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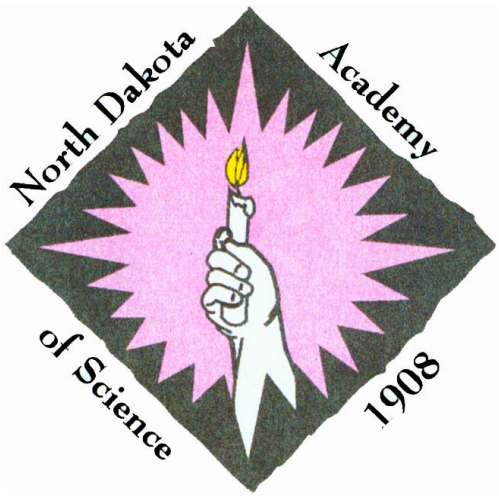

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2013-2014

OFFICERS AND MEMBERS OF THE EXECUTIVE COMMITTEE

EDITOR

106th Annual Meeting

April 24, 2014

Valley City, North Dakota

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HISTORY

The *Proceedings of the North Dakota Academy of Science* (NDAS) was first published in 1948, with Volume I reporting the business and scientific papers presented for the 40th annual meeting, May 2-3, 1947. Through Volume XXI**,** the single yearly issue of the *Proceedings* included both abstracts and full papers. Commencing with Volume XXII, the *Proceedings* was published in two parts: A, published prior to the annual meeting, contained an abstract of each paper to be presented at the meeting, and B, published later, contained full papers by some of the presenters.

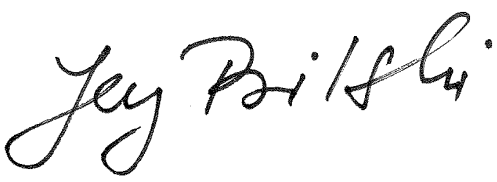
In 1979 (Vol. 33) the *Proceedings* changed to an 8½ x 11-inch format. Produced from camera-ready copy submitted by authors, it was distributed at the annual meeting. As desktop computing became more prevalent vol. 51-vol. 64 of the *Proceedings* were assembled with desktop publishing software from submitted computer disks. The current volume was assembled from electronic submission of abstracts via email and the *Proceedings* archived online as pdfs.

VOLUME 67 ORGANIZATION

In 2003 the NDAS council voted to accept all abstracts scheduled for presentation at the Annual Meeting. Thus, communications in volumes 58 to present haven't undergone a "typical" peer review. Rather, they provide an accurate reflection of the material presented before the NDAS membership at the Annual Meeting. The presentations in this year's *Proceedings* are presented in three major sections. The first contains the undergraduate communications presented as part of the A. Rodger Denison Student Research Competition. The second section comprises the graduate Denison Competition papers, and the final section comprises professional communications presented by faculty members of the Academy. Readers may locate communications by looking within the major sections of these *Proceedings (see table of contents)* or by referring to the author index on page 62.

IN APPRECIATION

The Academy wishes to acknowledge current and emeritus members of the Academy who continue to support the mission of the North Dakota Academy of Science Research Foundation through their special gifts. A listing of these supporters accompanies the Financial Report. The Academy also wishes to express its thanks to the presenters of papers at the Annual meeting, the session chairs, as well as all who have helped in organizing spaces and places, soliciting manuscripts, and compiling of this year's communications.



Jerzy Bilski, President Paul Lepp, Secretary-Treasurer

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9:20 AM	9:40 AM	Effertz	Severson
9:40 AM	10:00 AM	***BREAK***	
10:00 AM	10:20 AM	Dodson	Hecker
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10:40 AM	11:00 AM	McCollor	Keller
11:00 AM	11:20 AM	***BREAK***	
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11:40 AM	12:00 PM	Mahdi	Shurtliff
12:00 PM	1:00 PM	***LUNCH***	
1:00 PM	1:20 PM	Doll	Haggarth
1:20 PM	1:40 PM	Wilson	Kurada
1:40 PM	2:00 PM	***BREAK***	
2:00 PM	2:20 PM	Hernandez	Burgard
2:20 PM	2:40 PM	Illies	Mueller
2:40 PM	3:00 PM	***BREAK***	
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3:20 PM	3:40 PM	Ghosparkur	Lee

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(all faculty members are encouraged to participate)

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UNDERGRADUATE COMMUNICATIONS

IN THE

← A. ROGER DENISON COMPETITION

(communications are listed alphabetically by the last name of the presenting author)

PRELIMINARY ANALYSIS OF THE CONTINENTAL MOLLUSCAN FAUNULE FROM DEVILS POCKET, KOOTENAI FORMATION, CENTRAL MONTANA

Janelle Beske*[1], Joseph H. Hartman, David W. Krause[2], and Donald L. Rasmussen[3]

[1] Harold Hamm School of Geology and Geological Engineering, University of North Dakota, Grand Forks, ND 58202; [2] Paradoxdata, Longmont, CO 80501; [3] State University of New York at Stony Brook, Department of Anatomical Sciences, Stony Brook, NY 11494

PREMISE. A rich deposit of continental mollusks occurs in exposures of Kootenai Formation in Devils Pocket of Middle Dome in the Shawmut Anticline, 15 km southeast of Harlowton, Wheatland County, Montana. The site (L0888) has been well collected over the years, with many institutions having examples. However, the relative abundance of has never been reported beyond descriptive terms. The results here are from bulk and surface samples collected in the 1980s and examined as part of a UND Advanced Paleontology course project.

STUDY HISTORY. In 1903, Stanton reported six new species of freshwater mollusks from fluvial deposits of the Kootenai Formation that were "certainly not older than the Lower Cretaceous" (1). About 50 years later, Yen expanded on Stanton's work from additional identifications (totaling 14), with two new species described from "near Harlowton." The Kootenai molluscan fauna was interpreted to be equivalent in age to localities in the Cloverly Formation (Sage Dome, L3058; Jackson Hole, Wyoming; L0799, L3565) and Peterson Limestone (Cokeville, Wyoming; L3375). Krause and Hartman studies in the 1980s included examination of the site for mammals and mollusks, as well as making it a stop on a Montana Geological Society field trip (3).

METHOD OF STUDY. With the assistance of Hartman's Advanced Paleontology class, eight fossil collections were divided among the students. Using a hand lens, photographs, and descriptions of Stanton and Yen's identifications, the morphotypes were separated, labeled, and counted.

BASIC DATA–CONTINENTAL MOLLUSCA IDENTIFIED. 3078 specimens were identified from the surface picked and bulk samples available to the students. Questioned identification (based on poor preservation) were not included in Table 1. The count's similarity to Yen's relative abundance descriptors [in brackets] is noteworthy.

Table 1. Identified Kootenai Formation continental molluscan faunule*

Protelliptio douglassi –47 (1.5%) [common] ; *Unio* farri –1 (0.00%) [rare];
Eupera onestae –7 (0.02%) [common]; *Sphaerium* sp. –2 (0.00%) [new];
Campeloma harlowtonense –9 (0.02%) [rare];
Reesidella montanaensis –2052 (66.7%) [abundant]; Opercula –233 (7.6%) [not reported];
Mesocochliopa cretacea –3 (not reported);
Circamelania ortmanni –687 (22.3%) [abundant];
Carinulorbis sp. undet. –37 (1.2%) [rare];
* –47 (1.5%) [common] = number of specimens (relative percentage of faunule), Yen 1951 description.

INTERPRETATION. The assemblage of continental mollusks from the Aptian Kootenai Formation at Devils Pocket is wide-ranging 1) in morphological disparity; 2) in size, from extremely small to (almost) as large as snails get; and 4) relative species abundance. A large number of Bithyniidae (*Reesidella montanaensis*) and possible Pleuroceridae (*Circamelania ortmanni*) are reported, representing almost 97% of the specimens identified. We suggest that the fauna represents rapid burial with many, if not most, individuals transported and buried from a living community. The continental mollusk collection at UND is taxonomically diverse and comparable to the assemblage reported by Stanton and Yen, but certain taxa are missing. We suggest smaller elements of the assemblage (e.g., rare pulmonates) were inadvertently saved in the fine fraction to pick for fossil mammal teeth. Athough preservation snails can be quite good, some species can find their way to the small fraction because of breakage during bulk excavation and screening. The diversity reported here may be augmented by new work on the mammal matrix.

ACKNOWLEDGMENTS. We wish to thank the students Benjamin Engleman, Connor Lindenberg, Don McCollor, Kyle Shurtliff, Matt Illies, and Richard Kaczor and Robert Grams; and Crazy Mountains field crews of Hartman and Krause involved in the collection of these fossils and bulk samples. Hartman field work was supported by the Philip M. McKenna Foundation.

1) Stanton, TW (1903) American Philosophical Society Proceedings, v. 42, p. 188–199.

2) Yen, T-C (1951) U.S. Geological Survey Professional Paper 233a. 20 p.

3) Hartman, JH and Krause, DW (1993) Montana Geological Society Guidebook, p. 71–84.

A NOVEL *IN* SITU METHOD OF CATHETER-ASSOCIATED BIOFILM FORMATION

Tanner Barnharst and Nathan Fisher
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Central line-associated bloodstream infection (CLABSI) is a major cause of morbidity and mortality in a range of healthcare settings, reaching as high as 35% attributable mortality and extending hospital stays by an average of 24 days. The first step of CLABSI involves colonization of an implanted venous catheter by one of wide variety of commensal or environmental bacteria and fungi. These microorganisms adapt to stressful environments by attaching to abiotic surfaces and forming a biofilm—a highly structured community of sessile cells embedded within a matrix of extracellular polymeric substance—and biofilm formation plays a critical role in colonization of catheters. Most CLABSI isolates readily form biofilms on a variety of abiotic surfaces, including polystyrene microtiter plates, which are used as a popular *in vitro* surface for the study of biofilm formation. However, our preliminary data indicates that at least some CLABSI isolates may use different mechanisms for colonization of abiotic surfaces *in vitro* and *in situ*. This could have profound implications when attempting to translate *in vitro* findings to clinical situations. We hypothesize that host immune pressure plays a significant role in shaping catheter-associated biofilms and have thus developed a novel *in situ* model that leverages the robust innate immune system of insects while retaining desirable throughput characteristics not possible with mammalian models. Venous catheters are inoculated with CLABSI-associated microorganisms prior to being implanted subcutaneously into the abdomen of *Blaptica dubia* cockroaches. At this anatomic location, the catheter rests directly beneath the insect epithelium and is bathed in hemolymph, a blood-like fluid that exposes any microorganisms present to both cellular and humoral components of the innate immune system. Here, we will present qualitative and quantitative analyses of biofilm formation by a variety of CLABSI-associated microorganisms in this *in situ* model and a typical *in vitro* system.

RECOVERY OF A RESTORED NATIVE CUTTHROAT TROUT POPULATION AFTER WATERSHED RENOVATION

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The Turner organization, in collaboration with state and federal partners, has implemented an initiative to restore native cutthroat trout (*Oncorhynchus clarki* spp.) to hundreds of km of stream on private and neighboring public lands in MT and NM. Of interest to practitioners and the angling public are how restored native populations compare to the pre-treatment non-native trout community and how quickly the recovery occurs. We examined the recovery of Rio Grande cutthroat in Costilla Creek, NM, following two separate rotenone treatments (2002 and 2008) and different restocking strategies. Only young-of-year fish were stocked following the 2002 rotenone treatment, while mixed aged fish were used after the 2008 treatment. Population data were collected over the period 2001-2013 with multi-pass electrofishing at four monitoring sites. Results show the restored population was comparable in density, and biomass to pre-treatment numbers within three years post-treatment using either stocking strategy. Furthermore, both post-treatment populations derived higher relative weights than the pre-treatment population. However, the biomass of the population derived from mixed age class stocking were slightly lower than the population derived from young-of-year fish. These results indicate that recovery of restored cutthroat trout populations can occur relatively quickly under multiple stocking scenarios and will compare favorably to the pre-treatment population.

MEASUREMENTS OF LIGHT POLLUTION IN THE SOUTH UNIT OF THEODORE ROOSEVELT NATIONAL PARK

Michelle Decker* and Corrine Brevik
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The explosion of oil drilling in the Bakken formation of western North Dakota has begun to significantly alter the amount of light pollution affecting North Dakota's dark skies. Many of the well sites choose to flare the natural gas which rises to the surface during extraction. This produces a significant amount of light pollution that can be observed for miles. In addition, rapid population growth has led to a marked increase in city lighting and vehicular traffic. The increase in light pollution has decreased the quality of the dark skies in western North Dakota and reduced the quality of astronomical viewing.

Theodore Roosevelt National Park near Medora, ND, is particularly concerned with the increase in light pollution due to nearby oil activity. The park has been long revered for its dark skies. Astronomy festivals are held there because of the pristine dark skies which make it easier to observe celestial objects.

In order to determine if the nearby increased light pollution is affecting the night skies in Theodore Roosevelt National Park, a Unihedron Sky Quality Meter was used to measure the Naked Eye Limiting Magnitude of the skies in the south unit of the park as well as areas immediately north of the park where oil activity is occurring. In addition, the skies in a rural region of North Dakota away from the oil activity were measured to provide a dark-sky baseline. At each location, darkness readings were taken at thirty individual sites and readings were repeated over multiple nights. The results were averaged and examined to determine whether the south unit of Theodore Roosevelt National Park exhibits significant light pollution compared to the dark rural skies away from oil activity.

IN SEARCH OF THE RUSTY CRAYFISH (*ORCONECTES RUSTICUS*) IN NORTH DAKOTA

Thomas A. Dodson*, Louis M. Wieland, Andre W. DeLorme

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The Valley City State University (VCSU) macroinvertebrate Lab and the North Dakota Game and Fish (NDG&F) Regional Fisheries personnel undertook a survey of crayfish in North Dakota to determine if the rusty crayfish (*Orconectes rusticus*) is present in North Dakota waters. The rusty crayfish is an invasive species and could have a dramatic impact on local aquatic environments. The NDG&F used fixed nets to collect crayfish while VCSU used seine nets and crayfish traps. Identification of crayfish was completed by the VCSU macroinvertebrate Lab. The identification process was problematic because the primary key for identification focuses on mature "first-form" males and the structure of their gonopods. The majority of our specimens were not first form males. We used general morphological characteristic to determine the species level on many immature and female crayfish. The NDG&F collected 419 crayfish from 228 lakes sampled from around the state. Not all lakes contained crayfish. Out of the 419 crayfish, 412 were identified as virile crayfish (O*rconectes virlis*), 3 were identified as calico crayfish (*Orconectes immunis),* and 4 were not identifiable. The VCSU macroinvertebrate lab sampled 58 sites, mostly in the eastern portion of the state, collecting 141 crayfish from 32 of these sites. In these samples were 130 virile crayfish, 8 calico crayfish, and 3 not identifiable. No rusty crayfish were found in our sampling of North Dakota. If present, rusty crayfish are limited in number and distribution.

ZOOPLANKTON, STOCKING DENSITY, AND WALEYE SURVIVAL IN PONDS AT BALDHILL NATIONAL FISH HATCHERY

Amy Doll*, Casey Williams, Kurt Eversman, David Demuth

Department of Science, Valley City State University, Valley City, ND 58072; US Fish and Wildlife Service Valley City National Fish Hatchery, Valley City, ND 58072; Great Plains STEM Education and Research Center, Valley City State University, Valley City, ND 58072

Success or failure of hatchery fish (fry) production is determined by both quantity and quality of fish produced. While hatchery managers can increase initial stocking rates to maximize the potential for improving the number of fish produced, both overall quantity and quality of fish produced are directly related to available food resources. Specifically, adequate food supply during the initial feeding and early larval stages represents a critical component of young-of-year fish survival. This study examined juvenile walleye survivorship at three stocking densities and the corresponding temporal patterns in zooplankton populations.

Walleye were stocked into six ponds at Baldhill National Fish Hatchery during June, 2013. In two of the ponds, walleye were stocked at 200,000 fish per surface acre (fpsa), 250,000 fpsa, or 300,000 fpsa. Ponds were drained, fish were removed, and % survivorship of stocked fish was calculated approximately 3 weeks after stocking. Zooplankton samples were collected from the outflow kettle throughout the growth period of stocked fish. Zooplankton were sampled by conducting three, 4 meter plankton tows (10 s per tow) and were preserved in ethanol after collection. In the lab, samples were divided into manageable sample sizes using a Folsom Plankton splitter. A dissecting microscope and a Ward Counting Wheel were used to identify and enumerate the zooplankton. Five different types of zooplankton were counted: Rotifer, Cyclopoid, Calanoid, Nauplii and Cladocera.

Walleye percent survivorship (mean = 47.5, SD = 0.7) was significantly higher when stocked at 200,000 fish per surface acre ($p < 0.03$) than at 250,000 or 300,000 fish per surface acre. However, based on similar temporal patterns among ponds, zooplankton production did not limit walleye fry survivorship. Thus, results suggest maximum survivorship and production may be best achieved when walleye are stocked at 200,000 fish per surface acre at Baldhill National Fish Hatchery.

ENVIRONMENTAL TOXICOLOGY AND COAL FLY ASH CHEMICAL COMPOSITION.

Garrett Hecker* and Jerzy Bilski,
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It is widely known that FA particles emitted from coal-fired plants contain several toxic trace metals (Alva et al. 2000). On the other hand, due to the availability of large quantity of FA and the presence of high concentrations of Ca and Mg in most FA sources, FA appears to be a suitable soil amendment for liming purposes and to enhance Ca and Mg contents in the soil (Rai 1987, Pathan et al 2003). FA utilization as a soil amendment indicates the necessity to take precautions against the excessive accumulation of heavy metals by plants grown on a media with coal FA.

The diversity of chemical properties among FA suggests that every use of FA as a soil amendment should follow its detailed chemical analysis because it has been established that leachate from places with high concentration of FA may affect water supply. Pollutants associated with FA include several elements (Al, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, V) whose excessive presence in the environment may become toxic (Bilski et al. 1995, Alva et al. 2000, Kabata-Pendias & Pendias 2001, Ugurlu 2004, Li & Chen 2006).

In this study we performed chemical analysis of coal FA and determined the concentration of mentioned above potentially trace elements using inductively coupled plasma spectrometry (ICP). Then we compared the concentrations of these elements to the levels present in the soil, and diverse water sources. Based on these comparison, we speculated about the environmental safety of coal FA as a material to be utilized as plant growth media.

Our work should contribute to the phytoremediation of coal FA deposits and prevent water and air erosion of FA

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Supported by North Dakota INBRE Grant Number P20 RR016741 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH).

USING MUSSEL POPULATION DATA AS AN INDICATOR OF STRESSORS IN THE SHEYENNE RIVER

Josue N. Hernandez*, Louis M. Wieland, and Andre W. DeLorme

Department of Science, Valley City State University, Valley City, ND 58072

In 2012 water began flowing from the east end outlet of Devils Lake into the Sheyenne River. This water has high specific conductivity due to high levels of ions such as sulfate and chloride. Little is known about the impact these contaminants may have on river biota. The Valley City State University Macroinvertebrate Lab conducted research on mussel populations in the summer of 2012, prior to the opening of the outlet; and the summer of 2013 to document any impact the new outlet may have on mussel populations. A combination of quantitative and qualitative sampling was completed at six sites along the Sheyenne River. In 2012 and 2013 the quantitative sampling used a systematic sampling protocol incorporating three random starts and generated more than 200 quadrates per site. Water quality records show sulfate levels reaching 800 mg/I for six to seven months in the fall of 2012 and winter-spring of 2013. Data shows a decline in population of over 60% at four of the five quantitative sites. At these sites, all species showed a decline of some degree. The wabash pigtoe (*Fusconaia flava*) appeared to have a size related mortality where both small and large size classes disappeared. However, other species such as the threeridge (*Amblema plicata*) did not show this. Because of the large increase in sulfates and other contaminants into the Sheyenne, further monitoring efforts should be conducted in order to determine potential effects of Devils Lake discharges on mussel populations and other biota of the Sheyenne River.

TOXICOLOGICAL ANALYSIS OF COAL FLY ASH (FA) USED AS PLANT GROWTH MEDIA. TRACE ELEMENTS FROM GROUP IV: TITANIUM (Ti) AND ZIRCONIUM (Zr), FROM GROUP V: VANADIUM (V), AND FROM GROUP VI: CHROMIUM (Cr) AND MOLYBDENUM (Mo).

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Major coal combustion residue, coal fly ash (FA) carries the potential for environmental contamination during the disposal of these coal combustion by-products (Bilski et al. 1995). Because FA contains multiple toxic elements, predominantly heavy metals, the disposal of FA may lead to leaching out of these elements and contaminate soils as well as surface water and groundwater. This contamination, combined with wind erosion of FA, could lead to the health, environmental, and land-use problems (Kramer 2007, Sajwan et al. 2006)

On the other hand, FA shows a potential to become a growth media for plants.The specific aim of this study was to analyze the environmental safety of agricultural utilization of FA. The concentrations of selected elements in FA belonging to Group 4 (Ti and Zr), Group 5 (V) and group 6 (Cr and Mo) has been analyzed and discussed (Bilski et al, 20013).

The concentration of mentioned above elements in growth media and digested young plants was determined. Chemical analysis was performed using inductively coupled plasma (ICP) emission spectrophotometry (Bilski and Alva, 1995). The data were analyzed statistically using ANOVA and Statistical Analysis System (SAS, 2010).

We did the comparison of mentioned above elements concentration in coal ash to the concentration values spotted naturally in the environment. The long-term goal of our research is to contribute to the conversion of coal ash piles into green, productive and environmentally safe areas.

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SAS, 2005, Statistical Analysis System.

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ALL THAT IS GOLD DOES NOT GLITTER? HERBARIUM SAMPLES AND DNA PHYLOGENY

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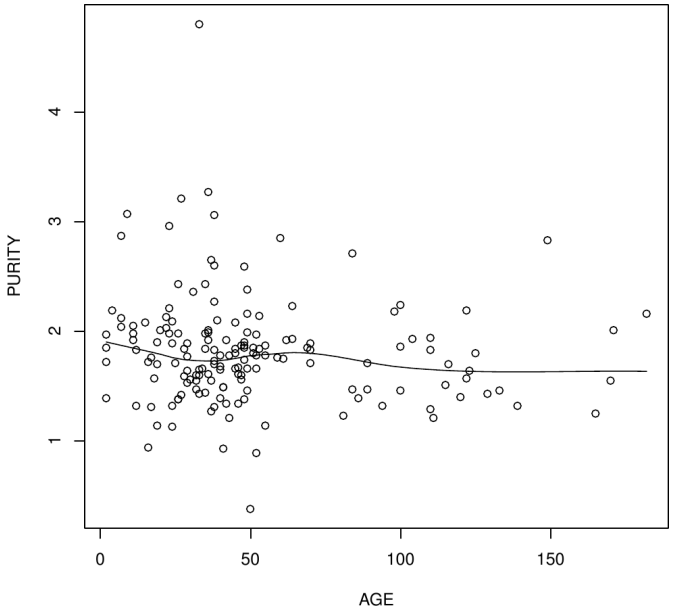
Plantains (*Plantago* L.) are widely distributed herbs and shrubs from the asterid family Plantaginaeae. There are more than 200 species of *Plantago* (Rahn, 1996). Plantains exhibit the transition from the insect-pollinated to wind-pollinated flowers (Preston et al., 2011) and unusually fast evolution (Ronsted et al., 2002; Cho et al., 2004): for 5.5 million years, this group produce hundreds of species and colonized of all continents including Antarctic. Unfortunately, the most detailed phylogeny of genus includes only 23 species (Hoggard et al., 2003). We decided to sequence as many species of genus as possible. Since the fresh material is often unavailable, we use herbarium samples from U.S. and international herbarium collections. With the collaboration of International Barcode of Life Project (iBoL), we checked several phylogenetic markers (*coi*5, *rbc*L, *trnl*F, ITS) and found that nuclear ITS2 pseudogene allows to make trees with the best resolution on the species level. ITS2 has the relatively short length (~ 330 bp) and therefore is suitable for amplification from the partially degraded DNA extracted from herbarium samples. Using two different protocols, we extracted DNA from more than 200 herbarium samples, and have now the comprehensive dataset which elucidates relations between age and weight of tissue sample, and concentration and quality of extracted DNA. One of our plots (dependence between the age of sample and DNA purity) is given below:



One can see that the estimated (LOESS method) curve does not constitute any real dependence, the slope is almost zero. In all, the "old DNA" may be as good as DNA extracted from freshly collected samples, even XIX century herbarium collections will work for our purposes.

Supported by Department of Biology of Minot State University. We are grateful to many people, including herbarium curators of different U. S. and Russia herbarium collections.

LATE TRIASSIC NORTH AMERICAN CONTINENTAL MOLLUSKS – THOUGHTS ON DISTINCTIVE ASSEMBLAGES SEEMINGLY WORLDS APART

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INTRODUCTION-PREMISE

Important questions concern the composition, chronostratigraphy, and origin of continental molluscan assemblages of the Late Triassic, Late Jurassic and mid-to-Late Cretaceous. These assemblages are separated by many millions of years and sometimes great distances. A related question concerns the first appearance of a taxon into these freshwater or terrestrial habitats and a means of showing evolutionary continuity. This preliminary assessment on the subject focuses on the Triassic record of North America. Reported freshwater mussels and gill- and lung-bearing snails of Triassic age have global distribution, but occurrences are widely separated geographically resulting in limited bio- and chronostratigraphic continuity. The North American record consists of mollusks from the American southwest and rift valleys of northeast states.

UNIONOIDS—COLORADO PLATEAU

Good provided a thorough examination of freshwater mussels from the Upper Triassic Chinle, Dockum, and Delores Formations of the southwest United States and noted the great evolutionary significance of documenting the first appearance of undisputed members of the superfamily Unionoidea (1). Good reported the shells of the mussel fauna to be small- to medium-sized, very thick, and lanceolate-shaped indicating high-energy fluvial systems. Good (1) recognized mussel families Hyriidae (e.g., *Antediplodon*) and Unionidae (e.g., *Pleisielliptio?, Uniomerus*), and snail families of Cerithioidea – Pleuroceriidae (*Lioplacodes*) and Ampullaridae (*Ampullaria*). These families were best documented from late Carnian and Norian (mid Late Triassic). Since Good's study, Rinehart and Lucas (2) identified an early mid-Norian the hyriid *Antediplodon* from the Chinle Group (3) of Texas. Good recognized ecophyenotypic changes in mussel parameters upsection with shells becoming slightly larger. Unionoid diversity also increased slightly, with less thick shells in the Sonsela Member of the Petrified Forest Formation. These characters indicate low current velocity (1). Only hyriids are present in the Owl Rock Formation, which Good suggested indicated a decline in mussel fluvial habitat quality. Sedimentological evidence for a large lacustrine system (1) would not necessarily be detrimental to mussel survival or reduction in diversity. Declining water quality may have been a factor in mussel survival with an increase in aridity.

UNIONOIDS – EAST COAST RIFT BASINS

Freshwater mussels from Upper Triassic Newark Supergroup of Atlantic coast rift-basin lakes were interpreted to belong to Mulleriidae (was Mycetopodidae; *Mycetopoda*), Hyriidae (*Diplodon*), and Unionidae (*Anoplophora, Unio*) by Pilsbry (4,5). Pilsbry's taxa occur in the Upper Triassic New Oxford Formation of York County, Pennsylvania. Earlier described taxa by Emerson and Troxell are from the Lower Jurassic Portland Formation (Hettangian–Sinemurian; 6) somewhere near Wilbraham, Hampden County, Massachusetts. Bogan et al. (5) described the Norian-age *Triaslacus* from the Sanford Formation of the Chatham Group, Durham County, North Carolina, and from the Newark Supergroup (undivided), Fauquier County, Virginia. Tentatively assigned to Unionidae, Bogan et al. hypothesized that this taxon and others from the rift lakes were from an extinct radiation and, as such, were not related to the currently recognized six families of the Unionida. Thus they did not represent the origin of any of the modern Unionida families.

FIRST APPEARANCE VERSUS COMMON ANCESTOR

Pilsbry (4,7) referred Triassic freshwater mussels from the Newark Supergroup to modern South American families Mycetopodidae based on similarity of shell shape and Hyriidae based on radial umbo sculpture (5). Remaining taxa were described or moved to the genus *Unio* and assumed to belong in the family Unionidae. Good (1) suggested the small or "dwarfed" size of basal southwestern unionoids was due to "environmental conditions not optimum for this group." Small shell size is common in modern and fossil unionoids and not here considered dwarfed. The continuity of globally widely spaced Late Triassic freshwater mussels (in particular) requires a global, phylogenetic approach to understanding its early ancestry.

ACKOWLEDGEMENTS

We wish to thank Art Bogan for his review of an earlier version of this manuscript.

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BACTERIAL POPULATION STRUCTURE OF A GASIFICATION COOLING TOWER

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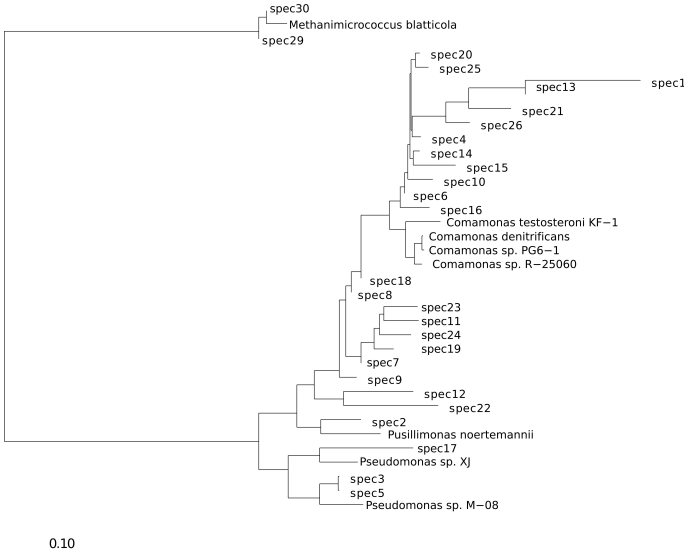
Introduction

This experiment was conducted so the Dakota Gasification Company can determine the composition of aqueous bacterial population in their cooling towers in Beulah, North Dakota. The Dakota Gasification Company relies on the bacterial populations living within these cooling towers to break down the hydrocarbons that are produced as waste product of converting gasified coal to natural gas. Occasionally and without warning these bacterial populations dwindle or crash, the Dakota Gasification Company hopes that by taking a survey of the bacterial community of the bacterial within the cooling towers, future crashes can be prevented if the species of the bacterial population within the towers is known and can be effectively maintained to prevent the build up of hydrocarbons.

Materials and Methods

Nucleic acids were collected from the aqueous bacterial population within the cooling towers in August 2010. With primers 8F and 1391R which are relevant to bacterial species, the PCR of 16S rDNA was amplified using cloning vectors specifically that of PCR4.0, the species were then imported into a database and aligned against *E.coli*. The sequences were then prepared to known sequences stored on a public database. The species were then compared to species within the cooling towers bacterial community. A phylogenetic tree was constructed with jukes-cantor methods and neighbor-joining algorithms to show the relationship between the species surveyed and known species.



Results and Discussion

Analysis of the phylogenetic tree showed that out of the 27 relevant species in the aqueous bacterial population of the cooling tower 7.4% were most closely associated with the genus *Methanimicrococcus*. *Methanomicrococcus blatticola* specifically was known to reduce methanol and methylamine in the cockroach species *Periplaneta Americana.*[1] *Comamonas* was present in 77.8% and *Pseudomonas* was present in approximately 11.1%. *Pusillimonas* was also present in 3.7%. Compared with the last populations surveyed December 2006 when 28 species were randomly sampled, the percentage of *Comamonas* increased by nearly 10%. *Comamonas* is a nitrogen-fixing beta-proteobacteria. The percentage of *Pusillimonas* was almost decreased by half, from about 7 to about 4% currently. Similarly, the currently sample shows a decrease in *Pseudomonas*, a gamma-proteobacteria, decreases from approximately 25% to roughly 11%. *Methanomicrococcus blatticola* was found to be present but wasn't previously and in turn the genus *Oligella* wasn't found but had been previously observed.

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GRADUATE COMMUNICATIONS

IN THE

A. ROGER DENISON COMPETITION

(communications are listed alphabetically by the last name of the presenting author)

THE CHARACTERIZATION OF Rfa INTERACTION WITH Csm3, Mrc1, AND Tof1

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The protein complex Replication factor A (Rfa) is a single-stranded DNA binding known to be involved in DNA replication, repair, recombination and cell cycle regulation[1]. This makes Rfa essential for genome fidelity and integrity, and thus, the prevention of genetic diseases such as cancer, Alzheimer's disease, and Trisomy 21 (Down's syndrome). This complex is heterotrimeric with three subunits: Rfa1 (70 kDa), Rfa2 (32 kDa), and Rfa3 (17 kDa)[1]. In response to DNA damage, Rfa2 is phosphorylated[1]. This phosphorylation may determine which proteins Rfa interacts with to carry out its respective functions. Via a large-scale genetic interaction map, Rfa1 has negative genetic interactions with Csm3, Mrc1, and Tof1 [2]. Checkpoint mediator proteins Mrc1 (mediator of replication checkpoint), Tof1 (topoisomerase I interacting factor) and Csm3 (chromosome segregation in meiosis) function during DNA replication to activate Rad53, an effector kinase[3]. Csm3 acts as a component of moving replication forks and is required to act with Tof1 to recruit Mrc1[3]. The details of the interactions between Rfa and this protein complex have not been fully characterized. The purpose of this study is to elucidate the details of how these proteins interact via yeast two-hybrid. This lab has created mutant forms of Rfa2 that mimic hyper-phosphorylation, demonstrate hypo-phosphorylation, or have had the entire phosphorylation domain removed to further characterize these interactions and what may affect them.

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EXAMINING THE ZOONOTIC POTENTIAL OF SWINE TOQUE TENO VIRUSES

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Anelloviridae is a recently described family of small DNA viruses that infect a variety of animals. Torque teno virues (TTVs) were the first anelloviruses discovered, and they remain the most studied member of this novel virus family. TTVs are extremely common in the human population, with some studies showing over 90% prevalence in healthy individuals. Similarly, species-specific TTVs are also commonly found in several animal species including pets and livestock. The exact role of TTV in the host remains elusive. No specific diseased state has been directly linked to a TTV infection, however increased prevalence and viral loads have been associated with ailments like childhood respiratory illness, multiple sclerosis and hepatitis. In swine, TTVs were found twice as often in piglets affected by porcine respiratory disease complex (PRDC) at about 89% prevalence when compared to their healthy counterparts with a 54% prevalence. Despite the lack of causal evidence linking TTVs to any particular disease, they remain possible contributors to disease complexes caused by co-infections. Hence it is important to determine whether TTVs are zoonotic. In this study, we aim to study the cross-species transmission of TTVs. A swine TTV specific PCR will be used to screen serum samples from pigs, humans, cattle, dogs and horses. Currently little is known about the possibility of cross-species transmission of TTVs. This study is a first step in determining whether TTVs are transmitted between human and animal populations. The possible repercussions of such transmission may have on the host will be the focus of future studies. Swine specific TTV was detected in 7 of 10 swine serum samples. Surprisingly, this swine-specific virus was detected in all human samples tested (10/10). This preliminary data suggests that TTV is capable of establishing zoonotic infections.

CHARACTERISTICS OF HYDROCARBON MIGRATION, FROM SOURCE TO POOL, BIRDBEAR FORMATION, WILLISTON BASIN

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INTRODUCTION. The Birdbear Formation of the Williston Basin in southwestern North Dakota, represents one carbonate transgressive-regressive cycle during the Upper Devonian. The Birdbear is conformable with the Duperow Formation below and the Three Forks Formation above. The Birdbear Formation was formally defined by Sandberg and Hammond in 1958 (1) from the Mobil Oil Producing Co. 1 Birdbear in Dunn County (between 10,310 to 10,400 ft below K.B.). High initial production rates and large cumulative volumes from the Birdbear Formation in southwestern North Dakota largely come from a 2 ft interval within the upper dolomites (2). In the Canadian Williston Basin complicated models exist explaining the sources of these upper Birdbear hydrocarbons. A third model is proposed indicating that several organic intervals within the upper member are sufficient to supply this prodigious production.

SOURCE MODELS. Gasoline fraction gas chromatograms and saturate fraction gas chromatograms (GFGCs, and SFGCs) characterizing Birdbear oil indicate two sources; Lower Bakken Member and Winnipegosis (3). They are described as Type II, Family B and Type II, Family D, respectively. Family B requires an over pressure model for migration, while Family D has a very long migratory path.

DISCUSSION. These suggest complicated source models. The Family B model can cause downward migration of hydrocarbons if several conditions are met. A) A source of hydrocarbons must exist near a sill that is extensive enough as to not allow significant seepage up section, or the geometry of the reservoir must be arranged in such a way that the oil is forced down. B) Potentiometric pressure must be greater than lithostatic pressure. C) Pathways must exist for hydrocarbons flow. D) An appropriate reservoir geometry must trap the oil. E) A bottom sill must be extensive enough to capture the depressed migratory hydrocarbons. Family D source model requires a large quantity of oil to migrate over 609 m (2000 ft) up section. This model requires A) an abundant oil source, B) pathways sufficient to accommodate oil migration, and C) an explanation as to why hydrocarbons are not trapped in the more porous lower unit of the Birdbear beneath the anhydrite cap. A third Birdbear Formation oil source model considers self-sourcing from within the formation. In this scenario hydrocarbons are sourced from several organic rich zones and migrate to the nearest sill; the evaporite unit that separates the Birdbear and Three Forks Formation. This subsurface study focuses on over 9000 mi^2 of southwestern North Dakota's Birdbear Formation. It includes 1221 wells, and 13 cores. Ojbectives of this study include interpreting the depositional environment, designating facies, investigating source-rock, and hydrocarbon migration, with an emphasis on describing the relationships porosity and permeability share with production. Additional tasks include investigating correlation of members, cycles and facies to those already assigned in the Canadian Williston Basin.

RESULTS. Core descriptions of the Mobil Oil Producing Co. 1 Birdbear well in Dunn County reveal carbonate-evaporate cycles consisting of alternating mudstone and dolomudstone beds, and an anhydrite capping carbonate mudstone to wackestone. The base of the upper unit is demarked by a 1.83 m- (6 ft) thick anhydrite cap that corresponds to the highest gamma ray spike above the Duperow Formation. Within the dark gray to brown anhydrite interbedded dolomudstone evaporite unit of the Birdbear Formation lie three organic rich intervals ranging from 3.81–63.5 cm and abundant smaller (0.35–1.2 mm) beds. The thicker units appear to correspond with microbial laminates. Five samples have been sent for TOC (Total Organic Carbon) and, if carbon content is significant (>1%), Rock Eval will be performed to identify potential sources.

CONCLUSIONS. Additional analysis of the remaining twelve core within the study area will be necessary to determine if units are correlative across the basin (by comparison with Canadian cores) and to determine whether the Birdbear Formation is self-sourcing. Chemical analysis (Rock Eval) will provide further evidence of the Birdbear source. Thin section analysis and analytical modelling will aid in determining the relationship porosity and permeability share with production. These findings will significantly advance the understanding of the Birdbear Formation and greatly enhance recovery of its natural resources.

ACKNOWLEGMENT. A Harold Hamm Graduate Assistantship and Student Experience Funds are gratefully acknowledged (senior author).

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THE N-TERMINAL PHOSPHORYLATION DOMAIN OF Rfa2 IS ESSENTIAL BUT ITS PHOSPHORYLATION IS DISPENSABLE IN *S. CEREVISIAE*.

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Abstract:

Lesions in DNA pose a threat to genomic stability and can lead to diseases like cancer. These DNA lesions (and potentially mutations) can arise due to defects in replication, repair, or regulation of cell cycle. Therefore, it is important to study proteins involved in these processes. Replication Protein A (RPA) is a heterotrimeric single-stranded DNA (ssDNA) binding protein involved in all these processes[1, 4]. In humans, the 32 kDa subunit (Rpa2) contains an N-terminal region that is phosphorylated in response to DNA damage, called the phosphorylation domain (Rpa2-PD)[3]. While checkpoint kinases phosphorylate this region at multiple serine/threonine residues[2], the importance of the putative yeast Rfa2-PD is not well characterized. In this study we attempt to understand the role of Rfa2-PD in DNA repair and cell cycle.

The Rfa2-PD is an unstructured region is present in most eukaryotes and in yeast; it has 11 different Ser and Thr sites. We hypothesize, that the phosphorylation of this domain is a 'molecular switch' in regulating the damage response. In order to elucidate the function of this domain in budding yeast we used mutagenesis approach. We have developed mutants where all these Ser/Thr sites are mutated to Asp or Ala representing 'hyper' and 'hypo' phosphorylation state respectively. We also created a deletion mutant where a 38 amino acid region consisting of these sites is deleted. We demonstrate here that the presence of this domain is important in yeast. The Asp mutant also shows sensitivity to DNA damage showing a probable alleviated response. However, a distinction can be made between the requirements for the presence vs. post-translational modification of this domain.

In order to elucidate which residues of Rfa2-PD impart the sensitivity shown by these mutants, we further tested single and multi mutants. It is clear from the study that none of the single mutants show sensitivity. Hence we developed mutants where group of these sites are mutated to Asp/Ala. This study demonstrates which sub-regions of the Rfa2-PD are important in the DNA damage response.

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PRELIMINARY ASSESSMENT OF FIRST OCCURRENCES OF CRETACEOUS CONTINENTAL MOLLUSCAN TAXA IN THE WESTERN INTERIOR OF NORTH AMERICA

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INTRODUCTION

The first appearance of a species, genus, or other taxonomic category based on controlled stratigraphic or temporal data is fundamental to bio- and chronostratigraphic correlation. Continental mollusks (Unionoida and Veneroida) include an array of fossil morphologies that are in need of study at many levels of interest. Posing questions to entice action for additional field work, morphological analysis, and general documentation is an objective of this note. This study reviews the first occurrence data (FAD, Table 1) of mostly Cretaceous (K) mussels and sphaeriid and some earlier records from the Western Interior of North America in advance of a detailed recalibration of occurrences relative to new a chronostratigraphic framework under development with others.

Table 1. Unionida and Veneroida First Occurrence Datums.

Cretaceous Stage	FAD of Suprageneric Taxon in K	FAD of Genus in K	# of FAD of Species of Genus in K
Maastrichtian	x	*Plethobasus† 1*	2
	Pisidiinae (V-S)	*Pisidium 4*	1
Campanian	x	*Lampsilis 1*	2
	Sphaeriinae (V-S)	*Sphaerium 4*	9
	Quadrulini (U-U)	*Quadrula 1*	5
	Parreysiinae (U-U)	*Proparresyia† 1*	13
		Rhabdotophorus† 1	3
	Anodontinae (U-U)	*Anodonta 1*	5
Santonian	x	x	0
Coniacian	x	x	0
Turonian	x	x	1
Cenomanian	Pleurobemini (U-U)	*Pleurobema 1*	6
	Margaritiferidae (U-M)	*Margaritifera 2*	2
Albian	Ambleminae (U-U) *	*Plesiellipti o† 1**	11
	Amblemini (U-U)	*Amblema 1***	5
Aptian	Lampsilini (U-U)	*Protelliptio† 1*	6
	x	*Sulcaptex† 1*	2
	x	*Ligumia 1*	4
	Trigonioididae (U-T)	*Americunio 3*	1
Barremian	Neiomiodontidae (V-N)	*Musculiopsis 5*	1
	x	*Tritogonia 1*	3
	Unioninae (U-U)	*"Unio" 1**	4
	x	*Murraia† 1*	1
Neocomian (lowermost Cretaceous)		x	0

Table 1a. Abbreviations and Footnotes

U-U	Order Unionida, Family Unionidae (1)
U-M	O U., Family Margaritiferidae (2)
U-T	O. U., Family Trigonioidadae (3)
V-S	Order Veneroida, Family Sphaeriidae (4)
V-N	O. V., Family Neiomiodontidae (5)
†	= fossil genus
FAD	First occurrence datum
*	Records in Jurassic and Triassic.
**	May have first record in Cretaceous.

METHODS

Databases of Western Interior North American continental mollusks developed over many years incorporated 1) species occurrences, 2) stratigraphy, 3) temporal control, 4) taxonomy, and other parameters of interest. Other commitments limited maintaining these databases with literature records more current than the 1990s. Recent revision of bivalve classification (1) and other evolutionary considerations (2) prompted placing the fossil observations into new phylogenetic context.

RESULTS

This project used 86 named Cretaceous Unionida and Veneroida freshwater species belonging to 20 nonexclusive Cretaceous genera; of these six genera are extinct. The remaining genera are "living fossils," some of which have been reported not to survive the Cretaceous–Paleogene impact event (3). There are more unnamed exclusive Cretaceous genus-group taxa not included in this analysis. Cretaceous species used in this analysis are organized into 20 (coincidentally) first occurrence data. Although the preponderance of first occurrence records are known from the Late Cretaceous (80%) with many yet to be described, an important number of genera may make their first appearance in the Early Cretaceous (Table 1). [Note that Trigonoididae is considered in Trigoniida by some. (6)]

CONCLUSIONS

As may be known from ongoing Cretaceous studies in Utah (4) and Montana (5), known continental molluscan diversity will like increase substantially over the next few years. Providing fundamental questions of taxonomy, evolution, biogeographic, and chronostratigraphic will promote project and publication interest.

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‡ Earlier fossil occurrence work by John Hanley, Erle Kauffman, and Loris Russell is gratefully acknowledged.

CORTICOTROPIN-RELEASING FACTOR MEDIATED EPILEPTIFORM ACTIVITY IN THE ENTORHINAL CORTEX: ROLES OF CRF_2 RECEPTORS, PKA PATHWAY & CATION CHANNELS

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PURPOSE: Whereas corticotropin-releasing factor (CRF) has been considered as the most potent epileptogenic neuropeptide in the brain (1), its action site and underlying mechanisms in epilepsy have not been determined. The purpose of the project was to determine the role and the mechanisms of CRF in facilitating epileptiform activity in the entorhinal cortex (EC).

MATERIALS AND METHODS: Slice preparation: Horizontal brain slices including the EC, subiculum and hippocampus obtained from 13-18-day-old Sprague Dawley rats.
Epileptiform activity recordings: Artificial cerebro spinal fluid (ASCF) containing the $GABA_A$ receptor blocker picrotoxin (100 µM) was bath applied and the same was used in electrodes. Drugs were bath applied after stable control.
Whole-Cell and Perforated-patch recordings: Whole cell recordings made using ASCF and K^+ -gluconate Ih recorded from layer II stellate neurons of the EC using the above extracellular solution, excluding picrotoxin and including Tetradotoxin (0.5 µM). Recording pipettes contained freshly prepared K^+-gluconate containing amphotericin B (200 µg/ml).
Immunocytochemistry: Cryoprotected rat brains, treated with H_2O_2. Then incubated in normal donkey serum and primary antibodies, biotinylated donkey anti-goat IgG, and finally with avidin-biocytin complex. Positive signals detected by Diaminobenzidine. Slides visualized and photographed with a Leica microscope.
Western blot: Equivalent amount of protein obtained from medial EC loaded to each well, separated by 12 % SDS–PAGE, and transferred to the polyvinylidene difluoride membranes. Blots incubated with individual primary antibodies followed by secondary antibody. Immunoreactive bands visualized by SuperSignal West Pico Chemiluminescent Substrate and detected by a Biospectrum Imagining System.

RESULTS: The EC expressed high levels of CRF and CRF_2 receptors and bath application of CRF increased the frequency of picrotoxin-induced epileptiform activity recorded from layer III of the EC in slices, via CRF_2 receptors and cyclic AMP, whereas protein kinase A was partially involved. Application of ZD7288, a blocker of the hyperpolarization-activated channels (H-channels), significantly reduced the frequency of epileptiform activity but increased the numbers of the synchronizing events within single epileptiform activity and the duration of individual epileptiform activity. In the presence of ZD7288, CRF failed to increase the frequency of epileptiform activity but still augmented the numbers of the synchronizing events in an epileptiform activity and the duration of epileptiform activity suggesting that part of the effects of CRF on epileptiform activity is mediated via H-channels. Furthermore, CRF increased H-channel currents recorded from layer II stellate neurons via activation of CRF_2 receptors. Cyclic AMP not protein kinase A was responsible for CRF-mediated facilitation of H-channel currents. CRF facilitated epileptiform activity by increase in neuronal excitability via increased firing frequency of action potentials (APs). The effects of CRF on neuronal excitability were mediated via activation of CRF_2 receptors and a cationic channel to generate membrane depolarization.

CONCLUSIONS: CRF facilitates epileptiform activity in the EC via activation of CRF_2 receptors. Functions of cAMP and partially PKA are required for CRF-mediated augmentation of epileptiform activity. CRF increases Ih in the EC via cAMP but not PKA and may play a role for CRF-mediated enhancement of epileptiform activity. Furthermore, CRF increases neuronal excitability via CRF_2 receptors and membrane depolarization.

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IDENTIFICATION OF *STENOTROPHOMONAS MALTOPHILIA* GENES THAT PROTECT AGAINST PHAGOCYTOSIS USING A HIGH-THROUGHPUT AMOEBA ASSAY

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Stenotrophomonas maltophilia is a metabolically diverse species of Gram-negative bacteria found ubiquitously in soil and freshwater environments. Individual isolates may exist as free-living microorgarisms, as members of the rhizosphere microbiota, as endophytes of plants, as endoparasites of amoeba, or as pathogens of vertebrates including fish, reptiles, and mammals. In humans, *S. maltophilia* is emerging as a significant cause for concern as an opportunistic pathogen associated with nosocomial outbreaks in patients with a range of comorbidities including cystic fibrosis, neutrophenia, chronic obstructive pulmonary disease, anti-cancer chemotherapy, and organ transplant. In most cases, *S. maltophilia* infection begins with colonization of an abiotic medical device and progresses to serious life-threating infection ircluding pneumonia, neutropenic fever, meningitis, and blood stream infections. Based on data reported by the SENTRY Antimicrobial Surveillance Program, *S. maltophilia* is the 8th most prevalent Gram-negative pathogen (13th overall) recovered from patient samples in North America, yet we know almost nothing about the mechanisms of *S. maltophilia* pathogenesis. Our incomplete understanding of *S. maltophilia* is even more concerning when we consider that both the incidence and prevalence of this pathogen is on the rise. Resistance or evasion of host innate immunity is clearly important for progression of disease caused by *S. maltophilia*. Here, we report preliminary findings from a large-scale forward genetic screen designed to identify genes within the *S. maltophilia* genome that may be involved in resistance to phagocytosis. A large-insert (~40kb) genomic library was screened for the ability to protect *E. coli* from predation by *Dictyostelium discoideum*, a bacterivorous environmental amoeba that shares structural and functional similarity with professional phagocytes of the innate immune system. Several positive clones were identified and transposon mutagenesis was used to further define *S. maltophilia* genes responsible for ectopic resistance to phagocytosis. This is an important first step in identification and characterization of virulence-associated genes in *S. maltophilia*.

CHARACTERIZATION OF RPA-PROTEIN INTERACTIONS AND THEIR DEPENDENCE ON THE PHOSPHO-MIMETIC STATE OF THE N-TERMINUS OF *SACCHAROMYCES CEREVISIAE* Rfa2

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Replication protein A (RPA) is a heterotrimeric complex in all eukaryotic cells that is essential for DNA replication, repair/recombination, and cell cycle regulation. A common intermediate of each of these DNA processes is the formation of single-stranded DNA (ssDNA) that needs to be processed to complete repair and acts as a signal to halt the cell cycle until DNA is restored to its native duplex form. The major biochemical function of RPA is to bind to ssDNA. Therefore, RPA not only acts as a sensor of incomplete duplex DNA, but also as a recruiter of factors necessary to process this intermediate. It is clear that RPA interacts with a number of proteins; however, many of these interactions have not been well characterized in yeast, making unclear the physiological role of each RPA-protein interaction in cellular DNA metabolism.

It is well known that in response to DNA damage, the N-terminus of the human 32-kDa subunit (Rpa2) becomes phosphorylated, and this has been demonstrated to modulate some RPA-protein interactions. Although phosphorylation of the Rfa2 N-terminus has not been definitively demonstrated during the DNA damage response, we have demonstrated in our lab that phospho-mutant forms of the budding yeast Rfa2 N-terminus show DNA damage-dependent phenotypes. This suggests that this domain may have a similar role(s) to that of the human Rpa2 N-terminus. Therefore, we hypothesize that the phosphorylation state of Rpa2 (or Rfa2) coordinates the response to DNA damage through regulation of RPA-protein interactions. The goals of this research were: *1)* to identify (potentially novel) yeast RPA-protein interactions, *2)* to map regions important for protein interaction, and *3)* to characterize whether these protein interactions are dependent on the phosphorylation state of the Rfa2 N-terminus. We have identified a number of RPA-protein interactions that are dependent on the state of the Rfa2 N-terminus, and we have mapped the region(s) of RPA that are important for some of these interactions. This combined data suggests the Rfa2 N-terminal phosphorylation state may be regulating protein interactions to coordinate RPA cellular function.

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CHARACTERIZATION OF NOVEL Rfa1 INTERACTION WITH YNR071C USING YEAST-TWO HYBRID METHOD IN *SACCHAROMYCES CEREVISIAE*

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Replication Protein A (RPA), also known as Replication Factor A (RFA) in yeast, is a single-stranded DNA binding protein (SSB) that is required for DNA replication, repair, and recombination (1). RFA is a heterotrimeric complex comprised of, Rfa1, Rfa2, and Rfa3 (2). The three subunits are approximately 70, 30, and 14 kDa in size respectively. RPA is a highly conserved protein in higher eukaryotic organisms, and a homolog of RFA found in the budding yeast, *Saccharomyces cerevisiae*.

In *S. cerevisiae*, Rfa1 contains DNA binding domains (DBD) F, A, B, and C. We have identified, in a previous yeast-two hybrid screen, proteins that interact with Rfa1, and of these interactions we have selected the protein YNR071C to characterize. YNR071C is a protein of unknown molecular and biological function. The purpose of this study is to investigate site of interaction on Rfa1. By utilizing the yeast-two hybrid method we identified DBD-B as the region of Rfa1 associated with the YNR071C interaction. Quantitative examination of this interaction was calculated measuring Beta-galactosidase activity. By characterizing the interaction between Rfa1 and YNR071C we are closer to understanding the biological role YNR071C plays within the cell. Also, understanding the states of Rfa1 (phosphomimetic or wild-type) that promote or disrupt this interaction can help us understand the role of the Rfa1-YNR071C interaction during DNA damage. Future characterization of these protein interactions with RFA, and their mechanistic role in DNA processing, will yield deeper understanding of how RFA orchestrates the complicated response to DNA damage (3).

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DIAGENESIS AND OIL PRODUCTION OF THE DUPEROW FORMATION IN SOUTHWESTERN NORTH DAKOTA

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INTRODUCTION

Bakken Formation oil production has brought much attention and economic growth to North Dakota. Bakken oil is now economically viable in light of new technology and human innovation. What if this technology could be used in other geologic units with a history of oil production? Duperow Formation began production in 1951 and was considered, at the time, a likely significant future contributor to North Dakota's oil industry. By 1989, the Duperow Formation on the Billings Anticline was the second most prolific hydrocarbon producer (1). By 2004, it was the sixth largest contributor of oil in all of North Dakota. However, in 2005, the Bakken Formation produced more oil in a year than the Duperow Formation for the first time; that was accomplished with twice as many Bakken wells (2).

DUPEROW FORMATION PRODUCTION

A study of the porosity and formation structure of the Duperow Formation can reveal new locations that will be most conducive to future oil extraction. This study focuses on determining how diagenetic alteration occurred in the Duperow Formation. The approach used here creates a map of the porosity of the Duperow Formation along the nose of the Billings Anticline and the southern part of the Nesson Anticline. The type of diagenesis occurring in the producing areas is mapped on the basis of 861 wells, 161 of which currently or have recently produced, in Dunn, Stark, Billings, Golden Valley, and McKenzie Counties. A comparison of these findings with similar structures elsewhere (e.g., Cedar Creek Anticline and the Wolf Creek Nose, Montana), will help determine areas for future production.

Production in the Duperow Formation is primarily from dolomitized stromatoporoid-assemblage patch reefs that occur in the lower unit of the formation (1). Though not laterally extensive like coral reefs, stromatoporoid-assemblages are good reservoirs because of their high porosity. These pools of oil have primarily been drilled by traditional vertical wells. Bakken Formation oil is recovered primarily from horizontal wells and hydraulic fracturing. A diagenetic model derived from a map of the porosity of the Duperow Formation on the Billings Nose and southern Nesson Anticline will assist in future exploration and production of the Duperow Formation.

METHODS

Methods include a comprehensive analysis and description of available Duperow Formation cores, logs, and thin sections. Using the results of this analysis and that of my predecessors, the porosity and permeability of the Duperow Formation can be mapped. Porosity and permeability trends and patterns will be most evident with this approach.

CONCLUSION

The Duperow Formation is a complex system of limestone, dolostone with lenses of mudstone and siltstone beds, along with interbedded fossiliferous stromatoporoid banks, as well as anhydrite beds. The various lithologies provide different porosities that are important for hydrocarbon migration. An isopach map of the Duperow Formation reveals that this unit thickens to the north with an overall change of 100 to 200 ft. Ground water flow is generally moving from the southeast to the northwest, which shows that porosity can be tracked through North Dakota. Further study of the porosity must be completed to determine which areas of North Dakota have similar porosities as those found associated with the Billings and Nesson Anticlines. The Bakken Formation is a great North Dakota resource, but other units also have great potential that is not being realized. We need to determine if other plays can be exploited to secure both North Dakota's growth and the nation's energy security.

ACKNOWLEDGMENT

A Harold Hamm Graduate Assistantship and Student Experience Funds are gratefully acknowledged.

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SEASONAL DIFFERENCES IN SURVIVAL AMONG ENTEROHEMORRHAGIC *E.COLI* (EHEC) ON PRE-HARVEST LETTUCE

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Produce-associated foodborne outbreaks have increased over the last few decades. The potential exists for produce to become contaminated with enteric pathogens in the pre-harvest environment. Fresh produce is often minimally processed and consumed raw, thereby increasing consumers' risk of exposure to severe gastrointestinal illnesses. Enterohemorrhagic *E.coli* (EHEC) is an enteric pathogen most commonly associated with produce outbreaks. Thus, our goal is to determine how pre-harvest environmental factors impact survival of EHEC on lettuce. Strains of serotype O157 and O26 represent genetically distinct groups of this foodborne pathogen. Lettuce was grown in the greenhouse under two harvest season conditions similar to those in Salinas Valley, California: June (14.8 hours light, maximum temperature 20 °C, minimum temperature 12.2 °C, relative humidity ranging from 70%-90%) and March (12 hours light, maximum temperature 17.2°C and minimum temperature 6.7°C at 75% humidity). Lettuce plants were spray inoculated in duplicate with one of 4 different strains and bacteria were enumerated on the day of inoculation as well as 1, 3, and 5 days post-inoculation. Under June harvest season conditions, no significant differences in survival were seen between EHEC serotypes O157 and O26 on one, three or five days post-inoculation. Overall, the average decrease in cell number was 2.92±0.63 and 2.95±0.59 log colony forming units (cfu)/g of lettuce, respectively. Under March harvest season conditions, no significant differences in survival were observed between EHEC serotypes on one and three days post-inoculation ($p>0.05$). Differences in survival were significant between EHEC O157 and O26, five days post-inoculation ($p=0.012$) with an average decrease of 2.40±0.61 and 1.70±0.33 log cfu/g of lettuce. These data suggest that there is potential for certain serotypes to survive better depending on the season. Based on this survival data, we will utilize transcriptional profiling to understand the physiological state of these pathogens in the pre-harvest environment. Understanding how these pathogens survive on lettuce is the first step in mitigating their presence in the food supply. The data will be used to develop effective post-harvest decontamination treatments to reduce consumer exposure to these pathogens on produce.

"SACCHAROMYCES SAPIENS": N-TERMINAL RFA2 PHOSPHORYLATION OF HUMAN-YEAST FUSION PROTEINS.

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Replication Protein A (RPA), a highly conserved hetero-trimeric complex, is a single-stranded DNA binding protein with roles in DNA replication, repair, recombination and cell cycle checkpoint function. In human cells, it is known that the N-terminal domain of the RPA second subunit, RPA2, is hyper-phosphorylated in response to DNA damage. The phosphorylation process in human cells has been fairly well characterized. In *Saccharomyces cerevisiea*, however, little advancement in understanding how the RPA homolog, Replication Factor A (RFA), is phosphorylated in response to DNA damage has been made. Utilizing different phospho-mutant forms of RFA2 we have observed DNA damage sensitivities in yeast cells. Additionally, the sequence specificity of these phosphorylation events has not been fully explored between yeast and higher eukaryotes.

Here we present data attempting to elucidate the phosphorylation state of the N-terminus of RFA2, and it's various N-terminal phospho-mutants, in the presence of DNA damaging agents. Utilizing RFA2 N-terminal mutants with Human N-terminal sequence, we also aim to determine if differences in the amino acid sequence between the two organisms affects or drives the phosphorylation of the N-terminal domain in yeast cells.

This project is supported by National Science Foundation CAREER grant 1253723, awarded to SJH.

Professional Communications

(communications are listed alphabetically by the last name of the presenting author)

ABSCISIC ACID AND CONTROL OF LEAF EXPANSION BY INDOLE-3-ACETIC ACID IN *ARABIDOPSIS*?

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Indole-3-acetic acid (IAA), a plant morphogenic hormone, controls multiple aspects of plant growth including vascular development and root and leaf initiation. Earlier we have examined how IAA impacts leaf expansion in the model plant, *Arabidopsis*. Increasing the IAA content of young expanding intact attached, intact detached, and wounded attached leaves resulted in inhibition of growth,[2] while IAA treatment of excised leaf strips or wounded detached leaves stimulated rather than inhibited growth.[1] These results suggested that leaf tissue must be both wounded and detached from the plant for IAA to induce increased growth.

Subsequently we addresses the requirement for detachment from the plant for IAA-induced growth. Implied is that an entity (presumably a chemical signal), continuously supplied by the rest of the plant, somehow interacts with IAA or auxin signal transduction in leaf blades of the intact plant to inhibit growth and preventing IAA-induced growth. Given the root to shoot movement of xylem transport, the chemical signal would seem most likely to originate from the root. Several candidate root derived chemical signals are known but the isoprenoid compound abscisic acid (ABA; 5-(1-Hydroxy-2,6,6-trimethyl-4-oxo-2-cyclohexen-1-yl)-3-methyl-2,4-pentanedienoic acid) seems a particularly strong candidate as it is a known plant growth inhibitor. At this venue, we have previously reported that ABA treatment to be a potent inhibitor of leaf growth in *Arabidopsis* and that ABA and IAA treated leaf strips grew less than IAA treated strips while ABA and IAA treated strips grew more than strips treated with ABA alone.[3] A pilot study (n=24) found a statistically insignificant trend towards IAA-induced leaf growth in the presence of 30 µM abamineSG (a new potent ABA synthesis inhibitor). Mutant plants (CS5736: Arabidopsis Biological Resource Center), deficient in ABA synthesis, however, produced leaves with significantly more robust growth detached from the plant which was not growth-inhibited by IAA. Attached mutant leaves also were not growth inhibited by IAA. Together, these results are consistent with an hypothesis that IAA treatment of Arabidopsis leaves induces ABA synthesis in roots and intact leaf tissue leading to slower growth. Here we report results of assays of endogenous leaf tissue ABA content in variously treated wild type leaves.

As with for previous experiments in this ongoing project, seedlings of *Arabidopsis* were grown in moist potting soil in a growth chamber at 19°C, with continuous illumination. After 10-14 days, plants were selected with both the first two true leaves 2.8-3.2 mm in diameter and rapidly expanding. One of these first two leaves from each plant served as the experimental leaf and the other leaf served as a paired control. Leaves, either intact attached, intact detached, or detached wounded were treated 24 hours with media +/- 50 µM IAA. After 24 hours (and at time zero) leaves were pooled for subsequent ABA content analysis using a high throughput purification and quantification with GC-MS.

At time zero, attached expanding leaves were found to contain 1907 +/- 181 ng/g fresh wt. ABA. After 24 hours, leaves still attached to the plant treated with a 5 µL drop of control media contained 1373 +/- 178 ng/g ABA while attached leaves treated with a drop of media also containing IAA contained 1631 +/- 159 ng/g ABA. Detached intact leaves floated 24 hours on control media contained 341 +/- 88 ng/g ABA while IAA treated detached intact leaves contained 260 +/- 61 ng/g ABA. Detached wounded leaves (three cuts from the margin to the midvein) floated on control media contained 194 +/- 61 ng/g ABA while IAA treated detached wounded leaves contained 385 +/- 111 ng/g ABA. Together these results indicate that IAA-induced leaf-growth inhibition is not the simple result of IAA stimulation of ABA synthesis in detached and attached leaves as hypothesized. Possible explanations for the lack of IAA-induced leaf-growth inhibition in ABA deficient mutants will be discussed.

This project is supported by grants from the National Center for Research Resources (P20RR016471) and the National Institute of General Medical Sciences (P20 GM103442) from the National Institutes of Health.

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THE RIVERDALE "LONG CORE"–A USEFUL RESOURCE FOR THE STUDY OF THE CANNONBALL FORMATION, NORTH DAKOTA

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INTRODUCTION–CANNONBALL FORMATION. The record of transgressions and regressions of the Western Interior Cannonball Sea are preserved in interbedded tongues of the Cannonball Formation within the Ludlow Member of the Fort Union Formation in southwestern North Dakota. At least four transgressive cycles are recorded (up section): an unnamed lower tongue, Boyce Tongue, Three V Tongue, and an unnamed uppermost tongue (1, 2). Available stratigraphic data for the Cannonball Formation has been compiled by Cvancara (3) and Hartman (4), while subsurface data remains relatively scant, since oil well documentation does not typically commence in Paleocene strata. **RIVERDALE LONG CORE.** In 1947, the U.S. Army Corps of Engineers began construction of Garrison Dam on the Missouri River near Riverdale. "Hole 1055" was drilled on the west side of the dam at its base, near the current power house, to ascertain the foundation geology of the dam site. A nearly continuous core (the Riverdale "Long Core"–Hartman Section M8607) was obtained to a depth of 722 ft (220.1 m). The core was meticulously examined by the Corps with full description and extensive physical testing. However, since the focus was on engineering properties of the strata, no attempt was made to relate the core to the regional geology. **LONG CORE FOSSILS.** Benthic foraminifera were retrieved by S.K. Fox (Rutgers University) from samples provided by Lemke (5) of the USGS. A Cannonball Formation age was determined based on planktic forams by Fox and Olsson (6). They noted that a complete section through the Cannonball Formation was represented in the Long Core. Later study showed ostracods, diatoms, and nanoplankton were also present (7). **GEOLOGICAL CONTEXT.** The current study places the Long Core into geological context. The original core description had an error or resolution of 722 ±0.2 ft (±6 cm). A transcription of the lithologic log to Excel™ indicated that the Cannonball Formation was from approximately 200 to 600 ft (61–183 m). The depth to the foraminifera horizons was not given (6). However, an unpublished and undated Fox student senior thesis (8) included a hand-drawn chart of the core drawn to scale, with brief lithologic descriptions, sample locations, and identification of foram horizons. Precise depth estimates were made of these fossil horizons and of the lithology in which they occurred. These occurrences were correlated with the original core descriptions. **RESULTS–FOSSIL/CORE CORRELATION.** Reasonably good correspondence of the original core lithologies made possible the approximate placement of the foraminifera horizons within the Cannonball Formation part of the Long Core. Further study is underway to correlate specific core samples and identified foraminifera with the core log, lithologies, and other markers.

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CONSTITUTION OF THE NORTH DAKOTA ACADEMY OF SCIENCE

Founded 1908, Official State Academy 1958

ARTICLE I - *Name and Purpose*

Section 1. This association shall be called the NORTH DAKOTA ACADEMY OF SCIENCE.

Section 2. The purpose of this association shall be to promote and conduct scientific research and to diffuse scientific knowledge.

ARTICLE II - *Membership*

Membership in the Academy shall be composed of persons who share the stated purpose of the Academy and who are active or interested in some field of scientific endeavor.

ARTICLE III - *Council*

The officers of the Academy shall be a President, a President-Elect, and a Secretary-Treasurer. The Council, consisting of the officers, the retiring President, and three elected Councilors, shall be responsible for the fulfillment of the scientific and business obligations of the Academy.

ARTICLE V - *Dissolution and Limits of Action*

Section 1. In the event of dissolution of the Academy, any remaining assets shall be distributed to organizations organized and operated exclusively for education and scientific purposes as shall at the time qualify as exempt organizations under Section 501(c) (3) of the Internal Revenue Code of 1954.

Section 2. No substantial part of the activities of the Academy shall be the carrying on of propaganda, or otherwise attempting to influence legislation, and the Academy shall not participate in or intervene in, any political campaign on behalf of any candidate for public office.

Section 3. No part of any net earnings shall inure to the benefit of, or be distributable to, Academy members or officers, or other private persons, except that the Academy may authorize the payment of reasonable compensation for services rendered.

ARTICLE VI - *Amendments*

Section 1. This Constitution may be amended at any annual Business Meeting of the Academy by a two-thirds vote. Proposed amendments shall be submitted in writing to the Secretary-Treasurer who shall send them to the members at least two weeks before the meeting at which such amendments are to be considered.

Section 2. Bylaws may be adopted or repealed at any regular business meeting by a two-thirds vote.

BYLAWS

BYLAW 1. *Meetings*

Section 1. *Scientific Meetings*. The Academy shall hold at least one annual scientific meeting each year at a time and place determined by the Council. Other scientific meetings, regional, state, or local, may be held at times and places determined by the Council. The Council shall establish regulations governing the presentation of papers at Academy sessions. Such regulations shall be made available to members at least three months before any meeting at which they are to apply.
Section 2. *Business Meetings*. A Business Meeting of the membership shall be scheduled at the regular, annual scientific meeting of the Academy. Ten percent of the active members shall constitute a quorum at the annual business meeting.

Section 3. *Special Meetings*. Special meetings shall be called by the President upon the request of ten percent of the active members and require twenty percent of the active members for a quorum. Notice of the time and place of such meetings shall be sent to all members of the Academy at least four weeks in advance of the meeting. Only matters specified in the call can be transacted at a special meeting.

Section 4. *Procedure*. Parliamentary procedures to be followed in all business meetings shall be those specified in "Standard Code of Parliamentary Procedure" by Alice F. Sturgis.

BYLAW 2. *Financial*

Section 1. *Fiscal year*. The fiscal year shall run concurrently with the calendar year from January 1 to December 31.

Section 2. *Dues and Assessments*. The annual dues and assessments may be changed from time to time by the Council, subject to approval by a two-thirds vote of the members at an annual Business Meeting. These dues are payable by January 31 for the current fiscal year or by the Annual North Dakota Academy of Science Meeting for those registering for the meeting

Section 3. *Supporting Members*. Council shall maintain a program to encourage members to voluntarily contribute funds over and above the regular dues and assessments for the support of activities of the Society.

Section 4. *Sustaining Members*. Any association, corporation, institution, or individual desiring to support the Society with funds or services valued at $50 or greater may be invited by the President or designee to become a Sustaining Associate.

Section 5. *Audit and Reports*. The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year. The Secretary-Treasurer shall report on the financial affairs of the Society, including the results of an annual audit, as may be requested by the Council.

BYLAW 3. *Membership*

Section 1. *Membership Categories*. Classes of membership shall include the following: (a) Regular, (b) Student, (c) Emeritus, (d) Honorary, (e) Supporting, (f) Sustaining, and (g) Lifetime Members.

Section 2. *Eligibility and Procedure for Membership*. Candidates for membership, except Sustaining Member, may be proposed by any regular or emeritus member of the Academy by submitting the candidate's name to the chairman of the Membership Committee.

(a) *Regular Members*. Any person who is active or interested in some field of scientific endeavor shall be eligible for regular membership. A majority vote of Council shall elect to regular membership.

(b) *Student Members*. Any student who is an undergraduate or graduate student in some field of science shall be eligible for student membership. A majority vote of Council shall elect to regular membership.

(c) *Emeritus Members*. Any member in good standing upon formal retirement is eligible for emeritus membership. A majority vote of Council shall elect to emeritus membership.

(d) *Honorary Member*s. The Academy may recognize, by awarding honorary membership, any person (nonmember or member) who has in any way made an outstanding contribution to science. It shall be the responsibility of the Membership Committee to be aware of individuals whom it would be fitting for the Academy to honor in this fashion. A two-thirds vote of members attending the annual business meeting shall elect to honorary membership.

(e) *Supporting Members*. Regular or student members may voluntarily contribute funds over and above the regular dues and assessments for the support of activities of the Society.

(f) *Sustaining Associates*. Any association, corporation, institution, or individual desiring to support the Society with funds or services valued at $50 or greater may be invited by the President or designee to become a Sustaining Associate.

(g) *Lifetime Members*. Any regular member in current good standing for at least one year may become a Lifetime Member by paying an assessment equal to 18 times the current annual dues in one lump sum or in two equal payments over the current and following year.

Section 3. *Privileges of Membership*.

(a) Voting at the annual business meeting is permitted of regular and emeritus members.

(b) Members of all categories may attend business meetings of the Academy.

(c) The Secretary-Treasurer and members of Council must be regular members in good standing.

(d) Regular, student, and emeritus members may submit abstracts or communications for scientific meetings of the Academy.

(e) Emeritus and Honorary Members shall be exempt from payment of dues.

(f) A Sustaining Member is provided a display area at the annual scientific meeting of five linear feet per $50 donation up to a maximum of 20 linear feet.

(g) Every member in good standing shall receive a printed copy or an electronic copy (if available and of equal or lesser cost than the printed copy) of the annual *Proceedings of the North Dakota Academy of Science*, the form to be determined by the member.

(h) Special offices such as Historian may be created by the unanimous vote of the regular members at the annual Business Meeting.

(i) All student research participants shall receive a properly inscribed certificate.

Section 4. *Forfeiture of Membership*.

(a) *Nonpayment of dues*. Members shall be dropped from the active list on 31 November following the nonpayment of dues during the membership year commencing the previous 1 December. A member may return to the active list by paying the current year dues.

(b) *Expulsion for Cause*. Membership may be terminated for conduct injurious to the Academy or contrary to the best interests of the Academy. The accused member shall be given an opportunity for a hearing before the Council. If a majority of the Council votes to expel the member, the action must be ratified by at least two-thirds of the members present at the next annual business meeting of the Academy. An expelled member shall forfeit all paid dues and assessments.

BYLAW 4. *Duties and Responsibilities of the Council and Council Members*

Section 1. *Council*. The Council shall meet, at the call of the President, at least twice a year. The Council shall:

(a) be the governing board of the Academy, responsible only to the membership.

(b) arrange for programs, approve committee appointments, be responsible for the fiscal affairs of the Academy, and transact such business as necessary and desirable for function and growth of the Academy.

(c) determine the location of the annual meeting three years in advance.

(d) annually appoint an Academy representative to the National Association of Academies of Science and to Section X (General) of the American Association for the Advancement of Science.

(e) shall appoint and may compensate a Secretary-Treasurer.
(f) shall appoint and may compensate an Editor of the PROCEEDINGS and other publications.
(g) shall be empowered to charge a publication fee of authors on a per page basis.
(h) shall control all activities of the Academy including grant applications.

Section 2. *President*. The President shall preside at meetings of the Council and over the annual business meeting of the Academy at the close of the regular term office. The President shall vote only to break a tie. Unless otherwise specified, the President shall, with the approval of the Council, appoint members to serve on Standing Committees and *ad hoc* Committees, designate the chair of each Committee, and appoint representatives to other organizations. The President serves as Coordinator of the Local Arrangements Committee for the annual meeting that occurs at the end of the President's term.

Section 3. *President-Elect*. The President-elect shall be considered a vice president and shall serve as such in the absence of the President.

Section 4. *Past-President*. The retiring President shall serve as Past-President and chair of the Nominating Committee. The Past President shall serve ex officio on those committees designated by the President and shall serve in the absence of the President and President-elect.

Section 5. *Secretary-Treasurer*. The Secretary-Treasurer shall:
(1) Assist Council in carrying on the functions of the Academy including the receipt and disbursement of funds under the direction of Council.
(2) Manage the Academy Offices under Council's general supervision.
(3) Serve as Managing Editor of the *Proceedings of the North Dakota Academy of Science*.
(4) Prepare a summary of the most recent audit and a report of the Academy's current financial status. This information shall be shared with the membership at the annual business meeting and published in the PROCEEDINGS following the business meeting.
(5) Perform all other duties of the Secretary-Treasurer listed in the Bylaws.
(6) Serve as archivist and be responsible for all official records, archives, and historic material which shall be in reposit with the Secretary-Treasurer.

BYLAW 5. *Appointment, Nomination and Election of Members of Council*

Section 1. *Eligibility for Office*. All candidates for election or appointment to the Council must be regular members in good standing. Nominees for President-elect must be members who reside within easy commuting distance of the site of the annual meeting selected by the Council that occurs when the President-elect serves as President.

Section 2. *Nomination Procedures*. The Nominating Committee shall be responsible for all nominations to elective office, shall determine the eligibility of nominees, shall ascertain that nominees are willing to stand for office, and shall be required to advance to the Secretary-Treasurer at least two names for each open position as needed. Academy members shall have been encouraged to suggest nominees to the committee prior to the Committee submitting its report.

Section 3. *Election Procedures*. Election shall be by secret mail ballot. The Secretary-Treasurer shall prepare a printed ballot that bears all names submitted by the Nominating Committee, that contains a brief biography of each candidate, and that has space for write-in candidates for each office. This ballot is to be mailed to all members no later than 1 November. Each member wishing to vote must return the marked ballot in a sealed signed envelope to the Secretary-Treasurer postmarked not more than thirty days after the ballots were mailed out to members. The President shall appoint tellers, who shall count the ballots that have been received by the Secretary-Treasurer and the tellers shall present the results in writing to the President. A plurality of the votes cast shall be necessary to elect and

in the case of a tie vote, the President shall cast the deciding vote. The results of the election shall be announced at the annual Business Meeting.

Section 4. *Term office*. A President-Elect shall be elected annually by the membership and the following years shall succeed automatically to President and Past President to constitute a three-year nonrenewable term. Three Councilors shall be elected by the membership to three-year, non-renewable terms on a rotating basis. All elected Council members shall take office at the end of the next annual Business Meeting following election and shall continue until relieved by their successors. Council is empowered to appoint and compensate a Secretary-Treasurer to successive three-year terms that commence with the beginning of the fiscal year.

Section 5. *Removal from office or position.* If for any reason any elected member of Council is unable to fulfill his/her duties, the Council member may be removed from office by two-thirds vote of Council. If for any reason the Secretary-Treasurer is unable to fulfill his/her duties, the Secretary-Treasurer may be relieved of all duties by a majority vote of Council.

Section 6. *Interim vacancies*. Should a vacancy occur in the Presidency, the Council by a majority vote shall appoint a member of the Academy able to coordinate the next annual meeting to fill the unexpired term. A retiring interim President shall succeed automatically to Past President. Should a vacancy occur in the Presidency-elect, the Council shall reassess and change the location of the coinciding annual meeting as necessary and then call for a special election by mail ballot. An interim vacancy in the Past-Presidency shall be filled by the most recently retired Past-President able to fill the duties of the Past-President. Persons appointed to fill the unexpired term of Secretary-Treasurer are expected to remain in the position for a minimum of three years. A vacancy in the office of Councilor shall be filled by a majority vote of Council until the following election at which time the interim Councilor may stand for a full three year nonrenewable term.

BYLAW 6. *Committees*

Section 1. *Standing Committees*. Standing committees shall include but not be limited to, the following: Editorial, Education, Denison Award, Necrology, Nominating, Resolution, Membership, and Audit Committees. The President shall appoint members of committees other than the Nominating and Audit Committees.

Section 2. *Editorial Committee*. The Editorial Committee shall consist of three regular members appointed to three year terms. The duties are explained in BYLAW 7 (Publications).

Section 3. *Education Committee*. The Education Committee shall consist of five regular members and two high school teachers appointed to five year terms. The Education Committee shall work with high school students and teachers in the state, in visitation programs, Science Talent Search programs, and other programs to stimulate an interest in science by the youth of the state. It shall operate the Junior Academy of Science program and administer the AAAS high school research program.

Section 4. *Denison Awards Committee*. The Denison Awards Committee shall consist of six regular members appointed to three year terms. The Denison Awards Committee shall have as its prime duty the judging of student research and paper competitions, both undergraduate and graduate, and any other similar competitions. The committee shall also maintain the criteria to be used in the judging and selection of papers, such criteria to be circulated to prospective competitors.

Section 5. *Necrology Committee*. The Necrology Committee shall consist of three regular members appointed to three year terms. The Necrology Committee shall report to the annual meeting on those deceased during the preceding year. Obituaries may be included in the minutes of the annual meeting and/or published in the Proceedings.

Section 6. *Nominating Committee*. The Nominating Committee shall consist of the five most recent past-presidents. The major duties of the Nominating Committee are listed in BYLAW 5 (*Appointment, Nomination and Election of Members of Council*). The Nominating Committee will also administer the selection process, develop a separate funding source for a monetary award, and develop, for Executive Committee approval, the criteria for the North Dakota Academy of Science Achievement Award.

Section 7. *Resolution Committee*. The Resolution Committee shall consist of three regular members appointed to three year terms. The Resolution Committee shall prepare such resolutions of recognition and thanks as appropriate for the annual meeting. Further, the Committee shall receive suggested resolutions for the membership and transmit such resolutions and the Committee recommendation to the membership.

Section 8. *Membership Committee*. T he Membership Committee shall consist of unlimited numbers of regular members appointed annually.

Section 9. *Audit Committee*. The Nominating Committee shall appoint on a yearly basis one member who is not a member of Council to conduct at least one internal audit per year.

Section 10. *State Science Advisory Committee*. The State Science Advisory Committee (SSAC) shall consist of five regular or emeritus members appointed to four year terms. The SSAC shall serve to direct questions of a scientific nature to the appropriate expert as requested, shall inform regional granting agencies and state and national science policymakers of its expertise and availability and shall counsel those agencies and persons upon their request. The SSAC shall adhere in particular to the guidelines described in Article V, Section 2 of the Constitution.

Section 11. *Ad hoc Committees*. The President may appoint such additional committees as may be needed to carry out the functions of the Academy. Ad hoc committees serve only during the tenure of the president who appointed them. Reports of ad hoc committees shall be presented to Council or to the annual meeting.

BYLAW 7. *Publications*

Section 1. *Editorial Committee*. Three regular members are appointed to the Editorial Committee for renewable three year terms. The Editorial Committee shall develop and recommend the Academy publication program and policies to the Council. It will assist the Editors of each official publication in reviewing manuscripts for those publications that include the *Proceedings*. Chairs of symposia will review manuscripts written for relevant symposia.

Section 2. *Managing Editor*. The Secretary-Treasurer shall serve as the

Section 3. *Editor*. Editors shall serve three year terms. The Editors shall edit all official publications of the Academy including the *Proceedings*.

BYLAW 8. *Memorial Fund*

The Council of the Academy shall establish a J. Donald Henderson Memorial Fund and administer this fund so that the proceeds will be used to promote science in North Dakota.

BYLAW 9. *Fiscal Year*

The fiscal year of the North Dakota Academy of Science, for the purpose of financial business, shall be 1 January to 31 December.

BYLAW 10. *Achievement Award*

The Academy establishes the North Dakota Academy of Science Achievement Award to be given periodically to an Academy member in recognition of excellence in one or more of the following:
a. Nationally recognized scientific research.
b. Science education.
c. Service to the Academy in advancing its goals.
The Nominating Committee will administer the selection process, will develop a separate funding source for a monetary award, and will develop, for Council approval, the criteria for the award.

BYLAW 11. *Research Foundation*

The **North Dakota Science Research Foundation** is established as an operating arm of the Academy. The purposes of the Foundation are:
(1) to receive funds from grants, gifts, bequests, and contributions from organizations and individuals, and (2) to use the income solely for the making of grants in support of scientific research in the State of North Dakota. Not less than 50% of the eligible monies received shall be placed in an endowment from which only the accrued interest shall be granted.

The foundation shall be responsible for soliciting the funds for the purposes described. The Foundation funds shall be in the custody of the Secretary-Treasurer of the Academy and shall be separately accounted for annually. The Foundation Board of Directors shall be comprised of five members of the Academy, representing different disciplines. Members shall be appointed by the President of staggered five year terms. The chairperson of the Board shall be appointed annually by the President. The Board shall be responsible for developing operating procedures, guidelines for proposals, evaluation criteria, granting policies, monitoring procedures, and reporting requirements, all of which shall be submitted to the Executive Committee for ratification before implementation.

The Foundation shall present a written and oral report to the membership of the Academy at each annual meeting, and the Secretary-Treasurer shall present an accompanying financial report.

BYLAW 12. *Affiliations*

The Academy may affiliate itself with other organizations which have purposes consistent with the purposes of the Academy. Such affiliations must be approved by the Council and by a majority of those attending a regularly scheduled business meeting of the membership.

BYLAW 13. *Indemnification*

Section 1. Every member of the Council or employee of the North Dakota Academy of Science shall be indemnified by the Academy against all expenses and liabilities, including counsel fees, reasonably incurred or imposed upon him/her in connection with any proceedings to which he or she may be made part, or in which he or she may become involved, by reason of being or having been a member of the Council, or employee at the time such expenses are incurred, except in such cases wherein the member of the Council or employee is adjudged guilty of willful misfeasance or malfeasance in the performance of his or her duties. Provided, however, that in the event of a settlement of the indemnification herein shall apply only when the Council approves such settlement and reimbursement as being for the best interests of the Academy. The foregoing right of indemnification shall be in addition to and not exclusive of all other rights to which such members of the Council or employee may be entitled.

Academy Officers and Committees

Executive Committee Membership
President
Past-President
President-Elect
Secretary-Treasurer (three-year term)
Councilors (three-year terms)

President
Jerzy Bilski
Math, Science and Technology
Rhoades Science Center 203
Valley City State University
Valley City, ND 58072
701-845-7453
jerzy.bilski@vcsu.edu

President-Elect

Past-President
L. Keith Henry
Department of Pharmacology, Physiology & Therapeutics
501 N Columbia Rd, stop 9037
Grand Forks ND 58202
(701) 777-2295
keith.henry@med.und.edu

Secretary-Treasurer
Paul Lepp (2010-2013)
Department of Biology
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Councilors
Christopher Beachy (2010-2013)
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Ronald Jyring (2010-2013)
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PO Box 5587
Bismarck, ND 58506
701-224-5459
Ronald.Jyring@bsc.nodak.edu

Vacant

Committees of the North Dakota Academy of Science

Executive Committee*
Editorial Committee*
Education Committee*
Denison Awards Committee*
Necrology Committee*
Nominating Committee*
Resolution Committee*
Membership Committee*
North Dakota Research Foundation Board of Directors*
Historian*

*indicates available openings

PAST PRESIDENTS AND THE LOCATIONS

OF THE ANNUAL MEETING OF THE NORTH DAKOTA ACADEMY OF SCIENCE

1909	M A Brannon	Grand Forks
1910	M A Brannon	Fargo
1911	C B Waldron	Grand Forks
1912	L B McMullen	Fargo
1913	Louis VanEs	Grand Forks
1914	A G Leonard	Fargo
1915	W B Bell	Grand Forks
1916	Lura Perrine	Fargo
1917	A H Taylor	Grand Forks
1918	R C Doneghue	Fargo
1919	H E French	Grand Forks
1920	J W Ince	Fargo
1921	L R Waldron	Grand Forks
1922	Daniel Freeman	Fargo
1923	Norma Preifer	Grand Forks
1924	O A Stevens	Fargo
1925	David R Jenkins	Grand Forks
1926	E S Reynolds	Fargo
1927	Karl H Fussler	Grand Forks
1928	H L Walster	Fargo
1929	G A Talbert	Grand Forks
1930	R M Dolve	Fargo
1931	H E Simpson	Grand Forks
1932	A D Wheedon	Fargo
1933	G C Wheeler	Grand Forks
1934	C I Nelson	Fargo
1935	E A Baird	Grand Forks
1936	LR Waldron	Fargo
1937	J L Hundley	Grand Forks
1938	P J Olson	Fargo
1939	ED Coon	Grand Forks
1940	J R Dice	Fargo
1941	F C Foley	Grand Forks
1942	F W Christensen	Fargo
1943	Neal Weber	Grand Forks
1944	E A Helgeson	Fargo
1945	W H Moran	Grand Forks
1946	J A Longwell	Fargo
1947	A M Cooley	Grand Forks
1948	R H Harris	Fargo
1949	R B Winner	Grand Forks
1950	R E Dunbar	Fargo
1951	A K Saiki	Grand Forks
1952	Glenn Smith	Fargo
1953	Wilson Laird	Grand Forks
1954	C O Clagett	Fargo
1955	G A Abbott	Grand Forks
1956	H B Hart	Jamestown
1957	W E Comatzer	Grand Forks
1958	W C Whitman	Fargo
1959	Arthur W Koth	Minot
1960	H J Klosterman	Fargo
1961	Vera Facey	Grand Forks
1962	J F Cassel	Fargo
1963	C A Wardner	Grand Forks
1964	Fred H Sands	Fargo
1965	P B Kannowski	Grand Forks
1966	Paul C Sandal	Fargo
1967	F D Holland, Jr	Grand Forks
1968	W E Dinusson	Fargo
1969	Paul D Leiby	Minot
1970	Roland G Severson	Grand Forks
1971	Robert L Burgess	Fargo
1972	John C Thompson	Dickinson
1973	John R Reid	Grand Forks
1974	Richard L Kiesling	Fargo
1975	Arthur W DaFoe	Valley City
1976	Donald R Scoby	Fargo
1977	Om P Madhok	Minot
1978	James A Stewart	Grand Forks
1979	Jerome M Knoblich	Aberdeen, SD
1980	Duane O Erickson	Fargo
1981	Robert G Todd	Dickinson
1982	Eric N Clausen	Bismarck
1983	Virgil I Stenberg	Grand Forks
1984	Gary Clambey	Fargo
1985	Michael Thompson	Minot
1986	Elliot Shubert	Grand Forks
1987	William Barker	Fargo
1988	Bonnie Heidel	Bismarck
1989	Forrest Nielsen	Grand Forks
1990	David Davis	Fargo
1991	Clark Markell	Minot
1992	John Brauner	Grand Forks
1993	John Brauner	Jamestown
1994	Glen Statler	Fargo
1995	Carolyn Godfread	Bismarck
1996	Eileen Starr	Valley City
1997	Curtiss Hunt	Grand Forks
1998	Allen Kihm	Minot
1999	Joseph Hartman	Grand Forks
2000	Mark Sheridan	Moorhead, MN
2001	Ron Jyring	Bismarck
2002	Jody Rada	Grand Forks
2003	Richard Barkosky	Minot
2004	Anna Grazul-Bilska	Fargo

2005	Holly Brown-Borg	Grand Forks
2006	Andre Delorme	Valley City
2007	Chris Keller	Minot
2008	Van Doze	Grand Forks
2009	Birgit M Prüβ,	Fargo
2010	Paul W. Lepp	Minot
2011	Lyle Best	Belcourt
2012	Michael A. Bingle-Davis	Wyoming
2013	Keith Henry	Grand Forks

MINUTES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

ANNUAL BUSINESS MEETING 2013

President Lepp convened the annual business meeting at the Alerus Center in Grand Forks, North Dakota on April 26, 2013 at 4:00 PM. President Lepp welcomed all and thanked them for their attendance.

There was no old business to complete.

Dr. Doug Munski was elected as a councilor. He will search for records on lifetime members. he will also work to bring in more scientist from earth science, geography, social sciences and economics. In addition, Dr. Laura Munski is an NDAS member who works in STEM with the Dakota Science Center. Both are willing to connect NDAS more with the ND State Sceince and Engineering Fair.

Current councilors are:

Joseph Hartman, University of North Dakota, 3 year term

Lyle Best, Turtle Mountain Community College, 1 year term

Renaelle Ivens, Minot State University, student councilor

Secretary-elect: Bryan Schmidt

Education Committee: Dr. Doug Munski

Dennison Award Committee: Dr. Joseph Hartman, Dr. Paul Lepp

Nominating Committee – according to the bylaws this committee is filled by the five most recent past presidents

Resolutions Committee – Kaylee Dockter, Joel Collins and Dr. Paul Lepp.

Research Foundation Board of Directors – Birgit Pruess, Jerzy Bilski, Paul Lepp, two vacancies

Historian – Alexey Shipunov

Dr. Ron Jyring stateed that traditionally the lifetime membership fees went to either the Scholarship fund or the Reasearch Foundation. We was not sure which.

The Spero Manson Native American Travel award was established with the donated speaker honorarium. The award will be spread over two years and could be used to cover membership, registration and a plaque. Motion put forth by Dr. Birgit Pruess and seconded by Dr. Ron Jyring. Motion carried.

Dr. Paul Lepp presented the NDAS budget:

$7074 checking

$5437 paypal

$510 scholarship fund

1069 shares of Sempra Energy worth approximately $52,000 in the Research Foundation Fund.

Dr. Lepp encourage the establishment of an audit committee. Dr. Doug Munski moved that the councilors look at the books on an annual basis. Dr. Chris Keller seconded the motion. Motion carried.

Dr. Lepp moved that the Research Foundation Board of Directors discuss over the next year what to do with the scholarship money and Research Foundation monies. The minutes do not indicate whether the motion was seconded or carried.

Dr. Alexey Shipunov volunteered to help with the website.

Meeting statistics: 50 Registered attendees

14 Professionals

26 Graduate Students

10 Undergraduate Students

0 Vendors

We had 6 professional talks, 26 Denison graduate student talks and 10 Denison undergraduate student talks. The Denison Awards were presented by President Lepp. The award winners were:

Denison Undergraduate Award			Denison Graduate Award		
Winner	Marcus Wilson	$200	2nd runner-up	Katie Collette	$100
Winner	Kathy Mok	$200	2nd runner-up	Danielle Pinsonneault	$100
			2nd runner-up	Brianna Goldenstein	$100
			Winner	Elliot Welker	$200

Dr. Jerzy Bilski invited everyone to attend next year's meeting in Valley City, ND.

Meeting adjourned at 5:00 pm.

Respectfully submitted,

Paul Lepp, Secretary-Treasurer

Lifetime Members

F. D. “Bud” Holland
Ron Jyring
Allen Kihm