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PROGRAM ABSTRACTS
100th Session
IOWA ACADEMY OF SCIENCE

April 21-23, 1988
Iowa State University

(Index of Contributed Papers by Author)

GENERAL SESSIONS

I. The National Ozone Expedition, 1986 and 1987

Dr. Susan Solomon, Head project scientist (NOZE-1 and II)

The total ozone abundance has decreased markedly over Antarctica during the spring seasons of about the past ten years, as demonstrated by the British Antarctic Survey measurements at Halley Bay, Antarctica. A great deal of research has been aimed at understanding the cause of this unexpected and spectacular change in stratospheric ozone. The "National Ozone Expedition" (NOZE) went to the National Science Foundation's McMurdo Station (78S) during austral spring, 1986 to investigate this phenomenon. A series of ground-based and balloon-borne measurements of stratospheric constituents was carried out to obtain more information about the chemical composition and dynamics of the antarctic stratosphere. These data demonstrated that the chlorine chemistry of the antarctic spring stratosphere was highly anomalous, and pointed towards chlorofluorocarbons as the most likely cause of the antarctic ozone hole. In 1987, a second National Ozone Expedition was undertaken. The current status of understanding of the antarctic ozone hole and its possible implications for other latitudes will be described.

II. Communications Network

Professor John W. D. Connolly, Center for Computational Sciences, University of Kentucky, Lexington, KY 40506

Computational science has become, in the very few years that computers have been available to science, a new mode of exploring the frontiers of knowledge. It is based on theoretical concepts, but is carried out in an experimental fashion. The supercomputer represents the latest manifestation of the investigative apparatus of this "third" method of scientific endeavor.

As supercomputer technology develops exponentially, so the complexity of the problems which the computer can solve will also increase exponentially. The present level of complexity is already impressive, but is a shadow of what can be expected in the future.

Thanks to the efforts of the National Science Foundation and other Federal agencies, state-of-the-art supercomputers are now available to the general academic community. Thousands of students have been trained on these machines, which were heretofore the exclusive province of military and security projects.
The Federal government is currently considering a "National Computing Initiative" to encourage computational research at many different levels. If the US is to remain at the forefront of the information age and not be surpassed by better organized economies, such an initiative is vital and needs to be supported and promoted by the entire scientific community.

III. Science education - getting more important - but not easier

G. C. PIMENTAL

Department of Chemistry, University of California, Berkeley

Because we live in an increasingly technological world, the need for better science education for every citizen becomes more and more important. At the same time, it becomes more difficult. Here are some dimensions of the challenge.

1. Precollege science teachers are undervalued and overhassled. We lose many able teachers to other jobs with better salaries and less stress.

2. The precollege student clientel has broadened to include everyone - including large numbers of students who used to opt out of science courses. These students present different teaching challenges and our educational goals must be recast to meet their distinctive needs.

3. At the college level, we must remember that every student deserves a truly liberal education. That imposes further constraints on how much we could aspire to do in preparing a science student for a professional career.

5. We must resist the temptation to extend even further the time a young person spends "getting ready" to begin a professional career.

This is, indeed, a challenging agenda. We've got a lot to do.

SYMPOSIA

Bioethics:

The Scientist Role in the Controversy over Genetic Engineering, Regulation, and Utilization of Microorganisms.

A. Bioinsecticides: biotechnology's answer to the Silent Spring

D. H. DEAN, Associate Professor, Department of Biochemistry, The Ohio State University, Columbus, OH 43210-1292

In the 25 years since the publication of Rachael Carson's Silent Spring, the public has come to realize the environmental impact of heavy use of chemical pesticides. To add insult to injury, many insects, including the disease vector, the mosquito, are now virtually resistant to standard chemical pesticides. Biotechnology is now providing a positive response to these dilemmas through the production and development of improved forms of microbial pest control agents: bioinsecticides. Bioinsecticides are pathogens, or predators, of insects such as bacteria, fungi, and viruses, and predatory insects or vertebrates such as mosquito fish which reduce the population of the pest.

Several biological insecticides are now registered with the EPA and are used as safe alternatives to chemicals. These agents are highly specific to the insect pests which they attack and are extensively tested and shown not to be toxic to man or animals or indeed to non-target insects.
Bioinsecticides are excellent models for release of genetically-engineered microorganisms into the environment because literally millions of tons of certain of these bioinsecticides have been released and extensive studies have been done on their persistence.

The goals of genetic engineering are to decrease the costs of production by increasing yield and specific activity of bioinsecticides. Through the use of genetic engineering, plants with the genes of bioinsecticides incorporated into their own genomes are now in field trials. These new developments further reduce the environmental impact of the pesticide by removing it from the environment niches of insects which do not attack the specific crop.

This presentation will review the persistence of non-genetically-engineered microorganisms. The release of newly engineered organisms into the environment will be critically discussed, considering the ethics and economic impact of genetically-engineered bioinsecticides.

B. Construction and release of genetically altered microorganisms

S. E. LINDOW

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Numerous opportunities exist for the utilization of genetically engineered microorganisms for useful purposes in agriculture and in waste management. An extremely diverse array of microorganisms is likely to be considered for such processes as biological control of plant peses, degradation of toxic wastes, reclamation of rare metals and other processes. For some purposes, such as in the degradation of toxic materials, it may be possible to make biologically compromised microorganisms that will exist only in the presence of the toxic chemicals that they were designed to transform. A better understanding of the genetics, biology and physiology of microorganisms which is being gained by biotechnological techniques will allow the development of environmentally "safe" microorganisms which would have a limited duration or dispersal potential in natural environments. Other applications, including many agricultural uses, will require environmentally competent microorganisms that actively grow in association with crop plans, for example. Such organisms cannot safely be assumed to a limited duration in the environment in which they are released or dispersal restricted only to that localized area of application. Most genetically engineered microorganisms will not represent the introduction of strains with greatly different genetic backgrounds, and thus ecological adaptivities, than already existing microbes. For the forseeable future, the most likely targets of genetic engineering will be endemic strains to which a unique gene or genes are added or deleted. Predictions of the behavior of such strains when reintroduced into environments similar to the original source are simplified because of considerable knowledge of the natural history of the native organism. Comparative behavior of modified compared to natural microbial strains can be approached experimentally in contained conditions and should describe the expected behavior in natural situations.

C. Planned introduction of microorganisms into the environment: critical scientific issues

Anne K. Vidaver, Department of Plant Pathology, University of Nebraska, Lincoln, NE 68583

This presentation raises questions of research needs and issues. Underlying assumptions are that only beneficial or useful microorganisms will be 'released'; that extensive laboratory and contained experiments will have been done prior to introduction and live microorganisms can be confined within the areas of introduction. Evidence to support these assertions will be presented.

Critical needs for progress in this area include: (1) Recognition that the nature of the product introduced into the environment is of primary significance, not how the organism was genetically altered or modified. (2) Recognition that microorganisms are introduced into the environment as part of our daily lives. (3) Classification of microorganisms into categories, include a GRACE (Generally Regarded as Compatible with the Environment) list. For example, most microorganisms used by humans in food and agriculture would be on such a list. (4) Categorization of 'new' traits transferred to microorganisms: all are not equal. (5) Revision of the Plant Pest Act. Interpretation by the USDA is now so broad that almost any microorganism may be a 'plant pest'. (6) Development of the means to enable continuation of basic research in small-scale traditional tests with GEMs. (7) Recognition of the adequacy of the methods used for mitigation and decontamination of microorganisms. (8) Development and use of selective, narrow spectrum chemicals and biologicals. (9) Critical evaluation of appropriate regulations and attendant costs for research on GEMs in the environment.

These issues need recognition and wide-spread support among scientists, policy-makers and the public if the potential uses for microorganisms in the environment are to be realized.

Preservation and Utilization of Iowa's Natural Resources.

Soil resources of Iowa: an overview

G. A. MILLER

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Iowa's soil resources are inherently productive for plant growth because of the unique combination of favorable climate, percentage of level and gently sloping topography, and a high percentage of deep, medium textured parent materials. Nearly 60 percent of Iowa's land surface occupies slope gradients of 5 percent or less. However, accelerated erosion causes an average displacement of over 9.4 tons of soil per acre per year on cropland. The impact of soil erosion on soil productivity differs from soil to soil based on the characteristics of the subsoil and substratum of each kind of soil. Recent studies suggest that the reduction in crop yields on steeper sloping, thinner topsoil, till-derived soils are greater than for loess-derived soils on similar slopes with comparable topsoil thickness. A model categorizing subsoil properties into favorable, unfavorable, and fragile groups for plant growth will be presented.

Living resources: Strategies to maintain species diversity

D. M. WALLER

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The forests, prairies, and savannas of Iowa, like the rest of the Midwest, has been completely reshaped to suit human needs. These radical, but gradual, changes have boosted the populations of many "edge" species while decimating populations of many more specialized native species. Such changes often boost local diversity at the expense of overall diversity. Although few species have been extirpated thus far, many populations face a precarious future as the result of habitat fragmentation, isolation, and changes in the type and rhythm of disturbance. Island biogeography has produced tools for predicting the effects of fragmentation and isolation, but no similar synthetic theory exists for predicting losses in response to changes in the scale and frequency of ecological processes. To prevent gradual, but inexorable, losses of species over the next 100 years we need to recognize the importance of maintaining large and/or connected natural areas and learn how to reestablish natural patterns of disturbance.

Science Education and the Public Understanding of Science.

G. HEINLEIN, Columnist, Des Moines Register, Des Moines, IA 50304

Science speaks a very strange language these days. To the layman, it might as well be Swahili. Researchers contemplate DNA, quarks, black holes and supercolliders while the rest of us are capable of being baffled to the point of vexation by the workings of simple plumbing fixtures. It is no secret that the gap between what scientists know and everyone else can even begin to comprehend is a mile wide and growing wider by the day. That makes writing about science a great challenge, further complicated by the fact that many people seem to want their information delivered in TV news-style blips. My newspaper's goals still are the same as ever: to discover that is important, then tell our readers in everyday language, how it affects them. But each of those goals is increasingly difficult to attain. In layman's terms, how important was the discovery that the African trypanosome changes its surface protein to avoid the body's immune system? And how do we provide people with a decent understanding of plant genetics? At the Register, we constantly look for patient, articulate scientists who can help us gain perspective and also make the leap of understanding between genetic coding and the whole organism. I discovered a surprising number of researchers willing to do that a few years ago at an American Cancer Society national science writers' seminar. By asking lots of questions - and trying their patience, I'm sure - I was able to trace some new findings about oncogenes up through tumors in "nude mice" and on to some ideas about that the findings might say about cancer in people. There are numerous other examples, but my key point is that scientists and reporters - now more than ever - must collaborate in getting out the news about scientific achievements. Scientists must train themselves to think about their work in common-man terms. Reporters must redouble their efforts to ask a lot of questions, however simplistic, and not be reluctant - whenever possible, I believe - to read back portions of their text for comment by the experts whom they have interviewed. The Register always has stressed precise language; now it is more essential than ever.

SECTION PROGRAMS

Agricultural Sciences

1. Mathematical modeling of the life system of a lepidopterous pest of Iowa nurseries

C.E. Anderson, E.R. Hart, and J.C. Weatherby

Department of Agricultural Engineering, Iowa State University, Ames, IA 50011

The yellowheaded fireworm, Acleris minuta (Robinson) (Lepidoptera: Tortricidae) is an economically important defoliator of nursery plantings. Development of a management plan has been difficult because its highly complex biology and seasonal history have been poorly understood. Research conducted by Weatherby during 1976-1980 clarified the biology of A. Minuta. Based on this work, a deterministic simulation model was developed including egg hatch, larval growth and development, pupation, adult emergence, mating, fecundity, oviposition, and mortality. A first order linear growth rate function was used with a rate coefficient dependent on environmental factors and age of the larvae. A developmental algorithm as a function of larval weight was used. Survival functions were used for environmental factors and natural diseases and predators.

The development, testing, and practical application of the model will be discussed.

2. Partial revertants at the W4 locus in soybean (Glycine max (L.) Merr.)

S. M. BLOMGREN, R. W. GROOSE and R. G. PALMER

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

In a soybean population containing a suspected transposable element at the W4 locus, which conditions anthocyanin pigment production, four lines were found that create highly unstable intermediate flower phenotypes.

Preliminary hypotheses of the nature of these mutations have been made on the basis of test crosses, pedigree analyses, and phenotypic observations. These hypotheses and a molecular model will be presented.

3. Physiological characteristics of Sclerotinia sclerotiorum in response to temperature.

C. J. Daugherty

Department of Plant Pathology, Iowa State University; Ames, IA 50011

The effect of temperature upon the physiological characteristics of Sclerotinia sclerotiorum was analyzed at six distinct temperatures between 18 and 33° C. Fungal biomass, oxalic and fatty acid production, and change of pH within the growth media were determined daily for 5 days. A factorial analysis indicated biomass and oxalic and caproic acid production to be significantly different in terms of temperature and exposure length while valeric acid production was significantly different in terms of exposure length. Formic acid production and change of pH within the growth media were significantly different in terms of temperature-exposure length interaction. The relevance of temperature-induced effects of S. sclerotiorum upon field crops will be discussed.

4. Double-stranded RNA in rose displaying symptoms of Rose Rosette

R. DI, A. H. EPSTEIN and J. H. HILL

Department of Plant Pathology, Iowa State University, Ames, IA 50011-1020

Rose "rosette", a disease of unknown etiology which affects multiflora rose (Rosa multiflora, Thunb.), has been found in Iowa. Previous workers have speculated that the disease is caused by a virus; however, no virus-like particles have been observed in infected tissue. We have demonstrated the presence of putative double-stranded RNA (dsRNA) in extracts of diseased multiflora rose leaves using polyacrylamide gel electrophoresis. After digestion with DNase and RNase, three distinct dsRNA species were identified in diseased samples. Similar dsRNAs were not detected in extracts from non-symptomatic rose tissue.

5. Comparison of yellow and pink isolates of bacteria that cause tan spot of soybean

J. M. DUNLEAVY

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Curtobacterium flaccumfaciens is a yellow-pigmented bacterium that causes a disease of soybeans called tan spot. It infects soybean leaves, from which it can enter the vascular system and, eventually, infect seed. Four isolates of a pink-pigmented bacterium were obtained from infected soybean leaves collected in Iowa. All isolates produced tan spot symptoms when inoculated to Clark soybeans, and the same isolates were reisolated from infected leaves. When the yellow isolate was compared with the pink isolates, all isolates produced acid from xylose, dextrose, fructose, mannose, galactose, maltose, cellobios, inositol, and erythritol; but not from rhamnose, arabinose, sorbitol, glycerol, sorbose, raffinose, lactose, sucrose, and trehalose. All isolates produced esculin, β-glucosidase, n-acetyl-glucosaminidase, β-galactosidase, leucine aminopeptidase, serine aminopeptidase, arginine aminopeptidase, and pyroglutamic acid arylamidase. All bacterial isolates gave a positive test for carotinoid pigments, and pink isolates were identified as C. flaccumfaciens.

6. Rosette - a lethal disease of rose

A. H. EPSTEIN

Dept. of Plant Pathology, Iowa State University, Ames, IA 50011-1020

Rose Rosette a disease of roses is now known to be present in Iowa. The disease, of previously unknown etiology, is thought to be vectored by an eriophyid mite (Phylocoptes fructiphilus). Multiflora rose plants displaying symptoms of rosette disease have been found along with the suspected vector in two locations in Iowa. Infected plants have been established in the greenhouse at Iowa State University. Rosette disease has been shown to be lethal to rose and is being considered for development as a biological control for multiflora rose, a serious pest on non-cultivated lands. This paper will present symptoms of the disease and discuss plans for its development as a biological control agent.

7. Alder hybrids for short-rotation intensive culture.

R. B. HALL

Department of Forestry, Iowa State University, 251 Bessey Hall, Ames, Iowa 50011-1021

Over the last 5 years an exploratory breeding program has been centered on the European black alder (Alnus glutinosa Gaertn.). Greenhouse and field studies have been conducted on these hybrids to determine morphological traits, biomass production, and insect resistance. Hybrids involving an early-flowering selection, parents of wide geographic separation, and two other alder species (red alder-Alnus rubra and gray alder-A. incana) all appear promising.

8. Effects of random mating in F_2 populations of maize (Zea mays L.)

A. R. HALLAUER, J. COVARRUBIAS-PRIETO AND GENG-CHEN HAN

USDA/ARS, and Department of Agronomy, Iowa State University, Ames, IA 50011

Different populations are available for the extraction of inbred lines for use as parent seed stocks to produce hybrids. Selection and inbreeding usually are initiated in elite-line F_2 populations without recombination. Intermating of F_2 plants may release genetic variability and extend the range of variability. A study was conducted in F_2 and F_2 populations intermated 5 generations (F_2 Syn 5) of an unrelated and related line crosses. Information was obtained on population means from random mating, variability among S_1 progenies in the F_2 and F_2 Syn 5 populations, and estimates of genetic variability in the F_2 and F_2 Syn 5 populations. Intermating F_2 plants for 5 generations was not effective for increasing either the range of variability among S_1 progenies or the estimates of genetic variability in either cross. Estimates of dominance variance and levels of dominance decreased with intermating, but the estimates of additive variance were unchanged. Intermating of F_2 plants was not effective in changing the relative amount of genetic variability available for selection.

9. Tree planting trials on CRP sites in southern Iowa.

R. D. HANNA, J. P. COLLETTI, R. B. HALL, R. C. SCHULTZ, and P. H. WRAY

Department of Forestry, Iowa State University, 251 Bessey Hall, Ames, Iowa 50011-1021

In 1987, four types of tree plantings were established on sites enrolled in the Conservation Reserve Program (CRP). Two of the trials were species suitability trials: (1) pure block plantings of 14 species and clones, and (2) 1:1 mixture plantings of pairs taken from 3 species. The objective in these two trials is to assess biomass energy production over mid-length rotations. The third trial is a test of windbreak plantings on a terraced site interspaced with seedings of native grasses for eventual hay production. The fourth trial is with black walnut and two nurse-tree species (autumn olive and white pine) planted on a toe-slope site. Establishment techniques, initial survival, first-year tree height, and the value of these potential applications will be discussed.

10. Dispersal of the European alder leafminer in an intensive culture plantation.

E. R. HART and R. B. HALL

Department of Entomology, 407 Science II and Department of Forestry, 251 Bessey Hall, Iowa State University, Ames, IA 50011

The European alder leafminer (EAL), Fenusa dohrnii (Tischbein) (Hymenoptera: Tenthredinidae) is a defoliating insect pest of Alnus in short-rotation intensive culture (SRIC) systems grown for biomass energy production. A study was initiated in 1987 to quantify movement from infested stands to uninfested areas. Both sticky traps and potted monitor trees were set out at different heights at locations within and at distances of 0, 5, 10, and 20 m from infested stands. First generation adults occurred in sufficient numbers to evaluate movement; both location and height were highly significant. Trap catches fell off sharply with distance, few insects being trapped at distances of 5 m or greater from the infestation. Within and at the edge of the stand, increasing trap catches were found at increasing heights up into the tree canopy level. Oviposition events did not seem to fall off as sharply with distance as did trap catches. Frequent and intense rainfall suppressed the second generation adult population to a level that precluded comparisons.

11. Growth and yield analysis of soybean infected with Phialophora gregata.

HIGLEY, P. M., TACHIBANA, H., AND MARTINSON, C. A.

151 Seed Science, Iowa State Univ., Ames, IA 50011

Brown stem rot (BSR), caused by Phialophora gregata, causes significant yield loss. A study was initiated to determine the effects of the disease on soybean growth and yield. Plants of a resistant (BSR 201) and a susceptible (Pride B216) cultivar were grown in the greenhouse. At the V1 stage, hypocotyls were injected with either a viable or nonviable (control) spore suspension. Parameters measured include leaf area, height, vegetative and reproductive stages, number of nodes, branches,

leaves, and pods, shoot, root, pod,and seed weights, seeds per pod, and total seed number. BSR caused a reduction in branching, leaf number, pod weight, and *seed number in* both Pride B216 and BSR 201. Leaf area, total seed weight, and the number of full-seeded pods were significantly reduced, and reproductive stage was delayed in Pride B216 but not in BSR 201. Yield loss resulted from a reduction in seed number rather than seed size. The decreased number of branches resulted in fewer nodes, leaves, and pods which affected the number of seeds produced.

12. Water flow analysis for a dual pipe sub-irrigation-drainage system

DON KIRKHAM and R. HORTON

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Theory is developed to describe saturated water flow, from subirrigation with drainage, for a dual pipe system. The dual pipe subirrigation-drainage system consists of uniformly spaced parallel irrigation pipes overlaying but laterally offset from uniformly spaced parallel drainage pipes. The theory takes the radius of drain and irrigation pipes into account and thus, refines earlier theory of the authors whereby they hypothesized slit irrigation channels and slit drain channels of thin rectangular cross section rather than circular ones. The present theory also shows how the subirrigation water table changes when one reverses flow direction in the drain pipes to cause them to act as additional "irrigation pipes." Numerous examples for various hydraulic and sub-irrigation condition parameters are worked out.

13. Resistance of Zea diploperennis and Zea perennis to lesion nematodes, Pratylenchus spp.

D. C. NORTON

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In previous separate experiments the perennial teosintes, Zea diploperennis and Z. perennis, had promise of possessing resistance to the lesion nematodes, Pratylenchus spp. In the tests reported here, the lines were tested side by side in the greenhouse (five replications) and at the Iowa State University Hinds Farm (six replications). After 103 days in the greenhouse, numbers of Pratylenchus/g dry root (mostly P. hexincisus) were reduced by 82 percent in Z. perennis and by 98 percent in Z. diploperennis relative to the maize cultivar Mol7Ht x B73Ht. In the field, samples were taken three times after planting. Numbers of Pratylenchus/g dry root (mostly P. hexincisus) decreased from 67 to 91 percent in Z. perennis and from 76 to 96 percent in Z. diploperennis relative to Mol7Ht x B73Ht, depending on sampling date.

14. Preliminary study of amaranth yield loss caused by the tarnished plant bug [Lygus lineolaris (Palisot de Beauvois)].

D. L. OLSON AND R. L. WILSON

Entomology Department and Plant Introduction Station, Iowa State University, Ames, IA 50011

Amaranth (Amaranthus spp. L.) is being considered, by many farmers, as an alternative crop. Little is known regarding the insect pest problems these farmers will encounter. One pest that is found abundantly on amaranth is the tarnished plant bug (TPB), Lygus lineolaris (Palisot de Beauvois). The TPB feeds on meristimatic tissue or on the plants developing embryos (seeds). This feeding may result in a seed yield loss.

In one study, 4 infestation levels of TBP, (0, 10, 50, and 100) were placed in bags on amaranth heads and later harvested for seed yield. A significant seed yield loss occurred when 50 or 100 TBP were placed on the heads. In another study, TPB were placed on heads for differing lengths of time and then removed. No yield loss occurred if TPB fed for 2 weeks. If feeding occurred for 4 or more weeks, a significant yield loss did occur. This information on damage to amaranth by TPB will be useful to amaranth growers for more efficient crop production.

15. Soybean production model with and without brown stem rot

H. TACHIBANA AND K. G. BIDNE

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Brown stem rot (BSR) of soybean, caused by the fungus Phialophora gregata, continues as a major disease problem of soybeans and reduces yield significantly in the Midwest. Although resistant cultivars have been developed, their utilization has been limited because of the inconspicuous nature of the disease, highly variable yield effects, and changes in variety development from public to private sectors. Based upon 17-years of disease, yield and recent moisture stress results, a Punnett square model was developed to characterize specific conditions for 10% lower yields in the absence of BSR to 20 to 30% highly significant yield advantages with resistant cultivars when BSR is present. Current development and promotion of resistant cultivars by private companies are expected to control the disease and increase soybean production significantly henceforth.

16. Evaluation of resistance to gray leaf spot in maize

P. R. THORSON AND C. A. MARTINSON

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Gray leaf spot, a foliar disease of maize, is caused by the fungus, Cercospora zeae-maydis Tehon and Daniels. With the pathogen overwintering in plant debris and the increased practice of minimum tillage, gray leaf spot incidence and severity have increased significantly throughout Iowa. Since few sources of resistance have been indentified, research was initiated to develop an effective artificial inoculation method and to screen for possible sources of resistance. Six inoculation procedures were tested to determine which method would produce optimal, uniform disease development. Five tropical populations (day length adapted for the Midwest) were observed to identify any resistant plants. Also, 75 open pedigree, single cross hybrids were evaluated for disease severity on a specific leaf per plant and disease severity per plot (16 plants, 3 replications). The methods utilizing spores produced on modified V-8 medium and hyphal fragments produced in a fermentor resulted in optimal disease. Large differences in disease severity were evident, but no immune plant was found.

17. The relationship between molecular genetic diversity and hybrid vigor in maize (Zea mays L.)

E. A. LEE, M. LEE, E. B. GODSHALK, and K. R. LAMKEY

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Maize breeders typically classify inbred lines into heterotic groups on the basis of pedigree and empirical evaluation (testcrossing). Data from inbred line diallels and testcross trials were used to test the potential of using molecular "fingerprints" (restriction fragment length polymorphisms, RFLP's and allozymes) to assign inbred lines to heterotic groups. Inbred lines were assayed at 35 RFLP loci and 20 allozyme loci. The molecular data were used to calculate several measurements of genetic diversity among the inbred lines.

The objectives of the study are: 1) to determine if a relationship exists between genetic diversity at the DNA level and hybrid vigor, and if such a relationship exists, 2) to investigate the utility of molecular data for assigning inbred lines into heterotic groups.

18. Genetic studies of new mutations in a genetically unstable line of soybean (Glycine max (L.) Merr.).

S. M. BLOMGREN, R. W. GROOSE, B. R. HEDGES and R. G. PALMER.

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

Several new mutations have been recovered from a soybean population suspected of containing a transposable element. These new mutations include four chlorophyll-deficient lines and three lines with necrotic root systems. Preliminary genetic analysis of the chlorophyll deficients indicated that three of the lines with yellow leaves were aberrations involving the same chromosomal region. The fourth chlorophyll-deficient was produced by an independent mutational event. Preliminary analysis of the plants with necrotic roots suggested that these mutants were allelic. Further genetic analyses are being conducted to characterize better these mutants.

Anthropology

19. The political transformation of Burmese Buddhism

C.K. MAHMOOD

The use of indigenous tradition as a form of political statement and a medium of political action occurs primarily under conditions of cultural duress such as that imposed by colonization. In Burma, the Buddhist religion was reinterpreted to accomodate new socialist and anti-British sentiments, while the Buddhist order of monks became actively involved in political protest. The syncretic religico-political order which emerged must be considered in light of both its native and Western roots, which preclude easy accomodation to Western political categorization. Likewise, anthropology must widen its disciplinary focus to include the political dialogue that takes place between non-Western and Western traditions if it is to remain relevant in the contemporary global situation.

20. The rescue excavations of two Late Archaic sites in the Marks Bay Park Reserve, Sault St. Marie, Ontario

M. L. ANDERSON

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Two archaeological sites, from the Late Archaic period, are examined in this paper. The sites are located in the Marks Bay Park Reserve, approximately 15 km. west of Sault Ste. Marie, Ontario. The purpose of the excavations are two-fold. Since the sites are located on sand beach ridges in a riverine context, the first objective was to rescue the sites from destruction due to erosion by the St. Marys river. Using the archaeological information gained during three seasons of field work and the description and analysis of the information, the second objective was to study the settlement and activity patterns of the occupants.

21. Cahokia's dispersed farmstead communities

M. W. MEHRER

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Recent fieldwork in the American Bottom has yielded a large amount of new data pertaining to the farmsteads that surrounded the mound centers there. Much of this new data has been synthesized in a new settlement study of building, household, and village organization. Trends of small-scale settlement paralleled changes at nearby mound centers during late prehistory (AD 950-1400). Regional population nucleation changed small-village organization and the disposition of the rural farmsteads.

These changes were accompanied by intensification of local, regional, and interregional communications and exchange networks yielding an increasingly complex hierarchical settlement system. The chronological patterns of development have strong implications for the way that large-scale social and economic fources incorporated small-scale settlements in Cahokia's regional networks. These implications are discussed using the results of the farmstead settlement study as supporting evidence for a model of late prehistoric settlement trends in the American Bottom.

22. Archaeological use of an avian comparative skeletal collection

J. L. CORDELL

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The Iowa Office of the State Archaeologist is building an avian comparative skeletal collection. In 1988, the collection consists of 215 specimens, representing 14 orders, 34 families and 87 species of birds. The collection is being built by salvaging dead birds under federal and state salvage permits. The collection will enable archaeologists to identify avian remains recovered from archaeological sites. Identifying recovered avian remains will aid investigators in answering such questions as: the environmental conditions during, and season of occupation; the range of area exploited; the diet of the people who occupied the site; and what birds were exploited for ornamentation and ritual use. Correct identification involves overcoming problems of osteological similarities among families of birds, variations in a single species, and stages of bone development. Assistance in building the comparative collection is requested from wildlife refuges and raptor rehabilitation centers, where dead birds may be salvaged.

23. A typology for Nebraska phase shell tools.

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Results of recent investigations on freshwater mussel shell tools from sixteen eastern periphery Nebraska phase archaeological sites are given, for developing a tool typology. The paper combines research results with a literature review to create a coherent tool typology, with definitions of classes based on form and usewear. As with stone, bone, and pottery, shell tools reflect subsistence strategies, and at the same time manifest symbols of social and cultural identity. Subsistence activities are demonstrated by corn shellers, spoons, and hoes; scrapers and mat needles indicate special function economic strategies. Decorative articles such as beads, pendants, and gorgets reflect possible ties to other cultural groups.

24. An interdisciplinary approach to northeastern Iowa archaeology

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The Turkey River Basin encompasses a five-county area in northeastern Iowa. The Office of the State Archaeologist conducted an archaeological overview and survey of the region with support from the Iowa DNR and State Preserves Board. Paleoenvironmental background studies focused on the development of the Turkey River terrace system and on regional vegetation history. Archaeological work included extensive examination of private collections in order to discern regional patterns of land-use through time. Late and Terminal Archaic sites (Durst phase and Red Ocher "culture") were examined in detail, as was the historic site of Fort Atkinson and its environs. Preliminary correlations between environmental and cultural change are evaluated. Integrated investigations of human paleoecology in northeastern Iowa will be promoted by the regional paleobotanical and geomorphological contexts defined by this work.

25. Accidental entrepreneurs: rural development and high technology small businesses in mid Wales.

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As one of the strategies for halting the depopulation of rural Wales, the Mid Wales Development Agency supports new, high technology industry. These small firms were founded by University faculty, or by immigrant engineers attracted across the border from England. The latter are often redundant former employees of major corporations who have been "pushed" into entrepreneurship. Some are voluntary exiles attracted by the vision of the good life in a scenic, rural environment. The locational characteristics usually associated with high technology industries--good amenities, high accessibility, and concentrations of business services and company headquarters--do not account for the emergence of an electronics industry in Mid Wales. The number of new jobs created by the industry is likely to remain small since few of the "accidental" entrepreneurs aspire to building large companies.

26. Tensions in commercial development in an industrializing Welsh new town

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Acceleration of entrepreneurial ventures in Newtown, Wales is one goal of the promotional efforts of the Mid Wales Development (MWD) Agency whose general objective is to improve the region's economy. However, various shopkeepers are dissatisfied with the level and type of support offered to the business community by MWD. These complaints ranged from inadequate facilities to lack of marketing expertise and inappropriate business advice. Among the nine local business support agencies, the Welsh Craft Council (WCC) has the greatest potential for assisting small craft business start-ups. However, reduced budget and a negative local reputation of the MWD, with which WCC is associated, hampers its effectiveness. Partly as a result of these tensions between the development agencies and the transience of the population, many business ventures fail, few succeed, and others relocate to more prosperous regions.

27. The political and social effects of the governmental centralization in a rural community

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In 1974, a Reorganization Act centralized the boroughs of Montgomeryshire, Radnorshire, and Breconshire, to form Powys County, Wales. The political and economic powers of Montgomeryshire were distributed into District and County councils, located in Welshpool. District councillors also acting as town councillors silently insures Montgomery of financial and governmental support for most requests. However, despite the financial and political benefits the Reorganization Act provided Montgomery, the townspeople claim that the town council has lost its autonomy and is not attuned to the public's needs. This is a partial consequence of the growing separation between the town councillors and the leadership of local voluntary social organizations, as well as the decreasing prestige of the councillor's positions.

28. Old church, new church and cult in mid Wales

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In Newtown, Wales, the religious community is dense and diverse, with fourteen church buildings and fifteen different denominations. A prominent distinction exists between the old churches, the new churches, and the cults. The older churches are bonding together in an ecumenical movement, organized under the feckless Newtown Council of Churches, but have found little respite from their slow decay. The new churches and the cults' success stems from two general qualities: an evangelical style of recruitment and an encompassing program of services. Although individuals from various churches may socialize well, when it comes to mixing religious attitudes, beliefs, or practices, the "ecumenical" feeling tends to fall into sectarian grievances.

29. The problems of recreational facilities for older youth in Newtown, Wales

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The adequacy of youth recreational facilities in Newtown, Wales has recently been brought into question. Newtown has been targeted as a development center by the Mid-Wales Development Board, and has experienced both a rapid rise in population and an increase in juvenile crime. The recreational interests of Newtown's young people is compared to and contrasted with the reality of what the town offers them. This study shows there is a lack of recreational facilities that fit the interests of older youth, aged approximately 16-20 years. The official youth clubs, and the voluntary youth groups focus on fulfilling the interests of younger children. The pubs better fulfill the interests of 16-20 years olds, but are not always accessible to young people. The lack of recreational facilities is particularly acute for young women, who often feel uncomfortable in the male-dominated youth groups and pubs. Recreational facilities that better fit the interests of older youth are both feasible and advisable.

Biotechnology

30. Isolation and *in vitro* synthesis of a polypeptide specific to mitochondria of the Texas male-sterile cytoplasm of maize.

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Mitochondria of maize with the Texas male-sterile (T) cytoplasm synthesize a 13-kDa polypeptide (p13) that is not found in normal maize mitochondria. Texas male sterility is associated with susceptibility to race T toxin produced by the fungus *Helminthosporium maydis*; indirect evidence implicates p13 in the causation of both male sterility and toxin susceptibility. As a first step in determining how p13 might affect mitochondrial function, we have purified it and prepared antibodies to it. Using these antibodies, we have confirmed that p13 is absent from normal mitochondria and that it is present in reduced amounts in T-cytoplasm plants whose fertility has been restored

by nuclear genes. The protein is present in the inner membrane fraction of mitochondria and behaves as an intrinsic membrane protein. Synthesis of p13 can be detected when RNA isolated from T mitochondria is translated in vitro. This synthesis is arrested when a clone of the URF13-T gene from T mitochondria is hybridized to the RNA, confirming previous evidence that this gene codes for p13.

31. Expression in yeast of a gene from Texas male-sterile maize mitochondria.

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Mitochondria of maize with the Texas male-sterile cytoplasm contain a unique 13-kDa polypeptide, p13 (see C. Lin et al., this meeting). In order to assess its effects on male sterility and susceptibility to race T toxin, we are introducing p13 into mitochondria of other organisms. Chimeric genes that code for p13 attached to the mitochondrial targeting sequences of two yeast mitochondrial proteins have been introduced into the nuclear genome of the yeast Saccharomyces cerevisiae. Detection with antibodies to p13 shows that the fusion proteins are translated and targeted to mitochondria; approximately half the fusion protein is processed to a polypeptide the same size as p13, presumably by removal of the amino terminal targeting sequence. Yeast mitochondria containing p13 are not affected by race T toxin. Mitochondrial fractionation shows that p13 is mainly located in the outer mitochondrial membrane. We are attempting to identify targeting sequences that will be effective in delivering p13 to the inner membrane.

32. An Immunological and Fluorescence Microscopy Study of Tcms Corn Mitochondria

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An immunoelectron-microscopy technique has been developed to localize and visualize a mitochondrial protein gene product (PT_{13}) in the outer membranes of mitochondria of Tcms corn. In addition, a cationic potential sensitive fluorescence dye (DiOC6) has been used to study the response of the mitochondria to a fungal pathogenic T-toxin and respiratory inhibitors. These techniques have helped to understand the fate of mitochondria in tapetal cells of Tcms anthers as a function of premature tapetum degeneration that leads to male sterility.

33. Identification and genetic localization of loci affecting yield and other agronomic traits in maize

D. Grant, D. Blair, W. Behrendsen, R. Meier, B. Beavis, S. L. Bowen, R. Tenborg, J. Martich, R. R. Fincher, S. Smith, O. S. Smith, J. Keaschall

Pioneer Hi-Bred Int'l., Inc., Johnston, IA 50131

We have begun a series of experiments to use Restriction Fragment Length Polymorphisms (RFLPs) to identify and localize to chromosomal segments the major loci affecting agronomically important traits in Z. mays. As an initial step in this study, we are examining the cross B73 x Mol7. This cross was chosen because 1) the two parental inbreds differ at many RFLP loci, 2) the cross is extremely heterotic and 3) F2 progeny from this cross would be expected to show segregation for many important traits. Major effect loci will be mapped by correlating the presence of parental RFLP alleles in individual F2 plants with the family means for agronomically important traits measured in F3 families and F4 top crosses derived from these plants. This data, along with the RFLP map we have prepared, will give a minimum estimate of the number of major genes which condition these traits, along with their approximate chromosomal location.

34. Evaluation of Kanamycin, Hygromycin and Chlorsulfuron for selection of genetically transformed cells in plants.

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Genetic transformation of maize and tobacco via microprojectile bombardment of cells occurs at low frequencies which necessitates the use of a period of enrichment to allow recovery of transformed cells, tissues and plants. We have determined growth conditions and levels of the two antibiotics, kanamycin and hygromycin, and the herbicide, chlorsulfuron, which might be appropriate for transformation experiments with maize (Zea mays L.) callus cultures. Although > 500 mg/l of kanamycin and 50 mg/l hygromycin arrest growth, inconsistent growth, and "escapes" in control cultures of transformation experiments have confirmed that these two antibiotics cannot be used successfully. Chlorsulfuron, on the other hand, gives excellent and consistent growth inhibition at 1-10 ug/l at callus and regenerated plant level. Transformed tissue has been obtained via microprojectile bombardment from tobacco suspension cultures using chlorsulfuron as the selectable marker. Similar experiments are under way in maize callus cultures.

35. Scanning electron microscopic study of surface characteristics of human Enamel and Dentin: A pilot study

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Coronal dentin surface is considered to be a replica of the external enamel surface. Differences between these two surfaces will reflect if these changes are due either to developmental processes of the tooth or to the functional role of the surfaces. Scalloping of the dentino-enamel junction (DEJ) has been reported in several studies. These irregularities have been suggested to strengthen the union between the enamel and the dentin.

The purpose of this pilot study was to observe and compare the scalloping pattern of the enamel and dentin surfaces in different regions of the tooth crown. Four posterior human teeth from young adults were prepared and coated with Au+Pd for observation under scanning electron microscopy. Micrographs were taken at three different levels of the crown: The gingival 1/3, the middle 1/3 and the occlusal 1/3. The expected scalloping pattern was observed in the enamel crown. It was found to be more priminent at the different teeth. If this pattern is also found at the DEJ, it can be concluded that the bond between enamel and dentin is not only biological but also biomechanical. It was just the opposite of that on the external surface of enamel. More scallops were seen in the dentin at the DEJ in the occlusal 1/3 and the fewest were observed in the cervical 1/3. This might suggest that the mechanical bonding between enamel and dentin is strongest in the occlusal 1/3 and weakest in the cervical 1/3.

36. Surface examination of vitallium and titanium endodontic implants using scanning electron microscropy

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This study examines the surfaces of Vitallium (Vi) and Titanium (Ti) endodontic endosseous implants. Four Cynomolgus monkeys underwent root canal instrumentation in all central incisors. Osseous preparations were done through the tooth near the apex and 2-6 mm into bone. Tapered, size 50, endodontic implants of Vi and Ti were inserted. Three months after the operations the animals were perfused. Specimens were processed routinely for scanning electron microscropy (SEM). From a total of 24 implants, 15 were photographed in a SEM. Examination of SEM micrographs show that the surfaces of the implants change in vivo. The pre-op surfaces of Vi implants appear rough with crevasse-like pits and machine marks. The pre-op surfaces of Ti implants looked smoother with crater-like concavities of many sizes and subtle valleying. After three months in vivo the Vi surfaces have blunter edges and small pits are smoother with large ones partially filled. Ti surfaces are valleyed with sharp longitudinal ridges. Both metals have cell attachments and evidence of some contamination.

37. Application of electron microscopy techniques in urinary tract stone analysis

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Several techniques ranging from chemical analysis to x-ray diffraction were applied to study urinary tract stone composition. Nevertheless, all these methods have advantages and disadvantages. In this study, the Hitachi S-570 Scanning Electron Microscope equipped with a backscattered electron detector, and Kevex 8000 Energy Dispersive (EDS) and Microspec WDX-2A Wavelength Dispersive (WDS) X-ray Microanalysis systems was used. Ten stones from ten different patients were surgically extracted for analysis. Three random sites were selected; each site was first scanned with the SEM and then observed with backscattered electron imaging (BSE). Signal mixing techniques (SM) were applied to each site by mixing the signals of SEM and BSE 50%, 75%, and 100%. Each location site was analyzed using EDS and WDS, and elemental distribution maps were applied to each site. Stone structures with SEM were found to have layered structures. Calcium was more prevalent in the honeycomb matrix, while phosphate and magnesium were more prevalent in the crystalline structure. Although potassium, sulfur, iron, and zinc were found in the stone, the relationship of these elements remains unknown at the present time. Therefore, combining electron microscopy techniques such as SEM, BSE, SM, EDS and WDS elemental distribution mapping will enable us to understand stone formation, and to find precise content and nature of stones which will lead to better diagnosis and treatment.

38. Comparative electron microscopic study of "dental chewing sticks"

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Our literature search showed that no electron microscopy work has been performed to characterize dental chewing sticks. The purpose of this project was to characterize the physical and chemical components of the chewing sticks using comparative electron microscopic techniques including scanning electron microscopy (SEM), x-ray fluorescence (XRF), and energy & wavelength dispersive x-ray microanalysis (EDS & WDS). Hitachi S-570 SEM, Tracor Northern XRF, Kevex 8000 EDS, and Microspec WDX-3PC WDS were used. Samples were obtained from Lebanon, Saudi Arabia and Nigeria. SEM study reveals that there are rhombohedral and round shape crystals in the samples from Saudi Arabia and Lebanon. The round objects abound in the lignified cell structures. X-ray microanalysis study shows the rhombohedral crystals are composed mainly of calcium and round objects contains both calcium and sulfur. XRF study indicates presence of calcium, phosphorous, and fluorine. However, rhombohedral crystals are not observed on samples from Nigeria.

Ca, P and F are all important components of tooth structure, and presence of these chemicals support the theory that the chewing sticks offer more than mechanical cleansing since the nature's toothbrush is used without a toothpaste.

Botany

39. Kernel smut disease of big bluestem

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Kernel smut of big bluestem is caused by Sphacelotheca occidentalis (Seym.) Clint. This fungus is perennial in its host and produces smut sori and spores in the florets of dwarfed culms. There is no record of the disease in Iowa prior to 1978, but since then it has been found every year in native prairies in northwest Iowa and may be increasing its distribution in the state.

Disease epidemics in natural grasslands are poorly investigated. Some features of the bluestem/S. occidentalis system make it a good model for future study. The host is widely distributed and disease effects on host reproduction are dramatic and easily assessed. Field and laboratory studies concerned with dissemination, sites of invasion into the plant, and disease development are in progress.

40. Fungi of Big Bend National Park area, Texas

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Fungi of the desert areas of the Southwestern United States and especially of the Big Bend area of Southwestern Texas are not well known. Saprobic species have been opportunistically reported, particularly the unusual Gasteromycetes of this region. Parasites of the native plants, with the exception of the rusts, have been only sketchily observed and recorded. Botany Club trips to Big Bend National Park in early spring of alternate years since 1979 have given us an opportunity to work intensively, albeit briefly, with the fungi of the park. This report will deal with the fungi we have found, with emphasis on the fungal parasites of species of Yucca, Agave, Dasylirion, and Nolina.

41. A survey of the vascular flora of Black Hawk County, Iowa

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The vascular flora of Black Hawk County, Iowa was studied in the field and from herbarium specimens during 1981-84. The documented flora of native or naturalized plant species known to grow or to have grown independent of cultivation consists of 826 species representing 399 genera and 98 families. Eighteen species are included on the Iowa list of threatened and endangered species, including two species unique to the state: Carex leptalea Wahl. (Cyperaceae) and Dalea villosa (Nutt.) Sprengel (Fabaceae). Another rare species, Rubus hispidus L. (Rosaceae) is also found only in Black Hawk County in Iowa. Significant habitats include sand prairies, floodplain forests, upland forests, marshes and ponds.

42. Advantages of sequential processing when using microcomputers with large textual data banks.

L. J. EILERS

Biological and other data are frequently collected and stored as alphanumeric text in a microcomputer. Field collection data for organisms are of this type. Often these data consist of sets of related pieces of information (fields) collected at the same time (binomial, locality, date, etc.), and collectively forming one data entry, or record. A particular record field may be of uniform length for all records, but very often varies considerably in length.

Most microcomputers allow data to be processed either sequentially or in random access format. In sequential processing the various fields are stored end-to-end and separated by a marker. The fields can be of any length, subject to the overall restriction on total record length. Random access processing, generally used by commercial applications programs, require that the length of each field be designated beforehand. If the length of the longest possible data piece is chosen, then shorter entries in the same field will be extended by padding with blanks. Thus, much space is used simply to store blanks. Sequential processing takes more time, but where storage space is scarce it has distinct advantages over random access processing.

43. The status of Orchidaceae in Iowa

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As a result of research conducted in the early 1970's, David Niemann (PIAS 93:24-34) published the distribution of the 25 species of orchids he determined to be, or were, native to Iowa. Since the completion of his research, six new species or varieties have been discovered in Iowa, or described from the state as a result of taxonomic refinements. Additionally, many new county records have been established.

The status of all orchid species in Iowa will be discussed, with special emphasis given to the following species new to Iowa: Cypripedium calceolus L. var. parviflorum (Salisbury) Fern., Platanthera lacera (Michx.) G. Don ex Sweet, P. praeclara Sheviak & Bowles, Spiranthes lucida (Eaton) Ames, S. magnicamporum Sheviak, and S. ovalis Lindley.

44. Classification and conservation status of Iowa fens

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Three types of fens are represented in Iowa as classified by nutrient content of seepage water. Nutrient-poor ("poor" or "hypotrophic") fens have pH between 5.5 and 6.5; the only known Iowa example is Pilot Knob Bog on the central Des Moines Lobe. Nutrient-rich ("rich" or "mesotrophic") fens have pH between 6.5 and 7.5; over 60 examples are known from the Iowan Surface, northwestern Des Moines Lobe, Paleozoic Plateau, and Mississippi Alluvial Plain. Very nutrient-rich ("hypertrophic") fens have pH $\geq$ 7.5: 16 examples are known from the northwestern Des Moines Lobe.

Grazing is the leading land use on and around fens, often exposing them to severe trampling. Cropland is the second most common surrounding land use; drainage and apparent herbicide damage are noted threats. A small number of fens are adjacent to mining operations. Seven fens in Iowa are owned by conservation agencies, two of which are disturbed by mining or past heavy grazing.

45. Rare plant discoveries from Iowa fens during 1987

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In 1987 over 75 potential fen sites in Iowa were inventoried for rare plant species. Forty-one new records on 18 sites in 8 counties were found in Iowa Surface fens. Highlights include the first Iowan Surface collections of *Rhynchospora capillacea*, *Scleria verticillata* and *Triglochin maritima*, plus 3 new sites for *Salix pedicellaris*. Sixteen new records on 7 sites in two counties were found in Des Moines Lobe fens. This included 1 new site for *Platanthera hyperborea* and 2 new sites for *Berula erecta*. One site contained Iowa's largest populations of four rare species including a huge population of *Scleria verticillata*. Five new records were found on a Paleozoic Plateau fen. This fen produced a state record, *Spiranthes lucida*.

46. Population structure of the threatened plant, *Aconitum noveboracense*, in Iowa habitats.

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Aconitum noveboracense is a perennial herb that is federally classified as threatened. It occurs on algific talus slopes and related features of periglacial origin in northeast Iowa. In the first year of a long-term study, a total of 8 populations of *Aconitum noveboracense* were sampled from 4 of the substrate types upon which it occurs. Permanent demographic plots were established and a variety of measurements were made, including plant size and stage class, genet size, flower number, bulbil number and extent of herbivory.

Differences in population stage class structure, amount of vegetative reproduction, flower production and bulbifery were observed among sites. Differences in these parameters were also apparent in a comparison between shaded and sunny microsites within one of the localities. These results will be compared to those obtained previously in four years of similar study in Wisconsin. Implications for management will also be discussed.

47. Use of Radioisotope Labelling Technique to Study Pollination and Microsporogenesis in Milkweeds (Asclepiadaceae)

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A radioisotope labelling technique using $^{14}CO_2$ was used to mark pollinia in milkweeds to study insect pollination. Following a 9-hour incorporation, pollinia were removed and fixed as flowers opened over the next 12 days. Some pollinia were air dried and mounted on slides while others were processed to resin and sectioned. All slides were coated with autoradiographic emulsion, exposed and processed for viewing. Whole pollinia from flowers that were in bud stage at time of incorporation, showed greatest label, whereas pollinia from progressively older flowers showed less to none. In sections, the greatest amount of label was over pollen cytoplasm and less over pollen walls and pollinium sacs. Some of the heavily labelled whole pollinia were acetolyzed, and sectioned for followup autoradiography. No label was observed over pollen walls or sacs. These results have important implications about events in the anther and the role of the tapetum, as well as supporting use of this technique to track dispersal of pollinia by pollinators.

48. Development of the ear and tassel of two annual teosintes

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The ontogeny of ears and tassels in two annual teosintes, *Zea mays* ssp. *parviglumis* and *Z. mays* ssp. *mexicana* was examined using SEM and LM. The data indicate two distinct developmental patterns in these teosintes: one characteristic of the male inflorescence and similar to that previously described in *Z. diploperennis* (Sundberg and Orr, A.J.B., 73: 1699-1712, 1986); the other the female inflorescence that follows the pattern previously described as "mixed" in *Z. diploperennis* tassels. The results of this study further supports the idea that a teosinte tassel is ancestral to the maize ear.

49. Effect of repeated acid exposures on cuticle permeability

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The permeability to acid of the waxy cuticle covering leaves may be an important factor in the susceptibility of a plant to acid precipitation. The permeability of isolated cuticles was determined by placing the cuticle between pH 7 deionized water and pH 4 sulfuric acid. The neutral drop gradually became acidic due to acid moving through the cuticle. The permeability as a function of time was calculated from the pH. This procedure was repeated and the permeability recalculated. Cuticles were treated in one of three ways: 1) two permeability measurements were made without further treatment between measurements, 2) the cuticle was soaked 24 hours in pH 7 deionized water between measurements, or 3) the cuticle was soaked for 24 hours in pH 10.5 KOH between measurements. During the initial acid treatment, the permeability was generally very low at first, then increased greatly. During the second treatment there was no such increase, and the permeability was near that calculated during the latter portion of the first treatment. Soaking in water or base did not change this pattern. The permeability of isolated pear leaf cuticle to acid is initially low, but if the cuticle is exposed to acid for a sufficient time, the permeability can greatly increase, apparently irreversibly.

50. The relationship between inflorescence size and self-pollination in the milkweed, Asclepias syriaca.

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We estimated the amount of self-pollination occurring on umbels of various size in Asclepias syriaca. Estimates were made by comparing the total number of pollinia insertions on emasculated umbels (where only outcross insertions can occur) to control umbels (where both outcross and self insertions can occur). Over all umbel sizes we estimated that 36% of inserted pollinia were of self origin. Self-insertion levels were highest for smaller and larger umbels and lowest for intermediate size umbels. This paralleled the level of removals per flower (a measure of pollinator visitation) which was low for smaller and larger umbels and high for intermediate size umbels. Thus self-pollination decreases as the pool of self-pollen available on the umbel decreases. For larger umbels, the loss of pollinia due to self insertion and the lower levels of removals per flower act in concert to reduce the total number of pollinaria donated to other umbels. Consequently, male function is greater for umbels of intermediate size.

51. Paraveinal mesophyll in a goldenrod, Solidago canadensis: First report from the Asteraceae.

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Paraveinal mesophyll (PVM) is the current term for a median cell layer distinct from palisade and spongy regions in some leaves. PVM has been described in most detail from Glycine max (Leguminosae), and shown there to be distinctive in its development, anatomy, and function. Other legumes, and some taxa of a few other families, reportedly have PVM or a similar layer, but descriptions are unsatisfactory. We have found PVM in the common goldenrod Solidago canadensis (Tribe Astereae). Freehand and resin sections, and clearings showed PVM similar to that of Glycine in position and appearance, but with no evidence of precocious maturation or protein accumulation during flowering. PVM in Glycine extends just beneath the minor veins and vein endings, where abaxial bundle sheath cells are contiguous with it. In S. canadensis, in contrast, PVM abuts the median bundle sheath cells of these vein orders except at vein endings, where bundle sheath cells protrude and become part of the PVM layer. Our observations indicate a true PVM in S. canadensis, the first report from Asteraceae, but the cited anatomical differences from Glycine reflect independent PVM evolution in the two families.

52. Lens morphology in seeds of Mimosoideae (Leguminosae).

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The lens is a variously developed structure of legume seeds distinct from hilum and micropyle. Experimental evidence from papilionoid legumes has shown that H_2O enters the lens to initiate germination. In Mimosoideae, a few observations long supported the generalization that there is no lens. Gunn (USDA Tech. Bull. 1681.1984), however, concluded from examining intact seeds that a lens occurs in over than 50% of the taxa. We examined seeds, from herbarium specimens and botanical gardens, of 16 species from 14 genera representing all 5 mimosoid tribes. Scanning electron microscopy was used to observe intact and razor blade-sectioned seeds. A few species seemed to lack a lens, but in most it was a specialized area of the testa. We found variation in lens size, shape, and relationship to underlying vascular bundle, but it was less than in Caesalpinioideae. In some mimosoid species, the lens was of the "pop-off" type, which offers indirect evidence that it allows H_2O to enter the seed. This study verifies Gunn's conclusion that most mimosoid seeds have a lens, and it provides structural details.

53. Lens morphology in seeds of Caesalpinioideae (Leguminosae).

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The lens (boss, strophiole) is a variously developed structure of legume seeds distinct from the hilum and micropyle. Experimental evidence from papilionoid legumes has demonstrated that H_2O enters the lens area first to initiate germination. In the Caesalpinioideae, a few existing light microscope observations support the generalization that no lens occurs in this subfamily. We examined seeds, obtained from herbarium specimens and botanical gardens, of 13 species from 13 genera representing all 5 of the "Groups" that approximate tribes. Scanning

electron microscopy was used for intact and razor blade-sectioned seeds. A few species lacked a lens, but in most it was a specialized area of the testa of various sizes, shapes, and relationships to the underlying vascular bundle. In some species the lens was a delicately attached lid, which popped off easily and provides strong indirect evidence that the lens is a primary site of H_2O entry. This study has shown that, contrary to current opinion, a lens is a common feature of seeds of Caesalpinioideae.

54. Cuticular crystals in Stylosanthes (Leguminosae) leaflets

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In developing leaflets of Stylosanthes guianensis (Aubl.) Sw., twin prismatic calcium oxalate crystals form in vacuoles of epidermal cells which later die and collapse leaving the crystals embedded in cup-like accumulations of cuticle and cell wall material. Adaxial crystal cells are located directly above conical cells which, in turn, are interspersed among smaller multiple layered palisade parenchyma. Abaxial crystal cells are located beneath large horizontally branched cells occupying the lowermost level of mesophyll. Spongy parenchyma occupies the middle mesophyll above the two-dimensional layer of branched cells. Formation of abaxial crystals and differentiation of the branched cells of the lowermost mesophyll occur simultaneously. Adaxial crystal formation begins later and parallels differentiation of the conical cells. Cuticular crystals are known from other legumes. But, to our knowledge, this is the first report where crystal development, involving cell death and collapse, is correlated with specialized mesophyll cells.

55. Iowa liverwort distribution extensions

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Several extensions of Iowa liverwort and hornwort distributions have been identified in the past three years. Over 100 county records have been collected, nineteen of these in Guthrie County. The xerophytic Riccia austini Steph., Riccia dictyospora M.A.Howe and Riccia hirta (Aust.) Underw. were discovered at Gitchie Manitou State Preserve in Lyon County and are new additions to the state flora. There are now sixty three hepatic species presently known for Iowa.

56. The genus Lindernia All. (Scrophulariaceae) in the New World

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The genus Lindernia is represented in the New World by eleven species in six sections. It has been postulated that the genus falls naturally into three main geographical groups - Asia, Africa, and the New World; testing the hypothesis that those taxa native to the New World indeed form a natural group provided the basis for this study. More than 5000 herbarium specimens from 26 institutions have been examined.

Six of the species are in Sect. Brachycarpae (Benth.) Philcox, and the center of distribution of this section is in the New World. One species, also native to the New World, is in Sect. Lindernia; the four remaining species are introductions from the Old World and are in various other sections. One of these, L. viscosa, was not known from the New World prior to this study. The species will be compared and their sectional affinities and geographic ranges briefly discussed.

57. Ada Hayden

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In the sense that Pammel was father of the state park system, Hayden bequeathed us the state preserves. The first woman Ph.D. (1918) from Iowa State, she was a member of the faculty from 1918 until her death in 1950. The establishment of the first preserves, those now called the Hayden and the Kalsow prairies, in the early 1940's, are a direct result of her efforts. Subsequently as a member of an IAS committee charged with finding and inventorying prairie fragments deserving preservation, she described some 22 areas in 10 counties. That publication (IAS Proceedings, 1946) remains a reference for current conservationists.

Hayden was curator of the Iowa State Herbarium, 1932-1950, and contributed immeasurably to its development. It is presently proposed to name this research facility the Ada Hayden Herbarium.

Hayden's floristic studies of the lake region in northern Iowa are perhaps presently the most authoritative for any part of the state.

58. The taxonomic status of Lindernia saxicola M. A. Curtis (Scrophulariaceae), a candidate for inclusion in the U. S. Fish and Wildlife Service List of Endangered Plant Species

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Lindernia saxicola occurs in cracks in rocks in mountain streams in the southern Appalachians. It has always been thought to be extremely rare, and has been known from only three sites.

It has long been recognized that Lindernia saxicola closely resembles Lindernia monticola Muhl., a more

common granite outcrop species in the SE U.S. The two species have historically been separated by the presence and size of cauline leaves, length of the pedicels, size and shape of the capsules, and phenology. A comprehensive study of herbarium specimens has shown that the characters previously used to separate the taxa are inaccurate, with measurements overlapping between the two taxa. Field studies in Alabama have shown that a great deal of intermediacy exists in the "Lindernia saxicola" population there. Greenhouse studies show that morphological changes can be induced by changing conditions. Therefore, the conclusion is made that L. saxicola should be treated as a synonym of L. monticola.

59. Soil fungi of selected prairie sites in central Iowa.

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In soil mycoflora studies of virgin and restored prairie soils in central Iowa, over 450 species of soil fungi were identified. The fungal community of tall grass prairie soils appears to be distinctly different from the soil fungi of other grassland communities worldwide.

Sampling at intervals during the growing season provided data concerning effects of burning and seasonality on the soil fungal community.

Fungal species can be grouped into three basic categories: 1) ubiquitons species with high frequencies and densities on all sites; 2) broad amplitude species with low densities; and 3) site specific species. Moisture and disturbance history seem to be the major factors influencing soil fungal community composition.

60. The plant parasitic fungi of Stinson Prairie--a preliminary report.

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Two years ago a research project was initiated to obtain basic information about plant parasitic fungi of the native plants of Iowa prairies. Intensive collections were made at selected prairies throughout the summer of 1986 and continued at a less intensive level in 1987. Additional observations will be made this summer in some sites.

Stinson prairie in north central Iowa seems at this time to be one of the more interesting sites in terms of the diversity of plant parasitic fungi and in the number of unusual fungus species present.

Parodiella perisporioides, black mildew on Desmodium canadense, has not been observed on other prairie preserves in northern Iowa. Almost 40% of the species recorded are not listed in Gilman and Archers' 1929 paper on the plant parasitic fungi of Iowa or in the supplements of 1932 and 1949.

61. Early Wisconsinan vegetation in southcentral Iowa

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The first pollen and plant macrofossil analysis of early Wisconsinan or Sangamonian deposits from Iowa are from the St. Charles proboscidian site, and reveal both local and regional vegetation. The pollen and macrofossil-bearing deposits occur within fine-grained "late-Sangamon" alluvium. Thermoluminescence dates on the alluvial deposits range between 65,000 and 75,000 yr. B.P. Lower pollen samples indicate a prairie-like setting, with high percentages of Poaceae, Artemisia, and Asteraceae pollen, along with some Pinus and Quercus. Middle samples show high pollen percentages of Pinus, with lower but still substantial amounts of prairie taxa. Upper samples show fluctuating Pinus and prairie taxa, ending with high pine. Plant macrofossils indicate an evolving wetland community, with predominantly aquatic taxa at the base, a mix of marsh, wet prairie, and disturbed ground plants in the middle, and marsh species in the upper part. The overall vegetational reconstruction may resemble modern environments along the prairie-forest border in the Canadian prairie provinces.

62. D-lactate dehydrogenase in Chlorella sorokiniana

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Three strains of Chlorella, C. sorokiniana, C. vulgaris, C. pyrenoidosa, were tested for the presence of D-lactate dehydrogenase (LDH). LDH activity was demonstrated in C. sorokinana but not in C. pyrenoidosa and C. vulgaris. Two isoenzymes of lactate dehydrogenase were detected by slab electrophoresis. Enzyme activity at different pH values was monitored by a change in absorbance at 340 nm caused by the disappearance of reduced nicotinamide adenine dinucleotide substrate. A mixture of the two isoenzymes showed two pH optima at pH 7.5 and pH 7.9. Possible reasons for the presence of LDH in C. sorokinana will be discussed.

63. Purification of the first enzyme in the chlorophyll biosynthetic pathway from *Chlamydomonas reinhardtii*

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Plant cells start the chlorophyll biosynthetic pathway with glutamate. The enzyme involved in the first step of the pathway, a glutamyl-tRNA synthetase, has been purified from the green algae *Chlamydononas reinhardtii*. Glutamyl-tRNA serves as the precursor of δ-aminolevulinic acid, the intermediate under regulation in chlorophyll biosynthesis.

The purification procedure includes ammonium sulfate fractionation, gel permeation, DEAE ion-exchange and Blue-Sepharose affinity column chromatography, and non-denaturing polyacrylamide gel electrophoresis.

The enzyme has an isoelectric point of 4.6 and is composed of 2 identical subunits, each with a molecular weight of 32,500 daltons. The amino acid composition and partial N-terminal amino acid sequence of the enzyme have also been determined. Polyclonal antibodies have been raised and inhibit the activity of the native enzyme.

64. Early root development in nursery grown red oak seedlings

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Documentation of the formation and growth of tree root systems is essential for evaluating manipulation of root system form in efforts to enhance seedling survival and growth following transplanting. The main objective of this study was to develop a detailed chronology of root and shoot development for northern red oak (Quercus rubra L.) in the first season after germination in a nursery bed. The growth of seedlings on 4 plots in a bed was evaluated at one or two week intervals over a 26 week period. Analysis of the relationship between shoot and root growth shows that red oak seedling development follows an episodic growth pattern (alternating periods of rapid shoot growth and rapid root growth), similar to that previously reported for conifers. Results of soil analyses (texture, pH, and organic matter) indicate significant variation in soil properties among the 4 plots studied. Seedling growth data will be analyzed to determine whether differences in the amount or timing of seedling development may be related to soil characteristics.

65. Rooting hardwood cuttings of (Acer saccharinum L.)

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Hardwood cuttings of silver maple (Acer saccharinum L.) were taken from one- and two-year-old stem segments off second year coppice regeneration. The cuttings were treated with one of nine IBA solutions and one half had all buds removed. The two-year-old stem segments had better survival and produced more root biomass than did the one-year-old ones. Cuttings with buds intact also had better survival and greater root mass than cuttings with buds removed. Two-year-old cuttings were slower to initiate shoots and therefore had lower transpiration rates during the early states of root development.

66. Nuclear Condition of the Anther Tapetum in Fertile (N) and Texas-cytoplasmic Male Sterile (Tcms) Corn (Zea mays L.)

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Relatively few studies have been conducted on corn anther tapetal cell nuclear number and ploidy level in its diverse cytoplasmic lines. Although the corn tapetum has been described as being binucleate throughout microsporogenesis, our study indicates that the tapetum is a mixture of uni- and binucleate cells during and following meiosis in both N and Tcms lines. The percentage of binucleate N cells is about 60% during microsporogenesis while the percentage of binucleate Tcms cells is 75%. Tapetal cell, nuclear volume and tapetal cell size also vary significantly between both the uni- and binucleate cells in each line as well as between the two lines. The biological significance of these differences may have a direct bearing on the Tcms tapetal cells prematurely degenerating during microsporogenesis and causing the developing male cells to abort prior to pollen maturity.

67. The effects of caffeine and cytochalasin B on antheridial formation in Vittaria graminifolia gemmae

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Gibberellic acid (GA) in Knop's medium induces antheridia in the body cells of 6-celled filamentous gemmae in succession. In continuous 8mM caffeine (CF) and 15 mM GA, cell divisions are blocked and large dense bodies appear in the vacuoles. Gemmae removed from this medium after 6 days produce antheridia in all 4 body cells synchronously. A 24-hour pulse of GA during CF treatment also produces numerous antheridia after removal on day 6 to Knop's. If CF is added after day 2 to Knop's plus GA, only nuclear divisions occur. If added after day 3, both nuclear divisions and cell wall expansions occur at the differentiation sites. From 4-5 days, addition of CF results in wall formation of the initials. Preliminary staining with alizarin red S, specific for Ca^{2+}, reveals little stain in the chloroplasts and much stain around the dense bodies in the vacuoles of CF-treated gemmae. In GA-treated gemmae, the chloroplast membranes stain darkly. Cytochalasin B causes an abnormal placement of the antherial initial cell.

68. Influence of different cytoplasms on photosynthesis and related traits of soybean

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RuBP carboxylase (rubisco) is a chloroplast enzyme that catalyzes the initial step in photosynthesis. The large (catalytic) subunit is encoded in the chloroplast genome, the small subunit in the nuclear genome. Different chloroplast genomes might result in different photosynthetic rates.

Nine soybean lines, representing four different chloroplast genomes, were crossed to a common high photosynthetic parent. Reciprocal crosses did not show cytoplasmic influences on CO_2-exchange rate (CER), rubisco activity, soluble protein or chlorophyll content. The chloroplast genomes used were obviously not different with respect to genes involved in photosynthesis. Dominance for low CER was evident in the progeny of parents having large differences in CER. This effect seems to be under nuclear influence as it occurred both in the F_1s and in the reciprocal F_1s. Dominance for low CER was mainly due to low protein content.

69. Alternative respiratory capacity in soybean and pea

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The capacity of the alternative respiratory pathway was assessed in leaf and root tissue of male-sterile and fertile soybean (Glycine max [L.] Merr.) plants and in leaf, embryonic axis, and epicotyl tissue of Alaska and Progress No. 9 peas (Pisum sativum L.) by measurement of oxygen uptake in the presence or absence of KCN and SHAM. Although it had been previously reported that soybean ms1 ms1 male-steriles lacked the alternative pathway, we found that both male-sterile and fertile tissues possessed the alternative pathway. In contrast to published results that reported Progress No. 9 pea to lack the alternative pathway, both Progress No. 9 and Alaska peas were found to have a sizeable capacity for the alternative pathway.

70. Megaspórogenesis and megagametogenesis in a male-sterile, female-sterile mutant line of soybean (Glycine max (L.) Merr.)

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Ovules from sterile and fertile plants were compared at various developmental stages. Ovules from fertile plants exhibited normal gametophytes and embryo sacs. No normal gametophytic configurations were found in the 120 ovules examined from sterile plants. Ninety-eight percent of the ovules from sterile plants exhibited small, crowded gametophytes. The early gametophyte contained large unidentifiable cells with well-defined, large nuclei; at later stages dark staining, clumped nuclei were present. Ovules from sterile plants at post-pollination stages had either small 'embryo sacs' at the micropylar end of the nucellus, or degeneration of the nucellus. Total degeneration of the entire nucellus was seen at the latest stages. In two cases a slightly larger but still abnormally small embryo sac was noted, one of which contained degenerating nuclei. It is suggested that failure of development of a normal embryo sac in sterile plants of this line is due to lack of proper elongation of the megagametophyte.

71. The pollination biology of Verbena

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Three sympatric species of Verbena were investigated on the Cedar Hills Sand Prairie. The three species were Verbena stricta Vent. an upland species, V. hastata L. a wetland species, and the their putative hybrid V. X rydbergii Moldenke. The breeding system of Verbena spp. was investigated through the study of anthesis, pollen-ovule ratios, and pollinator exclusion studies. All Verbena spp. had overlapping blooming periods. Anthesis studies indicated a three day floral cycle for all species, with pollen available as soon as the flowers opened on the morning of the second day. Nectar production was continuous until the flowers abscissed. The flowers were protandrous with maximum stigmatic receptivity occurring on the third day. Pollen-ovule ratios and pollinator exclusion studies for the three species indicated facultative xenogamous breeding systems associated with early successional plant communities dependent upon generalized pollinators.

72. Some Aquatic Hyphomycetes from Panamá, Central América

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Ten species of aquatic hyphomycetes were collected from foam samples at Mayagua river at David district in the Republic of Panamá. The following species apparently are reported for the first time from this country: Anguillospora longissima, Brachiosphaera tropicalis, Campylospora chaetocladia, Campylospora parvula, Clavariopsis aquatica, Heliscus submersus, Tricladium sp., Tetracladium marchalianum, Tetracladium setigerum and Triscelophorus monosporus.

73. A Mississippian age root-bearing sandstone in Keokuk County, Iowa

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Recent investigations of Mississippian age deposits in west-central Keokuk County by members of the Iowa Geological Survey Bureau and the Field Museum of Natural History have yielded abundant fossil remains of amphibians, fish, and plant roots. The plant fossils occur in the upper sandstone and carbonaceous shale lithofacies of the newly proposed Waugh Member of the St. Louis Formation. These remains consist of internal molds of the rhizophores (roots) of large scale trees. They are assignable to the organ genus Stigmaria, but differ from the commonly occuring Pennsylvanian age Stigmaria ficoides in several respects. These fossils are significant in that

they represent the oldest known Carboniferous plant macrofossils in Iowa and indicate the presence of a scale tree swamp in this region prior to the end of the deposition of the St. Louis Formation.

74. Potentiality of silicon's phytochemical essentiality.

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Research started in 1930 on maize ear characters related to yield was interrupted by 16 years of plant breeding experience with an eastern US seed company and a pineapple company. The initial research was finally completed in 1952 as a Ph.D. thesis on these overall studies. The results, based on parent-progeny variances and on multiple and partial correlation approaches, showed many significant interrelationships between independent syntheses in the maize ear end products. A literature search uncovered the potential for siloxy- and silhydroxy-ions with their thixotropic properties to fit an hypothesis for Si requirements in plant nutrition. More recent technological developments of silicon's phytoelectrical properties permit the original hypothesis to be amplified into identifying silicon as an essential plant nutrient.

Chemistry C (Inorganic, Analytical & Physical)

75. Reactions of OH^- with $(\eta^6\text{-arene})Mn(CO)_2(L)^+$ (L= CO, PPh_3)

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Metallocarboxylic acids and metallocarboxylates are known to be synthesized by the reaction of metal carbonyls with hydroxide ion. The thermal loss of CO_2 by metallocarboxylates is often considered of significance in modeling steps of the water gas shift reaction.

Hydroxide has been observed to react with $(\eta\text{-}C_6Me_6)Mn(CO)_2L^+$ (L = CO or PPh_3), in acetone-water mixtures to form $[(\eta^6\text{-}C_6Me_6)Mn(CO)_2]_2$ at room temperature. At -63°C, a visually detectable reaction occurs. Upon warming to room temperature the product of the low temperature reaction is converted to the dimer. The reaction of hydroxide with $(\eta^6\text{-}C_6H_6)Mn(CO)_3^+$ does not form the equivalent non-methylated dimer but produces what has been tentatively identified as $(exo\text{-}\eta^5\text{-}C_6H_6(OH))Mn(CO)_3$. A mechanistic rationale will be presented for these observations.

76. Dehydrogenation of cycloalkanes catalyzed by metals in supported molten salts

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The reduction of platinum or nickel salts in molten salt eutectics supported on SiO_2 or Al_2O_3 produces metal dispersions which have been used in Supported Molten Salt Catalysis, SMSC. These catalysts have been used to study the catalytic dehydrogenation of the cycloalkanes methylcyclohexane and decalin. The hydrocarbons were passed through a packed tube reactor containing the SMSC catalysts over the temperature range 450 - 600°C. The Pt SMSC catalysts displayed catalytic activity equivalent to conventional Pt heterogeneous catalysts but displayed lower rates of deactivation. The Ni SMSC catalysts displayed significantly enhanced activity and retarded deactivation when compared to a conventional Ni heterogeneous catalyst. The discussion will include preliminary observations on the effect of operational variables including molten salt composition, catalyst preparation techniques, dehydrogenation temperature and pressure, and flow rates.

77. Transmetallation of transition metal organometallic complexes with akyllithiums.

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Transition metal organometallic species with high electron density at the metal center have been observed to exhibit unusual reactivity patterns. When CH_3Li is added to $(\eta^6\text{-}C_6Me_6)Mn(CO)_2X$, Mr'X, (X = Cl, I) in THF, the expected methyl complex forms in very low yield as determined by IR. If a less concentrated solution of Mr'X is used, Mr'_2 is formed almost quantitatively. However, if a THF solution of Mr'X is added to a solution of CH_3Li, the methyl adduct is the major product. In all cases, Mr'_2 is formed to some degree. Results consistent with transmetallation are also observed when t-BuLi or PhLi react with Mr'X. Similar results have been observed in the reaction of CH_3Li with $(\eta^6\text{-}C_6H_6)Mn(CO)_2X$, MrX, $(\eta^5\text{-}C_5Me_5)Fe(CO)_2X$, Fp'X and $(\eta^5\text{-}C_5H_5)Fe(CO)_2X$, FpX (X = Cl,I). By contrast, the reaction of CH_3Li with $Mn(CO)_5Br$ produces only the methylated product. The rhenium analog of Mr'I, $(\eta^6\text{-}C_6Me_6)Re(CO)_2I$, does not react with CH_3Li at room temperature. A mechanistic rationale for these results will be discussed.

78. Studies of the basicity of phosphines and organometallic compounds as determined by calorimetric titration

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In contrast to organic chemistry there is little quantitative understanding of the factors which influence the basicity of organometallic

compounds. In an effort to determine these factors we are studying the enthalpy of protonation of basic organometallic compounds.

The heat of protonation (ΔHhp) of a series of phosphines have also been measured. The reactions are done in 1,2-dichloroethane solvent with triflic acid at 25.0°C by titration calorimetry. The ΔHhp values range from -17.9 kcal mol^{-1} for $(p\text{-}ClC_6H_4)_3P$ to -36.6 kcal mol^{-1} for $(t\text{-}Bu)_3P$. An excellent correlation of the ΔHhp values with reported pKa's is observed.

$CpIr(\eta\text{-}1,5\text{-}C_8H_{12})$ (Cp is C_5H_5 and $C_5(CH_3)_5$) is protonated at the metal center. The heat of protonation (ΔHhm) values for these compounds demonstrate that the $C_5(CH_3)_5$ ligand increases the basicity of the iridium metal by 4.4 kcal mol^{-1} compared to C_5H_5.

79. Room temperature phosphorescence of indicans

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Indicans are 3-O-substituted indoles which are found in urine and which, we have discovered, exhibit unique room temperature phosphorescence (RTP) behavior. The RTP of several indicans on filter paper treated with 2 M cesium and iodide ions, which are known to enhance the phosphorescence of many organic compounds by increasing spin-orbit coupling and intersystem crossing, was examined. Although the RTP excitation and emission wavelengths of many indoles, including the amino acid tryptophan, are not changed by cesium and iodide, those of the indicans were altered dramatically. For example, indoxylsulfate with cesium ion had an excitation wavelength of 393 nm and an emission wavelength of 505 nm; these wavelengths with iodide were 419 nm and 517 nm respectively. (The greater increase in RTP intensity was seen with iodide.)

Log-log calibration curves for the indicans studied were linear between 2.0 mg/ml - 0.1 mg/ml. A discussion of these results as well as fluorescence data for the indicans will be presented.

80. An HPLC method for determining trace amounts of herbicides in water

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Trace levels of herbicides (ca. 1 ppb) commonly found in rural water supplies are determined by high performance liquid chromatography following a 500 fold concentration using commercial C_{18} solid phase extraction columns. Separation occurs using an inexpensive C_{18} HPLC column and 30% V:V aqueous methanol as solvent. Detection and quantitation employs UV absorption at 214nm. Data will be presented showing the efficiency of the trapping/concentration process for various herbicides and the results of testing of local water supplies.

81. Stability of sulfur forms in coal during storage

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The stability of sulfur forms for 4 eastern and 4 western coals was studied as a function of time and storage conditions. Pyritic, sulfate, elemental, and total sulfur levels were monitored periodically over almost 7 years for these coals stored under argon at room temperature and under argon at about -3°C. Based on changes in the sulfate and pyrite levels, it was shown that an argon atmosphere at -3°C provided the best environment for storing the coal samples. On the same basis, all the eastern coals stored under argon at room temperature showed a greater tendency for oxidation (than the western coals). Evidence suggests that oxidation can occur in less than 5 months at room temperature, even for coal samples kept under argon. Elemental sulfur increased somewhat with storage time; however, it amounted to less than 0.05% for even the most oxidized coal.

82. Treatment of spent acid from a chemical coal cleaning process by precipitation of jarosite-type double salts

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The applicability of treating spent acid washing streams from a molten caustic coal cleaning process by precipitating double salts was studied using model solutions of $Fe_2(SO_4)_3$, Na_2SO_4, and K_2SO_4. Under the reaction conditions employed, jarosite compounds ($MFe_3(SO_4)_2(OH)_6$) were the only double salts formed. Precipitate yield was studied as a function of pH, reaction time, and temperature. When Na_2SO_4 was the only alkali sulfate present, iron concentrations had to be increased in order to suppress the formation of contaminant phases (eg., FeOOH). When both Na_2SO_4 and K_2SO_4 were present, jarosite ($KFe_3(SO_4)_2(OH)_6$) formed preferentially to natrojarosite ($NaFe_3(SO_4)_2(OH)_6$). Precipitate yields increased dramatically when acid which was formed during the reactions was neutralized with $CaCO_3$. In those tests, substantial amounts of Fe, Na, and $SO_4^=$ were removed as natrojarosite and gypsum ($CaSO_4 \cdot 2H_2O$). The best precipitate yields were obtained at 95°C at a pH of 1.5-2.0, and precipitation was completed in less than six hours.

83. Removal of Pyrite and Mineral Matters from Coal.

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Wartburg College, Waverly, Iowa

Removal of sulfur from coal is important for the prevention of pollution. While fairly good amount of knowledge has been accumulated about the inorganic forms of sulfur in coal, the nature of organic sulfur is yet not fully understood. In order to make further studies on the nature of organic sulfur in coal we have prepared coal samples free from mineral matters and all forms of sulfur except

organic forms. We have been able to remove elemental sulfur, pyrite and other mineral matters from coal by treating the samples with lithium aluminum hydride followed by the reaction with a solution of hydrochloric and hydrofluoric acid. The process and the results of analyses of different samples will be discussed.

84. Stereochemistry of mixed amino acid-olefin complexes of platinum(II)

G. JONES, M. ELOUT and L. ERICKSON

Department of Chemistry, Grinnell College, Grinnell, IA 50112

NMR techniques were employed to examine the stereochemistry of mixed olefin-amino acid complexes of platinum(II). Cis and trans (N,olefin) species can be distinguished on the basis of chemical shifts of ligand protons and carbons. Diastereomers of species containing two chiral centers can also be distinguished to permit an assessment of the selectivity of coordination of one ligand imposed by the chirality of the other ligand. The range of stereoselectivities found in these species will be illustrated with complexes of general formula PtAA(olefin)Cl, containing the water soluble prochiral olefin 2-methyl-3-butene-2-ol and several amino acids(AA) of varying complexity.

85. An nmr study of acid-base properties of a platinum(IV) complex

L.E. ERICKSON, D. COOK and J. SARNESKI

Department of Chemistry, Grinnell College, Grinnell, IA 50112

Proton, carbon-13 and platinum-195 nmr techniques have been employed to explore the acid-base properties of the unique platinum(IV) complex, denoted $[Pt(bipy)(tach\text{-}H)OH]Cl_2$, that is formed by air oxidation of the product of the displacement of chloride of $Pt(bipy)Cl_2$ by cis, cis-1,3,5-triaminocyclohexane (tach). The effect of pH on chemical shifts of ligand protons and carbons and the central platinum are consistent with pK_a values for in-plane nitrogens of the coordinated tach of about 5.5 and 12. The rate of proton exchange of the C-6 proton of the coordinated bipy was also examined as a function of pH and temperature. Such C-6 proton exchange is unusually facile in this complex in sharp contrast to the behavior of bipy complexes of Ru and Os, which show facile exchange of C-3 protons under similar conditions.

86. A novel NADH biosensor utilizing the bacterial bioluminescence reaction

M.A. STUEVER and M.A. ARNOLD

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

A novel biosensor for the determination of NADH has been developed that utilizes the enzymatic luciferase bioluminescent reaction. The luciferase (LUC) and NADH:FMN oxidoreductase (OR) reactions are coupled as follows:

$$NADH + FMN \xrightarrow{OR} NAD^+ + FMNH_2$$

$$FMNH_2 + O_2 + RCHO \xrightarrow{LUC} FMN + RCOOH + H_2O + hV$$

LUC and OR are co-immobilized at the tip of an optical fiber. The probe is immersed in a solution containing the NADH sample, FMN, and decanal. The light intensity generated by the reaction is proportional to the concentration of NADH in the sample. Sensor configuration, response time, detection limit, and dynamic range will be discussed. This system can be coupled with NADH generating or consuming hydrogenases to produce sensors specific for innumerable analytes.

87. An enzymatic fiber optic glutamate biosensor

B. S. WALTERS, AND M. A. ARNOLD

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

A novel fiber optic biosensor for glutamate has been developed by using glutamate oxidase coupled with a fiber optic ammonia sensor. The following enzymatic reaction occurs at the sensor tip:

$$Glutamate + O_2 + H_2O \xrightarrow[Ox]{Glu} \alpha\text{-ketoglutarate} + NH_3 + H_2O_2$$

The ammonia produced at the sensor tip is measured and related to the concentration of glutamate in the sample. Detection limit, selectivity, and dynamic response characteristics of this glutamate sensor will be presented.

Glutamate is suspected to be the principle excitatory neurotransmitter in the central nervous system. We hope our sensor will be useful in studying the functions of this putative neurotransmitter.

88. Reconstruction of Gas Chromatograms from Digitally Filtered GC/FTIR Interferograms

J.M. Bjerga, G.W. Small

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

Thousands of interferograms are collected in a gas chromatography/fourier transform infrared spectroscopy (GC/FTIR) experiment, yet only a fraction contain spectral information of interest. Selection of interferograms for further study can be based on information in the interferograms themselves, i.e., a GC/FTIR reconstruction. Several methods exist for producing a plot analogous to a GC trace from a series of interferograms. The simplest involves a plot of overall signal intensity vs. interferogram number. A more sophisticated approach treats a series of reference interferograms as vectors defining a subspace to which subsequent interferograms are compared (Gram-Schmidt orthogonalization). These reconstructions are sensitive to a changing background, especially CO_2 and H_2O vapor levels. Recent developments in digital signal processing make it possible to overcome this problem. GC/FTIR reconstructions from digitally filtered interferograms will be compared to reconstructions from the raw interferograms. The capability for developing filters which are specific to chemical classes will also be examined.

89. Digital Filtering of Interferograms

A. C. HARMS, G.W. SMALL

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

Passive Fourier transform infrared sensors show promise for analytical applications requiring automated, on-line monitoring of atmospheric chemical species. Increased emphasis is being placed on the speed and power of data interpretation algorithms for these sensors as application environments become more demanding. Preliminary studies indicated digital filters could be used to detect the presence of compounds from interferogram data without using the computationally expensive Fourier transform. The essential aim of our research is to maximize the information gain while minimizing the number of computational operations required. The methods used for developing, optimizing and applying digital filters will be described and results from a variety of test data will be provided.

90. Normalization and pattern recognition applied to FTIR interferograms for qualitative analysis

A. S. Barber, G. W. SMALL

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

The development of a passive Fourier transform infrared (FTIR) sensor to be used in mobile field applications has led to a number of data analysis problems. Unlike the precise conditions under which a laboratory FTIR functions, this sensor has a number of sources of variability: the infrared source, the sun, varies in intensity; the sample is whatever falls in the field of view of the detector; and the path length can vary greatly. The overall intensity of the radiation detected by the sensor can change markedly over time. The great variety of backgrounds, temperatures, and atmospheric conditions adds levels of complexity to the interpretation of the data.

The focus of this study is to develop an automated, interferogram-based pattern recognition approach to determine rapidly and precisely the presence of an analyte. Central to this research is developing a normalization scheme for the data that is independent of the environmental conditions or particular use (mobile or stationary) of the sensor. Data sets from a variety of field conditions will be used to evaluate the normalization schemes.

91. The reactions of doubly-bonded ditantalum complexes $(\eta\text{-}C_5Me_4R)_2Ta_2X_4$ with oxygen and hydride sources.

Ching Ting and Louis Messerle

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

The doubly-bonded organoditantalum complexes $(C_5Me_4R)_2Ta_2X_4$ (1; R=Me, Et; X=Cl, Br) is reactive towards H_2 gas, yielding a bridging dihydride compd, $(C_5Me_4R)_2Ta_2X_4(\eta\text{-}H)_2$. However, reaction of 1 in Et_2O with $LiBH_4$ affords mono- and bis-diborane adducts depending on the stoichiometry of the reaction.

Reactions of 1 with Me_3NO or N_2O both give yellow oxygenated complexes. Present evidence is consistent with a oxotantalum species, $(C_5Me_4R)TaX_2(O)$. A black intermediate can also be isolated in the Me_3NO reaction.

The results of these reactivity studies, with spectroscopic and X-ray crystallographic characterizations of reaction products, will be presented.

92. Low Valent Mono(Peralkylcyclopentadienyl) Vanadium and Divanadium Chemistry.

Michael S. Hammer and Louis Messerle*

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

The organoditantalum species $(C_5Me_4R)_2Ta_2(\mu\text{-}X)_4$ (R=Me, Et; X=Cl, Br) exhibit a rich and diverse reactivity because of the Ta=Ta bond. We have been developing the analagous vanadium chemistry to study how the reaction rates and reactivity of the vanadium analogs compare to the tantalum species.

The paramagnetic vanadium (IV) precursor $(C_5Me_5VBr_3)_x$ can be prepared in 70% yield via bromination of $C_5Me_5V(CO)_4$. $(C_5Me_5VBr_3)_x$ can be reduced by sodium to give a diamagnetic divanadium complex presumed to be $(C_5Me_5)_2V_2Br_4$ on the basis of mass spectrometry. The divanadium compound is reactive towards dihydrogen and other small molecules. The results of these reactions and structural studies will be discussed.

93. Structure and reactivity of low-valent bis(dialkylphosphino)methane ditantalum complexes.

B. A. FERM, T. JOHNSON, S. FRANCIS, L.MESSERLE

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

We are interested in metal-metal multiple bonds as a functional group for metal-centered small molecule reactivity. The Lewis-basic binucleating ligands bis(dialkylphoshpino)methanes, $R_2PCH_2PR_2$ ($R=CH_2CH_3$, $CH_2C_6H_4\text{-}p\text{-}CH_3$), can be used to form metal-metal doubly bonded complexes of of the low-valent, Lewis-acidic, early transitionmetal tantalum. These doubly bonded binuclear tantalum compounds react readily with the small molecules CO, N_2O, and Me_3No. These reactions along with interesting structural features will be discussed.

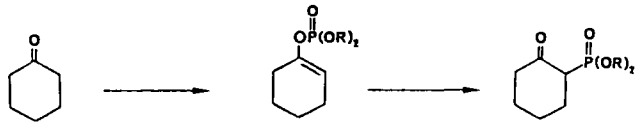
Chemistry D (Organic & Biological)

94. Applications of phosphates in organic synthesis

D. F. WIEMER, T. CALOGEROPOULOU, AND K. B. GLOER

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

The Wadsworth-Emmons reaction is a popular method for preparing conjugated carbonyl compounds through condensation of a β-keto phosphonate anion with an aldehyde or ketone. However, this reaction effectively has been restricted to the use of acyclic phosphonates, simply because there have not been convenient methods available for synthesis of cyclic β-keto phosphonates. With our recent discovery that cyclic vinyl phosphates undergo rearrangement to cyclic β-keto phosphonates upon treatment with strong base, the scope of the condensation is greatly expanded. Studies on the synthesis of cylic vinyl phosphates, the regiochemistry of this vinyl phosphate-keto phosphonate rearrangement, and applications of the cyclic β-keto phosphonates, will be presented.

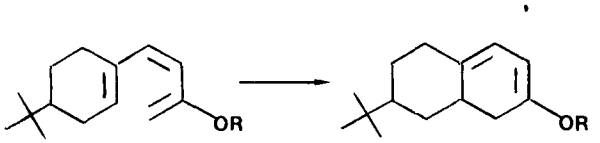


95. Studies in hexatriene cyclizations

C. M. Hamot and W. J. Scott

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

In order to study an approach to the total synthesis of cortisone utilizing a hexatriene cyclization, a model trienyl system was devised. This material was obtained initially by ultra-violet irradiation of the corresponding trans-dienone. However, this method resulted in an O-cyclization product. Other methods for synthesizing the model via the related enynone consisted of a series of coupling reactions and reductive steps. Current studies are directed toward improved routes for the synthesis of the model, as well as induction of cyclization.



96. Palladium catalyzed reduction reaction

K. Yuan and W. J. Scott

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

The use of palladium as a catalyst in organic reactions with most electrophiles has become increasingly useful. However, alkyl electrophiles have found little use due to a lack of reactivity and a propensity toward β-hydride elimination. While studying the palladium catalyzed coupling of various alkyl iodines with a variety of nucleophilic, it was found that treatment of the iodide with Grignard reagents containing β-protons in the presence of dppfPd(0) (formed by treatment of 1,1'-bis(diphenylphosphino)ferrocene-palladium(II) dichloride with 2 equiv. of DIBAL-H) led reduction to the alkane. Phenylmagnesium bromide and methyl-magnesium iodide offered no reaction.

97. Adenine nucleosides resistant to ADA

V. NAIR* AND A. N. PRYOR

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

The ubiquitous enzyme, adenosine deaminase (ADA), catalyzes the hydrolytic deamination of adenosine to inosine. This metabolic conversion limits the therapeutic efficacy of adenosine analogues. The design and synthesis of novel analogues of adenosine which are resistant to degradation by ADA will be discussed. Correlation of structure with hydrolytic activity towards this enzyme will be presented.

98. New hypoxanthine ribonucleosides

V. NAIR* AND A. G. LYONS

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

Hypoxanthine ribonucleosides with functionalization at the 2-position, are not only of antiviral interest, but there is enzymological interest in these compounds as potential inhibitors of a key purine metabolizing enzyme, inosine monophosphate dehydrogenase. The synthesis of new functionalized hypoxanthine systems will be presented. Particular emphasis will be placed on analogues containing unsaturation at the 2-position. The antiviral importance of the target compounds will be mentioned.

99. Prolactin-stimulated growth of MDA-MB231 human breast cancer cell line

M. A. WAKNITZ

Box 1016, Clarke College, Dubuque, IA 52060

The nature of this investigation was to determine the role of prolactin in the growth of the estrogen-receptor negative MDA-MB231 human breast cancer cell line. MDA-MB231 cells were exposed to various concentrations of ovine prolactin as well as 10^{-8}M estrogen which served as a control study. Growth was not observed at any concentration of prolactin or with the estrogen due to contamination of the cells. After prolactin stimulated growth is established, further research will be performed to determine if tamoxifen will inhibit the prolactin-induced growth. The significance of this research in the future treatment of estrogen-receptor negative breast cancers will be discussed.

100. Inhibition of mRNA cap methylation

B. DAWSON AND M. KAEHLER

Biology Department, Luther College, Decorah, Iowa 52101

Following transcription of a gene, the pre-mRNA undergoes a series of events called processing prior to transport of mRNA to the cytoplasm. The first processing event is the addition of a 5'-terminal cap, which is then normally methylated. Polyadenylation and splicing generate a mature mRNA. This project attempts to assess the relationship between methylation and cap stability, and its role on subsequent processing events.

Inhibition of methylation in Chinese hamster ovary (CHO) cells in vivo is accomplished using the antibiotic Neplanocin A (NpcA). [C-14]-uridine incorporation measures total RNA synthesis, and [H-methyl]-methionine incorporation provides a means of monitoring RNA methylation. The extent of inhibition by NpcA at each specific methylation site is analyzed using high performance liquid chromatography. Comparison of pre-mRNA and mRNA size, $^{3}H/^{14}C$ ratios, and methylation patterns from inhibited and control cultures will be presented.

101. Insect antifeedant metabolites from the sclerotia of Aspergillus flavus

M. R. TEPASKE and J. B. GLOER

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

The fungus Aspergillus flavus produces numerous secondary metabolites, however, the sclerotia (survival structures) of A. flavus have not previously been screened for novel natural products. The sclerotia of A. flavus (NRRL 6541) were examined for the presence of secondary metabolites which may afford protection from insect predation. The sclerotia were powdered and extracted with hexane and chloroform. The resultant chloroform extract was shown to contain five closely related indole alkaloid components. The individual components were isolated utilizing chromatographic techniques, and their structures were determined by application of NMR and MS techniques. The major component was shown to be dihydroxyaflavinine. These metabolites exhibit potent antifeedant activity against the fungivorous beetle Carpophilus hemipterus, and serve to protect the sclerotia from insect feeding in laboratory studies.

102. Isolation and structure determination of Brassicicolin A

G. K. POCH, D. M. SHORT, and J. B. GLOER

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

Cultures of the phylloplane fungus Alternaria brassicicola (NRRL 1299) were found to exhibit antibacterial and antifungal activity. Silica gel chromatography of the ethyl acetate extract of the culture filtrate furnished a metabolite (brassicicolin A) containing two isonitrile groups: structural units which are rarely encountered in natural products. High resolution FAB mass spectrometry suggested the molecular formula $C_{32}H_{48}N_2O_{14}$ for this compound, and its structure was established by chemical degradation and NMR decoupling experiments. The structure consists of two -isocyanoisovaleryl units, two -hydroxyisovaleryl groups, and two acetyl units attached to a D-mannitol backbone. Brassicicolin A exhibits potent activity against gram positive bacteria, including Bacillus subtilis and Staphylococcus aureus. Details of the isolation, structure determination, and biological activity of brassicicolin A will be presented.

103. Natural plant defenses against leafcutter ants

G. B. HAMMOND, T. GREEN, AND D. F. WIEMER

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

The leafcutter ants (Hymenoptera, Formicidae, Attini) are the most important insect pests in the forests and plantations of the tropical Americas. They collect plant material from a variety of plant species, using most of it as a culture medium for the mutualistic fungus that serves as their major food. For several years, we have examined different native plant species avoided by these insects, in a search for natural insecticides. Our research has uncovered a variety of terpenoids with insecticidal and/or anti-fungal activity. Recent studies have focused on Smilax spissa, Annona spraguei, and Eugenia salamensis. The structures of the most recently isolated compounds, as well as profiles of their biological activity, will be presented.

104. Novel approaches to biologically active nucleosides

V. NAIR* AND G. S. BUENGER

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

Strategically modified purine nucleosides are of interest as potential antiviral agents. This paper reports on new approaches to the modification of both the carbohydrate and base moieties of natural purine nucleosides. Details of the synthetic methodologies used and the biological importance of the final products will be discussed.

105. The design of antiretroviral molecules

V. NAIR

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

The acquired immune deficiency syndrome (AIDS) has become recognized as one of the most catastrophic diseases to confront humanity. A logical target for therapeutic approaches towards AIDS appears to be the retrovirus itself. The design and synthesis of nucleosides with therapeutic potential against the AIDS virus will be presented. Major emphasis will be placed on nucleosides involving modifications in the carbohydrate moiety. The biochemical basis for their mechanism of action will be discussed.

106. Adventures in Homogeneous Catalysis of Photochemical Reactions

GENE G. WUBBELS

Chemistry Department, Grinnell College, Grinnell, IA 50112

Since our discovery and quantitative description of catalysis in photochemistry, we have been exploring the scope and nature of the phenomenon. The basic definition will be reviewed. Examples from recent research illustrating a variety of forms of acid catalysis, base catalysis, and electron hole transfer catalysis will be discussed.

107. Photosubstitution of 3-Bromonitrobenzene

E.B. COUGHLIN, D.P. SUSENS, and G.G. WUBBELS

Department of Chemistry, Grinnell College, Grinnell, IA 50112

3-Bromonitrobenzene is cleanly but inefficiently photosubstituted by chloride ion. The photosubstitution is uncatalyzed at low $[H^+]$, and catalyzed by acid at $[H^+]>0.3$ M. The limiting quantum yield for photosubstitution at infinite $[H^+]$ and 3.0 M $[Cl^-]$ is only a factor of two larger than that for the uncatalyzed photosubstitution at 3.0 M $[Cl^-]$. The absence of deuterium incorporation on the aromatic ring during photosubstitution agrees with the hypothesis that catalysis results from protonation of the $^3\pi,\pi^*$ excited state. The photosubstitution appears to involve direct heterolytic nucleophilic attack on the excited state.

108. Photosubstitution of 4-Bromonitrobenzene

E.B. COUGHLIN, E.J. SNYDER and G.G. WUBBELS

Department of Chemistry, Grinnell College, Grinnell, IA 50112

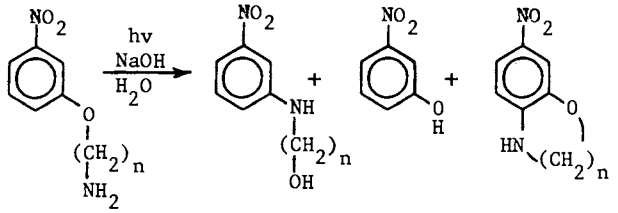
Irradiation of 4-bromonitrobenzene in the presence of $[H^+]$ and concentrated $[Cl^-]$ cleanly but inefficiently produces 4-chloronitrobenzene. The photosubstitution is exclusively acid catalyzed and shows second order dependence on $[Cl^-]$. The second order dependence is found to require a quadratic expression. The presence of 2-propanol causes efficient photoreduction, forming 4-bromonitrosobenzene and 4-bromo-2-chloroaniline without appreciably affecting the quantum yield of 4-chloronitrobenzene ene. The photosubstitution is ascribed to electron transfer from Cl^- to $^3n,\pi^*$ nitroaromatic, protonation of the resulting exciplex, and attack by Cl^- on the protonated exciplex.

109. Photochemistry of β-nitrophenoxyalkylamines

S.M. OHLINE and G.G. Wubbels

Chemistry Department, Grinnell College, Grinnell, Iowa 50112-0806

Photo-Smiles rearrangements of β-nitrophenoxyalkylamines that give mainly II, also give a photohydrolysis product (III) and photocyclization product (IV).



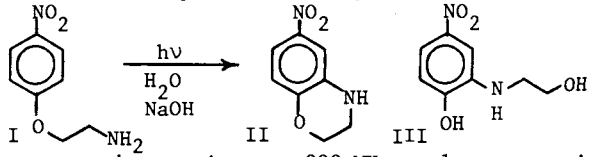
It is puzzling that the yield of IV increases with n. Products (II-IV) have been analyzed quantitatively for n = 2,3 and 4 at varying pH values. Attempts to synthesize authentic samples of the photocyclization products (IV, n = 3 and 4) will be reported. Possible mechanisms for the formation of product IV will be presented.

110. Detection by NMR of Dihydrobenzene Intermediates in Photocyclization of 2-(4-Nitrophenoxy)-ethylamine.

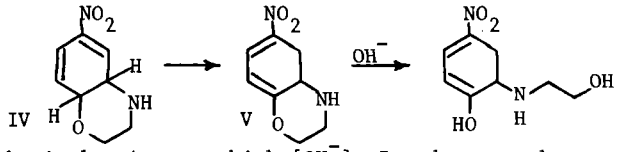
SIMEON WINITZ and GENE G. WUBBELS

Department of Chemistry, Grinnell College, Grinnell, IA 50112

2-(4-Nitrophenoxy)-ethylamine (I) undergoes base-catalyzed Smiles rearrangement thermally, but forms II and III photochemically.



Proton nmr observations at 300 MHz at low conversion reveal that the primary photoproduct is IV, which thermally forms the hydrolytically labile V. The dehydrogenations to final products are also photo-



chemical. At very high [OH^-], I undergoes photo-Smiles rearrangement, apparently by a novel electron hole transfer catalyzed pathway.

111. Synthesis of new poly(acetylene) analogs

W. J. Scott

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

Poly(acetylene) and its analogs are of interest due to their conductivity in the doped state. Unfortunately, the conductivity of these materials usually decays with time, leading to a need for the development of new poly(acetylene) analogs.

While developing an approach to the synthesis of a number of novel poly-(acetylene) analogs and other unsaturated polymers, we had need of a poly(acetylene) derivative which contains a potent leaving group, such as a dialkyl phosphate or a triflate substituient. Treatment of poly-(β-diketone) with base afforded poly-(1-(diethyl phosphinyloxy)vinylene) as an E- / Z-mixture. Similarly, treatment of poly(β-diketone) with base and triflic anhydride affords the very unstable poly(1-trifloxyvinylene). The latter polymer slowly decomposes at room temperature in neutral solution, liberating triflic acid.

Conservation

112. Another 'balance' of nature revealed

Wm. H. Gilbert III, T. J. Schantz, & B. E. Simms

Department of Biology and Environmental Science Simpson College; Indianola, IOWA 50125

Frank Preston's (1948) classic paper on "The Commonness, and Rarity, of Species" points out that (1) relative abundance at a given place and time is often distributed lognormally among many species. This has been demonstrated for bird species in IA. using data from Christmas Bird Counts (CBC's; by Gilbert at 1970 IAS meeting). Thus a 'balance' exists between the number of common winter bird species and the number of rare winter species.

Preston's (1969) influential paper on "Diversity and Stability in the Biological World" presents evidence that (2) commonness of a given species at one place is distributed lognormally among many time-intervals; he then speculated that (3) relative abundance of a given species at one time would be distributed lognormally among many localities. In what we believe to be the first study of this hypothesis, we analyzed recent CBC data and found that relative abundance of certain bird species (bald eagle, ring-neck pheasant, and others) is lognormally distributed among the localities sampled within North America. In these cases, there is a 'balance' between the number of localities in which the species is common and those in which it is rare.

113. Nitrates in farm wells of Warren County

Terry L. Webb, Wm. H. Gilbert III,

Department of Biology and Environmental Science Simpson College; Indianola, Iowa 50125

and Gene Bomgaars, Mike Orman,

Departments of Vocational Agriculture Indianola and Southeast Warren High Schools

..and Joe Narigon
Extension Service of Warren County

This study was done in response to increasing concern over accumulation of nitrate- (NO_3^-) in groundwater supplies of drinking water at many locations in Iowa. The Warren County Extension Office convened a Water Testing Planning Committee in December of 1987 to sample and test water from many wells for nitrate/nitrite concentrations. Water samples were collected at wells of concerned farm families by high school students working with local clubs of Future Farmers of America (FFA: Indianola & Southeast Warren Chapters). Testing was done at Simpson College using Hach kits.

The extent and magnitude of nitrate accumulation in these samples from central and southern Warren County will be described in this presentation.

114. Assessment and comparison of the density, diversity and biomass of benthic communities in the hypolimnion and epilimnion of Red Haw Lake, Iowa

G. H. LUIKART, R. W. BACHMANN AND L. MITZNER

Department of Animal Ecology, Iowa State University, Ames, IA 50011-3221 and Iowa Department of Natural Resources

The hypolimnetic and epilimnetic benthic invertebrate communities of Red Haw Lake, Iowa were surveyed and compared. The results, along with other lake characteristics, were used to predict the effects of summer destratification on Red Haw Lake's fishery. Average summer benthic biomass and diversity remained higher in the epilimnion than in the hypolimnion throughout the summer stratification period; however, due to high variability, the differences between the 3 most abundant benthic groups of the hypolimnetic and epilimnetic communities were not statistically significant. The coefficient of community and the percent similarity of the two communities were 21% and 60% respectively. Red Haw Lake's high productivity, good fishery and remnant common carp (Cyprinus carpio) population, lead to the pediction that summer aeration would not cause significant increases in fish production and that it may even damage the fishery.

115. Seth Eugene Meek, pioneer Iowa ichthyologist; an appreciation

K. E. GOELLNER, Emeritus Professor, Biology, Coe College; 1764 Sherbrook Drive, NE, Cedar Rapids, IA 52402

Iowa's first major ichthyologist, Seth E. Meek, came to this state almost exactly 100 years ago and his work deserves appreciation in this centennial year. An Ohio farm boy, he earned degrees from Valparaiso University and from Indiana University, where he studied under the great David Starr Jordan. He came to Coe College in 1887, spent five years collecting and studying the Iowa fish fauna and published the seminal papers which have been basic references for all subsequent studies in Iowa. He moved on to Arkansas University and to the Field Museum in Chicago, where he stayed until his death in 1914, perhaps of a tropical disease contracted during his many years of work in Mexico and Central America. He worked and published extensively for the U. S. Fish Commission, and for the Field Museum, and his many papers from this pioneer period are critical as sources portraying fish faunas prior to the alteration and destruction of ecological conditions in Iowa and middle America. No attempt is made to sort through the lengthy species lists and changes in taxonomy and nomenclature.

116. Attitudes, Objectives, and Behavior of Forestland Owners in eastern Iowa.

J. R. REGULA, J. P. COLLETTI

Department of Forestry, 251 Bessey Hall, Iowa State University, Ames, Iowa 50011-1021

A study of forestland owners in eastern Iowa was recently conducted by the Department of Forestry at Iowa State University in cooperation with the Iowa Department of Natural Resources. The current level of forestland management in eastern Iowa was found to be relatively low. This is probably due to the fact that 44% of the forestland is owned for reasons unrelated to the stream of forestry goods and services provided. Soil conservation, firewood and satisfaction of ownership were the most often cited benefits of owning forestland. Participation in forestry incentive programs was also low. Many factors including a lack of knowledge about and understanding of the government programs, unwillingness to make necessary investments, and a lack of technical skills in timber management are likely causal factors.

117. Lateral root distribution in red and white oak and walnut seedlings.

R. C. SCHULTZ, J.R. THOMPSON, P.A. LICHT, AND R. MEILAN

Department of Forestry, Iowa State University, 251 Bessey Hall, Ames, Iowa 50011-1021

Four state forest nurseries each provided 500 randomly selected, non-graded, seedlings from two of the following species: red oak (Quercus rubra L.), white oak (Quercus alba L.) and black walnut (Juglans nigra L.). All first-order lateral roots >1 mm in diameter were counted and height and root-collar diameter were measured. The 1 mm diameter root is considered the minimum size of permanent lateral to withstand the lifting, storing and shipping, and planting processes. About 50% of the red oak had 2 or fewer lateral roots. Only about 15% of the seedlings had 5 or more lateral roots. About 50% of the white oak had 4 or fewer and 15% had 7 or more lateral roots. About 50% of the walnut had 7 or fewer and 35% had 10 or more. Seedlings with more than 4 or 5 roots showed little relationship with size. The present hypothesis is that seedlings need a minimum of 5 roots to become successfully established in the field. Grading seedlings only by height and/or diameter does not accurately identify rooting characteristics.

118. Effects of silvicultural treatments on natural regeneration of the tropical forests at Quintana Roo, Mexico.

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In the state of Quintana Roo on the Peninsula of Yucatan, an experiment was established in 1986. 50 X 50 m plots were established in an undisturbed (for at least 40 years) forest. Treatments consisted of removal of four different levels of basal area. Trees removed were selected according to their position with respect to desirable species to liberate them of neigboring competition. The remaining basal area to be removed was distributed over the plot. Tree species selected as desirable were: Swietenia macrophyla King. (mahogany), Cordia dodecandra D.C. (siricote), Metopium brownwi Jacq (chechen), Simarouba glauca D.C. (negrito), Dendropanax arboreus L. (sacchaca), and Brosimun alicastrum Sw. (ramon). Regeneration during the first year of the study will be summarized; observations are planned to continue for 25 years.

119. Assemblages of Diatoms from NE Iowa Fens

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The diatom flora of a group of raised wetlands in northeast Iowa is being surveyed for the first time. These fens were identified as part of a recent series of forays sponsored by the Iowa Department of Natural Resources. Water quality in the ten sites sampled during November, 1987, indicate a range of habitats varying in pH (a range of pH 5.6 to 8.0), total hardness (a range of 30 to 380 mg/1), and conductivity (a range of 65 to 705 mhos/cm). Nutrient levels (nitrate, phosphate, silica) were moderate to high. The occurrence of taxa in diatom assemblages collected in composite samples from these wetlands is noted. The diatom assemblages from these fens are distinct from those found in the alkaline hard water rivers in NE Iowa.

120. Use of nest boxes by Eastern Screech-Owls (Otus asio) in south-central Iowa

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We studied the response of an Eastern Screech-Owl population to the introduction of 60 nest boxes in a 103-square-kilometer township in south-central Iowa during two nesting seasons. Road-counts indicated that screech-owls were relatively common in small or fragmented woodlots near small streams and subsequently used nest boxes in these areas. Several other nest boxes were also used as day roosts.

121. A summary of 1987 Iowa butterfly records

J. W. Fleckenstein

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Butterfly records collected during 1987 support extensive updating of species distribution maps. Numerous county records were recorded in under-collected regions especially southwest Iowa and Allamakee County, Due to early, warm spring, we had an invasion of southern species. Collections of several rare species will enable updating of ranks. The dusted skipper (Atrytonopsis hianna) and ottoe skipper (Hesperia ottoe), known from several western Iowa prairies, were found on Allamakee County hill prairies. The wetland subspecies of the Baltimore (Euphydryas phaeton) was found on a new site in northern Iowa. The first state record of the dry hillside subspecies (E. p. ozarkae) was collected in Lee County. Records of other species formerly presumed to be rare indicate that they may instead be under-collected. An example is Henry's elfin (Incisalia henrici). This species flies early in the year, in habitat rarely surveyed by lepdopterists. It was found this spring on all three sites which had redbud (Cercis canadensis), the host plant.

122. Big Sand Mound Preserve lepidoptera inventory 1987

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The lepidoptera of Big Sand Mound Preserve, Louisa County, Iowa were surveyed from April through September 1987. In seven samplings the Preserve offered 30 species of butterflies. Few of the species were abundant and several important Iowa taxa were absent. Sixteen new ten-day date records were recorded. Sixteen new records for Louisa County, Iowa were recorded. The mosaic of habitat types on the site offers insight into the butterflies use of patch units. We believe the maintenance of these patch units to be of primary concern in the management of rare invertebrates on prairies in Iowa.

123. Butterflies of the Sioux City Prairie

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Fifty-one butterfly species are present at the Sioux City Prairie, a 150 acre tract within the Sioux City city limits. Specimens were collected over a three-year period, on 40 dates ranging from mid-April to mid-October. Nineteen species of Hesperidae were found, including the state-ranked Erynnis martialis, Erynnis horatius, Hesperia ottoe, Hesperia pawnee, Atrytone arogos iowa, Atrytonopsis hianna, and Amblyscirtes vialis. Two range extensions found include a 75-mile extension from the nearest site for Erynnis baptisiae, and a 120-mile extension for Euchloe olympia, both state ranked as possibly endangered or threatened. Other records include 5 Woodbury county records and 15 state date records.

Also included are observations on the behavior of the Olympia, and concerns about management practices at prairie sites and their effects on lepidoptera populations.

Earth Science Teaching

124. Projected stereo photographs in the classroom

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Aerial photographs can be used effectively in the classroom to illustrate landforms and other landscape features, especially when they can be viewed in stereo by the entire class. Various methods of projecting stereo images have been used, but some of these require two projectors or a cumbersome set of procedures. Effective stereo images can be recorded on single 35mm transparencies using color filters which can then be viewed in projection with bicolor glasses. The procedure is simple and inexpensive, but attention must be paid to correct alignment of the photographs and other details. Projected stereo images will be demonstrated.

125. The November 23, 1987 balloon launch from southeastern Iowa

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A balloon launch on November 23, 1987 involving fifteen schools in the Burlington, Iowa area was extremely successful. Weather conditions were optimal to produce a narrow, dense pattern of returns which covered 1,300 miles. Cards were returned from seven U.S. states and three Canadian provinces. The jet stream was directly above the launch area with wind speeds at 30,000 feet of over 100 mph. Data which was returned suggested that selected balloons travelled in excess of 60 mph average speed. It appears that in these instances, the balloons made much of their trip at altitudes in excess of 20,000

feet. Careful planning can maximize the percentage of returns and can ensure successful involvement of all schools concerned. The percentage of cards returned was enhanced significantly because the launch coincided with hunting seasons in many of the states in the path of the balloons.

126. Earth science education in Iowa: students, teachers, and materials.

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Information on the status of earth science education in Iowa will be presented. The results of two UNI studies comparing the demographics of Iowa earth science course offerings and Iowa earth science teacher preparation will be reported. In addition, conclusions from a third UNI study of exemplary Iowa earth science teachers which may have implications for revitalizing earth science teaching will be presented.

Engineering

127. Mechanisms of coal-water-limestone combustion in fluidized beds

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Fluidized bed combustion (FBC) of coal in a limestone bed has been proven to be an effective method for reducing the sulfur dioxide emissions produced from coal combustion. However, there are several disadvantages associated with use of solid fuels compared to liquid and gaseous fuels. We are investigating coal-water-limestone mixtures as a coal-based liquid fuel for FBC. The combustion mechanisms associated with CWLM-fired FBC must be understood before optimal CWLM composition can be formulated. For example, if CWLM burns predominately as agglomerates, then coarse coal grind may be used in place of more expensive fine-coal grinds with no loss in combustion efficiency. The formation of such agglomerates may, however, require coals having high free-swelling indices. Furthermore, agglomeration may strongly influence calcination and sulfation processes in fluidized beds: effects of particle size, bed height, and combustion temperature may be significantly different than for dry sorbent addition. Several hypotheses concerning the fundamental mechanisms of CWLM combustion and their corresponding tests for exclusion have been developed. These tests are being performed in an 8" diameter fluidized bed combustor.

128. On-line determination of carbon in fly-ash

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Unburned carbon elutriated with fly ash from coal-fired combustors can be a major source of boiler inefficiency. Carbon burn-up is generally determined by collecting fly ash on a particulate filter. Not only are the present sampling and analysis methods inconvenient, but they make evaluation of combustion efficiency impossible for transient operation of a combustor. We are investigating photoacoustic spectroscopy (PAS) as a technique for automatic and continuous monitoring of carbon in fly ash. Photoacoustic absorption spectroscopy is based on the periodic heating of a gas when amplitude-modulated radiation is absorbed by the gas or by particles suspended in the gas. This periodic heating produces an acoustical wave that can be detected by a microphone. The PAS signal is unaffected by light scattering in the gas; consequently, only particles with complex refractive indices, such as soot or char, contribute to the signal. At visible light frequencies, most mineral matter scatters light rather than absorbing it. Accordingly, PAS has good potential for distinguishing unburned carbon from mineral matter in the fly ash suspended in flue gas. The apparatus used in these experiments consists of a gas cell mounted with windows that allow a modulated laser beam to pass through the cell without undue scattering of light; a microphone mounted within the cell to detect the PAS signal; a 35 mW HeNe laser chopped at 1000 Hz; and a lock-in amplifier. Preliminary experiments to determine detection sensitivity will be described.

129. A microreactor system for the study of high temperature gas solid reactions

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A microreactor system for the determination of gas-solid reaction mechanisms and kinetics is described. A single solid granule is mounted on a thin pin which is welded to a small support plate. This assembly is inserted in a small tubular reactor equipped with an internal gas distributor and sealed at each end with a cap containing a connection for gas transport. The preheated reactor is placed in a muffle furnace where the temperature of reaction can be precisely controlled. Application of the microreactor system has been demonstrated in a study of the combustion/sintering of coal refuse granules to form a stabilized disposable material.

130. Electrochemical surface modification in coal beneficiation.

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The separation of minerals from coal was conducted by such surface-dependent cleaning methods as froth flotation and oil agglomeration after altering the surface properties by

reducing the electrochemical potential (ε) of the system. Changing ε by the use of sodium hydrosulfite ($Na_2S_2O_4$) as a reducing agent results in improvement of the physical cleaning of coal; significant reduction in both sulfur and ash was obtained without affecting recovery. Estimates of the relative hydrophobicity of the treated particles may be obtained from viscosity and zeta potential measurements. It has been shown that even though control of particle surface properties improves beneficiation, liberation characteristics are also important. Mineral and pyrite grains cannot be easily separated from the coal if they remain associated with the organic portions after size reduction.

131. A new method for improving load turndown in fluidized bed combustion

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Fluidized bed combustion (FBC) offers a method for cleanly and efficiently burning coal. However, technical problems remain that prevent more widespread use of FBC. Among these is the inherently poor load turndown capability of fluidized bed combustors. Load turndown is the ability to vary the fuel-firing rate (hence energy input) of a combustor to match the energy demand. Load turndown capability is especially important for fluidized beds targeted for use in small-scale boilers and furnaces and in coal-fired gas-turbine power systems. The object of this research is to investigate a new concept in fluidized bed design that improves load turndown capability. This improvement is accomplished by independently controlling heat transfer and combustion in the combustor. This is achieved by surrounding the fluidized bed in which the fuel is burned (combustion bed) by another fluidized bed (heat transfer bed). The two beds have separate air supplies and are independently fluidized. A water jacket surrounds the heat transfer bed. The heat transfer bed will control the overall heat transfer rate between the combustion bed and the water jacket. The performance of the heat transfer bed has been investigated. The important parameters include composition and size of bed material and size and the bed width. The results of this investigation are being used to design prototype combustor. Experiments are being performed in this combustor using coal-water-mixture and coal briquette as fuel.

132. Internetworking of the token ring and the Ethernet local area networks: design, performance evaluation and the implementation

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Current Local area network (LAN) products do not conform to a single standard. The network designer often employs different networks in the same organization, each being used in a situation which allows its best features to be exploited. It then becomes essential to provide the means of interconnecting the different LANs to enable sharing of resources. A class of devices known as Bridges can be used to provide a protocol-transparent interconnection of similar or dissimilar LANs.

This research effort focuses on the issues involved in the internetworking of the token ring and the Ethernet. The paper discusses the simulation models employed to yield the performance parameters of the extended network and a solution based on the available off-the-shelf components.

133. Design and performance investigation of a document retrieval system on a voice/data integrated token ring network

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Local area computer networks have received considerable attention over the past decade. This paper addresses the problem of integrating voice, data, and a document retrieval system on a token ring local network.

Voice creates stream traffic on a network, where as data traffic is bursty. The performance requirements of the two traffic types are also different. Voice packets need to be delivered within a limited time interval, whereas the data emphasizes on error-free delivery. The presence of a document retrieval system on such a network poses further problems in optimizing the performance of a network. The necessity and the technological feasibility has prompted this study. The possible solutions, and the steps toward implementation are discussed in this paper.

134. A high-speed, byte-serial, multiple-bus interconnection network

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Multiple-bus interconnection networks offer the connectivity and bandwidth of a crossbar switch at a reasonable implementation cost. However, certain implementations of these networks result in high backplane line counts which limit the number of busses to about four.

This research effort investigates using a high-speed, byte-serial bus to implement a multiple-bus network. The project focuses on the electrical properties of the bus, the high-speed serial transmission circuitry, and the bus-contention resolution algorithm. Prototypes were developed to test critical aspects of the design and simulation was used to analyze the network's performance in a specific parallel architecture.

The primary motivation of this particular approach is to reduce the prohibitively high line counts associated with multiple-bus networks. An overview of the network will be presented along with a discussion of the simulation results.

135 Combinator-Based Functional Languages on Parallel Architectures

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In recent years, interest in functional languages has increased rapidly because they have inherent parallelism. A popular method of implementing functional languages is to use *combinator-based reduction model.* In this method, variables are abstracted (removed) from a program and replaced by a number of constants, called *combinators.* There are a number of abstraction methods but none addresses carrying out abstraction on elements of a list. Therefore, although the parallelism is available at the program level, the evaluation of functional subexpressions that involve list manipulation remains recursive.

The work described in this paper overcomes the problem of recursive list manipulation by defining a set of list combinators and a list representation to support the semantics of these combinators. It will be shown how these combinators and list representation make functional programs execute faster on parallel machines.

136. Status of Iowa plane coordinate system

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Geographic information systems have increasing application in society as warehouses of spatially referenced information. Dependable positioning or location in a common system is an essential part of this information.

Plane positions, expressed as x,y rectangular coordinates, can be established in a state-wide system based upon either the North American Datum 1927 or the more recent North American Datum 1983.

Considerations in using such positions include a general understanding of the development of state plane coordinate systems, institutional recognition of such systems and conversions between state plane coordinates and geodetic latitude and longitude.

137. Characterization of Indian flyash

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Fly ash particles, micron and submicron sized spheres that are liberated from the combustion of coal, is causing concern in the science community. The wide variation of elements make characterization somewhat difficult and some of these elements, even in trace amounts, can pose a threat to both the environment and man.

In this study, fly ash samples obtained from India were evaluated using the state-of-the-art analytical equipment. High resolution scanning electron microscopy was used to determine the single particle morphology; energy dispersive and wavelength dispersive x-ray microanalysis systems, x-ray fluorescence, and flame analysis with HF and HNO_3 sample digestion was used for elemental analysis. The results from these techniques show wide variation of elemental concentrations exists between various particles. Computer literature search has shown that very little attention has been paid to the relationships between the variability of elements and morphic parameters. For the Indian fly ash samples, trends in size and morphic features were recorded and relationships between some of the elemental concentrations and particle morphology have been established. For the future work, Indian fly ash will be compared to other well studied fly ash samples from USA.

138. Destruction of hazardous wastes with high voltage transfer arcs

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High voltage electrical discharge arcs create ideal conditions for destroying hazardous and toxic liquid wastes. They create exceedingly high, localized temperatures causing fast pyrolysis of all liquids in the immediate region of the arc. However, this localized high thermal flux diminishes very rapidly with distance from the arc's central core, so that the bulk temperatures of liquid remains comparatively low.

This paper will summarize some of the experimental findings for an apparatus (Al-Chem Detoxifier), which uses transfer arc energy to destroy hazardous chemical wastes. The liquid wastes included agrichemical residues and PCB contaminated transformer oils. Some non-hazardous wastes, such as domestic sewage sludges and waste pond water, along with pure hydrocarbons, such as heptane, will also be described.

139. Magnetoresistivity in NiFeCo multilayer films with elevated substrate temperature

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A multilayer structure of two ferromagnetic layers and a nonferromagnetic conductive middle layer has been used for magnetoresistive memory cells and transducers. In order to have appropriate signal output levels from these elements it is desirable to have high MR ratio.

In this paper multilayer thin films with elevated substrate temperature from 200° C up to 300° C were deposited by RF sputtering with Argon gas at 5 milli-Torr at 1 Å/sec deposition rate and the effect of pre-substrate heating on MR ratio was studied on these films.

Preliminary results indicate that the MR ratio increses due to pre-substrate heating by comparing the MR ratios of the multilayer films without pre-substrate heating. An investigation correlating grain size, resistivity and MR ratio with elevated substrate temperature was performed.

140. Self action in ZnSe thin films

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Recently, it has been observed that the semiconductor ZnSe possesses a large absorptive nonlinearity due to saturation of the free exciton resonance near the band edge. The saturation intensity of this resonance was found experimentally to be 10.7 kW/cm^2 at T = 77K and slightly less at room temperature.

Closely associated with this absorptive nonlinearity is a dispersive nonlinearity which causes the envelope and spatial profile of short ($\sim$ 1 nS) optical pulses to be modified. These changes are due to self action effects resulting from the non-constant pulse envelope and spatial profiles.

Experimental results concerning these effects will be presented and potential device applications of the phenomena will be discussed.

141. Micromagnetic study of multilayer MR elements

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The magnetoresistance effect of the multilayer ferromagnetic thin films in which two homogeneous magnetic layers are separated by nonmagnetic layer has been studied. These thin films have applications in high density magnetic read heads and nonvolatile computer memory systems. Generally, the elements are 2 x 20 μm and the uniaxial anisotropy constant either parallel or perpendicular to the long dimension of the element.

The exact analysis of the magnetic behavior of the element can be accomplished by solving highly nonlinear partial differential equation known as torque equation. The solution represents the equilibrium state of internal magnetization of the element. Because of the small dimensions of the elements, exchange and demagnetizing fields play significant roles in the equation.

A 2-dimensional numerical analysis is performed on the underlying torque equation for various inputs and the results will be discussed.

142. Preparation of silver films on Y-Ba-Cu Oxide Superconducting bulk material using pulsed laser processing

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With the recent discovery of the metal oxide high temperature superconductors (90 degrees Kelvin), a major research effort is underway to obtain a room temperature superconductor (300 degrees Kelvin). Currently, the material has limited use due to its brittle and unstable characteristics. A better understanding of the material requires adequate bonding of matal films for conductivity measurements at various temperatures.

An investigation was performed to study the effects of a laser induced surface reaction on bulk superconducting material. A pulsed Nd YAG laser was used to convert silver oxide to silver metal at specified power densities, i.e. $2Ag_2O + HEAT = 4Ag + O_2$. The silver oxide material as an insulator is transformed into a conductor at temperatures less than 500 degrees Centigrade. Scanning Electron Microscopy and Energy Dispersive X-ray Microanalysis techniques were used to examine the junction between the silver metal and the Y-Ba-Cu Oxide material.

143. Instrumentation for measuring domain wall velocities in magnetoresistive permalloy elements

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Magnetoresistive permalloy elements show promise as nonvolatile memory for computer systems. Domain wall propogation velocity is an important parameter in determining device characteristics.

The magnetic polarization of the magnetoresistive element determines the state of the bit. The state of the bit is reversed by a domain wall sweeping from nucleation sites at one end of the element to the other end. The progression of the domain reversal can be determined by the change in the element's resistance.

Test instrumentation has been investigated and propogation velocities measured for 2 x 20 μm magnetoresistive elements.

144. Ethanol to Hydrocarbon Conversion Using Novel Supported Molten Salt Catalysts.

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Ethanol produced by the fermentation of corn syrup is usually distilled and sold as a beverage or is further distilled to an anhydrous form which is used as a fuel extender and octane booster. Unfortunately the distillation process is extremely energy intensive. However, converting ethanol-water mixtures directly to hydrocarbon-water mixtures would result in a two-phase system that can be easily separated.

In analogy with the MTG (methanol-to-gasoline) process for the conversion of methanol to high octane gasoline using zeolite catalysts, this study is aimed at developing a new catalytic process to convert methanol-water mixture directly into hydrocarbons using a supported molten salt catalyst (SMSC), the catalyst being $ZnCl_2$. Experimental results will be discussed.

The results of this study could help in developing an economically attractive integrated corn wet milling and ethanol to hydrocarbon process.

145. Kinetics of calcium sulfate decomposition

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A potentially useful process has been demonstrated for recovering sulfur from gypsum or other forms of calcium sulfate by high temperature reductive decomposition. The decomposition reaction is notable for an initial induction period during which the rate of reaction is very slow followed by a period of very rapid reaction. During the induction period the rate of decomposition of calcium sulfate seems to be controlled by the rate of nucleation and growth of the solid reaction product, calcium oxide. After the induction period the rate of decomposition of calcium sulfate appears to be controlled by the rate of the following reaction when carbon monoxide is used as a reducing agent:

$$CaSO_4 + CO = CaO + CO_2 + SO_2$$

This appears to be a first order reaction with respect to carbon monoxide concentration. A mathematical model has been developed to represent the reaction kinetics and it seems to fit the experimental data rather well.

146. Recompact Iowa soil materials before using as liners for waste containment

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Soil materials are often used in hazardous-waste disposal facilities to provide a physical barrier to leachate movement. Both existing soils and recompacted soil materials have been used in barrier construction. Solute transport experiments and measurements of saturated hydraulic conductivity were used to characterize the transport properties of three Iowa soil materials. Experiments were performed with undisturbed soil samples as well as recompacted samples.

The experimental results show that recompaction greatly altered the solute transport properties of the three soil materials. Recompaction improved the ability of each soil material to reduce rates of leachate transport. It is concluded that recompaction would be necessary for any of these materials to satisfy U. S. Environmental Protection Agency standards for barriers in hazardous-waste landfills and surface impoundments.

147. A computational study of laminar burning velocities Fuel Mixtures of H_2, CO, CH_4, and C_2H_2

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The objective of this study is to calculate the burning velocities of several inflammable gas mixtures. While a number of computational studies have been performed on pure fuel-air mixtures, little has been done with blends of fuels. Such comparisons are important in validating reaction mechanisms proposed in theories of flame propagation. The resulting model is also useful in predicting flammability characteristics of gaseous fuel blends. Burning velocities for several mixtures of hydrogen, carbon monoxide, methane, and acetylene with air as functions of initial mixture temperature and pressure have been calculated and compared to experimental data in the literature.

The model simulates one-dimensional, laminar premixed flames. These flames are described by conservation equations for mass, species, and energy. The resulting system of partial differential equations are parabolic; they are solved with the general equation solver PARTIAL/ONE. The reaction mechanism was generated with the chemical kinetics editor program ASSEMBLE and gas mixture properties calculated with the thermochemical property program PROP.

148. Heat transfer in water-fluidized beds

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Heat transfer in water fluidized beds is being investigated in this study. The goal is to enhance and control heat transfer to water tubes in fluidized bed combustors. The approach is to induce aggregative fluidization in water tubes containing high density particles such as steel or lead. Aggregative fluidization is characterized by liquid bubbles appearing in the bed. These bubbles produce rapid mixing of particles in the bed with the result that heat transfer rates between the bed and the enclosing walls is greatly accelerated. We are also investigating aggregative fluidization in three-phase systems in which vapor bubbles produced by boiling produce the same effect as liquid bubbles. Tests are being performed in a cylindrical fluidized bed. A cylindrical heat transfer surface immersed in the center of the bed is wrapped with resistive wire across which electrical power is applied. The heat flux at the surface is equal to dissipated electrical power per unit area of cylinder. The temperature of the heating element was found from knowledge of the temperature coefficient of resistance of the wire and a resistance measurement. Water is pumped vertically through the cylinder and bed of particles, producing the fluidized bed. Heat transfer coefficients for a homogenous and hetrogenous fluidized bed were found to be significantly greater than those for water flow in a tube alone.

149. Automatic gain control of retinal light sensitivity in congenital stationary night blindness

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The physiologic basis of paradoxical pupillary response in Congenital Stationary Night Blindness (CSNB) is investigated with the aid of a mathematical model. The model explains experimentally observed phenomena in CSNB by representing the light adaptation process as an automatic gain control mechanism with both negative feedforward and feedback. The direct light path is apparently interupted in CSNB, giving rise to paradoxical constriction of the pupil when retinal illuminance decreases. The model also explains the observed increase in pupillary hippus which is understood as instability oscillations due to positive feedback. Finally, the model allows us to investigate rod-cone interactions in the retina and their constributions to neural dynamics of pupillary system response.

150. Modeling of Canine Pelvic Limb Muscular Anatomy

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A precise method locating relative muscle skeletal attachments enables the determination of individual muscle forces and moment arms which may improve our understanding of muscular function. We developed a model and devised a scaling system to predict the musculoskeletal geometry in living canine subjects. During the gross dissection of ten hindlimbs actual muscle attachments and certain bony landmarks were labelled with metal screws. "Effective" endpoints were used to more accurately depict the function of some muscles. Biplanar radiographs of dissected pelvic limbs determined threedimensional coordinates corresponding to the pelvic, femoral and tibial bony reference frames. Selected anthropometric dimensions scale coordinates for each muscular attachment site. Combining scaled coordinates from all five animals produced a "scaled coordinates" template to predict raw coordinates in living animals using their own anthropometric dimensions. Template predicted 3D coordinates compared to those measured during gross dissection of an eleventh pelvic limb confirmed the models' validity. Although limited to mid-sized dogs of collie-hound-labrador stature, small differences between coordinates identified by gross dissection and those determined from anthropometric scaling verify this mathematical model as an accurate method for predicting muscle locations in living animals.

151. Juxtarticular stress transients in a dynamically loaded joint

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Repetitive dynamic loading of joints has been linked to early onset of degenerative arthritis. Animal models involving impulsively loaded joints show osteoarthritic changes in cartilage and subchondral bone, but as yet can provide no information about the local stress levels actually being created. This study reports results from a dynamic nonlinear finite element model which has been developed to study juxtarticular stresses in the extension-splinted rabbit knee, an established laboratory model for creating osteoarthrosis due to mechanical loading. The computational model succeeds in producing realistic approximation of an initial impulsive force peak of 1.5 times body weight, which was recorded experimentally in the first 25 msec of a 200 msec, 9 cm cam-driven upstroke of the rabbit tibia.

152. Solving groundwater problems using boundary elements.

S. DAS

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A number of groundwater flow problems are governed by Laplace's equation. In most of the steady state problems the boundary conditions are Direchlet or Neumann type.

Using the fundamental solution and Green's identity the governing differential equation can be transformed into a boundary integral equation, which can be numerically solved to find boundary and domain data.

In the present work, a problem which is representative of real life situation is investigated. Drawdown in wells, effect of wells on each other, etc., are found and compared with experimental data, where available. The superiority of this method in comparison to the more commonly used Finite Element Method is also pointed out.

153. Kharitonov's theorem on the stability of systems

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Stability is a very old and important topic in the study of systems. A recent significant development by V. L. Kharitonov has renewed the interest in stability research.

A common method of testing the stability of a system is by locating the roots of its characteristic equation. The characteristic equation arises from modeling the system by differential equations. When the coefficients of the characteristic equation are not precisely known, but are bounded in an interval, Kharitonov's theorem allows one to test the stability of the entire family of characteristic equations by testing only four of the characteristic equations at extreme points.

An analysis of the significance and limitations of Kharitonov's result will be discussed.

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154. Sampling technique in sense amplifier design for magnetoresistive memories

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Thin film magnetoresistive (M-R) memories offer attractive properties as nondistructive read out, random access, nonvolatility and radiation hardness.

A special amplifier design has been investigated to detect and enhance the output of these memory cells which is highly corrupted by noise. In our technique a bit is read a number of times and a sample of the amplified output is taken each time.

The sampled signal is repetitive while the additive white noise is uncorrelated. Averaging of this leads to the reduction of the noise by square root of the number of samples taken. Enhancing the S/N ratio allows the reduction of bit size making very high density memory integrated circuits possible.

The design of the sense amplifier and the sampling technique will be presented. Investigation of minimum bit size and other applications will be discussed.

155. New approaches to signal average ECGs

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In order to improve the signal to noise ratio of Electrocardiographs (ECGs), previous investigators had averaged several ECGs together. Most investigators have employed only rudimentary morphologic criteria to decide whether a beat should be included in or excluded from the average.

In addition to morphologic criteria, we employ several means of estimating the electrophysiologic status of the heart (previous R-R interval, following R-R interval, difference in R-R intervals, timing of respiratory cycle, phase normalization and voluntary control of respiration) to divide beats into classes, which are then averaged. These are measures of the autonomic nervous system status at the time of the heart beat.

It has been shown that signal-average ECG and R-R variability separately help to detect individuals with increased risk of sudden cardiac death. The combinated method promises to greatly improve the efficacy of Signal Averaged ECGs in detection of cardiac disease.

156. Power spectrum estimation as a tool to investigate biological feedback mechanisms

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Biological control systems usually include feedback. Under certain conditions, these feedback control systems may oscillate. The frequency of such oscillations is characteristic of the time required to traverse the feedback loop.

It is sometimes possible to identify specific feedback mechanisms with particular frequency components. In these cases, power spectral analysis of biological signals may be a useful tool in investigating the control systems which give rise to the oscillations.

We are employing these analytical methods to investigate the varibility ("lability" in physiologic terms) of blood pressure and heart rate in order to investigate the mechanisms of increase of variability in deafferentated rats.

157. Internal friction study of the effect of hydrogen on the nitrogen Snoek peak in Nb

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To determine the nature of the interaction of interstitials in refractory metals, internal friction was used to determine the effect of hydrogen in solid solution on the nitrogen Snoek peak in Nb over the temperature range 300 - 700 K. Using analysis techniques developed by Weller and coworkers, activation parameters were determined from torsion pendulum results and compared to parameters found from frequency analysis. These activation parameters were found to be independent of hydrogen concentration indicating no interaction between hydrogen and nitrogen in this temperature range.

Ames Laboratory is operated for the U.S. Department of Energy by Iowa State University under contract no. W-7405-ENG-82. This work was supported by the Office of Atomic Energy Sciences, Division of Materials Sciences.

158. Speech Vocoders based on Line Spectrum Pair representation of LPC coefficients

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Linear Predictive Coding provides an efficient way to represent speech signal in terms of time varying parameters related to the vocal tract transfer function and the glottal excitation. An important application for this method is in supporting tactical voice communication over narrow-band channels. The Govt standard Linear Predictive Coder operating at 2400 bps provides good speech intelligibility (DRT score 88.4%) in error free conditions; however, the performance degrades rapidly in the

presence of bit errors.This has prompted researchers to develop even lower bit-rate vocoders so that the bits saved can be used for error protection. To meet this end, parameters with low spectral error sensitivities and good perceptual properties are critical. Line Spectrum Pairs (LSPs) (Itakura 1975) have been found to be better suited for such vocoders than the conventional reflection coefficients. An 800 bps LSP based vocoder (DRT score 87%) has been proposed recently by Kang et al (1985). In our presentation,the LPC background, LSPs, error protection and our own efforts with LSP based vocoders will be discussed.

159. Ultrastructural characterization of commercial coffee grains using scanning electron microscopy: Regular versus decaffeinated coffee

A. U. DOGAN[1], J. K. BEDDOW[2], D. W. LUERKENS[2], M. M. DOGAN[3], H. ELKADI[4] and A. H. MARDAN[5]

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Coffee is consumed by majority of the world population. Chemically coffee is rich in xanthine derivatives which is used extensively in western world as an analgesic. However, recent investigations have demonstrated the strong associations between caffeine and serious renal pathology including cancer. Urate kidney stone formation is also related high intake of xanthine products such as caffeine. Because caffeine has been correlated with serious damage to kidney, we aimed to compare regular coffee with decaffeinated coffee. Selected brands of regular and decaffeinated coffee grains is examined using Hitachi S-570 Scanning Electron Microscope. Particle size, shape, size distribution, surface texture, pore system geometry, pore size distribution, and microporosity were recorded for individual coffee grains. These results were combined with previously done morphological analysis. It is observed that size distribution, shape, and pore system geometry are important parameters, and there are significant differences among different brands of coffee particles. Caution should be taken for sampling which is still complex due to mixing of various types of coffee grains for certain brand of commercial coffees. Future study will involve the effects of regular versus decaffeinated coffee on kidney stone formation.

160. Microstructure characterization of powdered food grains using scanning electron microscopy

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With recent developments on electron microscopy, microstructure evaluation of powdered foods became increasingly important. Low accelerating voltage allows to observe samples without conductive coating, and cryo microscopy makes it possible to study samples in frozen stage. Also, improvement on sample preparation techniques contribute studying of food microstructure. In this study, several different types of food particles were studied including coffee, instant tea, powder cream, powder cheese, sugar, brown sugar, succrose, salt, cocoa, milk, chocolate, red pepper, and black pepper. Sample preparation for the foods is the most critical part. Air drying, oven drying, critical point drying, conventional chemical fixation, freeze drying for SEM, and freeze etching for TEM can be used, although air drying is the most commonly used alternative for SEM. HMDS can be an alternative for critical point drying method for very small particles. Although low acceleration voltage (1 to 5 KeV) is used for uncoated samples, thin layer of conductive Au coating improved mechanical stability of most food particles. Caution should be taken on shrinkage during dehydration processing for samples with water content, and dehydration process itself may create artifacts of microstructure. It is concluded that among the food particles studied in this work, cheese, sugar, and brown sugar are the most complex particles to characterize due to difficulties in sample preparation.

161. The mechanochemical behavior of 2826MB Metglas in H_2SO_4 solution

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In a recent study conducted by the authors, it has been shown that a ribbon of 2826 MB Metglas is susceptible to corrosion in H_2SO_4 solutions. The degree of susceptibility is found to vary depending on the concentration of the solution and the duration of the test. As a result, the study is extended on the Metglas in order to determine the mechanochemical behavior of this new electronic material in the same aqueous solution. As far as we know, this is the first investigation attempting to assess the behavior of the material under a combined action of stress and corrosion. The stress corrosion tests are carried out on specimens in as received and annealed conditions in different concentrations of H_2SO_4. The concentration of the solution is ranged from 0.5-$2NH_2SO_4$. In addition, the tests are conducted on specimens especially fabricated in a way that the open loading mode can be implemented in this study at specific loads. The surface of the material is examined before and after the stress corrosion tests by using a scanning electron microscope (SEM). The SEM examination is able to reveal the nature of corrosion cracking in all conditions of the heat treatment. Furthermore, the investigation is succeeded in documenting progressively the crystillization process of 2826MB Metglas as a consequence of the heat treatment. The documentation has been carried out by a transmission electron microscope (TEM) as well as by an electron diffraction technique. The TEM examinations have precisely identified various internal microstructures as they form due to the annealing treatment. Consequently, a qualitative relationship has been drawn between the microstructure and the mechanochemical behavior of the Metglas.

162. The multiquadric-biharmonic method of three dimensional mapping inside ore deposits

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The multiquadric-biharmonic (MQ-B) method is a physically deterministic method of mapping inside of volumes or on planes and lines. Many mining problems involve bore hole data which provide three dimensional information. A complete evaluation of the competitive methods in many mineral resource applications shows that the MQ-B method generally equals or exceeds the accuracy of the kriging and other stochastic process methods, with considerable savings in computer processing. The theory of the MQ-B method is based on mathematical physics rather than stochastic processes. No pre-processing is required. Making the sum of the biharmonic sources (coefficients) equal to zero satisfies the conservation of energy concept. The solution of (n+1) simultaneous equations provides a finite sum of continuous MQ-B functions which can be evaluated at any number of points to provide the basis for contouring by surfaces in three dimensions. This result also provides a meaningful basis for ore reserve estimation and positional block variances.

Geology

163. DOSECC: Deep Scientific Drilling Comes to Iowa

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DOSECC (Deep Observation and Sampling of the Earth's Continental Crust) is a non-profit corporation that was established in 1984 by a consortium of universities to manage scientific drilling activities for the National Science Foundation. Three DOSECC projects scheduled to begin in the next few years will sample and study Phanerozoic and Precambrian rocks from the Iowa subsurface. A series of nine deep core holes are planned along a line from northwest to southeast Iowa as a part of the "CICSCO" (Continental Interior Crustal Studies Consortium), and at least two deep cores are proposed along the trend of the Midcontinent Rift Zone in Iowa by "MCR" (Midcontinent Rift Scientific Drilling Project). The isotope geochemistry of igneous rocks recovered in these drilling programs will be studied and their petrogenesis and ages investigated by "Project Upper Crust," which also funds bottom-hole projects to deepen pre-existing drill holes and sample igneous basement rock. These projects promise an opportunity to study presently unknown Paleozoic and Precambrian units and will lead to some of the most significant advances ever in our understanding of the geology of Iowa.

164. Chemical interaction between acid and basic magmas, SE Iceland

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Basic masses enclosed by granite in the Austurhorn net-veined complex have been interpreted to be the result of basic magma intruding acid magma. Major and trace element concentration profiles from the edge to the interior of a typical large diabase mass have been determined to assess chemical interaction with the surrounding granite. Comparisons with experimental and calculated profiles indicate that diffusional transfer of elements has occurred in the outer portions of the diabase and across the granite-diabase interface. Si and Na diffused into the diabase while K and Sr diffused into the granite. Ca, Fe, P, Mg, La, Rb, Zr, and V also exhibit profiles suggestive of diffusion. Ca, K, Rb, and La diffused up concentration gradients. Diffusion and thermal modelling have been carried out assuming coexisting magmas. Profiles of Na and Sr resemble model profiles requiring 4 weeks to develop; this is well within the time constraint imposed by cooling of the diabase to its solidus. These results are permissive evidence for the coexistence of acid and basic magmas and the formation of basic pillows.

165. Geochemistry of the Sonju Lake mafic layered complex, northeastern Minnesota

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The Sonju Lake complex is part of the Beaver Bay intrusion of Keweenawan age. The 3.5 km thick intrusion consists of layers, from base to top, of picrite, troctolite, two pyroxene gabbro, augite gabbro, apatite ferro-diorite, granodiorite and perhaps granite. Stevenson (1974) observed systematic changes in mineral compositions across the intrusion, and calculated a tholeiitic bulk composition.

The Sonju Lake intrusion has affinities with many other Keweenawan intrusions such as the Duluth gabbro, Mineral Lake intrusion, Bald Eagle intrusion and several others. Stevenson (1974), however, found a wider range of differentiation in the Sonju Lake intrusion than has been found in any other Keweenawan intrusion. This research is part of an ongoing study in cooperation with the Minnesota Geologic Survey.

166. Trace elemental constraints on the evolution of peralkaline phonolites, Chico Hills, New Mexico

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Peralkaline phonolites of Oligocene age (25 Ma) are part of the Chico Sill complex, SE of Raton, NM. The phonolite consists of minor nepheline and large, tabular alkali feldspar phenocrysts in a groundmass of alkali feldspar, nepheline, sodalite-group minerals, and needles or sprays of aegirine.

The more evolved rocks show a greater nepheline/alkali feldspar ratio and contain a suite of rare accessory minerals.
Trace element variations show two distinct and parallel trends in REE vs Zr and diverging trends in Rb, Mn and Y vs Nb and Zr. The trend exhibiting greatest REE enrichment contains samples from most primitive to most evolved. Chondrite-normalized REE patterns for this trend show a slight negative Eu anomaly and an unusual increase in HREE with evolution. The second trend lacks significant Eu anomalies or HREE enrichment. Evidence suggests that two slightly different parent magmas were subject to similar differentiation processes, and that the phonolite did not evolve from the same parent as other rock types in the area.

167. The geochemistry of manganese-rich garnet-bearing rocks associated with the Aggeneys Cu-Pb-Zn-Ag-Au deposits, Namaqualand, South Africa

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The Aggeneys deposits (Broken Hill, Black Mountain, and Big Syncline) are contained in a thick sequence of metasediments and metavolcanics (Bushmanland Sequence)in the Namaqualand district, South Africa. These deposits contain in excess of 260 million tonnes of ore averaging 3.4% combined Cu+Pb+Zn and 20 gram/tonne Ag. Mineralization which has been metamorphosed to upper amphibolite grade and subjected to five fold episodes is contained in a 200 m thick succession of schists and iron formation known as the Aggeneys Ore Formation. The ores are intimately associated with a variety of manganese-bearing garnet-rich rocks including garnet quartzite, amphibole-garnet quartzite, magnetite-garnet quartzite, gahnite-garnet quartzite, and garnet rock. Major,trace and rare-earth element studies of these rocks suggest that they were originally hydrothermal chemical sediments which had a detrital input of alumina. Manganese-rich garnet-bearing rocks serve as an important guide in the exploration for metamorphosed massive sulfide deposits.

168. The geology and geochemistry of barite vein deposits, northern Ontario, Canada

B. KUTZ AND P. G. SPRY

Proterozoic barite vein deposits are distributed in rocks of Archean and Proterozoic age throughout the Superior Province of northern Ontario. These veins occur in a variety of rock types including granite, syenite, diamictite, and diabase. The deposits, which are up to 160 km apart, are east-west trending and are parallel to a regional set of faults. Veins are composed of barite, calcite, and fluorite, and minor pyrite, sphalerite and chalcopyrite. Trace amounts of native copper, bornite and covellite are also present. Fluid inclusion data indicate that the veins were deposited from low temperature (80°-110°C), low to moderately saline (0 to 10 equiv. wt % NaCl), CO_2-poor fluids. $d^{34}S$ values for sulfides and barite range from -13 to 0 °/oo and 3 to 10 °/oo, respectively, and suggest a mixed source of sulfur (i.e. reduced seawater sulfate and biogenically derived sulfur). The origin of carbon in the deposits is ambiguous because $d^{13}C$ ranges from -8 to 0 °/oo in calcite. Values of $d^{18}O$ (1 to -10 °/oo) and dD (-147 to -10 °/oo) for fluids in fluid inclusions in calcite and fluorite suggest a significant meteoric water component; however, these data do not rule out a contribution from either a connate brine or a magmatic fluid.

169. Regional geology of Archean gold lode deposits of the Atlantic City-South Pass district, Wyoming

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The Atlantic City-south Pass gold district is hosted by Archean metasedimentary and metavolcanic supracrustal rocks. It is one of the few Archean gold deposits in the US and has produced ~325,000 oz. Au. The supracrustal rocks form a tightly folded, northeast-trending synclinorium and have been metamorphosed to amphibolite grade. Basal ultramafic rocks are overlain by iron formation, quartzites, and pelitic schists of the Goldman Meadows Formation. Thin iron formation units also occur in the overlying Roundtop Mountain Formaiton, which is overlain by metagraywackes, graphitic schists, cherts, and intercalated mafic flows and tuffs of the Miners Delight Formation. Most lode gold occurrences of the district are hosted in shears located near the contacts of a northeast-trending belt of meta-igneous dikes and sills with the surrounding Miners Delight Formation metasediments. The spatial relationship of gold mineralization to iron formation,graphitic schists, and cherts is similar to that observed at Archean gold deposits in Canada and other parts of the world. Preliminary sulfur isotope values of -1.0 to 2.9 °/oo suggest a magmatic source for sulfur in sulfide minerals associated with gold mineralization.

170. Iowa geology: the early years

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In 1975 on the occasion of the first one hundred years of the Iowa Academy of Science, Robert W. Hanson summarized the history of the organization. Additional historical accounts were published during the centennial year covering many of the science disciplines. Although geology was not treated separately in the special articles prepared during the centennial year, the contributions of early geologists were important to the development of science in our state. In celebration of the one hundredth annual meeting of the Iowa Academy of Science, it is appropriate to consider the contributions of early geologists in Iowa. Included in this report are the contributions of R. Ellsworth Call, Samuel Calvin, James Hall, Charles Keyes, W. J. McGee, David D. Owen, Frank Springer, Orestes St. John, James Todd, Charles Wachsmuth, Clement Webster, Charles White, and A. H. Worthen. Correspondence between Charles Keyes and Samuel Calvin in 1892 and 1893 provides historical background on the political climate in Iowa at the time of the establishment of the Iowa Geological Survey in 1892. Highlights of this correspondence are reported.

171. Twinning enhanced disordering in $NaAlSi_3O_8$

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Triclinic $NaAlSi_3O_8$ is the sodic endmember of the framework aluminosilicates (feldspars) which comprise the bulk of the earth's crust. $NaAlSi_3O_8$ is assigned a non-standard space group of CI due to its slight distortion from a C2/m. At low temperatures, the tetrahedral rings are ordered (low structural state) with Al in 1 of the 4 tetrahedral sites. With increasing T, the Al becomes randomly distributed. The kinetics of disordering is a function of P and T (Goldsmith, 1987).

Cores from single crystals (3mm x 7mm) were deformed in a triaxial solid media device (P_c = 1 GPa, $\dot{\epsilon} = 10^{-5}$ s^{-1}, and T varied from 800 - 1000 °C). Cores were oriented to favor or oppose twinning. Due to thermal gradients within the sample assembly only the central 1/3 of the sample was within 50 °C of the maximum temperature. Partially disordered samples show a serrated boundary between the low and high structural states when the cores were favorably oriented to twinning (parallel and normal twins). These serrations follow the crystallographic orientations of the twin laws. Cores in the anti-twinning orientation do not show these serrations and take longer to disorder.

172. Evidence for dynamic recrystallization in naturally deformed quartzites from Cholla Wash, Eagle Mountains, southern California

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Well lineated and foliated andalusite and sillimanite-bearing quartzites from beneath a ductile thrust have strong quartz crystallographic preferred orientations (CPO's). Optically determined c-axis orientations define modified single girdles at a high angle to the foliation and lineation. These CPOs are typical of quartzites deformed by intracrystalline glide. Detailed measurements on samples whose fabrics are least modified by post-deformational recovery processes show that the largest, most elliptical grains have their c-axes oriented at low angles to the foliation and nearly perpendicular to the lineation. Smaller, less elliptical grains have a broader range of c-axis orientations.

New grains develop through polygonization and subgrain rotation of older, highly strained grains. As they grow and deform by intracrystalline glide, the crystals may rotate toward preferred orientations. This is suggested by the strong CPO of the large grains and weak CPO of the small ones.

173. Microstructures within porphyroblasts as indicators of foliation regeneration, Orocopia Schist, southern California

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Porphyroblasts in metasediments in an accretionary complex show evidence that the foliation has been transposed at least twice during deformation. The earliest deformation produced quartz bands with finely foliated graphite and mica layers (S1). This foliation is preserved only in pseudomorphed porphyroblasts. Albite, idioblastic garnet, and idioblastic sphene porphyroblasts overgrew earlier porphyroblasts and the previous matrix foliation (S2). Folds have transposed this foliation at least once more, producing the present coarse-grained matrix and bands of graphite. Development of the present foliation (S3) may have been the result of a change in the direction of tectonic transport, based on the change in asymmetry of pressure shadows between S1 and S3.

174. A model for listric faults

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Many normal faults flatten out with depth, such faults are termed listric faults.

Recent study of the formation of listric faults has either focused on how listric faults develop through continuous stretching and detachment of the crust during continental extension (McClay & Ellis, 1987), or modeling of the detachment process (Bosworth, 1985).

This study attempts to theoretically predict the geometry of a listric fault from the physical properties of the rock and the applied stress field.

Bosworth, W., 1985, Geometry of propagating continental rifts: Nature, v. 316, p. 625-627

McClay, K.R. & Ellis, P.G., 1987, Geometries of extensional fault systems developed in model experiments: Geology, v. 15, p. 341-344

175. Comparative study of the Paleo-Tethyan Ophiolite Suites

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The large, west-narrowing, triangular embayment of the Permo-Triassic Pangea has been widely presumed to have been destroyed as a result of subduction and collision during Post-Triassic times. However, the details of this collision with Laurasia and demise of this oceanic embayment, now commonly referred to as Paleo-Tethys. Rare earth and trace elements data of Paleo-Tethyan ophiolites along the North Anatolion Fault have been synthesized and compared with the other Paleo-Tethyan Ophiolites. Hitachi S-570 Scanning Electron Microscope equipped with Kevex 8000 Energy Dispersive and Microspec WKX-2A Wavelength Dispersive X-ray Microanalysis systems and Tracor 2000 X-ray Fluorescence system form the basis of the analysis. The data is used along with other geological evidence in determining the nature and geologic evolution of the uppermantle and paleotectonic setting of the ophiolite suites. The compositional diversity of the ophiolite series indicates the complexity of the geodynamic environment.

176. Tertiary strata in Iowa

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International definition of the Plio/Pleistocene boundary at 1.6 Ma now places Iowa's oldest tills (>2.2 Ma) in the Pliocene. A widespread sub-till fluvial unit in western Iowa reaches thicknesses to 200 ft and is composed of "salt & pepper" sands, silts and clays. This unit is well exposed near Folsom Lake in northwest Mills County. In Plymouth County it is overlain locally by a glacial-derived sand/gravel unit with pre-1.6 Ma mammals (Stegomastodon), and hence both units are of Tertiary age. Unlike glacial-derived Quaternary sands in Iowa, the sub-till unit contains a notable component of volcanic rock fragments (up to 7%, avg. 2.6%) and plagioclase (up to 6.3%, avg. 4%). This compares favorably with Ogallala strata in nearby northeast Nebraska (avg. volc. 4.7%, plag. 3.7%) and modern Missouri River alluvium (avg. volc. 4%, plag. 5.4%). Therefore, the sub-till unit is not glacial-derived but is western sourced. Reworked Ogalalla fossils (Miocene) are known from Quaternary gravels in western Iowa-northwest Missouri (rhinos, three-toed horses), and their presence raises the possibility that Ogallala outliers may occur east of the Missouri River.

177. Representative lithostratigraphic sections of the Little Cedar and Coralville formations (Devonian) Black Hawk County, Iowa

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Witzke, Bunker, and Rogers (1987) have prepared a new stratigraphic nomenclature for rocks of the Cedar Valley Group (Devonian). An updated lithostratigraphic column using the new nomenclature will be presented for the Little Cedar and Coralville formations at Pint Quarry in Raymond, Waterloo South Quarry, and a core from the Black Hawk County Landfill.

Photographs and thin sections of various sedimentary structures and textures in the study area will also be presented.

178. Conodont fauna and biostratigraphy of the Upper Devonian (Late Frasnian) Lime Creek Formation of north-central Iowa.

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The conodont fauna of the late Frasnian Lime Creek Formation is dominated by species of the genus Polygnathus. Relative abundance of conodont species in Lime Creek Formation is similar to faunas characteristic of the Polygnathus Biofacies reported by Klapper and Lane (1985, 1988) from Frasnian successions in western Canada.

Palmatolepis semichatovae first appears near the base of the Juniper Hill Member and ranges into the lower Cerro Gordo Member. Palmatolepis foliacea was reported by Anderson (1966) from a position just above the last occurrence of P. semichatovae in the lower part of the Cerro Gordo Mb. The occurrence of the former species is correlated with Zone 5, and the latter with Faunal Unit 7 of the Frasnian conodont sequence in Alberta (Klapper & Lane, 1988).

179. Report of Fossils from the Red Rock Sandstone Quarries of the Amana Colonies

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The Red Rock sandstones of the Des Moines series are found in the southeast third of the state of Iowa. Sandstone buildings of the Amana Colonies are built of Red Rock sandstone taken from seven local quarries. These quarries and their typical products are discussed.

An outcrop near the Middle Amana quarry is described, as are calamite fossils collected from the quarry and the outcrop. Although five nearby counties are known to have yielded plant fossils in Red Rock sandstone, this is the first report of such fossils in Red Rock sandstone from Iowa County.

180. A sample preparetion technique for TEM and XRD analyses of the same clay mineral specimens

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A new sample preparation technique has been developed which permits both transmission electron microscopy (TEM) and x-ray diffraction (XRD) analyses of the same clay mineral specimen. Clay samples, saturated with various organic and inorganic cations, were prepared as oriented specimens on Teflon film and analyzed by XRD. The specimens were then treated with Spurr resin and again analyzed by XRD. Finally, portions of the oriented specimens were separated from the Teflon film, embedded in more resin, sectioned, and analyzed by TEM. With this technique it was observed that the resin may penetrate the interlayer space of expandable 2:1 phyllosilicates and thereby, increase the apparent basal spacing of these clay minerals. A comparison of the XRD and TEM data further suggest that coherently diffracted x-rays may be detected from relatively disoriented clay specimens.

181. A pollen profile of the Cedar Hills Sand Prairie

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A core of sediment of approximately 250mm in length was obtained from a marsh area in the Cedar Hills Sand Prairie located about ten miles northwest of Cedar Falls, Black Hawk County, Iowa. Samples were taken at 20mm intervals and were processed according to standard palynological lab procedures. The pollen grains were stained and mounted in glycerin jelly. Approximately 300 palynomorphs were counted from each sample. A relative frequency diagram was constructed. Grass, sedge, and Ambrosia-type pollen were major contributors to the pollen sum in all parts of the core. The low values of Ambrosia-type pollen at the bottom of the core suggests a maximum age for the cored sediment. Aquatic plant pollen indicates the site was a pond in the recent past.

182. Parent material heterogeneity and its overprinting on three soil profiles from Northeast Iowa

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Framework mineralogy of the sand-size fraction (300-63 μ) was studied to examine parent material homogeneity and to monitor any vertical fractionation of minerals within a soil profile. Three soil series were used in this study: Winneshiek (Mitchell Co.) and a Jacwin Variant and Rockton (Floyd Co.). The Winneshiek soil mineralogy includes texturally diverse contents of rutilated-quartz, chert, potassium feldspar, albite, micas, grossularite, hornblende, kyanite, staurolite, epidote, dravite, rutile, and minor zircon. Variable abundance of individual mineral species within the profile has been attributed to parent material heterogeneity and pedogenesis. The Jacwin Variant is similar in mineralogical composition to the above, except for slightly higher percentage of mature tourmaline and zircon. The Rockton soil, unlike the others, shows a large amount of texturally mature zircon, in addition to containing tourmaline, rutile, and garnet. This study demonstrates strong heterogeneity in parent materials as well as the influence of weathering intensity on the vertical fractionation of minerals within soil profiles.

183. Comparisons of loess and silty alluvium in two biosequences from Northeast Iowa

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Two soil biosequences from Allamakee and Clayton Counties were studied to determine parent material uniformity among loess, redeposited loess, and silty alluvium parent materials. The well-drained, upland Tama-Downs-Fayette biosequence formed in loess (wind-blown silt) dated between 14,000 to 28,000 RCYBP. The well-drained, high stream terrace Richwood-Festina- Bertrand biosequence formed in slope-washed loess and/or silty alluvium. This biosequence occurs along major rivers such as the Upper Iowa, Turkey, and Volga Rivers and their tributaries. Particle size distributions of 12 soil profiles were determined by the pipette method at the ISU Soil Survey Laboratory. To determine parent material uniformity, clay-free particle size distributions of sand, coarse silt and fine silt were computed, thereby reducing pedogenic effects on depth distributions. Comparisons of coarse/ fine silt ratios between upland and terrace biosequence members showed upland soils with lower ratios (1.0-1.7 range) than stream terrace soils (range 1.5-3.0).

184. Abandoned underground coal mines of Des Moines

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Underground coal mining occurred in the Des Moines, Polk County area from 1865 to 1947. Until recently the locations of many of these mines were only vaguely determined. A map showing the locations and extents of these mines was compiled from historic literature and recently restored mine maps of abandoned underground coal mines. The map locates 160 mines which encompass over 12,000 acres (19 sq. miles) and are categorized into four groups: 1) mines of known location and extents taken from restored mine maps; 2) mines of which the extents are taken from the State Mine Inspectors maps; 3) coal lease properties drawn from literature sources; 4) located mines with unknown underground extents.

Results of the research include, improved delineation of undermined areas, revelations of new and suspected areas of multiple level (stacked) mining and an improved understanding of the geology of the Des Moines area.

In addition to the obvious geological and historical applications of the map it may also have implications in Des Moines area engineering and land use strategies.

185. Isotopic compositions of sulfate evaporites from southeastern Iowa

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Analyses for stable isotopes of oxygen and sulfur have been performed on 24 samples of gypsum or anhydrite, representing each of the major evaporite units in the state of Iowa. In each case, values for $\delta^{34}S$ are consistent with values for sulfates of the same age on the global sulfur "time line" determined by other workers. Some samples, however, have $\delta^{18}O$ values as much as 6 permil lighter than sulfates on the global oxygen "time line." These anomalies occur in both Devonian and Mississippian samples, but are restricted to a small region near Ottumwa. The Mississippian and Devonian strata in this area host major aquifer systems which may have disturbed the isotopic systematics of the sulfate evaporites. This association is circumstantial, however. No mechanism proposed to date, including those that involve interaction with deep waters, accounts for these light oxygen values.

186. Mineralogy and stable isotopic ratios of sulfide mineral deposits from late Paleozoic karst fills in Devonian limestones, eastern Iowa.

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Pennsylvanian karst occurs in older carbonate strata in east Iowa, and hosts sulfide mineralization. At Conklin Quarry (CQ), Johnson Co., karst-fill mudrocks contain clasts of Cedar Valley Ls. Minerals grew on surfaces and filled veins in clasts, and grew as nodules in mudstones. Minerals include pyrite & calcite, with minor sphalerite, barite, marcasite, millerite, and chalcopyrite. Sulfur, carbon, and oxygen isotopic analyses were performed to compare karst-fill minerals with previously studied vein-filling minerals from CQ and Upper Mississippi Valley (UMV) Zn-Pb deposits. Isotopic ratios of calcites ($\delta^{13}C$= -3.86 to 1.21 o/oo PDB; $\delta^{18}O$= 23.67 to 27.15 o/oo SMOW) differ from those reported in UMV calcites. Sulfur isotope ratios have wide range of values ($\delta^{34}S$= -30.9 to 15.7 o/oo CDT). Different isotopic ratios in karst-fill vs. UMV minerals show each originated from different fluids. Data suggest sulfide generation from bacterial sulfate reduction in closed system. Isotopic ratios of CQ calcites suggest ppt. from cool meteoric waters.

187. Process-response models for prediction of sandstone diagenesis.

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In sandstone diagenesis, parameters such as depositional environments, tectonic history, temperature, pressure, time, detrital mineralogy, pore system geometry, initial pore water chemistry, and pore water migration from external sources can be used to deconvolute post-depositional histories and to develop process-response models. Upper Cretaceous lenticular sandstones in the Powder River Basin provide excellent rock systems for developing such models. The Upper Cretaceous Mesaverde Group (the Teapot, Parkman, Sussex, and Shannon Sandstones) contain lenticular sandstone units surrounded by the Pierre Shale in the Powder River Basin, Wyoming. The Parkman Formation has been studied in detail for stratigraphy, petrography, depositional and post-depositional environments. It is observed that the sources for authigenic minerals for the Parkman Formation appear to be predominantly exogenic, possibly from the Pierre Shale. Therefore, it is predicted that the other lenticular sandstone units in the Powder River Basin could have similar diagenetic histories. In order to test this prediction, petrographic microscopy, SEM and X-ray microanalysis study were performed on the Shannon Sandstone. The results indicate that general paragenetic sequences were similar to that of the Parkman Formation. Preliminary analysis on the Teapot and Sussex Sandstones also show similar general trend in paragenetic sequences. In this study, it is shown that process-rasponse models can be very powerfull tool to evaluate and help to predict diagenetic styles of other sandstone complexes in similar geological settings.

188. The pre-late Wisconsinan glacial record in Iowa: Evidence from striations and till fabrics

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In this study, we have compiled striation and till fabric data on a 1:500,000 Iowa map. This investigation emphasizes pre-late Wisconsinan ice movements inasmuch as the direction of movement of younger glaciers is apparent from moraines and other glacial landforms. Of all the observed pre-Illinoian striations, the oldest and least frequently occurring striations observed indicate ice movement toward the south and southwest. Although these striae cannot be firmly associated with a specific till, they are probably related to the event(s) that eroded and dispersed erratics of native copper and banded iron formation across eastern Iowa. The oldest striations are cross-cut by a younger set that trend west-to-east. The nature of the striae, till fabrics, and glaciotectonic bedrock disruptions point to a westerly source. This event produced a clay-rich black till derived from Pennsylvanian black shales. The youngest and most frequently occurring striations are associated with pre-Illinoian glaciers moving into Iowa toward the east-southeast.

189. A finite difference model of contaminant transport at the La Bounty site, Charles City, IA

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The La Bounty chemical dump is located in the floodplain of the Cedar River in Charles City, Iowa. The site was used for waste material from Salsbury Labs from Sept. 1953 through Dec. 1977 when it was discovered that leachate was moving into the Cedar River. The site is approximately 12 acres in size and contains over 3 million cubic feet of waste material. Remedial efforts to slow the movement of the leachate include the placement of a clay cap over the area and the installation of an upgradient cut-off wall. A study has been undertaken using a two-dimensional finite difference model to determine what effect the upgradient cutoff wall has had in slowing the movement of the leachate into the river and to predict the long-term movement of the leachate from the dump site.

190. Denitrification and nitrate movement in the shallow alluvial aquifer of the West Des Moines River, Iowa

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Water quality monitoring conducted on sets of nested piezometers in an alluvial aquifer show that nitrate concentrations vary spatially and decrease with depth. To determine whether denitrification is a factor controlling nitrate levels within the aquifer, the following parameters were

measured: DOC, TOC, DO, alkalinity, N-series, and presence/absence of denitrifying bacteria. Field tracer studies were performed using NO_3^- and Cl- injected simultaneously into the aquifer. Results suggest that nitrate is reduced within the aquifer. Lab studies verify that soils and groundwater from the region are capable of reducing nitrate under anoxic conditions. Laboratory nitrate reduction rates using 150g soil samples range from 5 - 40 mg/L/day as NO_3^-. Flow-related changes in nitrate concentration are postulated for one site where well-oxygenated soils and gravel lenses characterize the shallow portions of the aquifer, the vertical gradient is low, and high nitrate levels decrease markedly with depth.

191. Pesticides in alluvial groundwater in western Iowa.

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Studies by several agencies over the past eight years have found that many of the commonly used pesticides are being found in shallow groundwater. State-wide, wells completed in alluvial aquifers have a thirty-nine percent positive detection rate. Twenty-one percent have shown multiple detections. The use of nested wells has shown that vertical stratification of pesticides does occur and is probably caused by flow regimes within the aquifer. Municipal wells tend to have higher detection rates than monitoring wells. Local contamination may account for some of these discrepancies. Alternately, pumping may destroy stratification and lead to higher concentrations of pesticides being observed than would otherwise be found in deeper parts of the aquifer.

192. Authigenic mineral characterization in sandstone reservoirs using comparative electron microscopy techniques

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Authigenic minerals can play an important role in sandstone reservoirs and when correctly identified help to evaluate and predict reservoir characteristics. The most common authigenic minerals in sandstone reservoirs include quartz, feldspars (orthoclase, plagioclase), clays (chlorite, kaolinite, illite, smectite), calcite, dolomite, sericite, ankerite, zeolites, apatite, pyrite, iron-oxides (hematite, magnetite, ilmenite, limonite), halite, gypsum, and anhydrite. In this study, *comparative electron* microscopy techniques including scanning electron microscopy, backscattered electron microscopy, transmission electron microscopy, scanning transmission electron microscopy, signal mixing and signal processing techniques, X-ray fluorescence, energy dispersive and wavelength dispersive X-ray microanalysis, elemental mapping and mineral mapping TM techniques is used to characterize sandstone reservoirs. Future work will include automatic characterization of reservoir sandstone, as well as pore system characterization with the advancement on the image analysis system and automatic stage control.

Linguistics

193. When did things start to get interesting? Or, does historical linguistics have anything to say to cognitive science?

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1. Crosscultural research on the facial expression of human emotions (Ekman et al. 1971, 1972, 1983) suggests that an expression of interest is one of the few universally recognized human facial gestures, along with facial expressions of basic emotions like happiness, sadness, anger, fear, and surprise.

2. Words expressing the emotion of interest are perhaps not as universal as the facial expression, being fairly recent in French and English. Interest for a long time meant a financial interest or other concrete interest. Not until the 17th century in France and the 18th in England was the word interesting first used in something like its current sense.

3. Although the word interesting is an adjective, it does not describe any quality inherent in a thing or a person. We attribute to entities outside ourselves something that is really a reflection of our own mental processes.

4. If the way the lexicon is organized reflects universal human thinking processes (G. Lakoff 1987), do changes in lexicon reveal changes in the way people think?

194. Controlled degradation of natural language texts as a means of revealing lexical patterns in writing.

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A computer program (texter) written in both Pascal and C computer languages has been designed to allow natural language texts in English and various other languages to be processed in a controlled manner producing a quick visual identification of lexical patterns. Given a control list generated by the investigator, texter will visually show the positive or negative locations of items in the list within a given text, by replacing such words or other words with a marking symbol on a letter by letter basis. Although the process degrades the text

under study, it does so in a way that reveals semantic structure for poetry, prose, and other forms of written communication. Texter facilitates rapid visual textual analysis of natural language texts on a PC by the application of such control lists.

195. Field independence/dependence as a predictor of variance in cloze tests of language ability

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Non-linguistic factors contributing to variance in performance on a language test present a problem for its construct validity. This study used 160 students in freshman English classes at Iowa State University to investigate the influence of the non-linguistic factor, field independence, on a cloze test of language ability. This paper will describe the study's background, procedures, instruments, and results of a multiple regression analysis, which tested the hypothesis that field independent individuals will perform better on cloze tests than field dependent individuals regardless of their language ability. It will discuss the implications of these results for using cloze tests to evaluate linguistic proficiency.

196. Colloquium: Resources for Introductory Linguistics Courses

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Introductory courses in linguistics at the undergraduate level must address a wide range of topics and students. Instructors are usually specialists in some area of theoretical or applied linguistics and perhaps not current on other developments in this rapidly expanding field. Furthermore, locating effective instructional materials for linguistics courses is time consuming and often frustrating in an era of dwindling library and media budgets.

This colloquium offers an opportunity for colleagues to identify, share, demonstrate, and propose effective materials for courses in general linguistics. Everyone who attends is encouraged to be an active participant by bring samples of handouts, film and video synopses, computer-assisted lessons, audio or video tapes, supplementary exercises, reading lists, textbooks, etc. Brief presentations on recent trends in general linguistics are also invited as a means of updating the knowledge base of the audience.

Nursing

197. Siblings as change agents in promoting functional status for children with cerebral palsy

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Siblings can have a powerful influence on brothers or sisters with cerebral palsy (CP), although the positive effects may be thwarted by misconceptions about CP and underdeveloped helping skills in siblings. This project examined an intervention called "SIBS", or Siblings Inspiring Their Brother or Sister, to determine whether siblings could be effective change agents for the 15 children with CP, as measured by increases in the range of motion (ROM) for extremities, and on improvement in self-care skills. Functional status was assessed before, during, and after the four month SIBS program. When calculated as a percent of the total motion possible for each joint, ROM improved significantly ($p < .05$) for shoulder, elbow, and wrist; no significant changes were observed for hip, knee or ankle. Self-care items showed gain scores in the areas of Personal Hygiene (tooth brushing, hand washing and hair combing), Dressing (putting on clothes), and Eating (using a spoon).

198. Predictive validity of admission selection variables and performance of baccalaureate nursing graduates on licensure examination (NCLEX-RN)

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The purpose of this study was to investigate the relationship between admission selection variables and subsequent achievement in baccalaureate nursing programs and performance on the National Council Licensure Examination for Registered Nurses (NCLEX-RN). Subjects for this study were 283 graduates of nine baccalaureate nursing programs. Pearson Product-moment correlation and stepwise multiple regression analyses were performed to examine the relationships among predictor variables and criterion variables.

All of the correlation coefficients between predictor variables and selected GPA's and NCLEX-RN were statistically significant at the .01 level. The highest predictor for achievement on NCLEX-RN was the ACT social science subscore ($r = .48$). The preliminary analyses suggest that it may be possible to identify potentially successful candidates for admission to nursing programs, and to predict success in the licensure examination on the basis of admission data.

199. Hand washing in public restrooms

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Studies have found that hand washing is still a major factor in stopping the transmission of nosocomial infections, particularly those directly transmitted from one individual to another, through touch. This field study attempted to identify the hand washing behavior of persons in public restrooms at O'Hare International Airport. Research questions were: (a) Do persons wash their hands after using toilet facilities in public restrooms? and (b) How thoroughly do they wash their hands? The convenience sample included 373 females and 169 males observed in the airport restrooms.

Results showed that 46% of men and 23% of women failed to wash their hands. Adult or adolescent females alone without luggage, and adult or adolescent females alone with luggage, engaged in some part of hand washing behavior with the same frequency (78%). While 57% of adult or adolescent males alone without luggage engaged in some part of hand washing behavior, only 47% of adult or adolescent males alone with luggage did so. Suggestions for controlled clinical follow up studies were generated.

200. A descriptive study of the methodologies used to teach the history of nursing in baccalaureate programs

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The goals of nursing knowledge are to describe, explain, and predict about human beings. This ability to predict is the reason for the study of history in nursing. Martha Rogers' concepts of time, patterns, change, and rhythmicity combined with principles of adult learning formed the conceptual framework for this study.

A survey was conducted to ascertain if history of nursing content is being taught in baccalauerate programs, the extent of its presence, and the methodologies used to teach it. Ninety-three nurse educators in National League for Nursing accredited programs located in ten central Midwestern states composed the population for the study. There was a 77.4% return rate of the mailed questionnaires.

Findings showed that history of nursing content is part of a broad course, included in a required course or part of introductory, trends or issues courses. It is usually presented in one or two courses of the curriculum. History of nursing content comprises 1% to 5% of course time. Teaching methodologies for presenting the content are predominantly lecture, discussion, and textbook reading.

201. Health care preferences of rural adolescents: types of service and companion choices

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One-hundred sixty-three rural adolescents were presented with nine health problems to determine preferences for health services and companion choice when using health services. Association of five variables to preferences was examined: (1) age; (2) sex; (3) number of health service visits during the past year; (4) number of books read in the past year with an illness topic; and (5) health problems. Data showed physician offices as the general favorite for health service along with parents as companions. However, as adolescents increased in age they were likely to select a variety of services and to choose to go alone. All adolescents preferred alternative health services and companions for problems of substance abuse and birth control. Health service preference depended on companion choice for every health problem. Adolescents have preferences for health services and compansions, which need to be considered in health service planning. Rural areas without community clinics to assist teens with birth control information and substance abuse need to develop alternatives for adolescents.

202. Prevalence of nursing diagnoses in free living rural elderly adults

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Health care trends showing increases in the incidence of chronic health problems, and numbers of persons at high risk for developing these problems such as the elderly, as well as the rapid acceleration of health care costs is providing the impetus for more rigorous promotion of community and personal health monitoring and maintenance. This study investigated the prevalence of nursing diagnoses (actual or potential responses to health problems) of rural elderly adults who attended one of three health screening clinics conducted in Eastern Iowa by nursing faculty and students. Retrospective analysis of health assessment data from 205 clients showed that 44 different nursing diagnoses were made. Only 18 (8.7%) of the clients had no diagnosis. The five most frequently occurring diagnoses were Sensory-Perceptual Alterations (n=57), Alterations in Nutrition, Less than Requirements (n=46), Impaired Physical Mobility (n=44), Alteration in Health Maintenance (n=29), and Alteration in Nutrition, Greater than Requirements (n=19). Knowledge obtained from epidemiological studies facilitates early case finding and prevention as well as the identification of life style predispositions.

Physics

203. Chaotic inflation and baryosynthesis in a supersymmetric grand unified theory

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Grand Unified Theories (GUTs) provide attractive solutions to many problems of the Standard Model but also introduce new problems, such as excess entropy production during GUT symmetry breaking. A recently proposed supersymmetric flipped SU(5) GUT has been shown to solve the problem of excess entropy production provided the SU(5) strong-coupling scale $\Lambda_c \gtrsim 10^9$GeV. In this paper we address the problem of obtaining compatible scenarios of inflation and baryosynthesis, and apply the joint analysis of baryosynthesis and entropy generation to further constrain the parameters of the flipped SU(5) model.

204. Coupling constant unification, proton decay, and dimensional transmutation in flipped SU(5) grand unification

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We present a detailed phenomenological investigation of a recently proposed supersymmetric flipped SU(5) grand unified theory inspired by the superstring. We analyse coupling constant unification, $\sin^2\theta_W$, proton decay, and radiative breaking of the grand-unified and electroweak symmetries. We show that this simple flipped SU(5) GUT is phenomenologically consistent with all low-energy constraints, provides a natural understanding of the gauge hierarchy $M_W \ll M_{GUT} < M_{Pl}$, and thereby provides a highly promising link between the D=4 or D=10 superstring and the observed structure of physics at low energies.

205. Superstring grand unification

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We describe a new supersymmetric grand unified theory based on the gauge group SU(5)xU(1) which is simpler and phenomenologically more successful than previous grand unified theories. The gauge group is broken to the Standard Model gauge group using just $10,\overline{10}$ Higgs representations, and the doublet-triplet mass splitting problem is solved naturally by a simple missing partner mechanism. There are no fermion mass relations, the proton is long-lived ($\tau_p \gtrsim 10^{33}$ years), and there is a unique F and D flat direction and hence no vacuum degeneracy problem. GUT symmetry breaking occurs naturally via dimensional transmutation without excess entropy generation. We show that SU(5)xU(1) is the only viable GUT group obtainable from manifold compactifications of the heterotic string and also occurs naturally in four-dimensional string formulations. It thereby provides a promising link between the heterotic string and the observed structure of physics at low energies.

206. Does weakly interacting dark matter change the primordial helium abundance?

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The existence of nonbaryonic dark matter has been postulated to reconcile the inflationary prediction $\Omega = 1$ (where $\Omega = \rho/\rho_c$) with the nucleosynthesis constraint on the baryonic contribution $\Omega_B < 0.2$. We show that the annihilation of weakly interacting dark matter candidates (X) with cosmological mass densities $\Omega = 1$ can significantly affect the primordial abundance of light elements. The largest effects are 1) XX annihilations increase the n/p ratio once the temperature T falls below the n/p freeze-out temperature (T 0.7 MeV), leading to increased ^{4}He production; and 2) XX annihilation following helium synthesis dissociates some of the ^{4}He into ^{3}He and D, leading to increased ^{3}He + D abundances. Since both effects are inversely proportional to M_X, applying the observational constraints on the abundances of ^{4}He and ^{3}He + D yields significant lower bounds on M_X for photinos, Higgsinos, Majorana neutrinos and Dirac neutrinos.

207. Solitons and turbulence in plasma physics

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A plasma is a hot gas of electrically charged particles. Over 99% of the observable matter in the universe consists of plasma, including the sun and all of the stars. Plasma can support several kinds of waves, including light waves. Some of these waves can self-focus catastrophically, like a black hole, concentrating the wave energy at a point and expelling plasma. This turbulent situation can be studied by showing movies of the contour lines of increasing wave energy density, such as the ones shown below.

208. Stellar Winds and the Age of the Universe

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There are four essentially independent methods used to determine the age of the universe: (1) the Hubble expansion; (2) nucleocosmochronology; (3) globular cluster Hertzsprung-Russell diagrams; and (4) the luminosity function of white dwarf stars. The first method uses the observed recession velocities of distant galaxies and quasars; it yields ages between 7 and 20 Gyr, or between 7 and 12 if currently favored ("inflationary") cosmologies are assumed. The second is based on the radioactive decay of long-lived isotopes formed in supernovae, and yields 10.5 $\pm$ 1.5 Gyr. The third method gives the ages of the clusters through a comparison with stellar evolution models; it typically gives 14-18 Gyr for the oldest stars. The fourth method depends on the long cooling time for the white dwarfs; the coolest and faintest, i.e. the oldest, white dwarfs observed are less than 11 Gyr old, and there do not appear to be any older than this. There is thus good agreement among the ages with the exception of the globular cluster ages; but it is this age that astronomers have believed to be most reliable. From our theoretical investigations of the possible effects of substantial mass loss from normal "main sequence" stars, we find that the ages quoted above for globular clusters may in fact only be upper limits, potentially bringing all four methods into agreement with an age for the Universe of 10-12 Gyr.

209. Chaos in physical systems

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In recent years, the study of the nonlinear dynamics of forced, dissipative systems has blossomed into a truly multidisciplinary subject. Studies by meteorologists (weather prediction), physicists (reaction-diffusion plasma instabilities), fluid dynamicists (transition to turbulence) and biologists (dynamics of insect populations) have demonstrated that the bifurcations leading to chaos and turbulence in different dynamical systems can be quite similar.

In addition to a brief review of chaotic dynamics in a variety of physical systems, the nonlinear dynamics and mathematical properties of simple models of the atmosphere and implications for atmospheric predictability will be discussed.

210. Superconductivity: an intellectual and practical challenge

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Since the discovery of superconductivity above liquid nitrogen temperature there has been a rush of experimental and theoretical research to unravel the intellectual puzzles involved in this phenomenon. In parallel with this has been a rush to develop processing techniques need for practical applications. The copper oxide peroskites are a beautifully intricate system of chemical bonds which show one dimensional, two dimensional and three dimensional behavior all occur. An assessment of the present situation will be given.

211. On the influx of small comets into Earth's atmosphere

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Unique images of Earth's atmospheric dayglow at ultraviolet wavelengths as viewed from the satellite Dynamics Explorer 1 reveal the unexpected presence of transient intensity decreases with spatial dimensions ~ 50 km. These decreases, or 'atmospheric holes', are interpreted in terms of the obscuration of the dayglow by clouds of water vapor from the disruption and subsequent vaporization of small comets at altitudes ~ 1,000 to 3,000 km above Earth's atmosphere. The corresponding flux of small comets into the atmosphere is ~ 10^7 comets/year, each with mass ~ 10^8 gm. No other viable explanation has been found at present. The existence of such a large cometary flux has startling implications for Earth and the rest of the Solar System. The preliminary results of a search for these small comets with a special optical telescope will be discussed.

212. Evidence for low and medium frequency planetary waves in Total Ozone Mapping Spectrometer data

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Identification of deviations from the stratospheric seasonal mean circulation may lead to a better understanding of the general planetary circulation. Atmospheric normal modes have been identified in a variety of satellite derived data and recent measurements from the Total Ozone Mapping Spectrometer provide an additional means of identifying new normal modes.

Results from a study to corroborate stratospheric 4, 5, and 16 day traveling waves with eight years (1979-1986) of Total Ozone Mapping Spectrometer data along with evidence for new normal modes in these data will be presented.

213. The influence of crystal electric field on low temperature properties of $CeCd_{11}$

J.TANG, K.GSCHNEIDNER JR. AND D.FINNEMORE

Low temperature heat capacity, magnetic susceptibility and AC resistivity were measured on $CeCd_{11}$. Strong evidence for the existance of a crystal electric field (CEF) effect in $CeCd_{11}$ were observed in these low temperature property measurements. The ground state of Ce^{+3} ion $^2F_{5/2}$ is split by CEF of tetragonal symmetry into three doublets, with energy equal to E_1=17.5K and E_2=80.2K, respectively. The magnetic entropy up to 70K was calculated from heat capacity data. The magnetic susceptibility

follows a CEF modified Curie-Weiss behavior with an effective moment of p_{eff}=2.57. This indicates that 4f-electrons of Ce ions are localized and isolated from one another. Comparison of the AC resistivity of our sample with spin-disorder resistivity in presence of CEF is also discussed.

214. Modulation of optical signals through Raman solitons

K. DRUHL

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In stimulated Raman scattering, energy is transferred from a strong pump beam to a weak probe (Stokes) beam at lower frequency. Solitons can be generated by a phase shift of close to 180 degrees. They are seen as short pulses of pump radiation that are transmitted with only small loss. Detuning from exact Raman resonance leads to a decrease in soliton amplitude. We present numerical studies which show that at fixed detuning the final soliton amplitude is extremely sensitive to the total phase shift. The effect is explained in terms of the differences in gain for different frequency components of the total pulse. This phenomenon may have important applications in optical signal processing and transmission.

215. Calculations of Glass Structure

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Two physical properties of glass, density and glass transition temperature, have been quantitatively related to the microscopic structural groupings in borate glasses. The calculations have yielded the volumes of the various atomic arrangements as well as the characteristic glass transition temperatures for each of the units.

We have attempted to connect detailed knowledge of the fractions of units in the glasses obtained from spectroscopic sources with physical properties of the glass. The calculations used original programs which involved non-linear least squares analyses of the data.

216. A primitive cloud droplet growth model.

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A primitive cloud droplet model was developed to observe spectra growth through the formative stage preceding rain fall. The model is strictly mechanical with no microphysics or thermodynamics present in the calculations. Published droplet coalescence curves linking droplet size and size ratios determine the growth within the model. The source environment is represented by published fog or cloud droplet populations. The process compares the elements of an ordered matrix of cloud droplets; smallest to next larger, smallest plus next larger to third droplet, etc. If the size ratio is within the calibration envelop coalescence is assumed governed by percent efficiency and number of drops available in the environment.

Using different background environments we have been able to produce rain drop or no rain spectra. Our objective was to show how the population growth related to cloud droplet environments and whether a simulated rain drop spectra could be generated which had good agreement to the natural spectra.

217. Data logging system for the continuous measurement of radon and associated factors

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The data logging system uses a Keithley 570 Data Acquisition Workstation with a portable clone computer. The workstation has many analog input channels of which several are being used to measure temperatures and pressures with the appropriate transducers at various sites within the house being studied. A circuit constructed on an expansion board interfaces incoming pulses from two continuous electrostatic diffusion radon monitors with the data logging system. The development of this system will be discussed and some data recorded with the system will be presented.

218. Radon in houses in Eastern Iowa

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Year-long measurements of average levels of radon have been made on the main floors of 125 houses in Linn County with alpha-track detectors. About 10% of them have levels over 4.0 pCi/L, the level above which it is recommended by the U.S. Environmental Protection Agency that action to reduce levels be taken within a few years. The mean level for all houses was 2.0 pCi/L, and the highest was 7.2 pCi/L. These measurements represent the actual exposures of the residents to radon in the houses, not the maximum levels in the basements when the houses are sealed.

Results of other measurements, including grab samples to identify radon entry paths and continuous recordings of the time variations of radon levels, are presented and discussed in the context of the search for ways to reduce the health risk from radon in houses in this region.

Physiology

219. **The effect of prolonged exercise in the heat on thermal sensation and rated perceived exertion**

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This was a pilot study in which 4 male endurance runners performed 2 bouts of exercise on a motor driven treadmill at 60-70% VO_2 max for 3 hr in an ambient temperature of 33°C. During one run subjects ingested water and during the other they ingested a carbohydrate-electrolyte solution every 20 min. The volume ingested at each feeding was 200 ml at a temperature of 5°C. Ratings of perceived exertion (RPE) and thermal sensations (TS) were determined at 20 min intervals. There were no differences in RPE or TS between beverages throughout the experiment, thus the data for both beverages were pooled. Analysis of the pooled data indicated that in the first half of the experiment RPE increased significantly, but TS did not. In the second half of the experiment, both RPE and TS increased ($p<0.05$). The variability in the RPE measures also increased markedly in the last 60 min of the run. We conclude that the subjects were able to distinguish between RPE and TS for the first half of the experiment.

Supported by the Quaker Oats Company

220. **Effects of carbohydrates in fluid replacement beverages on gastric emptying during prolonged exercise**

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Carbohydrate concentration of a drink may decrease fluid absorption by inhibiting gastric emptying. Thus, inclusion of carbohydrate in an athletic drink may increase the risk of hyperthermia during exercise in the heat. To evaluate the effects of carbohydrate-fluid replacement, eight trained male cyclists (age 20-30 yr) completed four 3-hr bouts of cycling at 60% peak VO_2 in the heat (33°C) drinking either water (W), 5% glucose (G), 5% glucose polymer (GP) or 3.2% glucose polymer + 1.8% fructose (GP/F). For all drinks examined, over 90% of the 3.15 L consumed was emptied from the stomach during the 3-hr exercise bouts. Cyclists replaced 74% of fluid loss ($\bar{x}$ sweat rate = 1.0 l/hr) and experienced only a 1.6% loss in body weight. Gastric residual volumes (GRV) were similar for the W, GP and GP/F trials. The G trials yielded greater ($P>0.05$) GRV than W trials. Similar changes in rectal and mean skin temperatures, sweat rate, heart rate, percent change in plasma volume, and plasma Na^+, K^+ and osmolality were observed during all trials. These findings show that, during prolonged exercise in the heat, large volumes of 5% carbohydrate drinks can be emptied from the stomach to help minimize the effects of dehydration.

Supported by Ross Laboratories.

221. Influence of diet on hematology and erythrocyte indices of greyhound pups.

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Thirty-three greyhound pups from four litters were studied from 61 to 178 days of age. Each litter was divided into two groups. Group 1 was fed 50% meat and 50% dry food and group 2 was fed an all dry food. Blood samples were collected at two-week intervals for routine hematology determinations (PCV, RBC, Hgb). Blood indices (MCV, MCH, MCHC) were calculated from hematology values.

At six months of age (178 days) the hematology values for the meat diet pups were as follows: PCV = 48.7% $\pm$ 0.74, RBC = 8.6 x $10^6/mm^3$ $\pm$ 0.22 and Hgb = 17.24 gm/dl $\pm$ 0.32. Hematology values for the all dry diet pups were PCV = 45.54% $\pm$ 0.58, RBC = 7.88 x $10^6/mm^3$ $\pm$ 0.22, and Hgb = 15.89 gm/dl $\pm$ 0.27. Indices for the meat diet pups were $\overline{MCV}$ = 56.84 μ^3 $\pm$ 1.34, MCH = 20.12 x $10^6/mm^3$ $\pm$ 0.55, and MCHC = 35.35% $\pm$ 0.21. Indices for the all dry diet pups were $\overline{MCV}$ = 58.47 μ^3 $\pm$ 1.75, MCH = 20.42 x $10^6/mm^3$ $\pm$ 0.70 and MCHC = 34.88% $\pm$ 0.23. Hematology values for the meat group were significantly higher than for the non-meat group but RBC indices were identical.

222. Are any, blood-pressure errors caused by transmission through nonfatty tissue?

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Yes. Multiple regression of pressure P upon total, arm tissue C, upon subcutaneous fat F, and upon sex S yields:

$$P \pm S.E. = 58 \pm 1 + 0.8 \pm 0.3\ C + 9 \pm 4\ F + 5 \pm 2\ FxS,$$

where P is mm Hg of mean, auscultatory pressure as measured with a 12.5x25-cm, arm cuff; C is cm of arm circumference at midcuff; F is cm of skinfold thickness, over the biceps at midcuff; S is equated to -1 for 124, female, sitting, students of ages from 16 to 39 yr; S is +1 for 30, comparable, male students. Our interpretation is that the -0.8-mm Hg correction for every extra cm of C (1986 IAS Meeting, Abst. # 155) should be independent of an additional -4- (women) or -13- (men) mm Hg correction for each extra cm of F. With these subjects, such corrections negate any otherwise measurable dependence of P upon age, body weight, height, body shape, hematocrit, or time interval since food intake.

223. Calcium and monensin effects on turkey papillary muscle

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The effects of calcium level or monensin on turkey papillary muscles were studied. Paired muscles were excised from the left ventricle of each turkey. One muscle of each pair was used as a control, the other was treated with either five calcium levels from 1.70 to 19.91 x 10^{-3} M or two monensin levels, 5.6 and 11.2 x 10^{-6} M. Afterload curves were recorded for each muscle which was stimulated to contract isotonically 60x per minute. Determinations made were: 1) maximum isometric force, 2) contraction velocity, 3) relaxation velocity, 4) stimulus to contraction start, 5) stimulus to contraction peak, 6) stimulus to contraction end and 7) contraction amplitude. V_{max} was estimated using the Hill equation. A randomized block analysis of covariance was applied using the control value as a covariate for the treated value for each dependent variable. Significance was determined using a t-test. Both monensin exposure and elevated calcium levels altered papillary muscle parameters and increased contractility.

224. Optimal one gram preload for isometric contraction of rat aorta is unaltered by thyroid status

D. B. STRATTON AND S. J. MATTSON

Rings of thoracic aorta were removed from young male euthyroid control rats as well as rats pretreated with L-thyroxine (TRX) to simulate hyperthyroidism and propylthiouracil (PTU) to produce hypothyroidism. Rings were then mounted in tissue baths, and isometrically contracted in dose/response experiments with norepinephrine. A 1.0 gm preload is generally considered optimal for isometric ring studies with rat aorta. To evaluate whether thyroid status might alter this optimal preload, four rings from each rat were mounted in separate muscle baths, stretched to preloads of 0.5, 1.0, 1.5 and 2.0 grams respectively and isometrically contracted in dose/response experiments with norepinephrine. A 1.0 gram preload remained optimal for maximal contractile response whether rings were from control, TRX, or PTU rats. Active tension development was less than optimal in rings which were understretched (0.5gm preload) as well as those which were overstretched (1.5 gm and 2.0 gm preloads). This study shows that thyroid status does not alter the optimal 1.0 gm preload tension for isometric contraction to norepinephrine in rat aortic rings.

225. Invertebrate models of mammalian reperfusion injury implicate failure of oxidative defenses.

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Models of the metabolic pathology underlying the tissue damage which occurs during reperfusion of previously ischemic mammalian tissues are based on the irreversible conversion of the cytosolic enzyme xanthine dehydrogenase (XDH) into xanthine oxidase (XO). During reperfusion, XO generates superoxide radicals ($O_2^{\cdot-}$), reactive univalent reductants of oxygen, that mediate cell necrosis. Although XO conversion is strongly implicated as a mechanism for reperfusion damage, $O_2^{\cdot-}$ production from XO activities reported for mammalian and invertebrate tissues appears inadequate to account for the observed severity of post-ischemic necrosis unless cellular oxidative defenses are concurrently impaired. Data from the ocean scallop, Placopecten magellanicus, which like mammals does not tolerate hypoxia-reperfusion and shows XDH to XO conversion, indicate that superoxide dismutase activity, a major cellular oxidative defense, is significantly reduced 58% and 76% in gill and hepatopancreas tissues during hypoxia-reperfusion. Similar impairment of oxidative defenses could account for post-infarct reperfusion injury in the human myocardium where low XO activities are consistently reported.

226. Regional differentiation markers in the chick ectoderm

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Induction of a lens by the optic vesicle is a classic example of tissue interactions that occur during early chick development. However, it appears that the optic vesicle may be the last in a series of inducers because other ectoderm, never in contact with the optic vesicle, form lenses in vitro. In order to identify earlier inductive events, objective criteria are needed to distinguish between lens and non-lens ectoderm well before differentiated characteristics appear. We have used polyacrylamide gel electrophoresis and fluorography to examine protein and glycoprotein synthesis in presumptive lens ectoderm (ple) and dorsal skin (trunk) ectoderm to look for differentiation markers for these two regions. Although the pattern of synthesis of ^{3}H-leucine-labeled proteins does not differ between these two regions, ple and trunk show several differences in glycoprotein synthesis. Two prominent glycoproteins are found only in trunk samples labeled with ^{3}H-fucose or ^{3}H-glucosamine, while ^{3}H-mannose-labeled ple contains several glycoproteins absent from trunk ectoderm. (Supported by grants from the Iowa Science Foundation and Research Corporation).

227. Calcitonin gene-related peptide enhances calcium current and spinal excitatory synaptic transmission

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Regulation of voltage-sensitive Ca^{2+} current by neuropeptides is important in both the modulation of synaptic transmission and the regulation of neuronal excitability. Evidence indicates that neuropeptides depress Ca^{2+} currents in vertebrate neurones and reduce release of neurotransmitters. In the present study we have examined the effects of calcitonin gene-related peptide (CGRP) on Ca^{2+} current in the rat dorsal root ganglion (DRG) neurones, spinal excitatory synaptic transmission, and the release of putative excitatory transmitter candidates, glutamate and aspartate in the spinal dorsal horn. We demonstrate that CGRP increases the voltage-dependent Ca^{2+} current, by a direct action. This effect of

CGRP may be responsible for the increased extracellular fluid concentration of aspartate and facilitation of excitatory synaptic transmission. The CGRP-induced enhancement of voltage-sensitive Ca^{2+} current might be of physiological relevance for the well-known capability of chemical synapses to undergo plastic changes in synaptic effectiveness important in the processes underlying transmission and integration of sensory information incoming into the central nervous system.

228. Detection of monoamine oxidase inhibitors in human urine

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Elsworth et al. (J. Neural Transm. 67:45, 1986) reported the presence of a low molecular weight monoamine oxidase inhibitor (aka. Tribulin) in human urine. This substance has not been completely purified or identified. We have located a subject whose urine contains a consistently high concentration of MAO inhibitory activity and are currently developing techniques for its purification. Inhibition was detected upon incubation of urine extracts in a [methylene-^{14}C]benzylamine / platelet-rich-plasma reaction mixture. Our assays on methylene chloride extracts of acidified urine indicate 60-70% inhibition of platelet MAO with extract equivalent to 5 ml of urine, in 0.5 ml of reaction mixture. The crude extracts were also separated on silica gel preparative TLC plates (Uniplate from Analtech) with a mobile phase of hexane / ethyl acetate (40 / 60) and the 10 resulting bands scraped from the plate were eluted with acetone. MAO assays detected 50% inhibition in the band of Rf = 0.7-0.8 and another with 28% inhibition (Rf = 0.4-0.5). Our research appears to confirm the presence of low molecular weight inhibitors of MAO in urine. The higher activity migrates similarly to Tribulin in TLC and reverse phase HPLC systems. The unusually high concentration found in one subject may allow a quick purification and identification of this MAO inhibitor.

229. Urinary excretion of the serotonin metabolite 5-hydroxyindoleacetic acid (5-HIAA) correlates positively with alertness and health.

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A deficit of serotonergic activity, as indicated by low levels of 5-HIAA in cerebrospinal fluid (CSF), is associated with depression, criminal aggression and suicide. Elevation of serotonergic activity is associated with "mellow" and euphoric feelings. These relationships suggest that 5-HIAA might be a useful measure of psychological health. However, sampling CSF 5-HIAA is an invasive procedure, limiting its use in the general population. Recently, the urinary excretion of 5-HIAA has been shown to increase acutely and longitudinally with practice of the TM technique. Since many studies have shown improvements of physical and mental health as a result of this practice, we have begun an investigation of possible correlations between the average rate of 5-HIAA excretion and psychological measures. In the first study, the average of 3 overnight excretion rates for 5-HIAA (determined colorimetrically) for 21 male subjects (mean age, 44) was compared with the degree of alertness during the TM and TM-Sidhi practice, as estimated from an experience questionnaire (EQ). 5-HIAA excretion correlated with quality of alertness during the TM technique (r = .43) and during the TM-Sidhi practice (r = .42). In the second study both the State Trait Anxiety Inventory and the EQ were administered to 57 college students (mean age, 29), 35 of whom did not practice TM. 5-HIAA correlated positively with overall quality of alertness (r = .34) and EQ subscales of health (r = .26) and activity (r = .28). However, 5-HIAA correlated negatively with trait anxiety (r = -.30). 5-HIAA excretion may be a useful correlate of alertness and health.

230. Enduring aggression induced by noradrenaline and serotonin uptake inhibitors.

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Noradrenaline[NA] and serotonin [5-HT] neurotransmission systems have been implicated in CNS functions such as sleep, arousal, learning, and mood. [Re]Uptake inhibitors [UPI's] serve to increase the intrasynaptic concentration of NE and 5-HT. Chronic exposure to NA and 5-HT may alter the sensitivity of both pre- and postsynaptic NA and 5-HT receptors. Rats depleted of 5-HT by para-chlorophenylalanine (PCPA) develop muricidal activity (MA), but usually revert back to a non-aggressive state once serotonin repletion occurs. Chronic [SC] treatment of rats depleted of 5-HT via PCPA with the NA-UPI's [nortriptyline, desipramine, maprotiline], or 5-HT-UPI's [fluvoxamine, norzimelidine or fluoxetine] for seven days resulted in an EnduRing MA (ERMA) at high doses, and delayed ERMA at lower doses. Iprindole, a weak UPI, had little effect on the development of ERMA. Since treatments of this nature are known to produce a down-regulation of beta-adrenoceptors and the development of a subsensitivity of the NA-sensitive adenylate cyclase, it is tempting to attribute the perseverance of MA after the repletion of 5-HT to a decrease in the ability of CNS NA systems to suppress MA. However, concomitant desensitization of serotonin receptors may also be a prominent factor in the perseverance of ERMA behavior.

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231. Selective serotonin agonists: differential effects on the suppression of enduring murine aggressive behavior.

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It is generally accepted that CNS serotoninergic (5-HT, S) system(s) serve to suppress murine aggressive (MA) behavior. If administered chronically, noradrenaline and 5-HT UPIs elicit repetitive muricidal behavior (ERMA). A dampening or reversal of this behavior should ensue if selective serotonin mimetics are administered. Serotoninergic receptor sites have been classified as 5-HT_1 (S_1) and 5-HT_2 (S_2) receptors. Subsequently, two (or three) sub-classes of S_1 receptors (S_{1A}, S_{1B}) have been identified. The purpose of this investigation was to determine if one, or both, of the S_1 receptor sub-classes has a functional role in the suppression of ERMA. The S_{1A} agonists, 5-MeODMT and 8-HO-DPAT produced behavioral responses characteristic of the serotonin activation syndrome (SAS) which served only to interrupt ERMA. Conversely, the S_{1B} agonist CPP produced a transient decrease in ERMA, while RU-"69" produced a long-term suppression of ERMA without SAS or sedation. These findings suggest that S_{1B} receptors are functionally involved in the suppression of MA, whilst S_{1A} receptors are involved in behavioral excitation processes not associated with the suppression of MA.

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232. Substance M, a serotonin modulator candidate from human urine

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Active uptake of serotonin into neurons and blood platelets is inhibited by imipramine and other tricyclic antidepressants. This effect involves high-affinity binding to a portion of the uptake site, where the inhibitor appears to act allosterically. A reduced number of imipramine binding sites in a subset of depressed patients is thought to reflect differences in serotonergic tone between these patients and

normal subjects. The possibility that an endogenous ligand normally regulates serotonin uptake at this site is under investigation in our laboratory. We have previously reported an inhibition of imipramine binding by extracts of human urine. This inhibitory activity has now been further purified using TLC on silica plates with a mobile phase of acetone / methylene chloride / water / ammonia (80 / 20 / 2 / 0.2). The activity was first concentrated from the urine using a reversed phase C18 extraction column (Baker-10 SPE), eluting with acetonitrile. Variations in the urinary concentrations of inhibitory activity were up to ten-fold. In the highest concentration, 50% inhibition of [^{3}H]imipramine binding was achieved with extract from 0.1ml of urine (assay volume = 0.5 ml). Eluates from three regions of the TLC plate had inhibitory activity. Visualization by sulfuric acid charring allowed a maximum estimation of the IC_{50} of 1-10 μM for the faintest spot, assuming a molecular weight of 200. Further purification by preparative HPLC is underway.

233. Do the numbers involved in group practice of the TM and TM-Sidhi program affect the turnover rate of serotonin in the body?

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A previous study indicated that individual practice of the TM technique elevates urinary excretion of 5-HIAA, the major metabolite of serotonin. Several studies indicate collective practice of the TM and TM-Sidhi program has greater sociological effects than the same number of individuals practicing separately. This implies that group practice of these mental techniques is somehow more powerful than the practice of separated individuals. The question we addressed is whether an increase in the number involved in the collective practice of the techniques on the campus of MIU might increase the rate of 5-HIAA excretion by each individual. In separate studies involving 5 and 3 subjects, nightly 5-HIAA excretion rates over periods of 91 and 50 days, respectively, were compared to daily numbers in the group. The data were analyzed by the linear transfer function method of time series analysis modified by use of the Akaike information criterion, a method of minimizing subjective bias in model selection. The result of the first study was highly significant (2-tailed) at lag 0, t (68) = 2.82, p < .0063. (This effect at lag 0 indicates a contemporaneous, same-day increase of 5-HIAA excretion and of the number in the group.) The second study was highly significant at lag 0, t (34) = 2.91, p < .0063 and at lag 8, t (34) = 4.72, p < .0001. In both cases the total effect (steady-state gain) was positive. The results strongly suggest that increasing the number practicing these techniques together in one place increases the turnover of serotonin in the individual participants and are consistent with greater effectiveness of group over individual practice.

234. Hyperventilation reduces acidosis during cardiopulmonary resuscitation (CPR).

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After 5 minutes of ventricular fibrillation, either standard CPR (SCRP = 1 ventilation/5 compressions) or hyperventilation CPR (HVCPR = 1 ventilation/2 compressions; n = 5 each group) was begun on dogs. No bicarbonate was given. Arterial and mixed venous blood gases were obtained prior to fibrillation, after 4.5 minutes of fibrillation without CPR, then at 5 minute intervals after starting CPR. Arterial pH was significantly higher during HVCPR than during SCPR. Although mixed venous pH was consistently higher during HVCPR than SCPR, this was significant only at 5 minutes of CPR. Arterial PCO_2 was significantly lower during HVCPR (mean = 14.7 torr) than during SCPR (mean = 25.8 torr). No difference was observed in mixed venous PCO_2 between groups (average 47.9 torr during HVCPR vs. 54.2 torr during SCPR). The results suggest that higher ventilation rates during CPR may prevent arterial acidosis for up to 5 minutes of CPR and may reduce the degree of venous acidosis.

235. Electromyographic (emg) and skin resistance responses following osteopathic manipulative therapy (omt) in patients with low back pain

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Previous studies have shown that patients with low back pain have increases in absolute EMG levels in the lumbar paraspinal muscles during motion. This study evaluated EMG, skin resistance and supine lumbar lordosis measurements in patients with low back somatic dysfunction.

Forty subjects were divided into low-back pain and control groups. These were further subdivided into OMT treatment and nontreatment groups.

There was a significant decrease in EMG during motion and skin resistance levels in the low back-pain treatment as well as the control OMT group.

Subsequent studies are being conducted to determine the interrelationship between enzymes LDH and CPK, OMT, EMG responses and acute low back pain.

236. Effects of intensive training on the prolactin response to submaximal exercise in males

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Physical exercise is known to produce an endocrine stress response; however, such responses are usually attenuated after a training program. The purpose of this study was to determine if prolactin responses to submaximal exercise were affected by 8 weeks of intensive training (5 d/wk, 60-90 min/d). Nine males performed 90 min continuous bouts of cycle ergometry (65% maximal oxygen consumption) at the end of 1, 4, and 8 weeks of training. Blood samples were obtained before and after each exercise bout. All prolactin responses post-exercise were expressed as a percentage of pre-exercise concentrations. There was a significant increase in the prolactin response at week 8 (+233.3%) as compared with week 1 (-30.6%) while the week 4 (+101.1%) response was not different from either week 1 or 8. The findings suggest training results in an augmented not attenuated prolactin response to exercise.

Psychology

237. The effect of worksite setting upon the outcome of smoking cessation clinics

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A group-based smoking cessation clinic design has been found effective in field settings. An analysis of 48 clinic groups held in 1986, however, indicates success rates that are lower at all follow-up points than those for clinics held the previous year.

An outcome analysis, based upon clinic setting and sponsorship, suggests that this apparent diminution in overall treatment effectiveness is reflective of a significantly lower success rate in clinics held at the worksite and sponsored by the employer. Implications of these findings are discussed.

238. Extra-binomial variation in smoking cessation abstinence rates.

P. G. McGovern

The Smoking Research Group at Iowa State University, in conjunction with the American Lung Association of Iowa, has been offering group-based smoking cessation clinics throughout the state of Iowa as a public service since 1982. In 1987, a total of 853 persons attended these clinics, an increase of over 50% from the previous year.

Factors influencing abstinence rates over this span of time will be examined. These include group-level effects due to the overall quality of the clinic presentation, the group leader, and the type of situation in which the clinic is held (worksite, etc.). Suggestions for reducing these sources of extra-binomial variation will be put forward. Individual-level determinants of long-term abstinence (e.g., age, gender, etc.) will also be discussed.

239. Spatial navigation behavior in the rat: A neural basis for cue and place learning?

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Spatial navigation behavior was studied in two groups of rats allowed either co-occuring environmental and cognitive guidance cues (cue learning) or cognitive guidance cues only (place learning) in the Morris water maze. The impact of fornix lesions on these cueing systems was also investigated. Results indicated that cue and place learning rats performed equally well on measures of escape latency and swim patterns. On probe trials when the platform was removed, cue learning rats swam more frequently through the platform's previously correct location than did place learning rats. In contrast to previous research, fornix lesions did not selectively impair place learning. It was concluded that rats make use of all relevant strategies in solving spatial navigation tasks and the implication of a neural basis for spatial navigation requires further analysis.

240. Self-reporting of brain activity on some selected tasks

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Subjects (N=170) were asked to report which portion of the brain (left side, right side, both halves at the same time, or no impression) was being used to process two stimuli: music, then Spanish. Subjects were told nothing about the feasibility of awareness of brain activity. There was no significant difference among the 3 areas in incidence of response. In the music-stimulus response group 7.65% reported "no impression"; in the Spanish-stimulus response group 16.57% reported "no impression." The evidence indicates that self-reporting of the location of some brain activity is possible and argues for further study.

241. Regulation of unconscious operations by consciously engaged operations

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Avant et al. (in press) reported unconscious processing of the action message of traffic signs. The present experiment tested effects of consciously engaging four types of mental operations on unconscious processing. Subjects were asked to remember (a) low imagability nouns, (b) sign words, (c) random shapes, or (d) sign shapes and tested for unconscious processing during the retention interval. Only memory for traffic sign words disrupted unconscious processing of sign meanings.

242. The influence of an Ayurvedic herbal preparation on visual discrimination of a field with interfering stimuli

P. GELDERLOOS, H. H. B. AHLSTRÖM, D. W. ORME-JOHNSON, H. I. MSEMAJE, P H. GODDARD, J. GLASER. and R. K. WALLACE

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The present experiment investigated the influence of "Maharishi Amrit Kalash" (MAK), predicted to improve the state of general health, on visual discrimination. Two groups of a total of 48 men over 35 years of age, matched on age and education, participated in three testing sessions at zero, three and six weeks. They were randomly assigned to one of two experimental conditions: 1. twice daily consumption of MAK for six weeks, or 2. taking of placebo that was closely matched with the MAK tablets. The stimuli consisted of visual fields of "X's" with one "V" at

different places in the visual field at different presentations, formatted according to the stimulus material of Courtney and Hoi Shou (1985). Subjects had to identify the exact location of the "V". Stimuli were presented for 350 msecs in a Scientific Prototype N-1000/S Standard Three-channel Tachistoscope.

A repeated measurement ANCOVA, with the pretest scores as covariate, showed a highly significant main effect ($F=4.09$, $df=1,45$, $p<.05$), with the MAK group having improved consistently more. The taking of MAK appeared to enhance visual discrimination. Since success on this task requires a continuous flow of unrestricted attention, it is suggested that the MAK may influence alertness processes.

243. Collective consciousness and social change: Effects of the Maharishi Technology of the Unified Field on U.S. violence

MICHAEL C. DILLBECK

Department of Psychology, Maharishi International University, Fairfield, Iowa 52556

This study tests a prediction of the theory of collective consciousness of Maharishi Mahesh Yogi. On the basis of the position of the ancient Vedic tradition that consciousness at is basis has a field character, it has been proposed that a single group experiencing this field through twice daily practice of the Maharishi Technology of the Unified Field (MTUF) will result in improved quality of life of the whole society, if the size of the group exceeds the square root of one percent of the society.

The prediction was tested for the U.S. as a whole using weekly data from 1982-1985 on a violence index composed of the number of fatalities from the three major causes of violent death, homicide, suicide, and traffic fatalities. The independent variable is the weekly average number of MTUF participants in the largest U.S. group, located in Iowa. Data were analyzed by Box-Jenkins transfer function analysis, indicating a highly significant reduction in violence in the weeks immediately after the required number were reached. Theoretical and practical implications are discussed.

244. Medical care utilization at Maharishi International University

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Medical Care Utilization statistics on over 400 staff and faculty of MIU and the staff and faculty of other small private colleges in Iowa (controls) were provided by a major health insurance carrier for the year ending June 30, 1987. MIU and controls had very similar age distributions. However, hospitalization days/1000 members for the 0-19, 20-34, and 35+ age categories were fewer by 93%, 39% and 84% respectively for MIU compared to controls, representing an overall reduction of 79% in hospitalization. Outpatient visits/1000 were a mean of 17% fewer for MIU, but outpatient costs/1000 were 52% less, indicating that MIU's outpatient utilization was less for serious problems than for controls. Overall inpatient and outpatient costs were 75% less for MIU, and mean length of stay in the hospital was 43% less for MIU.

In light of previous medical research and the outcomes for other self-selected groups reported in the literature, these results are attributed to the participation by MIU staff and faculty in the transcendental Meditation and TM-Sidhi program and the Maharishi Ayurveda physiological purification program.

245. EEG coherence as a predictor of prime identification in a lexical decision task

W. D. SHEPPARD II AND R. W. BOYER

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Twenty-four subjects were presented 240 randomized trials of a lexical decision task (LDT) while connected to a 16 electrode EEG montage. EEG data was acquired for two seconds prior to the onset of each LDT trial. Each LDT trial consisted of a fixation asterisk (6-12s), a prime letter string (17 or 153ms), a pattern mask (300ms), and a target letter string which remained on the screen until the subject pressed one of two buttons, word or nonword. Following the lexical decision, the subject gave a verbal report identifying the prime as word or neutral and a number estimate of the confidence of that report. EEG coherence from 15 different combinations of EEG electrodes was used to predict prime report accuracy and confidence. Results suggest fast prime report accuracy and confidence are positively correlated with EEG coherence in left temporal and parietal regions.

246. Testing a field model of consciousness: Influence of the Maharishi Technology of the Unified Field on violence and accidents in Canada

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This study investigates the effect of the group practice of the Maharishi Technology of the Unified Field (MTUF) on weekly violence and accidental fatalities in Canada (1982-1985).

According to the theory of collective consciousness of Maharishi Mahesh Yogi, the square root of one percent of the population practicing the MTUF can influence in a positive way the quality of life of society; this is based on the suggestion that the deepest level of consciousness has a field character. This proposed new mechanism of social change has been supported by previously published research.

A violence index comprising weekly totals of deaths due to homicide, suicide, and traffic fatalities was one dependent variable and deaths due to all other accidents was another. Box-Jenkins time series analysis found significant decreases in each of these variables in the specific weeks immediately after the number of MTUF participants predicted by theory was reached. Theoretical implications and practical applications of these results are discussed.

247. Testing a field model of social interactions

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Recent research, consonant with current field theories of physics, suggests that individuals interact not only through direct and indirect interactions, but also through

an underlying field, that can be activated by a specific technology, the Maharishi Technology of the Unified Field (MTUF). This field theory of human interaction was tested by measuring changes in EEG coherence and performance on a concept learning task in laboratory subjects while a group practiced the MTUF in a separate building. The subjects, all right-handed males not familiar with this technology, took a 20 minute concept learning task on four separate days. The intervention, group practice of the MTUF, randomly overlapped either the beginning or end of the test sessions. During the intervention, the subjects' EEG coherence was higher ($p<.02$), and they completed more concepts on the task ($p<.04$), suggesting that individuals can be influenced through an underlying field.

248. Whole blood serotonin and 5-hydroxyindoleacetic acid: Biochemical markers of leadership ability?

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Several experimental studies have shown that serotonergic activity, as indicated by whole blood serotonin (WBS), is highly correlated with dominance position in socially living vervet monkeys. The few studies done with human subjects have suggested that WBS may be related to the pursuit of social dominance or successful power seeking. In addition, 5-hydroxyindoleacetic acid (5-HIAA)—the major serotonin metabolite—has been found to be related to alertness and psychological health.
Two studies with 22 and 9 subjects each investigated the correlations between biochemical markers and leadership ability as measured by the Leadership Ability Evaluation (LAE) scale. Study one employed 22 subjects, 13 males and 9 females, with an average age of 44 years. A significant positive correlation was observed between the average urinary 5-HIAA excretion rates of 5 overnight samples and general leadership ability (r = .41). Study two found leadership ability scores of 9 males at a commodities brokerage firm (M Age = 35 yr.) to be significantly correlated with WBS levels (r = .55).
The implications of these studies in furthering our understanding of the relationship between serotonergic activity in humans and leadership characteristics will be discussed.

249. Alleviation of political violence through reduction of collective stress: Time-series intervention analyses of the Lebanon War.

J.L. DAVIES AND C.N. ALEXANDER

Department of Psychology, Maharishi International University, Fairfield, IA 52556

Political psychologists have argued that in an environment where tensions are high, efforts for peaceful resolution of conflict and elimination of political violence are likely to succeed only with concurrent steps for drastic reduction of tension.

A procedure for reduction of collective stress (identified as incoherence in a field of collective consciousness, and associated with inhibition of societal development)--the Maharishi Technology of the Unified Field--is being applied in an ongoing series of prospective social experiments to assess its predicted impact on the war in Lebanon. Box-Jenkins impact assessment analyses to date indicate significant drops in war deaths and in a daily index of conflict during each experimental period, after controlling for temperature, holidays, and other forms of seasonality. Results are consistent with a concept of peace as dependent on continued individual and societal development, and with a proposed theory of consciousness as a dynamic field underlying individual and social life.

Science Teaching

250. Evaluation of student outcomes in PRISMS

R. D. UNRUH AND T. M. COONEY

Physics Department and Science Education, University of Northern Iowa, Cedar Falls, IA 50614

The PRISMS (Physics Resources and Instructional Strategies for Motivating Students) Project was designed to provide high interest activities and teaching strategies to cultivate reasoning/science problem-solving skills. The teaching strategies where initiated with an exploratory activity leading to concept development followed by an application activity.

Teachers participated in summer training sessions and supportive activities which included telephone conference calls, classroom visits by the PRISMS staff and feedback on video tapes from teachers' classroom teaching experiences.

Comparisons of PRISMS students were made with non-PRISMS students in physics achievement using the New York Regents Physics Examination, problem-solving skills utilizing the Test of Integrated Process Skills (TIPS) and their attitude toward learning physics with the Physics Attitude Index (PAI). The results of this study which lead to the validation of the PRISMS Project and its acceptance into the National Diffusion Network will be discussed.

251. Precise temperature measurements with a thermistor/APPLE.

R.LARVICK AND E. SHANE

Chemistry Department
Morningside College
Sioux City, Iowa 51106

Software such as that developed by Project SERAPHIM and the AAPT Microcomputer Workshop has been used to record thermistor-sensed temperatures through the APPLE gameport. Temperatures recorded in this way have typically been limited to single decimal place precision.

With the addition of an external capacitor from the thermistor to ground, we have altered the APPLE timing circuit and have expandedthe maximum paddle numbers which can be read at the gameport. When combined with a sixteen-bit counting loop which allows these higher numbers to be read by the APPLE, temperature precision

has been expanded to the third decimal place, i.e., to the thousandth of a degree. The adapted thermistor has worked well for studies of heat of reaction, freezing point depression, and bomb calorimetry.

252. The Iowa "Right to Know" Law and Your Science Program

J. A. Gerlovich

Iowa Department of Education, Grimes Bldg.
Des Moines, Iowa 50319

The 1986 Iowa Department of Labor "Right to Know" Rules will be presented, including school requirements, effective dates, chemicals regulated, sign posting, personnel training, variances, and the impact of this legislation on science programs.

253. Promoting science careers for women through education: a pilot program (ISF Grant 87-58)

R. W. SWENSON

Iowa State University, 204 Carver, Ames, IA 50011

Women scientists and engineers are visiting five secondary schools in Iowa to talk with students, teachers, and counselors about their work and preparation for careers in their fields. One objective is to increase awareness that science, engineering, and technology are fields open to men and women and that both are needed to remedy the growing shortages in the U.S. Enthusiastic practitioners are role models, encouraging girls to study math and science and to consider careers in fields in which women are severely under-represented. Each participating school determines the most effective grade level and setting for 3 visits by 6 role models. Pre- and post-tests are used to evaluate impact of the visits on career awareness and attitude. The schools represent rural and urban districts. Grades include 8 through 11. Career materials are provided for the schools' use. Other objectives are to raise the consciousness of teachers and counselors that women do succeed and find satisfaction in science careers and to convince them that their attitudes and support are essential in stimulating and encouraging the study of math and science.

254. Biotechnology/an enrichment for high academic ability seventh and eighth grade students

B. J. WHITE and L. TOTARO
Iowa State University, Ames, IA 50011

In the summer of 1987 Iowa State University offered a three week residential program for academically talented rising seventh and eighth grade students focusing on three areas: precalculus mathematics, expository writing and biotechnology. The biotechnology component, specifically designed to stimulate student interest in science, was selected because it incorporates a wide range of scientific disciplines. The curriculum provided a background for exploration of scientific developments in biotechnology. Relevant topics in inorganic and organic chemistry were followed by the biochemistry of proteins, carbohydrates, lipids, and nucleic acids. Molecular biology, recombinant DNA, and genetic engineering led into biotechnology. Learning activities included formal lectures, demonstrations, self-paced laboratory exercises, small group discussions, and field trips. The program emphasized a hands-on approach by offering more than 60 hours of laboratory work. The culmination of the program was an independent research project with the experimental results presented in a public forum combining posters and demonstrations.

255. **A variable for use in the study of the categorization of physics problems and associated expert-like behavior**

G. H. VELDHUIS

Northwestern College, Orange City, IA 51041
and Sheldon Comm. H. S., Sheldon, IA 51201

A variable that measures the degree of expert-like behavior of subjects who have sorted a set of physics problems and solved one of these problems is described. Expectations were that novices use surface structures (explicitly-stated features in the text of physics problems) and experts use deep structures (physics principles that determine and control solutions to physics problems) in the formation of representations. Cluster analysis shows that a) experts categorize according to deep structures; novices use both surface features and deep structures in the categorization process and b) the categorization by novices is less consistent than the categorization by experts.
Specifically, values of the DEGREE variable obtained by the subjects, showing differences in expert-like behavior in the sorting and solving tasks among the novices, allow for the analysis of variance.

256. Science: Cheap, Easy and Observable

J. CHRISTENSEN-EICHMAN, & C. R. LUNDSTRUM

McAuley Regional High School, 930 Pearl St.
Joplin, Missouri 64801

Teaching laboratory science courses can be expensive, difficult to manage and time consuming. Without laboratory science, students can find the lessons boring and a waste of time. Our goals for this presentation are to demonstrate and illustrate labs that are interesting and enjoyable for both the students and instructors.

We will demonstrate and/or illustrate: 1) Cell models using plastic bags, Jello and imagination. 2) Diffusion using a real membrane with hypertonic, hypotonic, and isotonic solutions. 3) Never-fail growth of large crystals in 24 hours. 4) Rockets and hot air balloons for

acceleration, gravity, vectors, and angles. 5) The effects of liquid nitrogen temperatures on volumes of gas and other matter.

All of these labs will be easy to follow and instructions will be available.

257. Learning under the sun

W. J. KLEIN

West High School, 2001 Casselman, Sioux City, IA 51103

Many modern day science students have learned to name the parts of a cell but are ignorant of the plants and animals in their own front yards. Learning Under the Sun is a series of labs written to help students learn the prime role observation plays in the scientific method and to show methods through which they can enhance their observational skills. A number of outdoor labs will be presented for discussion.

258. The development of problem solving software in circuit analysis through quality computer instruction

A. A. GOKHALE

Department of Industrial Education and Technology, Iowa State University, Ames, IA 50011

Researchers are currently getting positive results in most of their studies dealing with the effectiveness of Computer-Assisted Instruction (CAI). Hence, rather than asking "Is CAI effective?", the more sophisticated question would be "Under what conditions is CAI effective?". One of the critical issues in CAI today is the planning and production of quality CAI materials. The use of the computer to induce creative thinking is very important. We are developing CAI materials in circuit analysis that not only include problem solving but can teach the problem solving techniques more effectively.

259. Light curves of eclipsing binaries: Making an esoteric topic reasonable and even obvious

L. C. Hill

Department of Earth Sciences
University of Northern Iowa
Cedar Falls, Iowa 50614

Some spheres, disks, transparencies, gestures and animated talk will be used to demonstrate how to read "light curves" (graphs recording light intensity changes over time) of eclipsing binary stars, pairs of stars that periodically wholly or partially obstruct their companion's light. Various light curves will be presented and "read", i.e. size, shape and temperature information about the stars will be extracted from the light curves. The practical teaching implication of the demonstration is that seemingly abstruse and/or technical details are often readily apprehended once the student sees -- and thus understands -- the mediating visual model actually employed by scientists when interpreting their data.

260. Is a science of consciousness possible, and what are its implications for the physical sciences?

K. DRUHL

Maharishi International University, Department of Physics, Fairfield, Iowa 52556

We present four criteria that a study of consciousness should satisfy in order to be scientific. These pertain to the logical and intellectual content, direct experience of its object, objective verification by repeatable experiments, and practical application. These criteria are shown to be satisfied by Maharishi's Science of Creative Intelligence (SCI). On the other hand, only some of them are satisfied by most religious belief systems, by purely empirical systems of knowledge, or even by limited versions of objective science. SCI provides a basis for objective science, including the physical sciences, because it analyzes the connection between objective knowledge and the subjective nature of the knower. In doing so, it explains why objective science is possible and why the same basic laws of nature are found in widely different areas of objective science. In this way, SCI provides a powerful source of scientific intuition and makes scientific activity personally relevant and fulfilling.

261. Teaching plate tectonics by use of the graham cracker model

D. J. Perschau

Herbert Hoover High School
4800 Aurora Avenue
Des Moines, iOwa 50310

Teaching the concepts of crust plate movement, mountain building, subduction and earthquakes is difficult in the earth science laboratory. The graham cracker lab provides a simple and inexpensive new way for each student to experience these important geological processes for himself. Pre and post lab activities will be discussed and printed copies of laboratory instructions will be available.

Zoology

262. An idea for a final exercise in an elementary electronics laboratory

J. L. SABUTIS

School of Natural Science,
Buena Vista College, Storm Lake, IA 50588

Very few lab exercises incorporate all the topics presented during a semester. A lab designed around an AM radio is an excellent method of illustrating a majority of concepts encountered in an elementary electronics course.

This presentation will discuss how a Heathkit Am radio (#GR-1009) may be utilized to demonstrate the concepts of RLC resonant circuits, transistor amplifier biasing techniques, nonlinear signal mixing, heterodyning, filtering techniques, RF and AF amplification, oscillator circuits, AM detection, and push-pull amplification.

263. Teaching introductory electron microscopy at the undergraduate level

R.R. FITTON

Department of Biology, Luther College
Decorah, Iowa 52101

The Luther College biology curriculum was recently expanded to include undergraduate electron microscopy. Freshmen enrolled in the introductory biology course receive hands on experience during a laboratory designed to investigate ultrastructural form and function. Students enrolled in upper level courses receive a more detailed presentation of ultrastructural form and function through electron microscopy. Students of sophomore rank and above may elect to take an introductory course in electron microscopy in order to acquire the skills and knowledge associated with this powerful technique.

Teaching instrumentation is approached by stressing the mechanism and theory of operation. Using specific innovations developed at Luther in video interfaced ultramicrotomy and associated preparation techniques, to aid in individual and group instruction has proved successful. These innovations will be highlighted as well as student prepared micrographs.

264. The relationship of Trichomonas gallinae (protozoa: sarcomastigophora) to the pharyngeal mucosa of ring doves (Streptopelia risoria).

G. E. KIETZMANN, JR.

Department of Zoology, Iowa State University, Ames, Iowa 50011

Trichomonas gallinae (Rivolta) is the causative agent of avian trichomoniasis. Death of columbiform birds usually occurs within 15 days post-infection when large caseous nodules (cankers) form in the pregastric portion of the alimentary tract. In the study presented, ring doves (Streptopelia risoria) were experimentally infected with T. gallinae and their esophageal tissues were examined microscopically at various intervals during canker formation. Trichomonad attachment to the mucosal epithelium was the first activity undertaken. Following attachment, parasites localized beneath squamous cells which were eventually removed by mechanical and/or enzymatic means. With increased parasite multiplication, there was also increased squamous cell removal. Cankers formed by five days post-infection, but were not always in direct association with parasites.

265. Parasites of Petrochelidon pyrrhonota nests

David P. Harrison.

Department of Biology & Environmental Science
Simpson College, Indianola, IA 50125

The first in a series of a comprehensive studies of the relationship of parasites to Petrochelidon pyrrhonota was performed. Petrochelidon pyrrhonota nests collected from sites in the Des Moines metropolitan area yielded large numbers of Cimex species. No other parasites were found in the nests collected. Fifty of the Petrochelidon pyrrhonota nests were collected at five locations throughout the study area. The types and numbers of parasites, both within a particular colony and between different colonies, was evaluated. The findings have indicated that a great variance in total numbers of Cimex species exists within the individual colonies themselves but not between different nest colonies.

266. Update on Lyme disease and Ixodes dammini in Iowa

N. WILSON

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

It is difficult to say how many cases of Lyme disease have occurred in Iowa because of the lack of any clearly defined method of reporting. It is considered the number of cases are somewhat greater than generally thought and total around 25 since

1983. The primary vector of the disease, Ixodes dammini, has been collected 6 times in 4 counties, from dogs and white-tailed deer. Deer are the primary host of adult ticks and deer populations in the state are the highest they have ever been. This favors an increase in numbers of the tick and its spread which should result in more cases of Lyme disease being reported in humans.

267. Four species of ticks, genus Ixodes new to Iowa

N. Wilson

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

During the past 19 years many specimens and much information has been gathered on the ticks of Iowa. Twenty-one species in 2 families have been collected or recorded from the state. Two-thirds of the species (12/18) in the family Ixodidae belong to the genus Ixodes and 4 of these are new to the state. Information on these species is presented.

268. The Iowa Centipede Project

D. J. Perschau

1116 16th Street
West Des Moines, Iowa 50265

This study reports the first state wide systematic collection of the class Chilopoda in Iowa. Its objectives were to collect centipedes from a wide variety of habitats in the state, to identify the centipedes, preserve and label them, and catalog them into a research and study collection. Collecting was done from July 1986 through August 1987. Some previously collected material has been included. A variety of collection techniques were used. More than five hundred specimens from thirty-two species have been included in the collection.

269. Modes of purine catabolism in euryoxic and stenoxic marine invertebrates.

J.A. DYKENS and J.M. Shick*

Biology Dept., Grinnell College, Grinnell, IA 50112, and *Zoology Dept., University of Maine, Orono, 04469

Current paradigms of ischemia-reperfusion tissue damage (IRTD) are derived from mammalian tissues where diminished O_2 availability is pathological. Because intertidal invertebrates tolerate environmentally-imposed hypoxia and reoxygenation as a function of tidal flux, they are useful for study of IRTD and its avoidance. Mammalian IRTD entails adenylate depletion with consequent accumulation of purine catabolites such as xanthine, coupled with concurrent conversion of xanthine dehydrogenase (XDH) into xanthine oxidase (XO). During reperfusion, XO generates cytotoxic free radicals that mediate tissue necrosis. Euryoxic invertebrates such as Mytilus edulis apparently avoid IRTD by reducing overall metabolic rate during hypoxia and maintaining adenylates via efficient anaerobiosis. Moreover, these animals contain a form of XDH resistant to XO conversion. Conversely, aerobically poised stenoxic invertebrates such as the scallop Placopecten magellanicus not only show reductions in total adenylates during hypoxic exposure, but also contain a form of XDH that is converted into the deleterious oxidase.

270. The acoustic behavior of a chorusing prairie katydid.

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

Amblycorypha parvipennis is unique among chorusing (aggregated males sing at same time) orthopterans in that males overlap song phrases and synchronize phonatomes (sounds produced by single wingstrokes) where phrases overlap. Phonatome synchrony may be the result of males needing to hear female acoustic responses which fall between male phonatomes. Male phrase rate averages 5.9/min (phrase length: $\bar{x}$ = 5.1/s; phrase interval: $\bar{x}$ = 4.1/s) with a mean phonatome rate of 4.4/s (23^{o} C). During acoustic interaction of males, not all phrases are overlapped. Although one end of a male's phrases was overlapped an average of 70.1%, there was considerable variation among males in who overlapped whom.

Computer simulations, analyses of the acoustic interactions of pairs of males and males' response to electronically-generated sounds gave insight into the mechanism of phonatome synchrony and overlapping alternation of phrases. The relation of chorusing to reproductive behavior will be discussed.

271. The taxonomy of Strauzia , a sibling species group attacking sunflowers (Diptera: Tephritidae).

W. B. Stoltzfus

William Penn College
201 Trueblood Avenue
Oskaloosa, Iowa 52577

The separation of Strauzia Robineau-Desvoidy, into distinct species has been difficult due to lack of distinctive female adult characteristics and overlapping variability in the male. Use of biological data makes possible the recognition of species. All Strauzia use Asteraceae as plant host. The larvae tunnel through the stems sometimes destroying the entire pith. Puparation occurs in the crown of the plant or soil in the fall. Adults emerge in May or June. The female seeks out their host plant for oviposition. The male also seeks out the host plant, securing a mating territory on the upper leaves. This selection of host plants for mating and oviposition appears to play an important role in speciation.

272. Wintertime ecology of Hesperophylax designatus in northeastern Iowa

S. LEHTINEN AND M. BELANGER

Biology Department, Luther College, Decorah, IA 52101

The life history and movement patterns of the limnephilid caddisfly Hesperophylax designatus were evaluated during January 1985 and 1986 in Dunning's Spring, a small tributary of the Upper Iowa River, Iowa. H. designatus exhibits a univoltine life cycle with IV anv V instars being present during January. In general, mean case length, case width, head width, body weight and density of V instar H. designatus increased at collecting sites as one moved downstream from the spring source. Additionally a significant relationship existed ($r = .93$; p .01) between the density of H. designatus and the density of diatoms colonizing artificial substrates.

Observation of marked individuals indicated the average distance traveled per day to be approximately 1.0 m. The majority of marked individuals (38-55%) exhibited a downstream movement pattern as opposed to moving upstream, moving laterally or not moving. Recapture rates for H. designatus declined precipitously during the study indicating movement off the study site proper.

273. Second Dickinson County, Iowa molluscan study

R.W. COLEMAN

Department of Biology, Upper Iowa University, Fayette, IA 52142

Anodonta corpulenta, A.grandis grandis, Aplexa hypnorum, Discus cronkhitei, Fossaria obrussa, Gyraulus parvus, Helisoma trivolvis, Lampsilis radiata luteola, L.ventricosa, Leptodea fragilis, Musculium partumeium, Physa gyrina, Planorbula armigera armigera, Potamilus alatus, Promenetus exacuous, Retinella sp., Sphaerium sp., Stagnicola elodes, S.reflexa, Toxolasma parvus, Valvata tricarinata, and Zonitoides arboreus were seen on this survey. Of these mollusks, 12 additional species were found, not seen in the first Coleman paper of 1984. Environmental tests were made. Aquatic habitats were primarily basic. Hardness appeared to be due mainly to calcium. Derek S. Davis, Nova Scotia Museum, Halifax, Nova Scotia, Canada, Ms. Marian E. Havlik, Malacological Consultants, LaCrosse, Wisconsin, and the author determined the mollusks. Logistic support by the Iowa Lakeside Laboratory is gratefully acknowledged.

274. Distribution of fishes of the Upper Iowa River in northeastern Iowa

S.F. LEHTINEN, K. SCHATZ, S. OLSON, M. WALL, D. ORR, J. LAAKSO AND J. COOK

Department of Biology, Luther College Decorah, Iowa 52101

The Upper Iowa River is a predominantly spring-fed, free-flowing, state scenic waterway and is entirely contained within the driftless region or northeastern Iowa. Fishes of the river proper and its tributaries were surveyed between February and November 1987. Fifty-six collections revealed 41 species distributed among 9 families. Over 60% of the species were found in the cyprinid (n=17) and percid (n=18) families. The survey revealed six species Hybopsis x-punctata, Notropis atherinoides, Perca flavescens, Percina caprodes, Percina phoxocephala and Etheostoma radiosum) previously not reported in the drainage.

275. Problems with the distribution of Iowa's lizards

J. L. CHRISTIANSEN

Department of Biology, Drake University, Des Moines, IA 50311

Distributional questions exist with all five of Iowa's lizard species. The endangered great plains skink is known from only two localities with shrinking critical habitat in southwest Iowa. The extent of range overlap and competitive exclusion between northern prairie skinks and five-lined skinks in eastern Iowa is unknown. We have yet to acquire a specimen from a population of skinks observed along the Des Moines River, that could be a species new to Iowa. The few available specimens of slender glass lizards pose many questions about the range and habitat preferences of this species. Habitat destruction seems to be rapidly reducing the range of both subspecies of whiptail lizards, especially the prairie racerunner in the Loess Hills.

276. Use of non-parametric statistics to analyze habitat selection in birds

T. BRUSH

Biology Department, Marycrest College, 1607 West 12th Street, Davenport, IA 52804

Parametric statistical tests such as t-tests or analysis of variance often cannot be used to analyze ecological data. Reasons may include time-dependence, non-normality of frequency distributions and unequal variances. Non-parametric statistics such as Mann-Whitney U, Wilcoxon's signed ranks test, Box plots, and Spearman's rank correlation can be used successfully to test hypotheses about habitat use and other features of natural populations. Examples involving analysis of habitat use in cavity-nesting birds will examine the uses of non-parametric statistics. Advantages and disadvantages will be discussed.

277. Insulin stimulation of protein secretion by bullfrog tadpole and adult hepatocytes

J.J. HULSEBUS AND E.S. FARRAR

Marist College, Poughkeepsie, NY and I.S.U., Ames

Bullfrog insulin has a two amino acid extension at the A1 position. Addition of a bulky group to this position on mammalian insulin results in a loss of biological activity. We compared the effects of bullfrog and porcine insulins on protein secretion by hepatocytes from bullfrog and tadpole livers.

Hepatocytes were obtained by collagenase dispersion and were cultured in Waymouth's medium, a defined, serum-free medium, with and without hormone for 24 hours. Total protein in the medium was determined colorimetrically and cellular DNA fluorometrically. Both hormones stimulated protein secretion in tadpoles and adults. However, adult cells, both treated and untreated, secreted more protein than tadpole cells. In addition, adult cells, but not tadpole cells, secreted more protein in response to bullfrog insulin than to porcine. The patterns of protein secretion, as determined by electrophoresis, changed with development but not hormone treatment.

Supported in part by I.S.F.

278. The effect of substrate thermal properties on the water exchange and growth of Chelydra serpentina eggs and embryos

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Snapping turtle eggs were incubated in substrates (sand and vermiculite) with different thermal conductivities. The substrates had similar water potentials. Incubation occurred at constant temperature (30°C). Eggs were weighed about every 10 days throughout development. Eggs incubated in sand increased in mass at an increasing rate whereas eggs in vermiculite increased at a constant rate. Average egg mass for the sand treatment was heavier ($P<0.05$) than that for the vermiculite treatment at day 56. The rate of the water uptake of eggs in sand was higher ($P<0.05$) than that of in the vermiculite during second half of the incubational period. Treatment did not affect hatchling and residual yolk dry mass ($P>0.05$), but did affect total water content ($P<0.05$). Eggs incubated in substrate with high thermal conductivity take up more water than do eggs in substrate with low thermal conductivity. However, the amount of water available to eggs does not affect the growth of embryos although it may affects embryonic osmoregulation.