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ABSTRACTS OF PAPERS

95th Session of

THE IOWA ACADEMY OF SCIENCE

Luther College

Decorah, Iowa

April 22-23, 1983

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level. Any trait allowing identification of germplasm with adaptability to specific nitrogen environments would be of considerable interest.

Nitrogen harvest index (NHI) expresses the efficiency of nitrogen partitioning between reproductive and vegetative tissue. Twenty inbred lines of *Avena sativa* were selected for extreme values of NHI, 10 for high and 10 for low NHI levels. These lines showed a +0.42* correlation between NHI and change in groat yield (GTY) between high and low N environments (GTY_{high N} - GTY_{low N}). Further investigation involved the evaluation of these lines for grain yield and biological yield over 24 environments representing a wide range of productivity. Regression analysis was used to quantify the response of these lines to improving environmental conditions.

6. Resistance to *Septoria lycopersici* in *Lycopersicon* species.

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Approximately 4700 tomato accessions held at the North Central Regional Plant Introduction Station were screened for resistance to *Septoria lycopersici*, the causal agent of Septoria leaf spot. Species reaction varied widely. The wild green-fruited species, *L. hirsutum*, *L. peruvianum*, and *L. parviflorum* had high levels of resistance. The red-fruited currant tomato, *L. pimpinellifolium*, exhibited reactions ranging from susceptible to highly resistant indicating a significant degree of variability within the species. The common large red-fruited tomatoes, *L. esculentum*, and the cherry tomatoes, *L. esculentum* var. *cerasiforme*, were all susceptible except for a few accessions which are undergoing further testing to determine the nature and inheritance of the resistance.

7. Population increase of *Pratylenchus scribneri* in sweet corn roots.

D. C. NORTON and J. EDWARDS.

Dept. of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.

Sixteen sweet corn varieties were tested in sandy soil at the Hinds Farm, Iowa State University, in 1982 for increase of *Pratylenchus scribneri*. There were five replications of 20 plants (10 plants in each of two rows constituted an experimental unit) arranged in a randomized block. Mean numbers of nematodes/g dry root for samples taken on July 2 and August 27 ranged from 4,166 (Country Gentleman) to 25,558 (Hybrid Xtra Sweet). Numbers were generally higher and there was a greater significance by analysis of variance (P=0.001) on August 23 than on July 2 (P=0.07). For comparison, two dent hybrids (Mol7HtxB73Ht and A619HtxA632Ht) were included. They had mean populations less than any of the sweet corns. Consistent, but low to moderate negative correlation coefficients (-0.02 to -0.51) occurred when nematode numbers were plotted against days to sweet corn maturity.

8. Comparisons of green cloverworm larvae and various controlling factors in 4 soybean tillage systems.

H.G. THORVILSON AND L.P. PEDIGO

Entomology Dept. Iowa State Univ. Ames, Iowa 50011

The acceptance of reduced tillage production systems has been slowed by concerns about possible yield reductions, of which insects may play a part. During 1981 and 1982, shake-cloth samples were taken of GCW larvae in the soybean canopy in fall moldboard plow, fall chisel plow, till-plant, and no-tillage plots. Each GCW larva was counted, individually maintained in the lab., and its fate recorded. GCW larval numbers did not reach the economic injury level in either year. In 1981, significantly more GCW larvae were collected from fall mold. plow and fall chisel plow plots. In 1982, significantly more GCW larvae were found in the fall mold. plow plots. The entomopathogenic fungus *Nomuraea rileyi* caused the death of 68% of GCWs in 1981 and 14% in 1982. By early Sept. in both years, however, the fungus caused nearly 100% mortality. The most abundantly-reared parasitoid was *Rogas nolophanae*, 6.2% and 8.4% GCW parasitism in 1981 and 1982, respectively. No significant differences in *N. rileyi* and parasitoid numbers among tillage systems were found.

9. Population increase of *Pratylenchus scribneri* in exotic species and gene pools of *Zea*.

D. C. NORTON and J. EDWARDS

Dept. of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.

Thirty-one accessions of exotic species of *Zea* or gene pools of *Z. mays* were tested at Ames in 1982 for increase of the nematode *Pratylenchus scribneri*. There were three replications of 20 plants each. Samples were taken on June 1 (at planting), July 7, Aug. 9, and Sept. 17. Mean numbers of *P. scribneri*/g dry root for the July and Aug. samples ranged from 1,874 (*Z. diploperennis*) to 25,385 (*Z. mays* PI393774). Four accessions of *Z. mexicana*, two of *Z. mays parviglumis*, and one of *Z. luxurians* had higher counts (10,851 to 19,657/g dry root) than counts (2,179 to 10,004/g dry root) from 20 dent or flint gene pools obtained from CIMMYT. Nematode populations in the temperate gene pools generally peaked in Sept., while those from the tropical gene pools were more variable, peaking from July 7 to Sept. 17. Populations from species other than the gene pools peaked in July or Aug.

10. GCWSIM - A green cloverworm simulation model.

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

The green cloverworm (GCW), *Plathypena scabra* (F.), is a sporadic pest of soybeans in Iowa. The random nature of these outbreaks and extent of subsequent damage has prompted extensive research on GCW life history, seasonal abundance, and its impact on

15. The effect of local leadership on the development of a small Welsh village.

J.L. ROBBINS

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This paper follows from fieldwork, done in late 1981, in which I studied the government leaders of the small Welsh border village of New Radnor. The place of leadership in the local culture and the personal qualities of the leaders of this community of 300 people are analyzed. The personal situations of the leaders and the social life of the village are discussed as they relate to the way that the local government responds to the need for economic development of the village. Following from the conclusion that the local government cannot be expected to initiate or encourage development, changes in Welsh government are suggested.

16. Class attitudes toward development in a Welsh village.

B.J. ZILLIAC

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As with many rural regions throughout the industrialized world, the Welsh Borderland is characterized by unemployment and rural exodus, brought on in part by the mechanization of agriculture and rapid social change. One possible solution to unemployment and related problems involves the development of industry and tourism. This paper examines class attitudes toward development in the small village of New Radnor, Wales. The research methods used for the study consisted of informal interviews and participation in and observation of village life. The results of the study reveal that class cleavages are present among professional, working-class, service, and farming villagers. The main cleavage exists between professionals, who largely oppose industrial and tourism development, and the working-class, who overwhelmingly support both kinds of development. These attitudinal differences among village classes are partially responsible for the difficulty in stimulating growth and development in the Welsh Borderland.

17. The Welsh small town in conflict: reactions to a highway bypass.

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This study focuses on the events surrounding the construction of a highway bypass in Presteigne, a small town on the Welsh border. Designed to alleviate traffic congestion and safety hazards posed by large trucks passing through the narrow central business district of this market town, the bypass construction was alternately opposed and supported by an unorganized collectivity of merchants and local residents. The analysis of these events

reveals (1) the dynamics of small-town politics as a determinant for the town's reaction to the project, and (2) the larger implications of regional planning which escapes local attention as a determinant of the actions of the county authorities.

18. Economy versus ecology in Welsh farming practices.

J.E. HUNTER

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Studies of agricultural communities in western Europe have focused largely on the process of modernization. Many anthropologists and sociologists have tended to view this process as necessary and inevitable if not always beneficial in every way. This paper, written from the perspective of the appropriate technology movement examines traditional attitudes toward farming practices and pressure to modernize among farmers of the Welsh border country. The paper is the outcome of a five-week period of open-ended ethnographic interviews with farmers and farm workers of the area. A similar set of interviews conducted in Iowa provides a point of contrast. The results indicate that while there has been a trend toward modernization, many traditional attitudes and techniques remain. The paper concludes that many of the traditional technologies are adaptive to conditions of environmental and economic stress. This fact is important in examining the long range desirability of modernization.

19. An overview of programs involving Native Americans and anthropologists in Iowa.

D. C. ANDERSON

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Since 1975 anthropologists in Iowa have worked with representatives of the Native American community on programs of mutual interest. This paper focuses on six different projects and illustrates how each are benefiting contemporary Indians in one or more of the following ways: (1) preservation of sacred areas; (2) respect for religious beliefs; (3) enactment of favorable legislation; (4) education of the public on Indian values; (5) encouragement of traditional arts; (6) provisions for participation of religious practitioners; (7) reburial of sacred bones; (8) the establishment of programs favorable to Indians; and (9) use of Indian advisors.

25. Flora of the "Mines of Spain," Dubuque County, Iowa.

J. W. LEHMANN

Department of Biology, University of Northern Iowa, Cedar Falls, IA 50614.

Two years of floristic reconnaissance and collection at the Mines of Spain, a 1264 acre preserve along the Mississippi River, has yielded over 400 vascular plant species. These baseline data have been used in a plant community analysis conducted during the past growing season. A new record for the Driftless Area, Chorispora tenella (Brassicaceae) is reported. Numerous regionally rare plants of special interest include: Ammania coccinea, Arenaria serpyllifolia, Aruncus dioicus, Corallorhiza odontorhiza, Dodecatheon amethystinum, Dryopteris intermedia, Liparis loeselii, Polygala verticillata, and Spiranthes magnicamporum. No cold-air drainage boreal habitat similar to that of White Pine Hollow, Dubuque County, has been observed. Recognized disturbance species of the forest community are present. These species aid in the interpretation of the plant communities of a complex land-use mosaic: mining, quarrying, logging, pasturing, and farming.

26. A plant community analysis of the Mines of Spain, Dubuque.

T. J. BLEWETT, J. W. LEHMANN and S. K. WINTERS

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An analysis of community composition and forest reproduction trends in the Mines of Spain is in progress with support from the Iowa Conservation Commission. Three sites that have had different land use histories have been analyzed to determine present composition, the influence of land use history, and reproduction trends. Vegetation maps and aerial photos have been prepared to assist in future management planning, particularly in the process of identifying ecologically significant and/or sensitive areas that contain rare flora. Ironically, one of the areas most heavily pitted from lead mining has an all-aged forest including sugar maple and basswood in suitable exposures. Areas more recently disturbed by logging and pasturing tend to be more even-aged. Prairie ridges are gradually being overgrown, first with the invasion of cedar in the absence of fire.

27. Markov models and succession: A test from a Netherlands heath.

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Most discussions about the application of Markov models to succession have been theoretical, because of a lack of experimental data. We present a Markovian model for an Empetrum nigrum heath based upon 19 years of observations. The basic assumptions of the Markov model are tested, and the stationarity assumption does not hold for the present data set. Disturbing influences include climate and insects, and there is also evidence of spatial influences. However, the use of transition matrices can be a useful descriptive tool even when the system is not Markovian.

28. Special plants of Iowa's Driftless Area

W. P. PUSATERI

Iowa Natural Areas Inventory, Iowa Conservation Commission, Wallace State Office Bldg., Des Moines, Iowa 50315

Aconitum noveboracense, Chrysosplenium iowense and Cornus canadensis are a few endangered vascular plants whose range in Iowa is restricted to the Driftless Area. The high diversity of this flora reflects the rugged topography of this region. Here the dissected bedrock of the Paleozoic Plateau has an array of microhabitats harboring many species with boreal affinities. Approximately 50 endangered and 25 threatened species have been documented in this region of Iowa and the Driftless Area Flora comprises about 50% of the total taxa of the state.

29. The rust fungi of the driftless area of Iowa.

G. KNAPHUS and L. H. TIFFANY

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The earliest scholars who studied the rust fungi of the Iowa driftless area were E. W. D. Holway and Alois Kovarik. Holway, a Decorah banker, was particularly interested and collected 127 species of rusts between 1885 and 1905. During general collecting trips over the last five years, we have found 71 of these species. In addition, we have collected three rusts, Uredinopsis osmundae, U. struthiopteroides, and Gymnosporangium corniculans, which Holway did not encounter. Uredinopsis struthiopteroides has not been previously reported from Iowa. Of the 158 rust species which have been documented from Iowa, 28 species have been collected only in the driftless area.

Increases during the 128 year time period, however, differed from bluff tops (17% increase), upper slopes (97%), and lower slopes (96%). In 1981, leadplant (*Amorpha canescens*) was present only on bluff tops. Bur oak (*Quercus macrocarpa*) and roughleaf dogwood (*Cornus drummondii*) cover averaged 69% and 37% greater on upper slopes than on bluff tops but 44% and 16% less on upper than on lower slopes. Hackberry (*Celtis occidentalis*) was present only on lower slope sites. This study (1) documents woody plant invasion of Iowa loess bluff prairies, (2) projects the loss of this ecosystem within 80 years without proper management, and (3) indicates vegetative changes that should occur during ecesis.

36. Structure and distribution of secretory cavities in the legume tribes Amorpheae and Psoraleeae.

G. W. TURNER

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The legume tribes Amorpheae and Psoraleeae share unusual characters of gland dotted foliage and one seeded fruits. At various times they have been considered a single taxonomic group. They formed Benthum and Hooker's subtribe Psoraleeae of their Galegeae. The group was subsequently elevated to tribal level by Rydberg (1928) and then subdivided into the two smaller tribes in more recent treatments. Barneby (1977) has suggested that the Amorpheae and Psoraleeae are not closely related but had been previously combined on the basis of a superficial resemblance. Reported here are the results of an extensive survey of the types of secretory cavities in these two tribes. These cavities are responsible for gland dotted foliage that has been used by taxonomists as a single character. I have found two distinct kinds of cavities: one, occurring only in the Psoraleeae, develops by the elongation and separation of epidermal cells; and another in the Amorpheae develops with separation of subepidermal cells. This study supports Barneby's hypothesis that the two tribes are closely related.

37. Aquatic hyphomycetes from Doña Juana River at Toro Negro State Forest, Villalba, Puerto Rico

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Forty-two species of aquatic hyphomycetes were collected at Doña Juana River at Toro Negro State Forest Villalba, Puerto Rico. *Actinospora megalospora*, Ingold; *Altospora acuminata*, Ingold; *Anguillospora crasa*, Ingold; *Anguillospora longissima*, Ingold; *Angulospora* sp.; *Articulospora angulata*, Tubaki; *Articulospora tetracladia*, Ingold; *Brachiosphaera tropicalis*, Nawawi; *Camposporium pellucidum* (Grove) Hughes; *Campylospora chaetocladia*, Ranzoni; *Campylospora parvula*, Kuzuha, *Candida aquatica*, Jones & Slooff; *Clavariopsis aquatica*, De Wildeman;

Condylospora spumigena, Nawawi; *Dendrospora erecta*, Ingold; *Flabellospora tetracladia*, Nawawi; *Flabellospora verticillata*, Alasoadura; *Flagellospora penicillioides*, Ingold; *Gyoefferfella* sp.; *Isthmotri-cladia gombakiensis*, Nawawi; *Laridospora appendiculata*, Lemonniera; *Lemonniera aquatica*, De Wildeman; *Lemonniera terrestris*, Lunulospora; *curvula*, Ingold; *Mycocentrospora acerina*, Deighton; *Phalangispora constricta*; *Pyramidospora casuarinae*; *Scorposporium anaormalum*, (Ingold), Iqbal; *Sigmoidea* sp.; *Tetrachaetum elegans* Ingold; *Tetracladium apiece*; *Tetracladium marchalianum*, De Wildeman; *Tetracladium setigerum* (Grove) Ingold; *Tricladium* sp.; *Tricladium anomalum*; *Tricladium splidens*, Ingold; *Tripospermum camelopardus*, Ingold; *Tripospermum myrtii*; Spega zzi; *Triposporina* sp.; *Triscelophorus acuminatus*, *Triscelophorus monosporus*, Ingold; *Varicosporium elodeae*, Kegel.

38. Light microscopy of the "extra-floral nectaries" of *Passiflora foetida*.

Cohen, Paul F. and L.T. Durkee

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Glands located on the bracts and petioles of *P. foetida* have been consistently designated as extra-floral nectaries by a variety of workers. Light microscopy studies with differential staining of these glands during their development reveal a cytological picture different from that observed for nectaries generally. These studies and other evidence suggest that these glands are not nectaries, but are more likely to be secreting volatile oils or resins.

39. Electron microscopy of the "extra-floral nectaries" of *Passiflora foetida*.

Baird, C.W. and L.T. Durkee

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So-called "extra-floral nectaries" of *Passiflora foetida*, a neotropical weed species, were studied at the ultrastructural level by routine TEM. Mature secreting glands have an ultrastructure quite different from that of true extra-floral nectaries, with prominent intercellular spaces, abundant smooth ER, and many vacuoles containing an abundance of vesicles and/or lamellar material which is eventually deposited outside the plasmalemma and may represent the secretion product of these glands.

45. Development of syncytial raphide crystal idioblasts in the cortex of adventitious roots of Vanilla.

A.P. KAUSCH and H.T. HORNER

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Initiation and formation of calcium oxalate raphide crystals and crystal idioblasts were studied in adventitious roots of Vanilla planifolia L. (Orchidaceae). Crystal idioblast initials are first recognized by intense fluorescence with acridine orange; nuclear and nucleolar enlargement ensues. Crystal chambers form in association with an electron-dense vacuolar amorphous material and crystal deposition occurs within these chambers. Vacuolar cables of tubules become associated with the crystals and act to anchor and orient the crystal bundle. Crystalloplastids differentiate lobed regions similar to those seen in other mucilaginous raphide idioblasts, and their development is observed to precede mucilage accumulation. At this time the raphides change from being four-sided in cross section to six- and eight-sided. Idioblast maturation is completed as its transverse walls in a file break down to form a syncytium. This study uses bas-relief photographic processing for image enhancement of conventional light and transmission electron micrographs.

46. Cytochrome oxidase activity in the shoot apical meristem of Brassica campestris L. during transition to flowering.

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Histochemical studies on fresh-frozen, cryostat sections of evoked shoot apices of Brassica campestris showed there was an increase in cytochrome oxidase activity within the first 24 hr after plants were transferred from short days (8 hr light) to long days (16 hr light). Cytochrome oxidase activity was observed in the central, peripheral and pith-rib meristem zones of the meristem at the transition stage. Activity in the late transition stage was localized in areas of the peripheral zone where floral bud primordia would be formed. These observations support an interpretation of floral evocation in a transforming meristem of Brassica as consisting, at least partially, of a higher respiratory rate than the vegetative meristem of Brassica. Results are discussed in relation to other histochemical and cytological events which are known to occur in the meristem of Brassica.

47. Distribution of ent-kaurene-synthesizing enzymes in vegetative pea tissues.

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Cell-free enzyme preparations capable of incorporating [¹⁴C]-mevalonic acid into ent-kaurene, a diterpene precursor of gibberellins, have been derived previously from developing pea (Pisum sativum) seeds and shoot tips. The present study was to determine the incorporation of mevalonic acid into ent-kaurene in extracts from other tissues of pea.

Shoot tips, leaves, internodes and roots of light-grown Alaska peas were excised and homogenized. Dialyzed 150,000 x g supernatants were incubated with [¹⁴C]-mevalonic acid, Mn²⁺, Mg²⁺ and ATP for 90 min at 30°C. [¹⁴C]-ent-kaurene was extracted, separated by TLC and measured by liquid scintillation spectrometry.

The results indicate that ent-kaurene is synthesized in all above-ground plant parts. Comparative activity, based upon fresh weight or protein, was greatest in extracts of the uppermost internodes and declined progressively in those from lower leaves and internodes. Shoot tip extracts were intermediate in activity.

48. Cultural treatments of jack pine enhance strobilus emergence during August and September.

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Jack pine seedlings, germinated on October 1, 1981, were grown in a propane-heated, polyethylene-covered greenhouse until being transplanted to a nursery on May 11, 1982. A total of 39 ovulate strobili emerged, without a low-temperature treatment, from non-expanding buds of the 900 seedlings during August and September 1982, making these the youngest jack pine to flower. Spraying the seedlings with a gibberellin A₄/A₇ mixture between July 15 and September 16 significantly increased strobilus emergence 3-fold over that in the controls. Pollination failed because the ovulate strobili had immature ovules or bracts and scales only. All bracts were initiated prior to August 4. Three strobili that emerged in late September, however, contained mature ovules on the distal scales. Possible causes for this phenomenon will be discussed.

55. An Ecological Analysis of Central Iowa Forests

M.C. BACH

Committee on Science and Technology, U.S. House of Representatives, Washington, D.C. 20515

The native deciduous forests of Iowa occupied 16% of the total land area at presettlement according to land survey records of the mid-nineteenth century. Today, less than 4% of Iowa's native woodlands remain. This study was undertaken to obtain information on species composition of temperate deciduous forests in central Iowa with regard to patterns and factors affecting the distribution of these species, and to compare and contrast ordination and classification techniques used in analyzing vegetative data collected.

The tenth hectare quadrat method was used for measuring density, coverage, and frequency of forest vegetation on 30 sample plots. Data was ordinated according to four techniques: Weighted Averages, Polar Ordination, Principal Components Analysis, and Reciprocal Averaging. Classification approaches used were Orloci Agglomerative, a form of cluster analysis, and species dominance based on tree basal area. Central Iowa tree species support the theory of H.A. Gleason that species are individually distributed along continuous gradients.

56. Survey of seven endangered plant species in Iowa.

W. C. WATSON

Department of Biology, University of Northern Iowa, Cedar Falls, IA 50614.

Present knowledge of the status of Asclepias lanuginosa, A. meadii, Aster furcatus, Besseyia bullii, Chelone obliqua var. speciosa, Lespedeza leptostachya, and Platanthera leucophaea within the state of Iowa is presented. Aspects include nomenclature, historic distribution, and habitat description of each species. This information was sought from herbaria, literature sources, and communications with interested botanists. Information concerning extant populations is sought to provide a comprehensive status and possible protection for each of these species.

CHEMISTRY C

57. The determination of the presence and quantity of water associated with coal fly ash

L. M. SEAVERSON, G. BURNET AND J. F. McCLELLAND

Ames Laboratory and Department of Chemical Engineering, Iowa State University, 275 Metals Development, Ames, IA 50011

In connection with the development of the HiChlor process for alumina extraction from coal fly ash, the presence of H₂O or OH associated with fly ash samples from four bituminous coals and one subbituminous coal were examined with infrared spectroscopy via the photoacoustic method. The ashes were examined as received and after drying at 700° for 30 hours in a muffle furnace. A broad peak ranging from 3600-3100 cm⁻¹ caused by OH stretching frequencies was found to decrease somewhat at 120° and to be almost eliminated at 700°. The quantities of H₂O removed as a function of temperature were determined by Knudsen cell mass spectrometry and TGA-DTA.

58. Multinuclear NMR of Fe(II) and Co(II) N-Methyl Porphyrins

J. Lynn and H.M. Goff

Metalloporphyrins which are alkylated at one pyrrole nitrogen atom have unique coordination and electronic structural properties, and are also of physiological importance. Proton, deuterium, and carbon-13 NMR studies have been conducted on iron(II) and cobalt(II) N-methyl tetraphenylporphyrin derivatives. High-spin iron(II) N-methyl porphyrins exhibit a high degree of asymmetry in the unpaired spin distribution as characterized by deuterium NMR spectroscopy. This derivative is quite susceptible to demetallation, but the analogous cobalt(II) adduct is much more stable. In contrast to unmodified cobalt(II) porphyrins which are in the low-spin state, the alkylated complex is high-spin. This unusual species exhibits very large dipolar NMR shifts. Deuterium labelled compounds reveal a predominant dipolar shift of -55 PPM for the N-methyl protons. The large dipolar shifts and narrow linewidths suggest the possibility of using cobalt(II) N-methyl porphyrin derivatives as NMR shift reagents. Carbon-13 NMR measurements also demonstrate the high degree of electronic asymmetry in cobalt(II) N-methyl porphyrins.

59. Square-wave modulated hydrodynamic voltammetry

D.S. AUSTIN AND D.C. JOHNSON

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

In the title technique (QMHV), the rotational velocity of a rotating disk electrode is alternated about a nonzero mean value and the

water, reacts the compound with chromotropic acid and quantitates the resulting chromophore spectrophotometrically. Method 354 traps formaldehyde by reaction with N-benzylethanolamine forming 3-benzylloxazolidine which is desorbed and determined by gas chromatography. The methods are compared in detail including sampling times, analysis times, ease of sampling, limits of detection and interferences.

65. Deuterium NMR of Oxidized Iron Porphyrins

A.D. Boersma and H.M. Goff

Spin-admixed $S = 5/2, 3/2$ iron(III) tetraphenylporphyrin complexes (TPPF_x, X = ClO₄⁻, SO₃CF₃⁻) were oxidized electrochemically, and characterized *in situ* using deuterium NMR spectroscopy. Non-linear Curie Law plots indicate preservation of quantum mechanical spin-admixed $S = 3/2, 5/2$ character in the oxidized product. The $S = 5/2$ and $S = 3/2$ states are inverted relative to the parent iron(III) complex. Large alternating phenyl chemical shifts indicate porphyrin centered oxidation vs. metal centered oxidation. An iron(III) porphyrin π -cation radical formulation is thus favored.

66. Mechanism of acid formation in 2-heptanone

A. LANGE

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2-heptanone was found by the U.S. Army Corps of Engineers to decompose upon storage. GC/MS studies established the breakdown products to be acetic and pentanoic acids. The reaction was found to be catalyzed by organic acids, hence the reaction products are catalysts for further reaction. When 1,1,3,3,3-d₅-2-heptanone was reacted with organic acid catalysts, d₃ acetic acid and undeuterated pentanoic acid were formed. No formic or hexanoic acid were detected in any of the reactions. The reaction mechanism is proposed to be an oxidation by organic per acid which reacts with the 2-heptanone at the 3 position.

Additional support for the proposed peroxide oxidation mechanism is that the use of peroxide inhibitors were found to stabilize the 2-heptanone with no acid formation taking place under the experimental conditions employed.

67. Electrochemistry of folic acid.

RICHARD H. WINSTON and R.C. GURIRA

Department of Chemistry, Grinnell College, Grinnell, Iowa 50112

Recent work by R.C. Gurira and L.D. Bowers¹ on the electrochemical reduction of methotrexate (MTX) sheds considerable new light on the electrochemistry of 2,4,6-trisubstituted pteridines. Our research involves elucidation of the electrochemical reduc-

tion pathway of folic acid. Specifically, there seems to be a competitive non-electrochemical process occurring which has not been characterized. Current literature suggests the non-electrochemical process involved is cleavage of the molecule. However there has been no strong evidence brought forth to verify this assertion. It seems that the problem in the past has been associated with instrumental limitations and unclear interpretation of data. In an effort to rectify this situation, we have employed differential pulse polarography, cyclic voltammetry, and reversed-phase high performance liquid chromatography in conjunction with constant potential electrolysis to acquire what we hope to be sufficient data to fully characterize the electrochemical reduction pathway of aforementioned species.

1. J. Electroanalytical Chemistry, 00(1983).

68. Substituted hydrazones as reagents in spectrophotometric analysis.

K.J. WEST and R.T. PFLAUM

University of Iowa, Iowa City, Iowa 52242

Substituted hydrazones, formed in the condensation of aldehydes and ketones with 2-hydrazinopyridine and 2-hydrazinoquinoline, contain a multiplicity of nitrogen donor atoms. These chelating agents function as terdentate or quadridentate ligands toward many metal ions. The resulting intensely colored complexes are stable in mixed solvent systems.

Complexes formed in the reaction of 2,2'-pyridyl mono and bis pyridyl or quinolyl hydrazones with the first series of transition metal ions and with cadmium and mercury ions will be described. Spectrophotometric and spectrofluorometric characteristics of these colored species will be presented. Possible methods for the determination of trace levels of selected metal ions will be discussed.

69. Polarographic detection in ion chromatography

T. HSI AND D.C. JOHNSON

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

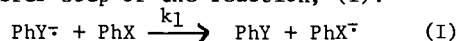
The constantly renewed surface and the large hydrogen overpotential of a dropping mercury electrode (DME) makes this electrode a very useful detector for metal ions in Ion Chromatography® (IC). However, the usual requirement of solution deaeration associated with polarographic techniques hinders the practical application of the DME for IC. To eliminate the need for deaeration, the technique of reversed-pulse amperometry was developed (RPA). In RPA, a large negative value of potential is applied initially for cathodic deposition of metal ions on the DME. Then a positive

74. Relative rates of reaction of iodo- and bromobenzene in aromatic $S_{RN}1$ reactions

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The relative rate of reaction of iodo- and bromobenzene in $S_{RN}1$ reactions (as measured in situ competition), k_{PhI}/k_{PhBr} , varies with the nature of the nucleophile. We hypothesized that this variation results from changes in the rate of the electron transfer step of the reaction, (I).



When PhY^- is strongly reducing, k_1 is large and there is little discrimination between iodo- and bromobenzene. When PhY^- is more weakly reducing, k_1 is smaller, and more discrimination results. As a test for our hypothesis we examined the electrochemistry of several PhY 's and found that k_{PhI}/k_{PhBr} correlates, at least qualitatively, with the reaction potential of PhY . We have also prepared para-Y-substituted benzoic acids by reaction of p-iodobenzoic acid with the appropriate nucleophile, Y. We then measured their pKa's and determined Hammett sigma-para values for the appropriate Y's. We also find a qualitative correlation of k_{PhI}/k_{PhBr} with sigma-para.

75. Redox catalyzed $S_{RN}1$ reactions of bromobenzene and bromopyridine

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Cathodic stimulation of $S_{RN}1$ reactions of phenyl and pyridyl halides fails due to rapid cleavage of the radical anion, ArX^- , forming aryl radicals, $Ar\cdot$ which are further reduced at the electrode. We have demonstrated the use of redox catalysts to circumvent this problem. The catalysts are reduced at the electrode, diffuse into the bulk solution, and transfer an electron to ArX . The $Ar\cdot$ formed from cleavage of ArX^- cannot be further reduced since they are distant from electrode. Yields of 68% diphenylsulfide have been obtained in $S_{RN}1$ reaction of bromobenzene with tetra-n-butylammonium thiophenoxide in DMSO using benzonitrile as the redox catalyst. The reaction consumes about 0.5 electrons per bromobenzene, indicating a chain reaction. Deuterium labeling studies indicate most termination steps are due to hydrogen atom abstraction from the solvent. Some termination, however, comes from hydrogen atom abstraction from other molecules. Under less favorable conditions we see some two electron reduction of the bromobenzene. We have also initiated reaction of 2-bromopyridine with thiophenoxide ion using phenanthridine as the redox catalyst.

76. Residual lead levels in vegetation surrounding a point source.

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Media allegations and publicity concerning a possible incidence of lead pollution from a battery plant's activities near Savannah, Carroll County, Illinois, resulted in the plant's closing in April, 1981. In order to determine if high concentrations of residual lead were still present, vegetation samples were collected from a 2.25 km² area surrounding the suspected point source, and assayed for lead content using dithiazone complexation and spectrophotometric determination. Results of these determinations will be presented.

77. Phenylketonuria and brain protein synthesis

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An experimental model for phenylketonuria, chronic hyperphenylalaninemia, was developed and maintained in newborn mice by daily injections of phenylalanine and a phenylalanine hydroxylase inhibitor α -methyl-phenylalanine. The result of this chronic hyperphenylalaninemia was an accumulation of inactive brain monoribosomes that persisted for 18h of each day. An elongation assay in vitro with brain postmitochondrial supernatants demonstrated that, in addition, there was an equally prolonged decrease in the rates of polypeptide chain elongation by the remaining polyribosomes. Analyses of the free amino acids in brains of hyperphenylalaninemic mice showed a loss of several amino acids, particularly the large, neutral amino acids that are co- or counter-transported across cell membranes with phenylalanine. When a mixture of these amino acids was injected into hyperphenylalaninemic mice, there was an immediate cessation of monoribosome accumulation and there was no inhibition of polypeptide chain elongation. Although the concentrations of the large, neutral amino acids were partially preserved by treatment of the hyperphenylalaninemic mice with the amino acid mixture, the elevated concentrations of phenylalanine remained unaltered.

be the basis for species recognition. Thus, lactones from the donkey and the zebra were entirely straight-chained but differed in the proportions of unsaturated compounds. Przewalski's horse and the Asiatic ass had mixtures of straight and branched lactones. The distinctions were readily seen in nuclear magnetic resonance spectra and gas chromatograms. The relative compositions of the lactones within the genus are in harmony with the evolutionary relationships which have been deduced from the serum proteins in these species. Furthermore, the lactone composition in the mule was intermediate between the horse and the donkey, indicating genetic control of the composition in the hybrid.

83. Specificity of acid and enzyme hydrolyses of oligosaccharides

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The specificity of partial acid hydrolysis and hydrolysis by α -glucosidase, β -glucosidase and invertase reacting with nine oligosaccharides (maltose cellobiose, lactose, turanose, melibiose, α , α -trehalose, sucrose, raffinose, and melezitose) was studied. Partial acid hydrolysis gave varying amounts of products, characteristic of the oligosaccharide, depending on the type of linkages present. The most completely hydrolyzed linkage was the α , β -acetalketal, sucrose-type linkage. Next was the α 1,4 linkage of maltose, then the β 1,4 linkage of cellobiose. Least hydrolyzed was the α , α -acetal linkage of trehalose. α -glucosidase was specific for only the α -glucosidase linkages in the nine oligosaccharides. The β -glucosidase had specificity for β -glucosidic linkages, but also hydrolyzed both α - and β -galactosidic linkages and β -fructofuranosidic linkages. Invertase was specific for the β -fructofuranosyl linkage of sucrose but did not hydrolyze the β -fructofuranosyl linkage in melezitose.

CONSERVATION

84. Fauna of Iowa's "Driftless Area" - an overview

ROBERT W. HOWE

Iowa Natural Areas Inventory, Iowa Conservation Commission, Wallace State Office Building, Des Moines, IA 50319

The Driftless Area and adjoining parts of the Paleozoic Plateau in northeastern Iowa harbor many of the state's most unique animal species. This presentation will review current knowledge about the "Driftless Area" fauna, which includes nearly 25% of Iowa's endangered or threatened vertebrates. Only a small fraction (3-6%) of resident fishes, amphibians, reptiles, birds and mammals are restricted in Iowa primarily or exclusively to the "Driftless Area". The region's peripheral location and its relatively extensive forest cover account largely for these limited state distributions. Less mobile organisms such as land snails and other invertebrates have been influenced more directly by the unusual geologic and climatic history of northeastern Iowa. Several species are endemic to the Paleozoic Plateau; a few are found only in Iowa. Recent studies suggest that the biological uniqueness of the region might not be fully realized.

85. Discovery of fourteen prairie sites in Black Hawk County through systematic inventory.

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Black Hawk County Conservation Board, 2410 West Lone Tree Road, Cedar Falls, Iowa 50613

A county wide inventory was conducted to locate and map natural areas and note their quality. Fourteen unknown prairie sites were located and verified. Information was gathered by section-by-section interpretation of aerial photos, topo maps and the soil survey; discussions with knowledgeable persons; literature search and herbarium review; and on site verification. Of the 14 sites, 5 are in RR ROW's, one is in a cemetery, 8 are privately owned. Most sites are untillable. Of the 8, two are sandy (41B, 41C), one is rocky (412C), four are wet (391B, 221), one is inaccessible (382). Three sites contain Phlox bifida Beck.. One site contains Melanthium virginicum L.. Of the two Palms muck sites (221), one harbors Salix candida Fluegge, the other harbors Gentiana crinata Froel.. Petalostemon villosus Nutt. is located on a dune stabilized by a pine plantation. The only other known Iowa site of this plant is one mile from this site. The new prairies comprise 50.5 acres plus the 20 acre plantation. This added to the 82.5 acres of the five known sites totals 153 acres of native prairie of varying quality.

Mean stem density in channel-side areas was greater than backwater areas (35.2 vs. 22.4 stems/m²). Dry below ground standing crop was greatest in fall (\bar{x} = 70.1 g/0.5m³). Fall dry below ground standing crop was 79.9 g/m³, significantly greater than the backwater mean of 62.7 g/m³. Water depth was significantly correlated with dry aerial standing crop, stem density, and flowering stem density.

91. Feeding and social behavior of Bald Eagles wintering on the Mississippi River near Burlington, Iowa.

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Bald Eagles (*Haliaeetus leucocephalus*) were studied during 14-28 January 1981 and 19-25 January 1982 along a 2-mile stretch of river where thermal water from the Iowa Southern Utilities Power Plant keeps the water ice-free. The number of eagles using the area varied from 7 adults to 65 adults and 7 immatures, increasing when the amount of ice-free water on the river decreased; at concentration sites within the study area eagle numbers ranged from 6 to 46. Eagles caught fish by: (1) swooping from a perch; (2) flying over open water, and then swooping down; (3) standing on shore ice or small ice masses moving with the current, and reaching into the water; (4) wading in shallow water. They also stole food from conspecifics (n=26), Common Mergansers *Mergus merganser* (n=23), and American Crows *Corvus brachyrhynchos* (n=20). As eagle density increased, the fishing and social interaction rates of individual eagles decreased.

92. Cannibals in a population of Iowa tiger salamanders' (*Ambystoma t. tigrinum*)

MICHAEL J. LANNOO and MARILYN D. BACHMANN

Department of Animal Ecology, Iowa State University, Ames, Iowa, 50011.

Cannibalistic morphs, differing structurally as well as behaviorally from the normal type, were found in a population of *A. t. tigrinum* from northwestern Iowa. Previously known in two other subspecies, this is the first time cannibalistic forms have been found in this subspecies. Cannibals and normal types are compared relative to structure, growth and feeding behavior.

93. Habitat associations and movements of shovelnose sturgeon in Pool 13 of the Upper Mississippi River

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Ames, Iowa 50011

Habitat associations and movements of shovelnose sturgeon, *Scaphirynchus platyrhynchus*, were studied in Pool 13 of the Upper Mississippi River from March

to October of 1982 using radio-telemetry, mark-recapture and catch-per-unit-effort (CPUE) techniques. Seven hundred seventy-eight telemetry observations were made on 22 fish tagged with 49-Mhz transmitters. Radio-tagged sturgeon moved an average of 364 m/day (max. 11.7 km) with 48% of the movements less than 50 m/day. Drifted trammel nets were used to sample sturgeon in channel habitats. One hundred thirty-eight sturgeon were recaptured out of 2,257 marked with monel strap tags. During high river stages in the spring, sturgeon were captured and located most frequently behind wing and closing dams and in areas of main channel border within 50 m of shore. During the summer, sturgeon were found most frequently close to or in the main channel and on the upstream sides of wing and closing dams. Radio-tagged sturgeon were found most frequently between 2 and 7 m in depth, in currents of 20-40 cm/s at the bottom and 40-70 cm/s at the surface.

94. Agricultural watershed impacts on primary production in small Iowa streams

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Eight sites from seven central Iowa streams were monitored throughout the spring and summer (1981) to determine the effects of agricultural watershed practices on stream primary production. These watershed and near-stream practices have increased stream solar radiation, temperature and nutrient regimes to a varying degree. Photosynthetic pigment concentrations (chlorophyll-a) of suspended and attached algae and diurnal oxygen curve analysis were used as indices of in-stream primary production. The effects of the altered temperature, nutrient and sunlight regimes on stream primary production will be discussed, as well as other aspects of agricultural stream structure and function.

95. Sediment resuspension in Little Wall Lake, Iowa

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Total phosphorus, filtrable phosphorus, chlorophyll a, organic and inorganic suspended solids, and turbidity were measured at two sites on Little Wall Lake in Hamilton County, Iowa. Measurements were made on 41 different days during the summer and fall of 1982. In addition, a continuous record of wind velocity was made at one location on the lake. Relationships between the wind velocity over the lake and the physical and chemical properties in the lake were investigated. A threshold wind value of between 10 and 15 mph seemed to exist for this lake. Below this value wind seemed to have little effect. Above this value significant positive correlations existed between wind and: total phosphorus (r=.48),

100. Processing of power station coal fly ash as a resource for alumina and cement

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272 Metals Development, Ames, IA 50011

A process is presented for converting the fly ash generated at coal-fueled power stations to usable, marketable products. As an alternative to disposal of the ash as waste, mixtures of fly ash, limestone, and soda ash can be sintered to form soluble alumina compounds. The latter can be recovered and converted to alumina (aluminum oxide) of purity suitable for the production of aluminum metal and the residue can be used in the manufacture of portland cement. Process economics are presented, and effects of fly ash composition, processing conditions, and cost estimation parameters are discussed.

101. Extending the Life of Iowa Bridges

K. F. DUNKER, F. W. KLAIBER AND W. W. SANDERS, JR.

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During the period 1930-1960, a considerable number of single span, composite steel and concrete bridges were constructed in Iowa and throughout the United States. Since their construction, design standards have changed, and legal load limits have been increased. As a result, many of the bridges cannot be rated for legal loads. A more attractive and economical alternative to posting or replacing the bridges is strengthening. With research grants from Iowa DOT, a team of researchers at Iowa State University has developed a method of strengthening: post-tensioning with high strength threaded steel bars. After a laboratory investigation during which a half scale model bridge was strengthened, two Iowa bridges were strengthened by the method during the summer of 1982. Field data has provided verification of most design assumptions. Thus, post-tensioning has been shown to be a viable strengthening method for single span composite bridges.

102. Formation of an Iowa SILA

LOUPEE, B.J.

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An organization to provide technical advice to state legislators and other lawmakers is being formed in Iowa. Such groups are known by the generic term SILA, meaning State Intersociety Legislative Advisory group. The history of SILAs and the status of the Iowa formation will be reviewed. The expected benefits and the inherent limitations of this form of legislative advice will be explored.

GEOLOGY

103. Upland wetlands created by eolian sand deposits on the Iowan Erosional Surface.

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Eolian sands are frequently found dispersed over the Iowan Erosional Surface. These wind-blown sands can accumulate to an appreciable depth and this deposition on the uplands can create wetlands. These wetlands are found in four general settings: 1) existing watersheds blocked by linear dunes, 2) existing watersheds blocked by mantle deposits, 3) swales, and 4) seeps. Prime factors affecting each type of wetland are variation in depth, slope position, size of blocked watershed and distance from sand source. The factors influencing the creation and degradation of these wetlands will be discussed.

104. The status of research at Cold Water Cave

M. J. BOUNK

Iowa Geological Survey, 123 N. Capitol St., Iowa City, Iowa 52242

Cold Water Cave was discovered, partly explored, and mapped by cavers in the late 1960s. Later studies of the cavern atmosphere, water quality, fauna, vertebrate remains, speleothems, and geology of the cave by and under the direction of the Iowa Geological Survey were published in *Report on Cold Water Cave* in 1974. A Theodolite and Subtense bar resurvey of about 7,200 feet of the main passage of the cave is published in this report, and at a larger scale as an open-file report.

In the eight years since the completion of the Geological Survey's studies, cooperative efforts by the members of several speleological organizations have continued research on the "Cold Water Project." This research consists primarily of completing exploration and mapping of the cave system which now has a surveyed length of about eight miles. The completed map will serve as a basis for future studies of cave development and hydrology. Other recently completed or ongoing studies include air movement, hydrology, development of the upstream part of the cave, variation in stream stage and discharge, and the relationship of the cave to surface features.

along a ring fracture. Trachyte, soda trachyte, vogesite and the remainder of the phonolite occurrences may have intruded along radiating fractures mechanically related to the ring system. Most or all of the quartz latite bodies are eroded plugs of major eruptive vents, the largest of which is Garfield Peak. Some deposits in the Wagon Bed Formation may be ash flows that incorporated stream gravels as they moved away from Garfield Peak. Ash surge deposits have not yet been found.

110. Mineralogy of pyroxines in Tertiary igneous rocks from the Rattlesnake Hills, Wyoming

L. S. POTTER

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Igneous Rocks in the Rattlesnake Hills are located 80 km west of Casper, Wyoming and consist of approximately 48 vents, plugs, or domes of Middle to Late Eocene age. Seven igneous rock types are present: rhyolite, quartz latite, latite, trachyte, soda trachyte, alkali mela trachyte, and phonolite. Green pyroxines are found in latite (6%), trachyte (9%), soda trachyte (6%), alkali mela trachyte (5%), and phonolite (4%). Though not observed in thin section, a few grains were separated from the heavy mineral fraction of rhyolite; and relict crystals were found in quartz latite. These green pyroxines have been previously identified as aegirine-augite. However, electron microprobe examination indicates that they are composed primarily of salite (Wo 44-49%, En 26-35%, Of 17-29%), and although the crystals show pronounced optical zoning with deep green centers and lighter rims, only minor chemical variation could be detected.

111. Mineralogy of apatite in the Tertiary igneous rocks of the Rattlesnake Hills, Wyoming

B. A. EPLING

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

The igneous rocks in the Rattlesnake Hills are 80 km west of Casper, Wyoming and consist of approximately 48 vents, plugs, or domes of middle to late Eocene age. Seven igneous rock types are present: rhyolite, quartz latite, latite, trachyte, soda trachyte, alkali mela trachyte, and phonolite. Apatite was identified in the heavy mineral fraction of all seven rock types. X-ray data indicates that all apatites are structurally and chemically fluorapatites, with unit cell dimensions of 9.371 Å for a⁰, 6.878 Å for c⁰, and an axial ratio of 0.734.

112. Mineralogy of sphene in Tertiary igneous rocks of the Rattlesnake hills, Wyoming

A. G. DODEN

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Tertiary igneous rocks occur in the Rattlesnake Hills, Wyoming as vents, plugs, and domes. Seven

distinct rock types are present: rhyolite, quartz latite, latite, trachyte, soda trachyte, alkali mela trachyte, and phonolite. Examination of each type revealed the presence of sphene as an accessory mineral. All sphene crystals investigated in hand specimen were less than 1 mm in diameter and ranged from euhedral to subhedral with the majority being euhedral. Color varied from light yellow to honey-brown. The abundance of sphene in all rock types, as determined by point counting, ranged from 4 to 6 percent. X-ray analysis showed no significant structural or chemical variations among the sphene crystals examined.

113. Petrology of the Tertiary igneous rocks exposed in the Rattlesnake Hills, Wyoming

K. J. DE NAULT

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

Igneous rocks of early late Eocene age (44 MYBP) crop out in approximately 48 necks, dikes, and shallow intrusive bodies in the Rattlesnake Hills, Wyoming. Exposed rock types include phonolite, quartz latite, latite, trachyte, soda trachyte, vogesite, and rhyolite. The suite is similar in chemistry, mineralogy, and age to the phonolite-rhyolite suite exposed in the Black Hills of Wyoming and South Dakota.

Radiometric age dates suggest that igneous activity occurred in a short one to two million year period, though stratigraphic data indicate a somewhat longer period of activity. The origin of these rocks is not known but two-element whole-rock variation diagrams and normative plots of nepheline, kalsilite, and quartz show fractionation paths that may indicate formation of the suite by differentiation of two parent magmas.

Questions that have not yet been addressed are why did volcanic activity take place in the Rattlesnake Hills of Wyoming? Is this activity related to that in the Black Hills? In Yellowstone? In the Rio Grande Rift?

114. Desmids and chrysoomonad cysts in postglacial sediment

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A body of postglacial sediment sampled from near the continental divide in west-central Montana contains a diverse assemblage of desmids and chrysoomonad cysts. Except for some rock flour and two intervals of volcanic ash, the sediment is almost entirely biogenic, being composed largely of diatoms with varying amounts of carbonaceous material. Geological and botanical evidence indicate the sediment accumulated in a soft water, somewhat acidic pond and marsh. The relative abundances of the desmid taxa change vertically. The paleolimnological significance of the changes are not understood but appear to be related to the evolution of the pond and perhaps to the succession of other flora.

the other in western Europe. Diagnostic analysis shows that wave 2 is maintained by a baroclinic process and wave 3 by a barotropic process.

The model-simulated blocking episode is similar to the observed atmospheric circulation conditions for January 1963 and the 1976-77 winter. The spectral energetics for these two periods are compared with those of the model simulation, and in most instances, are found to be quite similar.

120. Homogeneity of RF Sputtered Films

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Ames Laboratory, Iowa State University
Ames, IA 50011

The successful application of rf sputtering to the deposition of large area amorphous silicon films for photo-voltaics demands film homogeneity over reasonably large areas. Measurements of film thickness, composition, bonding and optical properties have been made as a function of substrate position in a 15 cm diameter target, sputtering system. The results to be presented show that although film thickness varies with position, other properties are nearly constant except near the extreme edges of the deposition region.

121. Capacitance-Voltage Curves for Amorphous Silicon Schottky Barriers

E. YAHYA and H. R. SHANKS

Ames Laboratory, Iowa State University, Ames 50011

Amorphous silicon Schottky barriers have been fabricated by deposition of first an n+ layer on the stainless steel substrate followed by deposition of an intrinsic amorphous silicon layer and then either platinum or gold to form the barrier. A.C. capacitance measurements have been made as a function of frequency and applied stress voltage. Data for several Schottky barriers will be presented and interpreted in terms of localized states in the energy gap.

122. Amorphous Silicon-Carbon Thin films

J. F. WARD and H. R. SHANKS

Ames Laboratory, Iowa State University, Ames 50011

Thin amorphous silicon-carbon films have been prepared by reactive rf sputtering of silicon in a propane-argon atmosphere. Composition of the films is characterized with Auger spectroscopy using single crystal silicon and silicon carbide as standards. Results of infrared absorption measurements will be presented and the various silicon-carbon, silicon-hydrogen and carbon-hydrogen modes will be discussed. Changes in the optical band gap of the material with changes in composition will also be presented.

123. Testing perpetual motion...seriously!

J. W. PATTERSON AND F. D. TRUMPY

Department of Materials Science and Engineering,
Iowa State University, Ames, Iowa 50011

Formal tests were recently completed on an electro-mechanical system deemed capable of producing more energy than it consumes during operation. The system, the people, the test, the results and the sequence of events will be described. Explanations and reasons will be given for why such schemes should be taken seriously and tested in a completely professional manner.

124. Insulation and residential heating requirements

D. T. Nelson

Luther College, Department of Physics, Decorah,
Iowa 52101

A study of the effects of insulation on the seasonal heating requirements of a residence in Decorah, Iowa, extending from 1970 to 1983. Predicted and actual changes in heating requirements are compared for three major changes in insulation during this time period.

125. Prospects for controlled fusion.

R. L. Merlino

Dept. Physics & Astronomy, The University of Iowa
Iowa City, Iowa 52242

A review of the U.S. and worldwide effort to produce a viable fusion reactor will be presented. Presently the magnetic confinement and inertial confinement schemes exist as possible candidates but two devices based on magnetic confinement, the tokamak and tandem mirror, appear now as the best candidates for a fusion reactor. A summary of the present status of the physical understanding of these approaches as well as a discussion of some of the remaining complex engineering issues will be presented.

126. Energetics of Standing Eddies in the General Circulation Models

Y.-H. LEE and T. C. CHEN

Iowa State Univ., 310 Curtiss Hall, Ames, IA 50011

Standing eddies are important to the long-term weather forecast. In general, the standing eddies in the numerical weather prediction model are not well simulated. To understand what causes this problem, 2 sophisticated climate models--the GLAS climate model and the NCAR community climate model are used to examine the structure and maintenance of the standing eddies. Attention is focused on the energetics of standing eddies. The existence of standing eddies is attributed to the longitudinally nonuniform

at both frequencies. These data are being used to investigate a number of topics such as: (a) the morphological structure of these objects, (b) the processes of energetic electron transport, and (c) the determination of basic plasma properties such as plasma density and magnetic field strength. In this paper we describe our attempts to compare the speed of energetic electron flow with the Alfvén speed in these sources. In the two best studied cases (the sources 3C 166 and 3C 192), this streaming speed appears to be several times the Alfvén speed. The implications of this result will be discussed.

132. Stimulated Cherenkov radiation.

W. B. CASE and R. D. KAPLAN

Department of Physics, Grinnell College, Grinnell, Iowa 50112

We consider an electron beam passing through a dielectric in the presence of a magnetic guide field at a rate greater than the speed of light within the dielectric. Such a system is found to be unstable at two frequencies. One corresponds to longitudinal space charge (plasma) oscillations and the other corresponds to cyclotron oscillations. The mechanism in both cases will be discussed. The frequencies for these instabilities for typical beams lie in the short wavelength microwave region.

The calculation is carried out by treating the beam as a warm fluid and linearizing the resulting equations. This leads to a dispersion relation from which complex frequencies (growth rates) are obtained.

Except for the case where the dielectric is a gas and the beam energy is very high, the beam cannot pass through the dielectric and the interaction must take place by passing the beam near the dielectric. This system will also be considered.

133. No abstract available.

PHYSIOLOGY

134. Vasospasm: in search of a model.

T. R. HILL, N. F. KASELL, and C. ELMER.

Cerebrovascular Laboratory, Division of Neurosurgery, University of Iowa. (Present address) American College Testing Program, P.O. Box 168; Iowa City, Iowa 52243

The effects of intrathecal injections of blood, saline in combination with thrombin, and blood in combination with thrombin on the basilar artery in dogs were studied in the attempt to develop an animal model for vasospasm. The degree of arterial narrowing was determined by the difference in the angiographic size of the basilar artery on day 0 (pre-subarachnoid hemorrhage [SAH]) and day 7 (post-SAH). Nine of the eleven dogs injected with 2 ml of thrombin (1,000 Units/ml) and 8 ml of blood developed vasospasm (the average arterial narrowing was $38.7\% \pm 2.11$). In the dogs subjected to intracisternal injections of 8 ml of blood (n=2) or 2 ml of thrombin plus 8 ml of saline (n=6), there was no angiographic evidence of arterial spasm. This experimental technique resulted in consistent changes in arterial diameter in dogs that have not been found in other acute animal models.

135. Vasospasm: in search of a model.

II. Platelets.

T. R. HILL^{*}, N. F. KASELL, C. ELMER, and M. DOMAYER.

Cerebrovascular Laboratory, Division of Neurosurgery, University of Iowa^{*} (Present address: American College Testing Program, P.O. Box 168, Iowa City, Iowa 52243).

The effects of intrathecal injections of ADP in combination with platelets on the basilar artery in dogs were studied in an attempt to expand the usefulness of the previously developed model of vasospasm. The degree of arterial narrowing was determined by the angiographic size of the basilar artery on day 0 (pre-subarachnoid hemorrhage [SAH]) and day 7 (post-SAH). Six dogs were subjected to intracisternal injections of 9 milliliters (ml) of platelets and 1 ml of ADP (20 mg/ml). This technique did not produce recognizable arterial spasm.

response was less ($P < 0.05$) in the T vs NT at the 50-ng dose ($T=11 \pm 1$, $NT=22 \pm 1$ mmHg). The results suggest that lower RBP following training in the SHR may be due in part to changes in the responsiveness of the RAS to AII. (Supported in part by NIH grant HL-29099-01 and funds from the Graduate College)

141. Development and evaluation of an isometric training program for facial muscles in a trumpet player's embouchure: a case study.

R. ENGLAND and C.M. TIPTON.

Department of Music and the Exercise Science Program, 302 FH, U. of Iowa, Iowa City, IA 52242.

The application of skeletal muscle training principles for musicians is seldom emphasized even though the strength of the facial muscles (orbicularis oris, levator anguli oris, and depressor anguli oris) will limit the "range" or the highest frequency achieved by the trumpet players. To determine whether a specific isometric exercise program would improve the range of an accomplished, but untrained, trumpet player, a 6-wk program was undertaken. Before and during the program, maximum voluntary contraction (MVC) of the facial muscles was determined by the highest pitch or frequency that could be produced by the player. Subsequently, a program consisting of 3 sets of 6 contractions was executed daily. The contractions were performed as 6-s tones performed at 60-70% MVC. At the end of the program it was found that a $1\frac{1}{2}$ -step increase in range had been achieved, corresponding to a 20% increase in MVC. This change was greater than expected. It is recommended that this approach be considered by other trumpet players and that research be conducted on its effectiveness with more subjects.

142. Neuromagnetic field sources associated with alpha-band EEG in man

D. KRIEGER, R. RABINOFF, D. ORME-JOHNSON, M. DILLBECK

Maharishi International University
MIU-EEG Lab
Fairfield, IA. 52556

A new analysis technique provided measurement in an unshielded laboratory of: (a) Magnetoencephalographic (MEG) fields time-locked to alpha band electric (EEG) fields detected in occipital, central, and frontal electrodes, (b) consistent time differences between MEG and EEG across subjects, (c) magnetic field source locations in the cingulate gyrus and elsewhere.

143. Adaptive and Functional Properties of Avfail.

R. W. POHL

Cooley/Baker, Chicago, Illinois 60601

Avfail is the failure of taste aversion conditioning to occur following specific conditioning procedures. Research indicating the functional properties of avfail will be discussed. In addition, future research possibilities and possible adaptive functions of avfail will be outlined.

144. World population growth as a second order, doubly autocatalytic reaction.

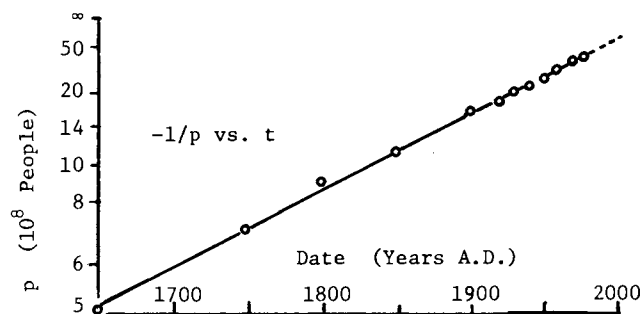
C. C. WUNDER

Department of Physiology and Biophysics, The University of Iowa, Iowa City, IA 52242

In contrast to most growing biological systems, doubling time for this population p has decreased with time t (years). This growth can be closely approximated (see Fig.) by the relationship

$$\Delta(p^{-1}) = -5.2 \pm 0.1 \times 10^{-12} \Delta t.$$

This might be rationalized by assuming \dot{p} is not only directly proportional to p (as with many growth processes) but also to some other variable (such as level of technology) which is itself also assumed directly proportional to p .



145. The ultrastructure of the labial glands of larvae from a carpenter ant.

C. L. SHARKEY and R. S. PETRALIA

Biology Department, St. Ambrose College
Davenport, Iowa 52803

The ultrastructure of the labial glands of the larvae of the carpenter ant (*Camponotus*) was investigated. The secretions of the glands are probably utilized for external digestion of food. Also larvae approaching pupation use labial gland secretions for silk production. Rough endoplasmic reticulum is well developed and indicative of active protein synthesis. The extensive basal infoldings facilitate transport between the labial gland and the hemolymph. The microvilli lining the lumen of the labial gland, and the intercellular junctional complexes (including septate

150. Transforming gene in x-ray transformed C3H/10T 1/2 mouse embryo cells.

S.W.C. Leuthauser, and D.L. Guernsey.

Dept. of Physiology & Biophysics, Univ. of Iowa
College of Medicine, Iowa City, IA 52242.

The molecular mechanisms of radiation induced carcinogenesis has not been well established. It is generally accepted that ionizing radiation interacts with cellular DNA causing genetic mutations and neoplastic transformation. It has previously been reported that DNA from mouse fibroblasts transformed by chemical carcinogens can induce foci of transformed cells when applied to monolayer cultures of normal mouse cells (DNA transfection). We have used transfection to confirm the presence of, and analyze the genetic information of malignant transformation induced by x-irradiation. Further, the DNA of x-ray transformed cells was treated with a variety of restriction endonucleases before testing their transforming activity by transfection. The data of endonuclease cleaved DNA transfection patterns from x-ray induced C3H/10T 1/2 cells is compared to the pattern of chemically transformed C3H/10T 1/2 cells. (Supported by the Milheim Foundation, NIH Research Grants #CA28848 and 5T32-CA09125 from NCI.)

151. Euphoria of the deep (EOD) in divers on compressed air; is the causal agent nitrogen or nitrogen in combination with another factor?

T. R. HILL

American College Testing Program, P.O. Box
168, Iowa City, Iowa 52243.

During the last 150 years, scientists have tried to determine the cause of euphoria of the deep (EOD). EOD has plagued divers on compressed air since the early attempts to salvage treasures. Since man has started to utilize the resources of the oceans, the ability to work longer hours and at greater depths has been the main impetus to try to find the cause of EOD. The major objectives of this paper are to determine if EOD in divers on compressed air is caused by an increase in the partial pressure of:

1. nitrogen in the air that the divers breath.
2. nitrogen in combination with another factor in the air that the divers breath.

152. Differential Effects of ACTH and Angiotensin II on Adrenal Fasciculata-Reticularis Steroid Function

M. H. SIMONIAN, M.L. WHITE and M.W. CAPP

University of Iowa, Department of Physiology and
Biophysics, Iowa City, IA 52242

The regulation of steroidogenesis by ACTH and angiotensin II (AII) was compared in monolayer cultures of normal bovine adrenocortical cells that were de-

rived from the zona fasciculata-reticularis. The endogenous production of $\Delta^4,3$ -ketosteroids was analyzed by reversed-phase high performance liquid chromatography and the steroids were quantitated by UV absorbance at 246 nm. After one day, ACTH maximally stimulated steroid production 3-fold over that of the control cultures and the 17α -hydroxylated steroids comprised 84% of the $\Delta^4,3$ -ketosteroids produced. Maximal stimulation by AII (2.5-fold) required three days of treatment with the production of 17α -hydroxylated steroids being only 30% of the total $\Delta^4,3$ -ketosteroids output. AII plus ACTH maximally stimulated steroid production after three days in a synergistic manner (9-fold). The 17α -hydroxylase steroids accounted for 65% of the $\Delta^4,3$ -ketosteroids produced. Direct assay of the 17α -hydroxylase activity in these cell cultures revealed that ACTH induced this enzyme activity 6-fold whereas AII had no significant effect either on the basal or ACTH-induced enzyme activity.

153. Nuclear envelope changes preceding cell differentiation detected by flow cytometry

A. YEN and S. REECE

College of Medicine, Department of Internal Medicine, University of Iowa, Iowa City, Iowa 52242

The human promyelocytic leukemia cell line, HL-60, proliferates in culture with a doubling time of approximately 24 h. When exposed to 10^{-6} M retinoic acid, the cells undergo myeloid differentiation accompanied by cessation of proliferation. The first phenotypically differentiated cells do not occur until 48 h., after two division cycles. Within the first 24 h., there is a change in the nuclear membrane structure. The change is transient. It occurs for cells in all cell cycle phases. The altered nuclear membrane structure thus precedes any overt cellular differentiation by approximately 24 h. and may be an early cell physiological response for effecting cell differentiation.

154. Effect of tolbutamide and disulfiram on canine liver cytosolic aldehyde dehydrogenase activity.

M. A. KILMORE and C. G. SANNY

Physiology/Pharmacology Discipline, University of Osteopathic Medicine and Health Sciences, 3200 Grand Avenue, Des Moines, Iowa 50312.

The intent of our experiments was to determine if a dose response curve could be established for inhibition of aldehyde dehydrogenase (ALDH) in canine liver by tolbutamide (TOL). Ten dogs were randomly selected to receive one daily oral dose of either 0 mg, 250 mg, 500 mg, 750 mg TOL or 500 mg disulfiram (DS) for one week after which a 2 gm liver sample was removed. After the surgery, no further medication was administered to the dogs for three weeks at which time a random selection of one of the remaining four treatments was instituted. A second 2 gm liver sample was removed after one week of treatment. The same time protocol was followed for the remaining three treatments so that every dog

159. Socio-biological analysis by survey of a phenotype in Des Moines

S.W. NEWELL

College of Education
Drake University
Des Moines, IA 50311

A survey of 145 randomly selected male individuals from the Drake area shows a statistical correlation between reporting stomach ailments and sex-role personality identification toward the feminine personality type. Chi-square was 43.1408 with a DF of 9.

160. Syntactic strategies used in unattended comprehension of speech.

D. UHL, P. CALVIN, & J. YATES

University of Northern Iowa, Cedar Falls IA 50614

Unattended sentences and prose can be comprehended. How? Possibly by using syntactic strategies rather than a full complement of syntactic rules. The SVO strategy, where the main words of a sentence are interpreted as subject, verb, and object, respectively, was investigated using a set of active normal sentences (e.g., The boy stepped on a bug) transformed to passive normal (e.g., A bug was stepped on by the boy) and to passive anomalous (e.g., The boy was stepped on by a bug) and played as the unattended channel in a shadowing task. Skin conductance (SC), which reflects comprehension of anomalous sentences, was measured. The three sets of sentences produced no differences in SC. The failure of passive normal and anomalous sentences to affect SC rules out the SVO strategy and full syntactic analysis, respectively. However, both results are consistent with a plausibility strategy, currently under investigation.

SCIENCE TEACHING

161. Teaching physics concepts K-12 in the B.H.S. Planetarium

D. A. SCHAEFER

Bettendorf High School
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Since 1973 more than 60,000 individuals, elementary, secondary and adult, have made use of the B.H.S. Planetarium. The facility has a Spitz 512 automated star projector, has a demonstration/rear screen projection area at the front and has 85 seats beneath a 33 foot diameter dome.

Programs/lessons have been produced that all match the science program K-12, and teachers at all levels may schedule classes on a voluntary basis. Teachers Guide Books describe all programs and have pre and post-visit recommendations for activities.

The Planetarium Director is a physics/advanced science teacher (with 2 periods for planetarium work), and he is assisted by a chemistry teacher (with one such period).

The emphasis, K-12, is on demonstration and learning of basic concepts; primarily those are the concepts of physics.

162. A set of microcomputer programs to record and check students' laboratory results.

R. T. WARD

Department of Physics, University of Northern Iowa,
Cedar Falls 50614

A set of programs has been developed for an Apple microcomputer which checks the results students obtain in an independent laboratory on weight and volume of mineral samples. This is part of an introduction to density in an activity-based general education course in science. The students are each assigned three samples to measure. The main program checks their name and ID number, the samples assigned, whether their results are sufficiently close to the standard values, and the number of measurements submitted for checking. A separate program available to the instructor produces reports on the students' achievement. The programs are designed to handle 30 different samples and 150 students. Other programs for use by the instructor set up and edit the files containing needed information. One portion can randomly assign 3 of the 30 samples to each student.

Use of the program allows students to do the measurements in an unsupervised "open" laboratory and to immediately check their results. It gives an accurate record of their achievement and allows easy production of reports. Some of the advantages

168. Determination of the influence that construct components had on the success of the fifth and sixth grade Berkeley Health Education Program.

GARY E. DOWNS

Iowa State University, N126 Quadrangle, Ames, Iowa 50011.

A study was done to determine the influence that construct components, of the fifth and sixth grade Berkeley Health Education Program, had on the success of the program. Three different questionnaires were developed. These were sent to parents of students in the program, classroom teachers who taught the program, and nurses and administrators in school districts that used the program. The data and results obtained from the collected questionnaires will be presented.

169. Snake traps and other herpetological techniques for the inexperienced.

D. J. PERSCHAU

Mereditth Junior High School 4827 Madison Avenue, Des Moines, Iowa 50310.

Snakes and other reptiles and amphibians cannot reliably be trapped or netted. They are difficult or impossible to bait, trap, or fool into succumbing to the casual collector. Fortunately, most amphibians and reptiles aren't as clever or as physically able to evade the prepared collector. Effective herpetological techniques include the use of roofing tin, limestone rocks, railroad ties, road signs, automobiles, flashlights, rubber bands, and pillow cases. The inexperienced can, with knowledge and preparation, enjoy successful herpetological collecting.

170. What type of high school student participates in a summer research program? A demographic study

T. R. HILL, G. O'BRIEN, and M. MOHAN

American College Testing Program, P.O. Box 168, Iowa City, Iowa 52243

The purposes of this paper are to describe the demographic characteristics of the students who participated in the 1982 Secondary Student Training Program and summarize the benefits they derived from this research program. The major objectives of this study are to:

1. describe the students' previous science background and educational environment.
2. evaluate the success of the program in matching the students' original expectations in Career Awareness, Research and Communication Skills and Social Interaction.
3. measure the change that occurred in the participants Research and Communication Skills over the course of the program.

171. Designing science courses for adults: an important group of learners usually overlooked by science educators.

T. R. HILL

American College Testing Program, P. O. Box 168, Iowa City, Iowa 52243.

It has been estimated that each year there are 1.3 million adults in this country requiring retraining so that they are able to move from one major occupational area to another. The purposes of this paper are to discuss the reasons why science educators should design science courses for these adults. The major objectives of this paper are to:

1. define the adult learner.
2. discuss why adults need to develop lifelong learning skills in science.
3. discuss the reasons why adult learners should be able to obtain scientific information that is appropriate for their needs in the future.

172. Design and construction of a new exhibit gallery of Iowa's natural heritage.

No abstract available.

ZOOLOGY

173. The food-web in Carver's Bad Caverns

W. H. Gilbert III

Department of Biology, Simpson College
Indianola, Iowa 50125

Common cockroaches (*Blatta orientalis*) are occasionally observed in the lower levels of Carver Science Hall, despite excellent custodial maintenance. The only apparent sources of food are pellets of mouse chow placed on slotted cage-covers in the animal room (basement level). Experimental observations indicated that (1) cockroaches can not gain access to this food, but (2) feral mice (*Mus musculus*) were using it. Live trapping revealed the considerable size of this previously undetected, feral population. Other experiments showed that cockroaches fed on dried mouse droppings only if water was available. The 'water hole' was located and eliminated, despite concern for carnivores that preyed on the feral mice; e.g. a pair of great-horned owls resident on campus for the past several years...and adopted mascots of the college !

179. Cross-transmission and *in vitro* excystation experiments with Sarcocystis muris.

D. B. WOODMANSEE

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

Sarcocystis muris would not infect meadow voles (Microtus pennsylvanicus) or gerbils (Meriones unguiculatus). S. muris also would not infect dexamethasone treated voles or gerbils. Control mice (Mus musculus) treated and inoculated in the same manner did become infected. *In vitro* excystation rates in the presence of mouse bile were significantly higher than rates in the presence of vole or gerbil bile through four two-fold serial dilutions of bile. These data indicate that S. muris is strictly host specific for mice, that dexamethasone-sensitive immune responses play little or no role in this specificity and that low excystation rates in the foreign hosts may contribute to the host specificity of S. muris.

180. Prevalence of coccidia in Kentucky turtles

R. S. WACHA, B. M. CHRISTENSEN, E. C. POWELL

Biology Dept., Drake University, Des Moines, IA. 50311; Veterinary Science Dept., University of Wisconsin, Madison, WI. 53706; Zoology Dept., Iowa State University, Ames, IA. 50011

An examination of the intestinal contents of 80 turtles, comprising 5 species from Western Kentucky, revealed the presence of 22 taxa of coccidia. Of these taxa, 18 were members of the genus Eimeria, 2 of Isospora, 1 of Sarcocystis, and 1 of Pfeifferinella. The overall infection rate for these parasites in the entire population of turtles sampled (n=80) was 55%. Infection rates per individual host species and the number of taxa harbored by each were as follows (n=number of hosts examined): Pseudemys scripta (n=26) 96%, 12 taxa; Sternotherus odoratus (n=23) 22%, 9 taxa; Terrepene carolina (n=13) 38%, 7 taxa; Chrysemys picta (n=11) 64%, 6 taxa; Chelydra serpentina (n=7) 29%, 4 taxa. Some taxa were shared by more than one host species. Tissues from laboratory mice, meadow voles, and domestic ducklings that were experimentally inoculated with the Sarcocystis species were negative for coccidia. (Funded in part by CIFR grant No. 757 from Murray State University, KY.)

181. The Inhibitory effects of twenty-five fungicides on four species of aquatic fungi (saprolegniales) pathogenic to fish.

T. A. Bailey

National Fishery Research Laboratory, P. O. Box 818, LaCrosse, Wisconsin 54601 and Dept. of Zoology, ISU, Ames, Iowa.

Salmonids, ictalurids, and other cultured fish are susceptible to fungal infection. This study was performed to identify potential fungicidal agents. Four species of aquatic fungi (Achlya flagellata,

A. racemosa, Saprolegnia hypogyna, and S. megasperma) were exposed to 25 chemicals representing seven classes for 15 or 60 minutes. The antifungal activity of each test chemical was compared to a reference compound, malachite green. The following six compounds, ranked in order of decreasing antifungal activity, inhibited fungal growth on artificial media at concentrations less than 100 mg/L: Malachite green > Du-ter > Copper oxychloride sulfate > Lesan > BAS-389-01F > Cuprimyxin > Roccal II. Data obtained from this study indicate that the cationic class of compounds shows some promise as aquatic fungicides. In addition, the amines and amide compounds should receive further attention to determine their effectiveness against aquatic fungi.

182. Morphological characterization of the sperm of Microtus pennsylvanicus, the meadow vole

L. A. DAVIS, A. L. GREENE, R. G. LEGG

Biology Department, St. Ambrose College, Davenport, Iowa 52803

Morphology of the sperm of Microtus pennsylvanicus was studied using light microscopy. In comparison to M. ochrogaster, the sperm of M. pennsylvanicus exhibits a longer midpiece and tail but a shorter and narrower head. M. pennsylvanicus also possesses an acrosomal hook which is not present in M. ochrogaster. Such differences in morphology may serve to act as a reproductive isolating mechanism between these related sympatric species.

183. Temporal separation of sympatric hognose snake species (Heterodon) in Iowa.

J. L. CHRISTIANSEN

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

Eastern hognose snakes (Heterodon platyrhinos) and western hognose snakes (H. nasicus) occur in abundance at Big Sand Mound, Muscatine and Louisa Counties, Iowa. Observations through seven years of study show the two species to occupy overlapping habitats, with the former species found more frequently at woodland edge and the latter in open sand dunes. Diets are similar, hence competition between the species would be expected. Peak above ground activity of the eastern hognose is in late April and May and the western hognose in June and July. Hatchlings of both species reappear in early September and are active above ground on warm days until late October. Blue racers (Coluber constrictor) were studied for comparative purposes. They occur in both habitats but have less specialized diets and are active from late April through July with a second period of activity in September and October. This study was conducted on a preserve created and maintained on Big Sand Mound by Iowa-Illinois Gas and Electric Company.

Pedigree Style in Teaching Genetics¹

WILMER J. MILLER

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

A single pedigree style, the arrow or network method, is presented that is generally superior to, or as useful as, the other commonly used methods in teaching genetics. It is adaptable to all uses of pedigrees and necessary in some. Clarity of inbred relationships, generation overlap, and lack of the need for right angle turns are the major advantages.

INDEX DESCRIPTORS: Pedigree style, teaching genetics.

Several types of pedigrees are used in animal and plant breeding, genetics problems, and genealogy. The well known line bifurcation style (Fig. 1) of animal science is not adaptable to many genetic problems. Further, it is inefficient in that inbred lines may have the same individual's name written down several places. In Fig. 1 "Favorite" is written 5 times in the ancestry of Lancaster, although this is not immediately obvious, nor is the fact that "Favorite" was mated back to his own mother to produce "Y. Phoenix." Presentation of this same data in the network or arrow style (Fig. 2) makes the multiple use of "Favorite" obvious even though his name is written only once. Further, the sex is readily distinguished by using dashed lines for the female contribution or line of descent. Alternatively, the sex symbols ♂ and ♀ may be used.

Such a network pedigree not only clarifies the breeding system but corrects the first impression one gets regarding the number of grandparents and the number of generations. In Fig. 3a there seem to be 3 ancestral generations, and there seem to be 7 great grandparents instead of the expected 8 (1 repeated). But "SPEEDY" actually has 5 ancestral generations indicated, and only 2 great grandparents (Fig. 3b).

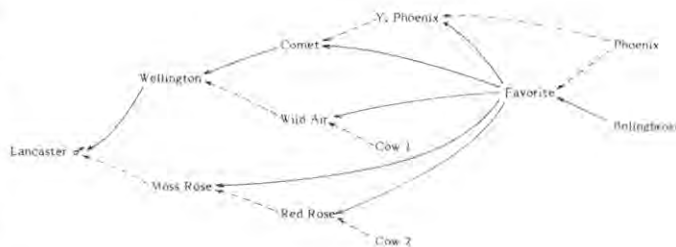


Fig. 2. Network or arrow style. Partial pedigree of the origin of the Shorthorn breed of cattle (after Wriedt 1930).

The traditional square and circle of human pedigrees have only limited uses genetically and are awkward in handling more than 2 marriages (not illustrated). The classical genetic style (Fig. 4) employs the P₁, F₁, and F₂ symbols in Mendelian problems. Since it is used vertically, the most interesting results appear at the bottom of



Fig. 1. Bifurcation Style. Partial pedigree of the origin of the shorthorn breed of cattle (after Wriedt 1930).

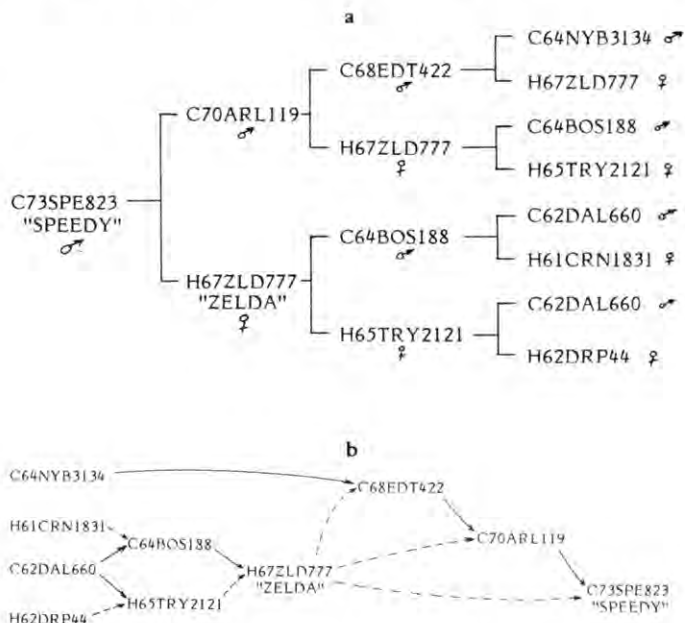


Fig. 3. A racing pigeon pedigree: a) conventional, b) arrow pedigree, no repetitions.

¹Journal Paper No. 29 College of Agriculture, Iowa State University, Ames, Iowa.

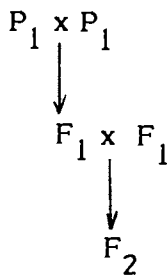


Fig. 4. Classical genetic style.

the blackboard where they are hard for students to see. Further, it requires frequent awkward separation or extension to one side.

The network pedigree style (Hollander 1944, 1971, 1972, 1980) surprised me in being generally adaptable and appropriate to all kinds of uses. It goes sideways on the blackboard very well. Left to right, as one normally reads, is convenient, but any direction is easily interpreted. Many lines of genetic contribution may come from one individual in an efficient use of space. These lines can fan out by arrows indicating direction of genetic contribution, to point to all progeny, in any generation level, wherever they occur, by whatever parents. It is ready made for the calculations of coefficients of inbreeding and relationship. These require the line diagram style back to ancestors common to both parents. Essentially it is that style (see Lush 1945) slightly modified to fit the P₁-F₁-F₂ or backcross needs of the Mendelian problems. Gene symbols, phenotype names, or both may be placed most conveniently as needed.

Figure 5 illustrates this new application of an old style (as used by Lush 1945) to a classical Mendelian dihybrid problem for comb shape in chickens. The phenotypes alone may be entered originally. Then, as desired, gametes may be inserted or omitted between generations. Either the full genotypes or shorthand designations (as

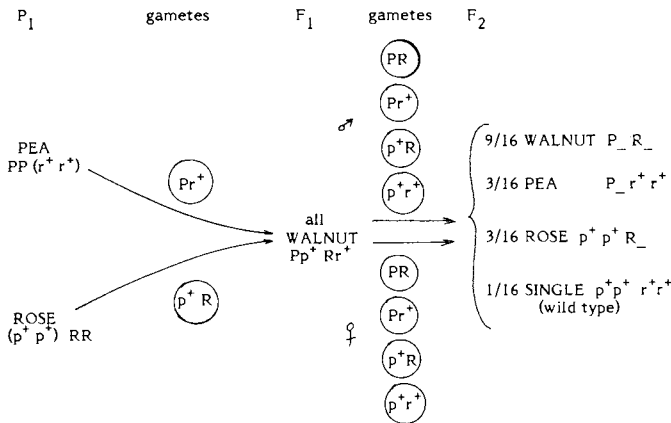


Fig. 5. Arrow pedigree for the classical problem of comb shape in chickens.

PEDIGREE STYLE

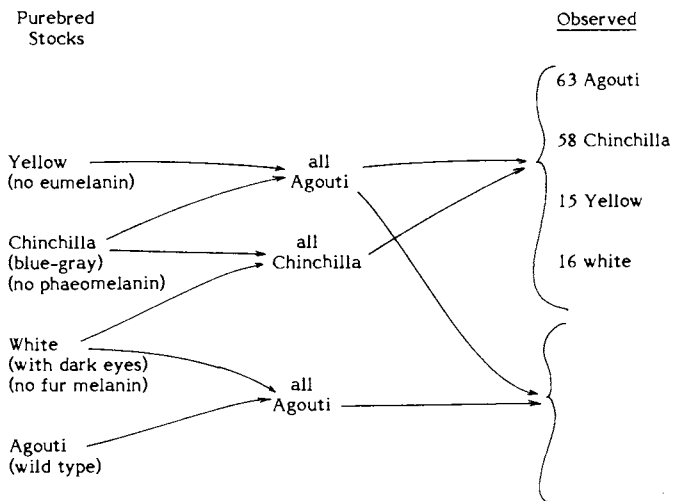


Fig. 6. Some coat color inheritance in rabbits. Agouti is the wild-type. Fill in the missing genotypes, phenotypes and frequencies.

in Fig. 5) may be used. The 2 arrows extending from the F₁ may imply selfing (in plants) or it may imply that like was mated to like of opposite sex, thus conserving space and avoiding clutter. There is no "x" indicating a cross to get mixed up with the X chromosome or a gene symbol. The bracket indicates 2 or more individuals or kinds of progeny; that is, all offspring are full sibs.

Mixtures of types of matings can easily be diagrammed in the arrow style. That is, P₁, F₁, F₂, testcrosses or other crosses in the same overall problem can be used to ask students to integrate what they have learned. For example, coat color in rabbits, as illustrated in Fig. 6, makes an interesting problem with a testcross for one gene pair and an F₂ for the other in the top family. The analytical abilities of the student are tested for mutants held in common, gene action, number of gene pairs, and for dominance versus recessiveness. When actual numbers testable by X² are inserted, this problem is two steps closer to a real breeding data situation than the formal F₂.

It took several years of teaching with alternative usages to become convinced of the superiority of this arrow or network style. I hope you will try it before your habit patterns in genetic usages harden.

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