subjects volunteered to participate in a 6-week unilateral isokinetic elbow strength training program. Average peak force (in N) of three concentric elbow flexor contractions in the KIN-COM isokinetic dynamometer at 60°/sec was evaluated bilaterally prior to and following a 6-week unilateral elbow flexor strength training program. Subjects trained their dominant upper extremity on the KIN-COM concentrically three times per week at 60°/sec completing three sets of 8 repetitions. A two-way ANOVA with repeated measures showed a statistically significant difference between the pre- and post-test values ($p < 0.0001$). Post-hoc analysis revealed statistical significant increases in both trained ($p < 0.001$) and untrained ($p < 0.001$) upper extremity. We conclude that a 6-week unilateral concentric isokinetic strength training program is capable of producing significant cross-transfer effects in the contralateral homologous musculature.

128. An assessment of the value of normalizing contractile force according to the size of cut blood vessel rings in tissue bath mounted vascular studies

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In tissue bath mounted vascular ring studies, the consistency of the width of cut rings is dependent upon the technical ability of the investigator. Further, it is logical to assume that generated force will be a function of ring size. Accordingly, contractile force in such studies is often normalized by some size parameter of the ring. It was the goal of this study to determine if the potential benefit gained from normalizing the responses according to ring size outweighs the experimental error introduced by making the additional weight and/or length measurements. Weight was recorded to the nearest 0.1 mg and circumferential length to the nearest 0.1 mm. Rat thoracic aortic rings were mounted in tissue baths and isometrically contracted by log increments of phenylephrine (0.01 nM to 0.1 mM). Analysis of concentration-response curves, expressed as a percentage of maximum response, showed that normalization to include the wet ring weight (mg/mg) or the cross sectional area (mN/mm^2) did not change the shape of the concentration-response curve from that seen when contractility was expressed simply as tension (mg). Further, the standard error of pooled measurements did not differ. We conclude that when rings are hand cut to approximately equal sizes, no further benefit is gained by normalizing responses to ring size.

129. Are auscultatory blood pressure readings meaningful for older subjects?

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Auscultatory readings have been reported to become misleadingly higher than actual pressure as age (A, yr) progresses. Our data which has been discussed at previous IAS meetings, therefore, was, reexamined to confirm that dependence of mean

auscultatory pressure (P, mm Hg) upon arm circumference (C, cm) does, itself, increase with A. Stepwise regression of 890 measurements gave: $P = \text{constant} + 0.031 \pm 0.006 A C - 1.1 \pm 0.1 A$, where standard errors are shown and the constant depends upon time, and body mass. The first coefficient's validity is strengthened by reanalysis of Ragan and Bordley's (Bull. Johns Hopk. Hosp. 69:504, 1941) classic data: $P = IP - 9 \pm 1 + 0.028 \pm 0.004 A C - 0.4 \pm 0.1 A$, where IP was the mean intra-arterial pressure. Much of the apparent increase of blood pressure with age may, therefore, reflect instrumental error.

130. Role of stress in health and aging: Chronic mild stress alters adrenocortical regulation in humans

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The physiological basis for the role of stress in disease and aging is not fully known. This question was approached by comparing neuroendocrine function in two groups of college students at different levels of stress. Assurance of different levels was based on use of an effective technology for reducing stress. An average-stress group, with no stress reduction, scored close to norms on psychological indicators of stress. A low-stress group, which had practiced Maharishi's Transcendental Meditation program for an average of 8.5 years, scored markedly lower on these indicators. Endocrine data were excretion rates of cortisol, aldosterone and dehydroepiandrosterone sulfate (DS), determined by radioimmunoassay. Excretion rates of the electrolytes Na, K, Mg, Ca and Zn were determined by atomic absorption spectroscopy. Average-stress students differed from low-stress students in adrenocortical regulation or function. Compared to the low-stress students, the average-stress group displayed: (1) elevated cortisol and aldosterone, (2) lower DS, (3) higher ratios of cortisol-to-DS, and (4) excessive mineralocorticoid activity. These results open some new avenues for linking low-grade stress to cardiovascular disease, cancer and suboptimal function of the immune system.

131. Chronic mild stress alters metabolism of serotonin and melatonin: Relation to adrenocortical function and health

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Animal studies support a progressive loss of efficacy of neural regulation of the hypothalamic-pituitary-adrenocortical (HPA) axis as a prime link between stress, disease and aging. An accompanying abstract (Walton et al., Physiology) reported results comparing two groups of college students at different levels of stress which appeared to support this mechanism. This abstract details other results from the same study. Excretion rates of the serotonin metabolite 5-HIAA (5-hydroxyindoleacetic acid) and the melatonin metabolite 6-sulfatoxymelatonin (6-SM) served as indicators of turnover of serotonin and melatonin. Serotonin turnover was lower in average-stress students than in low-stress students. Since glucocorticoids can lower plasma levels of the serotonin

precursor tryptophan, reduced serotonin turnover may result from hyperactivity of the HPA axis. In turn, a mechanism through which the stress-induced reduction in availability of serotonin could contribute to the decline of HPA regulation also exists. Average-stress students were lower in the sleeping/waking ratio of melatonin, another contributor to disease and aging. The results support the hypothesis that chronic mild stress produces detrimental influences on health and aging by altering HPA regulation and indole metabolism.

Poster

132. Correlation of EMG (electromyographic) and microcirculatory changes in low back pain (LBP) sufferers treated with osteopathic manipulation (OMT)

R.J. BECKMAN, L.A. HARRINGTON, S.M. DOSTERT, W.C. WATSON, M.F. KRPAN, D.R. BOESLER AND M.A. KILMORE

U O M H S Department of Osteopathic Manipulative Medicine; 3200 Grand Avenue; Des Moines, IA 50312

Previous work demonstrated that OMT decreased the EMG activity in the lumbar paraspinal muscles concomitant with diminished pain. The present study used the laser doppler flowmeter to measure skin blood (SBF) at T₁₁. The SBF was correlated to low back somatic dysfunction (as measured by EMG) before and after OMT. Forty-six subjects were used in the present study. Twenty had LBP and twenty were pain-free. In each group, ten subjects received OMT for the entire axial skeleton and pelvis. The other six subjects had LBP associated with dysmenorrhea and were treated in the same manner as those with LBP. The OMT subjects had EMG and SBF measurements taken before and after treatment, with the control group measured before and after a period of rest. As in previous studies, EMG activity diminished in most subjects receiving OMT, including all those with dysmenorrhea. After OMT, in subjects with LBP, SBF increased and correlated with the decreased EMG which was statistically significant. After OMT in subjects who had dysmenorrhea, SBF increased an average of 525.3%. These studies indicate that this relief is correlated to blood flow in the affected somatic region.

PSYCHOLOGY

133. The effect of reinforcement schedule on stereotypical responding: Interval schedules.

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We report the effects of interval reinforcement schedules on stereotypical responding in human subjects. Stereotypical responding occurs when a person repeats a response pattern while earning reinforcers.

Forty college students used two keys to navigate a cursor through a 6 by 6 square grid. Guiding the cursor to the lower right corner of the grid was reinforced occasionally with points. Later, the points were exchanged for money.

Points were awarded on Fixed Interval 7-second and Variable Interval 7-second schedules. Analysis of the results indicated that subjects showed less stereotyped responding than in previous studies using ratio schedules of reinforcement.

134. Habituation, sensitization, associative learning, and the logic of learning in the *Aplysia Californica*

G. W. Stickel,

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The work of Eric Kandel on the *Aplysia* suggests that the basic mechanism for learning and memory is the Ca²⁺ modulation in the presynaptic neuron. This paper examines the details of such neuroscience studies to show that there is a basic logic that is contained in the biochemical reactions as well as within the psychology of learning. The logic, while mathematical in nature, begins to define the basic structure of the learning process.

135. Ratio rule and free recall

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With immediate free recall, items occupying initial and terminal serial positions during input have a high probability of being retrieved compared to items in the middle of the list. With delayed free recall of only a few seconds, the recall advantage for terminal items (recency effect) may completely disappear, while the recall level for initial items (primacy effect) many not change. One explanation of the change in the recency effect is that it depends on the ratio of the time interval interposed between items during list input (I) to the delay interval interposed between list input and recall (D). When this ratio is reduced substantially from about 1.00, which is the usual case with delayed recall, the recency effect is much less probable. Our results indicated that the recency effect virtually disappeared with short delays even when the I/D ratio was held constant and close to 1.00, which is contrary to the ratio rule.

136. Factors related to anxiety among undergraduate students

S. S. MUNIR

The relationship between various types of anxiety, social support, and need for support among 100 female undergraduate students (freshmen to senior) was assessed. Two-way ANOVA procedures indicate a significant interaction effect of need for support and social support on free-floating anxiety ($p < .05$). A significant effect of year in school on anxiety was also obtained ($p < .05$). Anxiety decreased as the year in college increased. Social support also had a significant effect on anxiety due to school pressures ($p < .001$) but not due to other types of school-related anxiety. Results are discussed with implications for career development and related research from a separate ongoing study.

137. Optimizing neuroendocrine function: Superiority in job performance and leadership ability are associated with increased serotonin metabolism

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Neurochemistry Laboratory, Departments of Chemistry and Physiology, and *Department of Psychology, Maharishi International University, Fairfield, IA 52557-1005

Other researchers have shown that enhanced serotonergic mechanisms promote dominance acquisition in male vervet monkeys. This is true both in monkeys whose serotonergic mechanisms are pharmacologically enhanced and in monkeys with signs of naturally high serotonergic activity. Higher whole blood serotonin (WBS) levels were a major sign of elevated serotonergic activity in these studies. The present experiment sought to determine if similar associations with serotonin metabolism are found in humans. One group of men, employed by a brokerage firm, ranked at three levels in the company based on sales performance. Using one-way ANOVA, WBS (determined spectrofluorimetrically) showed a significant main effect with rank as grouping variable [$F(2, 30) = 4.23, p = .024$]. The contrast between lowest and highest rank was striking ($p = .005$). Of three psychological-test-based rankings, only Leadership Ability Evaluation showed a significant difference in WBS ($p = .04$, Outstanding vs. Typical). In a different group of men from a variety of occupations, serotonin metabolism determined in a different way (metabolite excretion) was elevated in Outstanding Leaders. These results likely signify more optimal neuroendocrine function at higher levels of performance and leadership, in man as well as in monkeys.

138. Part-list cues and output interference

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A subset of words from a recently learned list (part-list cues) used to prompt immediate recall of the remaining words on the list (targets) often inhibits retrieval compared to a non-cue control condition. One explanation is that while part-list cues are being scanned targets are lost from short-term memory, with targets in terminal serial position during list learning being most vulnerable. A second explanation is that the part-list cues disrupt retrieval strategies. A third explanation is that the part-list cues produce output interference. These contrasting explanations were tested by comparing the joint effects of delayed recall and serial position on degree of interference. Part-list inhibition was found, but there was little evidence that short-term memory loss or strategy disruption was responsible. The results are interpreted in terms of output interference effects.

139. Memory comparisons in recognizing traffic signs

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To recognize a traffic sign, a driver must compare a current visual input to stored visual memories of such signs. Sternberg's procedure was used to study perceptual encoding and memory comparison for a subset of traffic signs. Subjects were asked to remember 2, 4, or 6 traffic signs. Signs tested for being within the memory sets were Stop, Keep Left, Merge Right, and Signal Ahead.

Stop signs were encoded faster than the other test signs. For only Stop and Merge Right signs were correct "yes" responses faster than "no" responses. For only Keep Left and Merge Right signs did test sign recognition latency consistently increase as memory set size increased. These results reflect the complexity of mental operations required for visual stimuli and may provide suggestions for revisions of signs to simplify the mental operations required for rapid sign recognition.

140. Prime speed and recall interact in lexical-decision

B. A. VANVOORHIS AND V. J. DARK

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Traditionally, more semantic priming is shown in a lexical-decision task than in a naming task. When the lexical-decision response is indicated verbally rather than manually, however, lexical-decision only shows more priming than naming when the prime is briefly presented (50 msec) and the subject is required to recall the prime.

To examine the underlying causes of this phenomenon, priming was measured in three tasks (keypress lexical-decision, voice key lexical-decision, and naming) with 200 msec versus 50 msec prime presentation and recall or no recall of the prime.

The two lexical-decision tasks showed a speed by recall interaction indicating that priming in the short duration/recall condition was greater than all other conditions. Naming did not show this pattern indicating that the speed by recall interaction is a function of lexical decision. This suggests that semantic matching may underlie the phenomenon.

Poster

141. Self-esteem and related variables

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D. J. STACK, C. A. POCH, S. S. MUNIR

Much research shows self-esteem to correlate positively with internal locus of control. The present study examined the relationships among self-esteem and locus of control as well as self-efficacy and approval of others among one hundred undergraduate students. Preliminary analysis indicates that self-esteem correlated significantly (in a positive direction) with self-efficacy ($p < .0001$) and with approval of others ($p < .001$); and significantly (in a negative direction) with aspects of external locus of control - powerful others ($p < .0001$) and chance ($p < .0001$). However, self-esteem did not show a significant correlation with internal locus of control. Results are discussed in reference to the nature of the sample and ongoing research.

142. An evaluation of Project DARE

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A short-term evaluation was designed to assess the impact of DARE (Drug Abuse Resistance Education) on fifth and sixth grade students who received the complete DARE curriculum. Results were compiled using frequencies on demographic variables, subscales and total scores. T-tests were completed with subscales and total score as dependent variables and treatment groups as the independent variable. Compared to a control group, DARE students reported significant differences regarding attitudes on drug use and law enforcement officers.

SCIENCE TEACHING

143. The effect of a hands-on science content course on preservice elementary teachers' attitudes toward science.

L.D. MCGREGOR

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University of Northern Iowa, Cedar Falls, IA 50614

Elementary teachers' poor attitudes toward science have been blamed for the lack of science instruction at the elementary level. Hands-on science has been promoted as an avenue for shifting these attitudes.

Using a science attitude assessment, preservice teachers' attitudes were measured before and after completion of a hands-on science course. Although there was no significant difference in attitudes pre-course versus post-course, some interesting findings arose when results were analyzed by gender and minor.

144. Learning cycles for the masses: a multi-section collegiate introductory course in biology

C. A. LEE

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Cedar Falls, IA 50614-0421

The use of learning cycles as an approach to teaching science provides at least a decade of experience using this method. It has been incorporated into some elementary textbooks and tried at the secondary level in special curriculum projects. Considering teaching experiential science at the collegiate level in this manner may be a newer idea.

Laboratory in Life Science is in its eighth year, and third revision, as an introductory laboratory course for non-major biology students. The learning cycle approach has been used from the inception and appears to be quite successful in reaching uninterested, non-science students. Difficulties in teaching experiential science to the masses as well as successes will be discussed. Overviews of sample learning cycles for college biology students will be provided.

145. Mimicry - flight of fancy or pigment of the imagination

D.E. Nauman

Washington High School, 2205 Forest Dr SE, Cedar Rapids, Iowa 50403

In physics classes, when investigating lasers and holography, students invariably ask questions concerning the application of holography. It is relatively easy to point out uses in magazine covers, greeting cards, credit card copy protection, etc., but it is harder to point out uses in nature. Drawing on my background as a biology teacher and amateur lepidopterist, I have come across a vehicle for showing an example of holography in nature. I am using the concepts of convergent evolution to exemplify the use of holography in nature. Applications to biology as well as physics can be found in this discussion.

146, Abstract not available

147. Analogies in science teaching

P. H. JOSLIN

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Many crucial scientific concepts are abstract and difficult to learn and to teach. Student misconceptions acquired before formal science education begins also complicate effective science teaching. Teachers must thus teach for conceptual change and this requires different approaches than for teaching for initial concept acquisition.

Analogies, properly used, appear to have potential for teaching for conceptual change especially within a constructivist perspective of learning. But success with their use is apparently limited by teachers' traditional passive view of learning.

Characteristics of effective analogies, the potential of analogies for conceptual change, reports of teachers' use of analogies, recommendations for development of effective analogical teaching strategies, and suggestions for developmental studies, will be presented.

148. Field Biology, a positive choice for the non-traditional science student.

R. A. SLOAN

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Marion, Iowa 52302

Field Biology, an elective science course, is offered at Marion High School for the student who traditionally would not be successful in advanced courses. Textbooks are replaced with field experiences. Tests are replaced with journals, video essays, presentations and group papers.

Students develop a group identity and a positive self-image as a member of a unique class. The techniques used to promote the students success will be discussed.

149. A Test for Quality

R. L. IVERSON

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317 Columbus Drive
Marshalltown, IA 50158

How do you know quality when you see it? How do students identify and relate to quality? What about my reality, your reality and that other stuff?

With any luck this will be a light hearted look at William Glasser from the 1992 Practitioner's Paradise III. January 7-9, 1992, Rochester, Minnesota. Control theory will be mentioned along with Reality Therapy and acting in one's own best interest Vs. what's in it for me.

The answer is dignity, respect, and self esteem for everyone.

150. Transformational OBE

R. L. Iverson

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The emergence of content for the restructured curriculum in the restructured school is taking focus. There are many more questions than answers. Educational theory and application is changing faster than it can be printed. That is a little different but what is really different is that all seems to be on a convergent collision course. Actually, that is very refreshing from a theoretical position but very disequilibrating from a practical standpoint. Things are changing. Can school only get better?

151. Abstract not available

152. IANET: Linking all Iowa schools into a computer

J. A. GERLOVICH

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PSinet is a national computer conferencing network funded by the National Science Foundation (NSF) and the IBM Corporation. The state version of this network is IowaNet.

Under a grant from the Carver Trust, the national PSinet training Center was created at Drake University. IowaNet will link all educational institutions in Iowa into an interactive computer conferencing network that will also be connected to the national and international systems. Over the next three years, 2000 Iowa educators will be trained to use the system and receive the PSinet software. They will also receive funds to cover expenses.

Subjects included on the network will initially be science, mathematics, and health.

153. Iowa's statewide chemical cleanup - a status report

J. A. GERLOVICH

School of Education, Drake University, Des Moines, IA 50311

During the Spring and Summer of 1992, Drake University personnel coordinated a cleanup of unwanted school chemicals for the Iowa Department of Education.

To date, chemicals have been inventoried by local school districts within Iowa's Area Education Agencies. Licensed disposal companies have been contacted for their ability to meet state and federal standards in completing the pick up and transport at an equitable monetary rate. A blue-ribbon committee was convened to select the disposal company. Pick up dates and sites within each respective AEA were established that were mutually agreeable to both the disposal company and the schools. It is anticipated that the chemicals will be burned, recycled, neutralized, or resold to reduce disposal costs to schools. The entire operation should be completed by August, 1992.

A final report will be provided to the Academy next fall.

The status of project CRISTAL (Chemistry Resources and Instructional Strategies for Teaching all Learners)

B. A. Wilson, and J. Stone

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Project CRISTAL (Chemistry Resources and Instructional Strategies for Teaching all Learners) has received an Eisenhower grant to inservice twenty-five PRISMS teachers during the summer of 1992. Details of the current status of the project and the summer workshop will be disseminated.

155. A collection of laboratory experiments for high school and introductory college chemistry

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A variety of chemistry laboratory experiments will be distributed and discussed. These experiments are applicable to general high school and AP Chemistry, as well as introductory college chemistry.

The presenter was a 1991 participant at the NSF summer institute for chemistry teachers at Hope College in Holland, Michigan. Most of the experiments to be shared were collected during the summer institute.

156. Greater ability to apply concepts in the applications domain of the Iowa STS effort

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The active involvement of students seeking information that can be applied to solve real-life problems is a feature of Science/Technology/Society (STS) initiatives. This instructional paradigm is being used in conjunction with the Iowa Scope, Sequence, and Coordination (SS&C) project.

The student is in a central position as goals, curricula, instruction, and evaluation are considered in the learning environment. Most exciting, however, is the value placed upon student generated questions requiring mastery of knowledge and processes for solution. The learning and study based on need to deal with a topic is created by the students' question(s). The questions initiate the search for explanations and solutions. The value of the related science knowledge/concepts and processes necessary for eventual solutions and explanations validates the usefulness of the experience for the student.

For the purposes of the STS-SS&C initiative all of the higher order cognitive skills are collectively identified within this domain (Domain III in the Iowa Assessment Handbook) has been made.

The STS/constructivist approach to teaching science may take longer and fewer concepts may be covered (i.e., less content is covered in a specified timeframe) when compared with the traditional march through the textbook; however, the conviction that less is better is not limited to the STS classroom alone, nor are the success stories originating from this philosophical approach limited to SS&C-STS efforts alone.

157. Site-based accountability: taking assessment seriously

L. KELLERMAN

Concerns about appropriate and meaningful assessment are addressed in this presentation. This session will provide a short synopsis of current research detailing those concerns, and provide meaningful examples to alleviate and/or correct the deficiencies.

Many teachers view assessment as the end product of their instruction without realizing its applicability to developing instructional strategies, identifying appropriate resources, and determining subsequent student learning. The use of preinstructional assessment allows teachers to decide students' conceptual frameworks prior to instruction; ongoing instructional assessment allows teachers to modify instruction during the learning sequence.

Assessment can take many forms. Teachers involved in the Iowa Scope Sequence and Coordination project have developed alternative strategies for assessment. Examples of these will be provided to aid teachers who are unsure of alternative assessment methods. The examples will include alternate uses of multiple choice questions, assessment through the application of learned science concepts and processes, and several pre-instructional assessment methods.

The participants will be involved through active questioning strategies, a brainstorming activity and the subsequent grouping of ideas.

158. Portfolios and portfolios as an assessment technique across the curriculum (grades 4-9)

E. REZABEK, J. DUNKEL, R. GERBER

Portfolio assessment can be an effective mechanism for collecting evidence of student's knowledge, skills, progress, and dispositions.

During this session we will examine: (1) how portfolios can be assessed and shared with the student, parent, administration; (2) portfolio archives; (3) what to assess in the portfolio; (4) evidence to support portfolio assessment; (5) effectiveness of portfolio assessment; (6) methods of measuring growth in portfolio assessment.

Teachers who have implemented portfolio assessment and related techniques will share their successes and problems with portfolios and assessment. Examples of student portfolios will be available.

159. Foundations of science with liberal labs

R. HRECZ

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Elementary education majors often take only take the required general education science courses yet are expected to teach many sciences using hands-on activities or labs. Upper Iowa has modified Hunter College's Foundations of Science course. This modified course offers a lab intensive course from a

historical perspective designed for elementary education majors. Course content includes physics, chemistry, biology, genetics, earth science, geology and meteorology over two semesters. Goals for the course are to have the students address scientific reasoning, understand the nature of science and to develop a positive attitude towards science.

160. Seeking to improve middle level science

H. IBARRA, J. DUNKHASE, D. HARTMAN, AND G. STEFANICH

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This panel discussion will deal with issues and opportunities currently facing middle/junior high school science teachers. What are the unique characteristics of students in the middle grades that should influence what science is taught and the way it is taught? What are the teachers doing to implement an interdisciplinary approach to teaching within their building? What are the best resources available to middle level science teachers? How can the middle level science teacher effectively relate to the teachers at higher and lower levels? How can middle level science teachers participate in the development of the goals for the National Middle Level Science Teachers Association?

161. Water in art: substance, form, and dynamics of "nature's carter"

B. N. ELLIS and R. G. SHEPHERD

Talented and Gifted Program, Urbandale Community Schools, 7701 Aurora, Urbandale, IA 50322

Throughout recorded history, water has been a common compositional element used in art of all forms, from all schools, and by recognized artists. The solid, liquid, and gas phases and the complete range of static and dynamic patterns of water have provided settings and inspiration for artistic imagination and creation. Water is also a basic physico-chemical medium of suspension of color for painting.

Inventory and analysis of one-hundred works of art that include water reveals that: 1) a practical understanding and depiction of the principles of fluid statics and dynamics has been employed commonly by sculptors, especially fountain and clepsydra designers; 2) realist and impressionistic painters alike have taken broad license with the occurrence, character, and behavior of water; 3) modern "earthwork" artists have demonstrated little or no practical knowledge of geohydrology. A notable exception was Leonardo da Vinci, who was obsessed with "nature's carter". He recorded and portrayed numerous significant geohydrologic observations and generally may come to be considered as the father of theoretical and practical geohydrology. Leonardo's work exemplifies the combination of scientific reasoning and artistic creation, and is an important resource for an interdisciplinary approach to teaching in a science and art curriculum.

162. Geotoons: What's up, roc?

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Geotoons are cartoons that employ geological themes. Geologists enjoy geotoons and frequently use them in oral presentations and as teaching aids and occasionally in published papers. Comparison of the five major types of cartoons, the nine publication categories of cartoons, the ten most popular cartoonists, and geotoons from each of the twenty major subdisciplines of geology revealed that: 1) geotoons were some of the early cartoons; 2) several famous cartoonists have been fundamentally inspired by geologists or exposure to specific geologic subdisciplines; 3) most geotoons are of the gag or editorial/political cartoon types; 4) paleontologic cartoons (especially those featuring dinosaurs) are most abundant; 5) few geotoonists have been concerned with the geologic veracity of their geotoons; 6) geotoons are becoming more common in the cartoon literature, because of the increased public awareness of environmental geology and the better scientific education of cartoonists; and 7) geotoons are being used more in professional journals, but not in textbooks. Educators can stimulate student interest in the geosciences and enhance the retention of principles and concepts of geology by exposing students to geotoons and providing opportunities for students to develop their own geotoons.

ZOOLOGY

163. Two unusually severe bites from an Iowa population of massasauga rattlesnakes

J. L. CHRISTIANSEN and J. F. FIESELMANN

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Two people have been bitten by eastern massasauga rattlesnakes (*Sistrurus catenatus catenatus*) from a population near Conesville, Iowa in the last 10 years. Both bites occurred on a finger and produced unusually severe envenomation requiring intensive hospital care. While these bites were typical of those of massasaugas in producing little tissue necrosis at the sight of the bite, both caused life threatening reduction in platelets and associated severe swelling and ecchymosis of the entire arm. A milder bite from the massasauga population occurred in 1960, also on a finger, but this involved relatively little envenomation. It differed from the others in that only one fang penetrated the skin and suction was applied immediately after the bite. Massasaugas appear to be limited to four small populations in Iowa but some bites from this traditionally mildly venomous snake may require intensive medical management.

164. Successful nesting by Cooper's hawks in an urban environment in Dubuque

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The woodland raptor, Cooper's hawk (Accipiter cooperii), is on the endangered species list in Iowa. Its preferred nesting sites are in upland hardwoods. In 1990 and 1991, a pair of Cooper's hawks successfully nested on the Loras College campus. The campus is centrally located in Dubuque and is surrounded by residential areas. The nesting site in these two years was in an area of campus known as Keane Oaks. This area of approximately five acres is a remnant of the upland hardwoods formerly found on the hills in the Dubuque area. The predominant trees in this area are mature white oaks.

The nests produced three chicks in 1990 and five in 1991. Nesting was successful despite disturbances caused by construction, mowing machines, vehicular traffic and human presence in this area. The hawks tolerated these conditions and were able to survive and produce young in an urban environment.

165. Effects of cadmium on juvenile bluegill foraging behavior and growth

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Two experiments, using Daphnia spp. as prey, were conducted to assess the effects of 4 cadmium concentrations (30, 60, 120, 240 ug/l) on juvenile bluegill foraging behavior. Functional response experiments determined how cadmium exposures affected foraging rate and efficiency, mean handling time/prey, and general motivation to feed. In a second experiment, cadmium induced changes in the search component of the foraging process were assessed. Number of prey attacked and captured/30 s was significantly reduced ($P < 0.05$) in bluegill exposed to 60, 120, and 240 ug/l cadmium in all three functional response experiments. Recovery in prey attack and capture rates were dependent upon prey size. Mean run distance (the distance traveled between pauses while foraging) and mean pause duration (time that bluegill pause to search for prey between runs) were also affected by exposure to cadmium. Current data suggest that cadmium-altered search strategy leads to reduced prey encounter rates and the reduced prey capture rates observed in the functional response experiments.

166. Occurrence of meningeal worm in white-tailed deer in selected Iowa counties

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Prevalence and mean intensity of the meningeal worm, Parelaphostrongylus tenuis, recovered from white-tailed deer were determined for three Iowa counties over a two-year period. Prevalence varied greatly among counties and between years, whereas mean intensity did not. In 1990, prevalence varied from 27.3% in Pochahontas County, which has very little woodland, to nearly 50% in Fayette and Winneshiek Counties, which have considerable more acreage in timber. These results confirm previous studies documenting the absence of the parasite from grassland ecosystems. Prevalences were two to three times lower in 1989 compared to 1990, which was a wet year following a period of drought. This increase is probably due to higher densities of the gastropod intermediate host, which requires moist habitat. Prevalence was significantly higher in females, although this may be due to sampling bias.

167. Survey of intestinal helminths and hematozoa in green-winged teal

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Twenty-one hunter-killed green-wing teal (Anas carolinensis) were examined for the presence of intestinal helminths and blood parasites. Five species of helminths were recovered from the intestinal tract, including three trematodes, Echinostoma trivolvis, Cotylurus flabelliformis and Zygocotyle lunata; one as yet unidentified tapeworm; and one acanthocephalan, Polymorphus. All twenty-one birds were infected with Leucocytozoon.

168. The occurrence of Catenula sp. (Turbellaria: Catenulida) in Iowa

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Specimens of a Catenula sp. were found in samples of pond water from Polk County, Iowa. Zooids occurred singly or were attached in chains of from two to eight, with four-zooid chains being most common. Each zooid possessed a statocyst, a ciliated pre-oral groove, a simple pharynx and gut (both lined with cilia), and a single, median

protonephridium. Single unattached zooids measured 0.7 - 0.8 millimeters in length by 0.05 - 0.06 millimeters in width. Four-zooid chains averaged 1.7 millimeters in total length. The observation of Catenula sp. in Iowa appears to constitute a new geographic record for this genus.

169. Desiccation stress tolerance and behavior in Drosophila robusta

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Desiccation stress tolerance (DST), the ability to survive without water, has a low heritability in Drosophila robusta flies. This indicates that it is probably critical to the survival of the insect.

We studied the responses of flies with high and low DST levels to a temperature gradient. Four different treatments were studied: 1. high humidity (100% RH) and pre-desiccated flies, 2. low humidity (0% RH) and pre-desiccated, 3. high humidity and not pre-desiccated and 4. low humidity and not pre-desiccated. Sexes were tested separately.

The results were analyzed by analysis of variance to examine the importance of desiccation stress tolerance level to behavior.

170. The effects of caffeine on viability, fecundity, and mutation in Drosophila melanogaster

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We tested the effects of caffeine on adult viability, fecundity, and mutation rate in Drosophila melanogaster flies. Larvae were grown to adulthood on a medium with or without caffeine. The resulting adults were starved and then fed sugar water with or without caffeine.

This design yielded four sets of flies: those unexposed to caffeine, those exposed during the larval stage only, those exposed during the adult stage only, and those exposed during both stages. This allowed us to determine differences in sensitivity of the two life stages.

Viability was determined by measuring the survival rate when the adults were fed the sugar water. Fecundity was determined by counting the number of offspring per treated fly. Mutagenic effects were determined by the sex-linked recessive lethal test.

171. The effect of albumin concentration on the growth rate of Borrelia burgdorferi in BSK medium.

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The growth requirements for the cultivation of Borrelia burgdorferi, causative agent of Lyme disease, are numerous and complex. Bovine serum albumin (BSA) is a major component of the growth medium. Inconsistency in growth stimulation of B. burgdorferi among lots of BSA is well documented in Lyme research literature. This paper compares the growth stimulation of several lots of BSA at different concentrations. The rate of spirochete growth was determined in BSK medium using BSA at a range of concentrations (0.25X - 2X published recipe concentration). Our growth rate experiments were conducted on two strains of B. burgdorferi, Strain 297 and an isolate (LC-1) which we recovered from a live-trapped mouse. Our results suggest that the optimal BSA concentration for B. burgdorferi is lot dependent. In order to culture B. burgdorferi from a minimal size inoculum, optimal concentration of a strongly stimulatory lot of BSA must be incorporated into the growth medium. A strongly stimulatory lot may be identified by evaluating the growth stimulating potential of several BSA lots.

172. Recovery of organisms from a temporary pond after a simulated winter

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To determine overwintering organisms in a temporary pond, thirty soil samples were taken from a dry temporary pond, Polk County, Iowa, on October 28, 1991. To determine overwintering organisms, samples were frozen, dried and periodically rehydrated. Samples were maintained under growth lamps for six weeks while emerging organisms were identified. Organisms recovered: protozoa, rotifers, cladocera, blue-green algae, and duckweed.

173. Earthworm (Lumbricus terrestris) resistance to Alachlor

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Pesticide resistance has been shown not to be post adaptive and not induced by exposure to nonlethal doses. This theory was tested by comparing earthworms from a field treated with the insecticide Alachlor with those from an ecologically similar untreated field and with locally acquired earthworms. Acute toxicity tests were conducted with L. terrestris collected on August 17, 1991 in Weld County, Colorado. Earthworms were collected randomly throughout a corn field and an adjacent field. Randomly divided groups were used for toxicity tests and results were compared with results of L. terrestris obtained locally.

The Colorado earthworms were more resistant to Alachlor but showed little difference between fields.

Poster

174. Impact of Java fern, Microsorium pteropus, on nitrite levels in water containing live Betta splendens

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Comparisons were made of pH and nitrite changes in water containing individual Betta splendens under two experimental variables. These were the presence or absence of plant material (Microsorium pteropus) and changed or unchanged water.

Under both water conditions the presence of plant material prevented rises in nitrite levels. One experimental group developed nitrite levels nearly twice that considered very dangerous for fish. Betta splendens were able to tolerate this without apparent harm after 45 days. pH levels steadily declined from 7.5 to as low as 5 in the unchanged water.

The presentation will also include data on other factors such as fish length and weight gain, and correlations among fish in any one group.

