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OFFICERS AND MEMBERS OF THE EXECUTIVE COMMITTEE

EDITOR

102nd Annual Meeting

April 23, 2010

Minot, North Dakota

Minot State
UNIVERSITY

Office of the President

Dear Members of the North Dakota Academy of Science:

President Lepp and members of the Academy, I write on behalf of our faculty, staff, and students at Minot State University to welcome you to the 102nd annual meeting of the North Dakota Academy of Science. It is an honor to host this annual meeting at Minot State and to show our strong support of the Academy and its stated purposes, "to promote and conduct scientific research and to diffuse scientific knowledge." I am particularly pleased to express my high regard for your commitment to research and teaching—a commitment all of us share.

From the time Abraham Lincoln authorized the National Academy of Sciences in 1863 and since the start of the North Dakota Academy of Sciences more than 100 years ago in 1908, our country has benefitted greatly from your commitment to scientific research and study. I was interested recently to review the NDAS April 2009 Proceedings, and to see the wide array of research articles from across the state, including those authored by many of our own Minot State University scientists.

Our university holds in the highest regard the work of our scientists, the impact of INBRE, our faculty commitment to involve our students in research, and the way they uphold the critical role of science at a time in which anecdotes and unsubstantiated opinions continue unfortunately to affect public policy. Recently I heard a conference speaker attempt to debunk the fear of global warming by concluding that it must not be occurring since there are five feet of snow on our driveways. We must depend less on casual observation and more on the well-grounded research of scientists to guide our responsible actions. Along that line, I understand that Congress has requested from the NAS academies research on climate change, and in response the academies have initiated a host of research studies to "inform and guide responses to climate change across the nation." This critical topic and many others facing our world must depend on your research and the training you provide to our students.

Best wishes to all of you for a productive meeting and a pleasant visit to our campus and our community of Minot. I am very pleased to have you as our guests on the Minot State University campus.

Sincerely,

David Fuller

President

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EDITOR'S NOTES

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. Commencing with Vol. 51 submissions were on computer disk; the *Proceedings* was then assembled with desktop publishing software. This approach allows the Editor to format papers so as to assure the *Proceedings* a consistent look. This method also produces an electronic copy of the *Proceedings;* the Secretary-Treasurer has the capability to generate electronic copies of past issues.

VOLUME 64 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 91.

SYMPOSIA COMMUNICATIONS

Commencing with the 88th Annual Meeting [Vol. 50], Symposia presenters at annual meetings have had opportunity to contribute full-length articles or multiple-page contributions, thus providing much greater depth and coverage than that ordinarily possible. Speakers have presented educationally-oriented lectures and workshop discussions, and have still provided rigorous, more technical professional papers to the *Proceedings.*

COLLEGIATE AND PROFESSIONAL COMMUNICATIONS

Each Collegiate and Professional presentation at the annual meeting is represented by a Communication. Designed as more than a typical abstract but less than a full paper. Communications report results and conclusions, and permit sharing of important data and conclusions. Crucially, they provide for timeliness and ease of production.

CONSTITUTION AND BYLAWS

This issue of the Proceedings also contains the Constitution and Bylaws of the Academy, a list officers and committee members. We're working on maintaining a list of dues-paying members of the Academy (we'd appreciate your help in building and adding to this list with names of new and prospective members), a listing of past presidents of the Academy, and an index of presenters and paper authors. Copies of the financial statement and the unapproved minutes from last year's annual business meeting will be available at the business meeting.

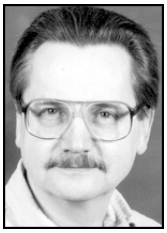
IN APPRECIATION

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 will accompany 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. The President of the Academy also wishes to sincerely thank Steven Kunkel who served as honored guest speaker at this year's meeting.

Paul Lepp,
President

Siegfried Detke,
Secretary-Treasurer

IN MEMORIAM SIEGFRIED DETKE



This past winter saw the passing of a beloved and long-time member of the North Dakota Academy of Science. Siegfried Detke died on January 13, 2010 in Grand Forks.

Siegfried was as associate professor in the Department of Biochemistry and Molecular Biology at The University of North Dakota (UND) School of Medicine and Health Sciences. He taught basic biochemistry and molecular biology to medical, graduate and undergraduate students. Whether in the classroom or mentoring in the lab he was by all accounts an exceptional teacher who inspired both his students and his colleagues.

Born in Bobingen Germany in 1951 he grew up in Lakewood, Ohio, just outside of Cleveland. Siegfried earned a B.S. in Biology from Case Western Reserve University and his Ph.D. in Biochemistry from Colorado State University in Fort Collins. He completed postdoctoral fellowships at the University of Florida and the University of Chicago Medical School before joining the faculty at UND.

In a respected academic career that spanned more than 30 years, Siegfried's research focused on the mechanism of multidrug resistance in *Leishmania mexicana amazonensis*; a protozoan parasite that infects an estimated 12 million people worldwide. This followed upon earlier work investigating the role of DNA-dependent RNA polymerase in the protozoan *Acanthamoeba castellanii.*

Siegfried served as the Secretary-Treasurer for the North Dakota Academy of Science from 2006 until his death. During his tenure he brought many innovations to his role as Secretary-Treasurer, including the development of a NDAS website, establishment of any online payment system, and numerous updates to the Academy's bylaws. He also provided invaluable guidance and advice to new Academy presidents.

In addition to his long-time membership in the North Dakota Academy of Science he was a member of the American Association for the Advancement of Science and the American Society of Microbiology.

Dr. Detke is survived by his wife of 36 years, Jan Detke of Grand Forks; two sons, Karl of San Diego, Calif. and Kyle of Lincoln, Nebr.; his parents, Emil and Anna; two sisters, Sigrid (Rick) Straka and Heidi Detke, all of Daytona Beach, Fla.; and sister, Eleanor Detke of Cleveland.

SCHEDULE

Summary Schedule

Time		Missouri room	Metigoshe room	Audubon room
8:00 AM	8:50 AM	Breakfast, Registration	--	--
8:50 AM	9:00 AM	Welcome	--	--
9:00 AM	9:20 AM	--	Azure	Wise
9:20 AM	9:40 AM	--	Uran	Bommersbach
9:40 AM	10:00 AM	-	Bathula	Chen
10:00 AM	10:20 AM	-	Best	Hartman
10:20 AM	10:40 AM	Break	--	--
10:40 AM	11:00 AM	--	Burbach	Strating
11:00 AM	11:20 AM	--	Dhawan	Goldstein
11:20 AM	11:40 AM	--	Henry	Keller
11:40 AM	1:00 PM	Lunch	--	--
1:00 PM	1:20 PM	--	Sansaver	Cooley
1:20 PM	1:40 PM	--	DeLong	Mertes
1:40 PM	2:00 PM	--	Nelson	Schumaker
2:00 PM	2:20 PM	--	Lepp	Pani
2:20 PM	2:40 PM	break	--	--
2:40 PM	3:00 PM	--	MeLean	Dissette
3:00 PM	3:20 PM	--	Gates	Lichtenberger
3:20 PM	3:40 PM	--	Zhao	Weiler
3:40 PM	4:00 PM	break		
4:00 PM	5:00 PM	Awards Ceremony, NDAS elections, etc		
5:00 PM	7:00 PM	dinner- Carnegie Center		
7:00 PM	8:00 PM	Guest Speaker – Lin Chao		
8:00 PM	9:00 PM	Social Hour		

METIGOSHE ROOM SCHEDULE OF PRESENTATIONS

MORNING SESSION

9:00 am ALPHA-2 ADRENERGIC RECEPTOR-MEDIATED ANTIEPILEPTIC AND SEDATIVE EFFECTS IN MICE. JoLynn Azure, Shyleen Poitra, Chris Jurgens, Raelene Charbeneau, Xinyan Huang, Richard Neubig, Van Doze

9:20 am RAPID SYNTHESIS OF N-[1-(1-NAPHTHYL)ETHYL] FORMAMIDE. Luke Uran, Mikhail M. Bobylev

9:40 am PLEIOTROPIC ROLE OF METALLOTHIONEIN-3 (MT-3) IN HUMAN PROXIMAL TUBULE (HPT) CELLS DIFFERENTIATION. Chandra S Bathula, Seema Somji, Donald A. Sens, Mary Ann Sens, Jane R. Dunlevy[3], John B. Shabb, and Scott H. Garrett.

10:00 am GENES ASSOCIATED WITH IMMUNE RESPONSE AND RISK OF PRE-ECLAMPSIA IN AN AMERICAN INDIAN POPULATION. Lyle G. Best, Kylie Davis, Shellee Bercier, Cindy M. Anderson, PhD.

10:20 am Break

10:40 am MUTATION OF AN ASPARAGINE IN THE FIRST TRANSMEMBRANE ALTERS ION-COUPLED SEROTONIN TRANSPORT AND CATION SELECTIVITY IN THE HUMAN SEROTONIN TRANSPORTER. Nathan Burbach, Kristin Pavlish and L. Keith Henry

11:00 am ROLE OF OLIGOMER AB IN TYROSINE-KINASE DEPENDANT STIMULATION OF MICROGLIA *IN-VIVO.* Gunjan Dhawan and Colin.K.Combs

11:20 am IDENTIFICATION OF AN ASPARAGINE RESIDUE IN THE SEROTONINNEUROTRANSMITTER TRANSPORTER ESSENTIAL FOR CHLORIDECOUPLED NEUROTRANSMITTER TRANSPORT. L. Keith Henry,Hideki Iwamoto, Julie R. Field, Kristian Kaufmann, Eric S. Dawson,Miriam T. Jacobs, Chelsea Adams, Bruce Felts, Vanessa Armstrong, Gary Rudnick, LouisJ. DeFelice, Jens Meiler & Randy D. Blakely

11:40 am Lunch (Missouri Room)

AFTERNOON SESSION

1:00 pm RAPID SYNTHESIS OF N-METHYL-N-PIPERONYLFORMAMIDE. Jaclyn M. M. Sansaver and Mikhail M. Bobylev

1:20 PM GENERATION OF SOYBEAN FEEDSTOCK FOR HIGH OLEIC ACID CONTENT. Hardy Delong, Janelle Berthold, Katelyn Peters, And Khwaja Hossain

1:40 PM RGS7 PROTEIN SUPPRESSION MODULATES CA3 EPILEPTIFORM ACTIVITY. Brian Nelson, Brianna Goldenstein, Ke Xu, Elizabeth Luger, Jacqueline Pribula, Jenna Wald, Lorraine O'Shea, Xinyan Huang, Richard Neubig, Van Doze

2:00 PM MICROBIAL DIVERSITY OF THE HUMAN ORAL ECOSYSTEM. Paul Lepp

2:20 PM BREAK

2:40 PM REVEGETATION OF COAL FLY ASH (FA) BY SELECTED CEREAL CROPS. Kyle McLean, Erin McLean, Mardee Lander and Jerzy Bilski

3:00 PM SELECTION OF COMMON BEAN GENOTYPES FOR HEALTH RELATED ATTRIBUTES. Lori Gates, Janelle Berthold, Masum Akond, and Khwaja Hossain

3:20 PM PHOTOTOXICITY OF FLUORESCENT SILICA NANOPARTICLES. Yang Zhao, Yuhui Jin, Min Wu, Julia Xiaojun Zhao

3:40 PM BREAK

AUDUBON ROOM SCHEDULE OF PRESENTATIONS

MORNING SESSION

9:00 am PREY CAPTURE KINEMATICS IN THE OPISTHOGLYPH COLUBRID *BOIGA IRREGULARIS*. Justina D. Wise, Alexandra Deufel and Stephen Mackessy

9:20 am EXAMINATION OF AGE AND LENGTH OF THE MUSSEL *PYGANODON GRANIDS* FROM THREE DIFFERENT WATER BODIES IN NORTH DAKOTA. Adam J. Bommersbach, Louis M. Wieland, And Andre W. Delorme

9:40 am DEVELOPMENT OF METAL-ENHANCED FLUORESCENT NANOCOMPOSITES FOR STUDYING OF EFFECTS OF METALLIC NANOSTRUCTURES ON PROPERTIES OF FLUORESCENT MOLECULES. Jiao Chen, Yuhui Jin, Julia Xiaojun Zhao

10:00 am THE COMPLEX TAXONOMY OF A COMMON CRETACEOUS-PALEOGENE CROSSING SPECIES. Joseph H. Hartman

10:20 am Break

10:40 am PHYSICAL AND CHEMICAL PROPERTIES OF GOLD NANORODS FOR THE OPTIMIZATION OF THEIR SURFACE PLASMON RESONANCE. Shaina Strating, Kali Shephard, Carrie John and Julia Zhao

11:00 am α_{1A} ADRENERGIC RECEPTORS ENHANCE NEUROGENESIS, LEARNING & MEMORY, AND ALLEVIATE DEPRESSION AND ANXIETY IN ADULT MICE. Brianna L. Goldenstein, Mariaha J. Lyons, Katie M. Collette, Sarah Wood, Brian W. Nelson, Ruby Fagerlie, James Haselton, Dianne M. Perez & Van A. Doze

11:20 am INDUCTION OF LEAF EXPANSION IN ARABIDOPSIS BY INDOLE-3-ACETIC ACID: THE ROLE OF WOUNDING AND LEAF DETACHMENT. Christopher P. Keller

11:40 am Lunch (Missouri Room)

AFTERNOON SESSION

1:00 pm A SPECIES-SPECIFIC ANALYSIS OF THE SEROTONIN NEUROTRANSMITTER TRANSPORTER. THE ROLE OF "OUTER-GATE" SALT-BRIDGE RESIDUES IN RECOGNITION OF THE DRUG OF ABUSE ECSTASY. Jacob Cooley. Bruce Felts, Eric L. Barker And L. Keith Henry

1:20 PM EXAMINATION OF SPECIES DIVERSITY AND POPULATION DENSITIES OF UNIONID MUSSELS IN THE SHEYENNE RIVER. Jacob T. Mertes. Louis M. Wieland, Gerald L. Van Amburg, Andre W. DeLorme

1:40 PM THE FOSSIL CARNIVORES OF THE TURTLE BUTTE ASSEMBLAGE (ARIKAREEAN), TRIPP COUNTY, SOUTH DAKOTA. Karew K. Schumaker. Matthew W. Weiler, and Rebecca Simmons

2:00 PM MOLECULAR INTERPLAY OF 'STIM1-TRPC1-CAVEOLIN1' ORCHESTRATE EPITHELIAL CELL PROLIFERATION. Biswaranjan Pani and Brij B. Singh

2:20 PM BREAK

2:40 PM AMELIORATION OF COAL FLY ASH (FY) BASED PLANT GROWTH MEDIA BY USING SPHAGNUM PEAT MOSS (SPM). Nadine Dissette, Kyle Mclean, Erin Mclean, Fakira Soumaila, Felix Kyei-Asare, Chinedu Ilogu And Jerzy Bilski

3:00 PM LIFE HISTORY OF THE WOOD FROG, *LITHOBATES SYLVATICA*, IN NORTHWESTERN NORTH DAKOTA. Kay Lichtenberger, Christopher K. Beachy, Joshua Sweet, and Kenneth C. Cabarle

3:20 PM PALEONTOLOGY AND GEOLOGY OF THE FORT RANDALL FORMATION AT FEYEREISEN GAP, GREGORY COUNTY, SOUTH DAKOTA. Matthew W. Weiler

3:40 PM BREAK

UNDERGRADUATE COMMUNICATIONS

IN THE

A. ROGER DENISON COMPETITION

(communications are listed alphabetically)

ALPHA-2 ADRENERGIC RECEPTOR-MEDIATED ANTIEPILEPTIC AND SEDATIVE EFFECTS IN MICE

JoLynn Azure[1*], Shyleen Poitra[1], Chris Jurgens[2], Raelene Charbeneau[3], Xinyan Huang[3], Richard Neubig[3], Van Doze[2]

[1]Departments of Pathology and [2]Pharmacology, Physiology & Therapeutics, University of North Dakota, Grand Forks, ND; [3]Department of Pharmacology, University of Michigan, Ann Arbor, MI.

Epilepsy is one of the most common neurological disorders in the world. It is characterized by recurrent seizures unprovoked by any immediately identifiable cause. Unfortunately, not only are current treatment options limited, but most of the antiepileptic drugs have severe adverse effects. Norepinephrine (NE) has been long known to possess potent antiepileptic properties. The mechanisms underlying this action are largely unknown. However, evidence indicates the antiepileptic effect is mediated, in part, through an alpha 2A adrenergic receptor (α2A AR). In addition to possessing antiepileptic properties, α2A ARs are also known to produce powerful sedative effects. The α2A ARs mediate their actions through G proteins, most prominently Gαo and Gαi. It is thought that Gαo modulates calcium channels and inhibits presynaptic neurotransmitter release. Gαi2 , in contrast, is believed to primarily regulate potassium currents which occur both pre- and post-synaptically. These G proteins are, in turn, regulated by GTPase-accelerating RGS proteins. We have evidence suggesting that a presynaptic α2A AR inhibits glutamatergic release in the pyramidal cell recurrent collaterals of the hippocampal CA3 region, effectively reducing seizures. Furthermore, we have shown Gαo to be involved in this response. In vivo evidence suggests that these results may have important implications for the treatment of seizures.

Supported by NSF 0347259, NSF0851869, NIH 5RO1GM039561and NIH P20RR0167141.

EXAMINATION OF AGE AND LENGTH OF THE MUSSEL *PYGANODON GRANIDS* FROM THREE DIFFERENT WATER BODIES IN NORTH DAKOTA

Adam J. Bommersbach[1]*, Louis M. Wieland[1], and Andre W. DeLorme[1]

[1]Department of Biology, Valley City State University, Valley City, ND 58072

Introduction

During our two years of sampling mussels in North Dakota rivers we noticed that individuals of a certain species of mussel, *Pyganodon grandis,* from the upper James River seemed to be much larger than those found in other water bodies, especially the nearby Sheyenne River. This difference in size could be due to several factors. First, this particular population of mussels may be older and thus larger than other populations. Second, the water body the mussels are living in may have a higher nutrient value, and finally this population may have some genetic differences, since the James and Sheyenne rivers are from different major watersheds, that lead to a larger size. The purpose of this project was to examine the rate of growth *P. grandis* taken from three distinct geographical locations in North Dakota; the upper Sheyenne River, the James River, and the McClusky Canal; and use this information to investigate our first scenario - they are larger because they are older.

Methods

Samples of 25-30 live *P. grandis* were collected from each of the three locations in the summer of 2009. Mussels were measured, cleaned, and catalogued. One side of each shell was thin sectioned using a Buehler Isomet Low-Speed saw. A dissecting microscope with a camera and photo editing software was used to create a composite picture of each section. These pictures were used to determine the number of growth rings in each shell thin section. The length of mussels was correlated with number of growth rings. In addition we examined average shell size of mussels from various water bodies.

Results

Our correlations showed that the mussels in the James did not have more growth rings and therefore are not appreciably older. For example, there were four mussels from the James and four mussels from the Sheyenne that had 15 growth rings, and so are assumed to be the same age. The four mussels from the James had an average length of 16.0 cm, the four from the Sheyenne had an average size of 9.1 cm.

Discussion

Our results allow us to eliminate our first hypothesis, that the mussels were larger because they were older. Of the other two hypotheses, examining average mussel sizes for other species also shows a larger size in the James River. Since it is unlikely that several species would all be genetically predisposed to be larger in the James drainage, it is most likely that nutrient content of the river plays a role in the large size of the organisms. However, further research would be needed to verify this conclusion.

This project was funded by a State Wildlife Grant from the North Dakota Game and Fish Department

MUTATION OF AN ASPARAGINE IN THE FIRST TRANSMEMBRANE ALTERS ION-COUPLED SEROTONIN TRANSPORT AND CATION SELECTIVITY IN THE HUMAN SEROTONIN TRANSPORTER.

Nathan Burbach[1]*, Kristin Pavlish[1] and L. Keith Henry[1]

[1]Department of Pharmacology, Physiology and Therapeutics
University of North Dakota School of Medicine and Health Sciences, Grand Forks, North Dakota 58201

The serotonin neurotransmitter transporter (SERT) like the norepinephrine (NET) and dopamine (DAT) transporters is a member of the Na^+- and Cl^--dependent SLC6 transporter family and is the target of several drugs of abuse as well as clinically important antidepressants. Serotonin (5-HT) transport via SERT functions to terminate synaptic serotonergic transmission and is energetically coupled to the inwardly-directed electrochemical gradients of Na^+ and Cl^-. However, the process by which 5-HT movement is coupled to the Na^+ and Cl^- chemiosmotic gradients is poorly understood at the molecular level. Previously, we identified an asparagine residue (N101) in transmembrane domain 1 of SERT that upon replacement with the smaller amino acids, alanine and cysteine, renders the transporter Cl-independent. The study presented here suggests that in contrast to native SERT, N101 mutants lack the strict requirement for Na^+ to drive 5-HT translocation. Interestingly, transport of 5-HT by wildtype SERT does not occur in the absence of Na^+ even at very high 5-HT concentrations. However, SERT N101 mutants exhibit a dose-dependent increase in 5-HT translocation in the absence of Na^+ suggesting at least a partial mechanistic uncoupling between substrate movement and the requirement for Na^+. Remarkably, N101 mutants exhibit an increase in basal activity of SERT about 20% above native SERT when Na^+ is removed. Full cation replacement studies suggest this enhanced basal SERT activity is not mediated by cations. To further characterize the altered cation selectivity of the N101 mutants, we are investigating the ability of other cations (e.g., K^+, Ba^{2+}, Mg^{2+}, Li^+, $Tris^+$, choline, NH_4^+) to functionally replace Na^+ in the N101 mutants. Preliminary results suggest enhanced transport of 5-HT in the presence of Ca^{2+} when compared to Na^+-free conditions in the N101 mutants. Finally, this study supports the critical role N101 plays in the coordination of ion binding to substrate translocation in SERT and by understanding N101 we hope to gain valuable insight into the transport mechanism.

A SPECIES-SPECIFIC ANALYSIS OF THE SEROTONIN NEUROTRANSMITTER TRANSPORTER. THE ROLE OF "OUTER-GATE" SALT-BRIDGE RESIDUES IN RECOGNITION OF THE DRUG OF ABUSE ECSTASY.

Jacob Cooley*[1], Bruce Felts[1], Eric L. Barker[2] and L. Keith Henry[1]

[1]Department of Pharmacology, Physiology and Therapeutics,
University of North Dakota School of Medicine and Health Sciences, Grand Forks, North Dakota
[2]Department of Medicinal Chemistry and Molecular Pharmacology,
Purdue University School of Pharmacy, West Lafayette, Indiana

Previous studies have identified a clear discrepancy in recognition of MDMA (club drug 'ecstasy')by the serotonin transporters (SERT) from different species. Specifically, the human SERT (hSERT) readily recognizes and transports MDMA (and MDMA analogs) whereas MDMA shows almost no interaction with the *Drosophila melanogaster* SERT (dSERT) and *Caenorhabditis elegans* SERT (CeSERT). This clear species-specific distinction in MDMA recognition would be mediated at the molecular level due to amino acid differences between hSERT, dSERT and CeSERT. Recently, it has been reported that an arginine-aspartate salt bridge which is proposed to form the outer gate of the transporter could play a critical role in MDMA recognition. Using species selective mutagenesis and biochemical methodologies, we will take advantage of this pharmacological distinction between these species to identify the molecular determinants for MDMA binding and translocation.

GENERATION OF SOYBEAN FEEDSTOCK FOR HIGH OLEIC ACID CONTENT

Hardy DeLong[1]*, Janelle Berthold[1], Katelyn Peters[1], and Khwaja Hossain[1]
[1]Mayville State University, Mayville, ND

Soybean (*Glycine max* L. Merrill) is the leading source of vegetable oil and protein meal and has been extensively used in producing biodiesel blend fuels. The five major fatty acids in soybean oil are palmitic (11%), stearic (4%), oleic (25%), linoleic (52%), and linolenic (8%) (1). High oleic acid (C18:1) in soybean seed is expected to increase oxidative potential and the yield of aromatic based chemicals suitable for hydrocracking. There are several efforts in increasing the oleic acid contents by genetic mutation in soybean lines. As much as 60% oleic acid content has been identified in the southern states. However, oleic acid as well as oil content reduces significantly in northern states due to shorter duration of growing period and low temperature (2). Our goal was to develop ND soybean feedstock with high content of oleic acid.

Several reverse genetic strategies have been successfully used for functional genomics in animal and plant species including chemical mutagenesis (3). Here, we report the use of TMP (Trimethylpsoralen), a chemical mutagen in generating soybean mutant population for altered fatty acid composition. Initially, we conducted several trails with 100 seeds of North Dakota soybean cultivar "Sheyenne" to find the effective dose for creating mutation in soybean. Seeds were incubated in water for 2 hrs and soaked in a petri dish for 12 hrs. Soaked seeds were incubated for 4, 8, 12, and 16 hrs in TMP solution (24 µg/ml of DMSO) with gentle shaking and UV treated every fourth hour. Each UV treatment consisted of five times at $90X10^4$ µ Joules/cm^2. All seeds were rinsed for 2 hrs under running water before planting in pots filled with 2:1 mixture of sunshine mix and sand. A 45% survival rate was determined with TMP at 24µg/ml for 12hrs and 3 doses of UV treatments were used in generating mutant population. Analyzing fatty acid composition of about 3000 soybean mutants of a ND soybean cultivar, we have identified lines with as high as 28% oleic acid content which is 1.6 times higher that untreated seeds (control).

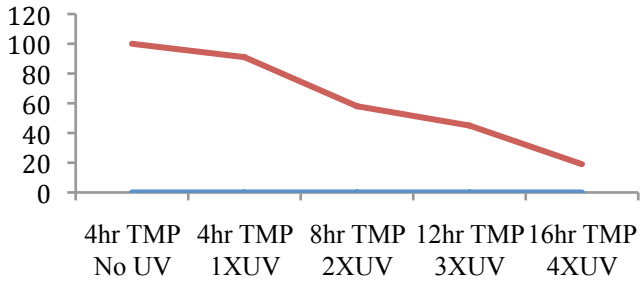


Fig. 1. Effective dose of TMP and UV for generating soybean mutant

Fig. 2. Albino seedling

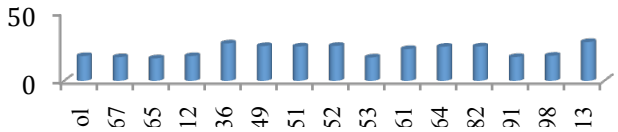


Fig. 3. Distribution of Oleic acid content of some soybean mutants

Conclusions being that soybean mutant with over 22% oleic acid content will be grown in the field and crossed among each other to further increase oleic acid content.

References:

1) Fehr Walter R., 2007. Breeding for Modified Fatty Acid Composition in Soybean, Crop Sci 47:S-72-S-87.
2) Joseph Burton, USDA-ARS, Raleigh, NC., Personal communication
3) Stemple DL. TILLING--a high-throughput harvest for functional genomics. Nat. Rev. 2004;5:145–150.

Acknowledgement: This work was partially supported by the ND Department of Commerce through SUNRISE Bioproducts Center of Excellences and the NIH grant P20 RR016741 from the NCRR.

AMELIORATION OF COAL FLY ASH (FY) BASED PLANT GROWTH MEDIA BY USING SPHAGNUM PEAT MOSS (SPM)

Nadine Dissette*, Kyle McLean, Erin McLean, Fakira Soumaila, Felix Kyei-Asare, Chinedu Ilogu and Jerzy Bilski
Department of Science, Valley City State University (VCSU), Valley City, ND

Besides the use of coal FA for construction purposes, soil amendments are the most extensively studied reutilization option (1). Several studies have shown the usefulness of FA as a soil amendment for growing plants (2, 3). Toxicity of heavy metals present in FY, FA high salinity, and high pH of coal FA may potentially restrict or even prevent plant growth on the media with high concentration of FA (1, 2). The pozzolanic nature of coal FA causes plant growth media to harden, especially in high concentration, thereby making it difficult to grow crops (1). Sphagnum peat moss (SPM) shows a potential to ameliorate coal FA based plant media by improving the texture of such media, making media less harder, decreasing high pH of the media, and potentially binding heavy metals present in FA (4). We hypothesized that addition of SPM to FA will improve growth conditions for selected plants. Therefore, the aim of this experiment was to determine the effects of growth media containing differing concentration of FA and/or SPM on growth of selected plants.

Two selected coal FA, from Montana semi-bituminous coal and from North Dakota lignite, alone or in combination with SPM have been tested as plant growth media (growth media is listed in Table below) for the following plant species: barley (Hordeum vulgare), oats (Avena sativa), rye (Secale cereale), wheat (Triticum aestivum), Regreen; a hybrid between wheatgrass (*Agropyron cristatum*) and winter wheat (*Triticum aestivum*), Triticale; a hybrid between wheat (*Triticum aestivum*) and rye (*Secale cereale*),, and perennial ryegrass (Lolium multiflorum).

Plants were grown on Petri dishes (3 replication for each plant species and treatment) for 14-21 days, harvested, dried, and weighed. The data of plant growth has been analyzed statistically using ANOVA and Statistical Analysis System. Table below shows results of the experiment. The concentrations of Ag, Al, As, B, Ba, Be,Ca, Cd, Ce, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Si, Sn, Sr, Ti, V, Zn, and Zr in growth media will be determined, and the concentrations of the same elements in young plants will be analyzed. Chemical analysis will be performed using inductively coupled plasma (ICP) emission spectrophotometry (2).

Mean weight of plants in grams after harvesting on day 14-21 (mean±SEM); P<0.05 values differ within a column				
Medium	Barley	Rye	Jerry Oats	Regreen
100% Soil	0.6±0.1[a]	0.4±0.05[a]	0.6±0.1[a]	1.2±0.2[a]
100% NDSU FA	0.5 ±0.1[a]	0.0	0.1±0.02[b]	0.2±0.03[b]
50% NDSU FA + 50% SPM	0.8±0.2[a]	0.0	0.4±0.1[a]	1.0±0.2[a]
33% NDSU FA + 33% SPM + 33% soil	0.6±0.1[a]	1.0±0.15[b]	0.8±0.2[a]	0.8±0.1[a]
100% VCSU FA	0.0[b]	0.0	0.0	0.0
50% VCSU FA + 50% SPM	0.3±0.05[c]	0.5±0.10[a]	0.2±0.04[b]	0.1±0.02[b]
33% VCSU FA + 33% SPM + 33% soil	0.2±0.03[c]	0.0	0.0	0.1±0.02[b]

Plants didn't grow on VCSU FA, and expressed significant growth restriction on NDSU FA. However, plants growth (except rye) on media consisting of NDSU FA+SPM was similar to control (100% soil). Growth of plants (except rye) on VCSU FA +SPM was less than on control soil. Growth of plants on media consisting of 33% of each NDSU FA/SMP/soil was similar to control, except rye. Growth of plants on 33% of each VCSU FA/SMP/soil was less than in control soil, but rye and oats did not grow on this media. These results demonstrated that the addition of SPM to FA (and soil) can provide beneficial conditions for selected plans, especially for barley and regreen. Thus, SPM shows potential as ameliorative factor for FA utilization as plant growth media.

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Selection of Common Bean Genotypes for Health Related Attributes

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Common bean (*Phaseolus vulgaris* L.) is consumed worldwide and is a staple food in many countries. The role of common beans as functional foods in chronic disease risk reduction has been increasing. It is not only a rich source of micronutrients but also contains compounds with antioxidant properties (Nyambaire et al. 2007). The first essential question regarding whether any species can be improved for a particular trait is to determine the degree of variability which exists for this trait within the species. Evaluation of genetic diversity among adapted and elite germplasm provides predictive estimates of genetic variation among segregating progenies (Manjarrez-Sandoval et al. 1997). Our objectives were 1) to analyze antioxidant activities of common bean genotypes and 2) to select genotypes based on genetic diversity and antioxidant activity for population development.

We analyzed antioxidant activity of 29 common bean genotypes that consist of US grown and CIAT (International Center for Tropical Agriculture) developed genotypes. After harvesting, seeds of each genotype were mixed thoroughly and 10 seeds from each genotype were ground. Three sample extract solutions were prepared from each genotype. For sample extract preparation, one gram ground powder from each genotype was dissolved in 40 ml of 90% methanol in 50 ml plastic tubes. Mixed samples were incubated with shaking for an hour in a 80°C preheated water bath. Solution was cooled down, filtered, and transferred into new sterile 50 ml tubes. Fifty microliters (50 µl) of this solution was diluted with four milliliter distilled water and placed in glass test tubes. The solution was mixed thoroughly with 1 ml phenol reagent for three minutes. One milliliter of 10% sodium carbonate solution was added and the tubes were shaken carefully for a few seconds. In a test tube, 10 µl of extract solution was mixed with 4 ml distilled water and 1 ml 250 µM DPPH (1-1-Diphenyl-2-picrylhydrazl). The mixed solution was left in dark for 30 minutes and spectrophotometric absorbance was measured at 517 nm wavelength. Absorbance data was converted to percent antioxidant activity compared with blank using the formula Antioxidant activity %=(Ablank – Asample/Ablank) x 100.

Total genomic DNA was extracted and purified from leaf tissue of 2- to 3-week-old greenhouse grown plants of all genotypes using the CTAB method. A total of 49 primer pairs from three different sources were used for genetic diversity analysis. After gel electrophoresis of the PCR products the presence or absence of each single fragment was coded by 1 or 0, respectively, and scored for a binary data matrix. The resulting matrix was used to estimate genetic similarity (GS) among all pairs of lines by Dice coefficient of similarity (Nei and Li 1979). Antioxidant activity varied from 17.09% to 36.96%. Based on the antioxidant activity and genetic similarity, we have selected BAT93 (36.96%) to cross with JaloEEP 558 (21.01%) and G122 (25.64%) to cross with A55 (17.52%) to develop populations to map gene(s) responsible for antioxidant activity in the common bean genome. The genetic similarity between Bat93 and JaloEEP 558 was calculated 20% and between G122 and A55 was 44.2%.

Fig 1: Antioxidant activity (%) of common bean.

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LIFE HISTORY OF THE WOOD FROG, *LITHOBATES SYLVATICA*, IN NORTHWESTERN NORTH DAKOTA

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Since 2005, the Amphibian Growth Project has collected seasonal samples of amphibians using full and partial drift fences, minnow traps, and large salamander cagetraps. These sites have produced 4261 amphibian captures of six different species: one salamander (*Ambystoma tigrinum*) and five frogs (*Rana sylvatica*, *Rana pipiens*, *Bufo cognatus*, *Pseudacris maculata*, and *Scaphiopus bombifrons*). All specimens are assayed for size (SVL and mass). In addition, some specimens can be externally sexed. Several destructive samples have been taken for all species to assess reproductive condition. We are using this database to develop estimators of migration behavior, growth rates, fecundity, mortality rates, and population sizes.

We analyzed size-frequency distributions, and examined several destructive samples in order to develop a model for the life history of the wood frog *Lithobates sylvatica*. These sites have produced 291 captures of the wood frog. Using several aquatic samples, we have been able to document date of oviposition, length of larval period and size at metamorphosis. Thus, we have been able to establish a size cohort in mid-summer metamorph samples that represents *L. sylvatica* in their first summer. Additional cohorts then represent all older animals (Fig. 1). In several cases we are able to identify three size cohorts that correspond to frogs in their first, second, and third (and later) summers. A series of dissections indicated that these size/age cohorts correspond to males that mature in their third spring/summer (i.e., at 24 months after oviposition) and females mature in their fourth summer (i.e., at 36 months after hatching). Thus we are able to estimate ages at metamorphosis and sexual maturation, which in turn allows us to estimate larval and juvenile growth rates. Our estimates for these life history variables show features both common and unique to other life histories taken at similar and different latitudes.

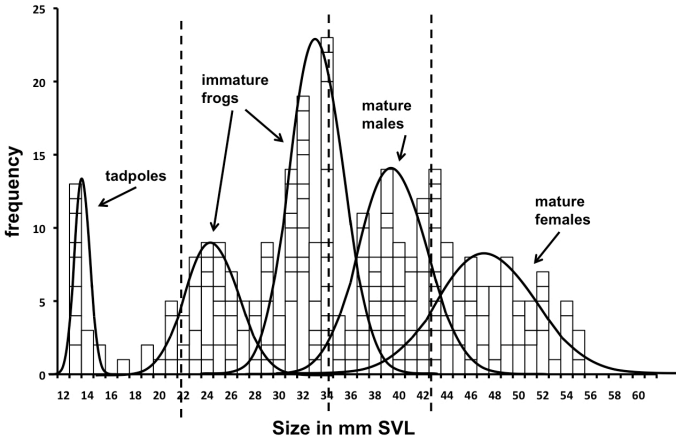

Fig. 1. – Size-frequency histogram of combined data that includes tadpoles, juvenile frogs, and mature male and female frogs. Normal distributions drawn here were fitted by eye, and were based upon a prior month-by-month histogram analysis of the first size/age cohort, followed by a month-by-month histogram analysis of all data. Dashed lines represent (from left-to-right): largest tadpole, smallest mature male, and smallest mature female. Size data were taken from 291 individual captures (some recaptures) over five field seasons, from 2005-2009, at three localities: Minot, Simcoe, and Wolford.

Acknowledgments.--All these data are accessible to the public at amphibiangrowthproject.org. This research was supported by NIH Grant Number P20 RR016741 from the INBRE Program of the National Center of Research Resources and by a State Wildlife Grant from the North Dakota Department of Game and Fish.

REVEGETATION OF COAL FLY ASH (FA) BY SELECTED CEREAL CROPS.

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A vegetative cover is a remedial technique utilized on coal FA landfills for soil stabilization and for the physical and chemical immobilization of contaminants (1, 2, 3, 4). Many herbaceous plants, primarily grasses which exhibit rapid growth, are moderately resistant to environmental stress, and are therefore often used as cover crops in environmental restoration and remediation projects (2). However, there is a great concern, that plants planted or voluntarily growing on media with high content of FA may absorb toxic amounts of Se and/or heavy metals. If such plants are ingested, it may result in toxicity to animals and humans (1, 3). Despite these objections, the utilization of FA as a growth medium for plants is an attractive alternative for disposal of FA in landfills (1, 3, 4). We hypothesized that selected plants will grow in media containing FA and/or bottom ash (BA) from several sources. Therefore, the objective of this experiment was to determine the effects of growth media containing FA and/or BA on several cereal crop plants growth including germination, seedlings growth and heavy metals, B and Se accumulation in the seedlings.

Two selected coal FA, from Montana semi-bituminous coal and from North Dakota lignite alone or in combination with BA from Montana semi-bituminous coal have been tested as plant growth media (growth media are listed in Table below) for the following plant species: barley (*Hordeum vulgare*), oats (*Avena sativa*), rye (*Secale cereale*), wheat (*Triticum aestivum*), regreen; a hybrid between wheatgrass (*Agropyron cristatum*) and winter wheat (*Triticum aestivum*), and triticale; a hybrid between wheat (*Triticum aestivum*) and rye (*Secale cereale*).

Plants were grown on Petri dishes (10 cm diameter, 3 replications) for 14-21 days, harvested, dried, and weighed. Experiments have been replicated three times. The concentrations of Ag, Al, As, B, Ba, Be,Ca, Cd, Ce, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Si, Sn, Sr, Ti, V, Zn, and Zr in growth media was determined, and the concentrations of the same elements in young plants was analyzed. Chemical analysis was performed using inductively coupled plasma (ICP) emission spectrophotometry (3). The data were analyzed statistically using ANOVA and Statistical Analysis System.

Weight (g) of plants after harvesting on day 14-21 (mean±SEM); $^{a,b,c,d}P<0.05$ values differ within a column

Media	Rye	ReGreen	Triticale	Barley	Jerry Oats	Jerry Winterwheat
Soil (Fargo clay)	0.12 ± 0.03^{a}	0.29 ± 0.04^{a}	0.21 ± 0.02^{a}	0.29 ± 0.08	0.16 ± 0.02^{a}	0.17 ± 0.02^{a}
FA 1 (lignite)	0.18 ± 0.03^{a}	0.34 ± 0.03^{a}	0.15 ± 0.02^{b}	0.33 ± 0.06	0.33 ± 0.06^{b}	0.23 ± 0.03^{a}
FA 2 (semi-butiminous)	0.06 ± 0.01^{b}	0.24 ± 0.02^{b}	0.07 ± 0.02^{c}	0.35 ± 0.08	0.02 ± 0.04^{c}	0.19 ± 0.02^{a}
BA (semi-butiminous)	0.24 ± 0.07^{c}	0.33 ± 0.05^{a}	0.16 ± 0.02^{b}	0.24 ± 0.02	0.14 ± 0.04^{a}	0.25 ± 0.05^{a}
BA + FA 2	0.07 ± 0.01^{b}	0.18 ± 0.03^{c}	0.05 ± 0.01^{d}	0.25 ± 0.02	0.07 ± 0.03^{c}	0.13 ± 0.02^{a}

The analysis of FA from lignite and semi-bituminous coal from North Dakota and Montana sources showed high concentrations of heavy metals (up to, in mg/kg): As:65, Cd:3.9, Co:38, Cr:77, Li:109, Mn:1547, Pb:106, Ni:41, V:306. The chemical analysis of plants grown on media containing FA and/or BA demonstrated minimal accumulation of heavy metals. In fact, most of metal concentration in plant material was below ICP detection limits.

All plants showed good adaptability to FA and/or BA in growth medium which indicates the potential of successful growth of these plants on FA and/or BA residue piles.

All tested plants were able to establish seedling growth on growth media with FA and/or BA. Decreased growth was observed for triticale grown on media with FA1; rye, triticale and jerry oats grown on media with FA2; triticale grown on media with BA; and rye, regreen, triticale and jerry oats grown on media with FA2 and BA. Overall, FA from lignite coal (from Washburn Station showed better potential as growth medium for tested plants. These results demonstrate that cereal crop plant can be used to cover FA and/or BA residue piles.

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).

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EXAMINATION OF SPECIES DIVERSITY AND POPULATION DENSITIES OF UNIONID MUSSELS IN THE SHEYENNE RIVER

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Introduction

Mussels are one of the most threatened groups of animals in North America. It has been estimated that 71.1% of the North American mussel fauna was endangered, threatened, or of special concern and very little is known about the current distributions of mussels in North Dakota. In 2008 our lab conducted timed searches on 28 North Dakota rivers looking for mussels (Unionacea). Those qualitative surveys have shown that, of the 15 species of mussels known to exist in North Dakota, 11 of them can be found in the Sheyenne River, thus making it the most species rich river in the state for mussels. In order to better understand the population dynamics of the mussels that occupy the Sheyenne River, and to build baseline data for use in future mussel monitoring studies, in 2009 we conducted a quantitative survey on 8 of the original sites on the Sheyenne.

Methods

At each of the eight sites we sampled a one hundred meter stretch, then moved down an additional 100 meters, and sampled a second one hundred meter stretch. This quantitative survey employed two types of quadrat sampling techniques. The first, a systematic sampling technique with multiple random starts, was applied to sites that were deemed "high density" (>50 mussels/hr found in timed searches). The second technique utilized an adaptive cluster method that is better suited for measuring the often patchy distribution of mussels at low densities.

Results

There is a clear increase of species from in the upper reaches of the river, 2 species per site, to the downstream part of the river, as many as 8 species per site. Density estimates peak approximately midway downstream, with a maximum of 46.8 mussels/M^2, after which they drop to numbers ranging from 0.2 to 2.7 mussels/M^2. In some sites there was a high variability between the two one hundred meter sampling sections.

Discussion

The Sheyenne River contains the most diverse and, in some places, the densest populations of mussels of any river in North Dakota. The information that is gathered during quantitative surveys such as these is an invaluable tool for monitoring and preserving the status of unionid mussels in North Dakota. With various water projects being proposed for the Sheyenne River, additional surveys on the Sheyenne River should be done to document their effects on mussels and further expand our ability to protect this imperiled group.

This project was funded by a State Wildlife Grant from the North Dakota Game and Fish Department

Rapid synthesis of N-methyl-N-piperonylformamide

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Background: N-methyl-N-piperonylamine is a methylated analog of piperonylamine which is an important intermediate in the synthesis of biologically active compounds. N-methyl-N-piperonylamine can be synthesized from piperonal by the Leuckart reaction via the intermediate N-methyl-N-piperonylformamide. Recently, we developed an accelerated procedure for the synthesis of formamides.

Methods: The reaction was conducted on 10 mmol scale at 188-189.5ºC.

Results: The reaction was fully completed in 1 minute and produced piperonylformamide in good yield.

Conclusions: The new reaction opens the way for the fast synthesis of N-methyl-N-piperonylamine and its derivatives in the laboratory practice and industry.

Support: The project is supported by NIH grant P20 RR016741 from the NCRR.

PHYSICAL AND CHEMICAL PROPERTIES OF GOLD NANORODS FOR THE OPTIMIZATION OF THEIR SURFACE PLASMON RESONANCE

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Metal nanoparticles have been used for the determination of numerous types of targets. Some metals, such as gold and silver, exhibit strong and stable surface plasmon resonance under suitable conditions. When gold nanorods (AuNRs) are coupled with fluorescent materials, an enhanced fluorescence signal is obtained because of the surface plasmon resonance of gold. The absorbance spectrum of the AuNRs has a distinct two-peak shape. The wavelength of the peaks can be adjusted by changing the ratio of the gold nanorods' length to width, known as the aspect ratio. Adjusting the wavelength of the absorbance peak allows for the possibility to enhance various fluorescent materials based on their excitation wavelengths.

A series of studies has been conducted to observe the stability of various sized nanorods which have a maximum absorbance in the range of 650 nm to 800 nm. First, the stability of the AuNRs has been examined over time, and it was found that nanorods produced stable absorbance spectra 5 weeks after synthesis, for both wavelength position and intensity. Second, the pH values at which gold nanorods are stable were measured. The results showed that the AuNRs are stable in the range of pH 2 to pH 7. Third, the optimal loading of ligands on the nanorods was determined by immobilizing various amounts of 6-mercaptohexanoic acid onto the nanorod surface. The results showed that gold nanorods are stable in solutions of less than 1μM 6-mercaptohexanoic acid, but the distinct absorbance spectrum of the gold nanorods is lost in solutions of greater than 100 μM 6-mercaptohexanoic acid. Finally, the stability of gold nanorods was investigated in various radiation intensities and storage solutions. Results obtained from this study will be significant for further study of the enhancement of fluorescent materials using gold nanorods.

Rapid synthesis of N-[1-(1-naphthyl)ethyl] formamide

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Background: N-[1-(1-naphthyl)ethyl]-formamide (I) is an important intermediate in the synthesis of biologically active compounds, including pharmaceuticals. (I) can be synthesized from 1-acetonaphthone by the Leuckart reaction. In the literature, the synthesis of (I) from 1-acetonaphthone was described only once, and it appeared to be a very slow reaction, taking 30 hours to complete. Recently, we developed an accelerated procedure for the synthesis of formamides.

Methods: The reaction was conducted on 10 mmol scale at 190-192ºC.

Results: The reaction was fully completed in 5 minutes and produced (I) in good yield.

Conclusions: The new reaction opens the way for the fast synthesis of (I) and its derivatives in the laboratory practice and industry.

Support: The project is supported by NIH grant P20 RR016741 from the NCRR

PREY CAPTURE KINEMATICS IN THE OPISTHOGLYPH COLUBRID *BOIGA IRREGULARIS*

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The venomous brown tree snake (*Boiga irregularis*) is a member of the Boiginae sub-family within the polyphyletic taxon Colubridae, and native to tropical Africa, India, and Australia (1). Since the late 1940s the brown tree snake has been introduced on several pacific islands, including Guam, where it as devastated local fauna. These nocturnal snakes are largely arboreal and feed on many different vertebrates such as lizards, small birds and mammals. The elongate maxilla of *Boiga* supports a grooved fang that is located at its posterior end and preceded by solid maxillary teeth, a condition termed rear-fanged or opisthoglyph. Front-fanged species either rapidly strike and hold prey (most elapids) or strike and release prey (most vipers) (2). Constriction as a means to subdue prey has rarely been observed in venomous snakes but has been seen in *B. irregularis*. The venom of *B. irregularis* is 10 to 30 times more toxic for reptilian prey than for mammals (3) and may suggest different handling strategies for different prey.

Snakes were filmed at the University of Northern Colorado animal facility using a JVC Everio Hard Drive Digital Camcorder. The snakes were fed live *Mus musculus* and live *Anolis carolinensis*. All snakes were large adult *B. irregularis* over 2m in length.

All of the mice and none of the lizards were constricted. This makes sense in light of the LD50 analysis by Makessy et. al. (3), which suggests that mammal prey may remain dangerous to the snakes much longer than lizard prey because of their low susceptibility to the venom. Out of 7 lizard trials 3 involved retaliation of the prey by biting the snake on the mouth and hanging on, impeding transport efforts of the snake. Mice did not retaliate. Greer (4) observed that *B. irregularis* preferentially constricts larger prey and a combination of both envenomation and constriction may be used in the wild (3). If size is the determining factor for constriction, it may be that the lizards used in our study were simply too small for constriction.

All of the brown tree snakes studied thus far have been from Guam. So whether or not this method of constriction developed recently on Guam in response to the overabundance of mammalian prey types or is an ancestral trait in their native habitat remains to be explored. The evolution of species-specific venom components may have driven the snakes toward preferentially using constriction over envenomation for mammalian prey in order to conserve venom, or prey capture kinematics drove the development of certain venom components.

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GRADUATE COMMUNICATIONS

IN THE

A. ROGER DENISON COMPETITION

(communications are listed alphabetically)

PLEIOTROPIC ROLE OF METALLOTHIONEIN-3 (MT-3) IN HUMAN PROXIMAL TUBULE (HPT) CELLS DIFFERENTIATION

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Cadmium (Cd^{+2}), a heavy metal is known to elicit nephrotoxicity by causing inflammation and necrosis of the proximal tubule cells in the kidney (1). Metallothioneins, a group of low molecular weight, cysteine rich, intracellular proteins is known to sequester heavy metals such as cadmium and mercury and provide protection against their toxic effects. Previous studies from our laboratory have shown that the third isoform of metallothionein (MT-3), a unique member of metallothionein family is involved in the maintenance of vectorial active ion transport in cultures of human proximal tubule (HPT) cells (2). We also demonstrated that MT-3 is involved in regulation of cell differentiation by controlling the epithelial-to-mesenchymal transition (EMT) and mesenchymal-to-epithelial transition (MET) (3). Recent *in situ* and *in vitro* studies have reported that MT-3 is interacting with other proteins and these interactions are thought to be playing an important role in execution of some of its functions. So the goal of our study is to identify the binding partners of MT-3, which will allow us to understand the mechanism through which MT-3 is regulating the vectorial ion transport and cell differentiation in HPT cells. We performed MT-3 pull-down experiments followed by SDS-PAGE and mass spectrometry analysis in an immortalized human proximal tubule cell line, HK-2 cell extract and renal cortical tissue extract. We have identified β-actin, tropomyosin, gelsolin and myosin (non-muscle) as the binding partners of MT-3. We further confirmed our interaction studies by performing immunofluorescence studies and demonstrate that MT-3 is co-localized with the above mentioned proteins. These studies demonstrate that MT-3 interacts with proteins that are involved in cytoskeleton reorganization of the cell and thereby regulating the vectorial active transport and cell differentiation.

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Development of Metal-enhanced Fluorescent Nanocomposites for Studying of Effects of Metallic Nanostructures on Properties of Fluorescent Molecules

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The mechanisms of metal-enhanced fluorescence have been extensively studied and applied to many areas, including bioanalysis. However, in spite of these well developed mechanisms, the rapid development of nanotechnology has produced various new types of metallic nanostructures which generate a number of new effects of metallic nanomaterials on molecular properties. Particularly, it is not well understood what geometric and dimensional effects metallic nanostructures have on the fluorescent molecular properties, such as fluorescence lifetime, quantum yield, and photostability, etc. Advances in understanding of these new effects are necessary for promoting future design of nanostructures. In this experiment, different types of gold nanomaterials, including gold nanorods and gold nanoparticles, were synthesized. Using these gold nanomaterials as a core, we have developed core-shell gold-silica nanoparticles. The different sized gold nanoparticles and nanorods were chosen to adjust the plasma peak of the metal cores from 500 nm to 900 nm. Fluorescent molecules were then doped into the nanoparticles to form fluorescent nanocomposites.

The results showed that fluorescence intensity and photostability of the nanocomposites significantly increased when metal cores were encapsulated in the silica shells. The fundamental study of geometric and dimensional effects of silica-based metallic nanostructures on molecular physicochemical properties is in the process.

Role of oligomer Aβ in tyrosine-kinase dependant stimulation of microglia *in-vivo*

Gunjan Dhawan* and Colin.K.Combs

Alzheimer's disease (AD) is the most common form of dementia with as many as 5.3 million Americans living with AD. Histopathologically, AD is characterized by age-associated progressive accumulation of β-amyloid (Aβ) peptide plaques. These Aβ peptides have the ability to self-aggregate to form oligomers and fibrils. Recent data have shown that the oligomeric form of Aβ has the potential to stimulate neuronal dysfunction and may play a prominent role in the pathogenesis of Alzheimer's disease. It is also well recognized that microglia are reactive in the AD brain. This observation has supported the idea that microglial-dependent proinflammatory changes are a component of disease events with Aβ peptides serving as the stimulatory source for microglial activation. Studies in our lab have demonstrated that oligomeric Aβ stimulates microglia cultures through activation of tyrosine kinases such as Lyn. This activity was required for subsequent secretion of the neurotoxic cytokine, TNFα, and was attenuated by treatment with the Src kinase family inhibitor, dasatinib. Intracerebroventricular infusion of Aβ into adult mouse brains validated *in vivo* that Aβ oligomers stimulated increased microglial activation and active tyrosine kinase levels that were attenuated by dasatinib administration. To further support a causative relationship between Aβ peptide stimulated tyrosine kinase activity in microglia during disease, the temporal profile between plaque deposition and microgliosis was quantified using a transgenic AD mouse model. As predicted, microglial activation increased with age and correlated precisely with increased tyrosine phosphorylation levels and Aβ plaque deposition. Examination of human AD and age-matched control brains demonstrated a similar increase in active microglial tyrosine kinase Lyn immunoreactivity in diseased brains. These data suggest that a tyrosine kinase inhibitor may prove useful in attenuating Aβ-dependent microgliosis and proinflammatory changes in the brain.

α_{1A} ADRENERGIC RECEPTORS ENHANCE NEUROGENESIS, LEARNING & MEMORY, AND ALLEVIATE DEPRESSION AND ANXIETY IN ADULT MICE

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Neurogenesis, the production of new cells, continues in the brain throughout adulthood. The most active areas of adult neurogenesis are the subventricular zone (SVZ) of the lateral ventricles and the subgranular zone (SGZ) of the hippocampal dentate gyrus. A major target of the noradrenergic system is the hippocampus, a region that is critical for learning and memory. Recent studies suggest the noradrenergic alpha-1A adrenergic receptors (α_{1A}-ARs) may regulate neurogenesis. This regulation may have additional behavioral effects on cognition, learning, memory, anxiety and depression. However, our understanding of the function of α_{1A}ARs is limited due to a lack of specific ligands and antibodies. To address this, transgenic mice were generated which over-express either the α_{1A}AR with enhanced green fluorescent protein (EGFP) or a constitutively active mutant (CAM) α_{1A}AR. Knockout (KO) α_{1A}AR mice were also generated. Immunohistochemistry showed that CAM α_{1A}AR mice had increased BrdU incorporation compared to normal and KO α_{1A}AR mice in both the SVZ and SGZ. Treating normal mice with the selective α_{1A}AR agonist also increased adult neurogenesis. The CAM-α_{1A}AR mice showed improved performance in behavioral tests for depression and anxiety (Tail Suspension Test, Marble Burying Test and Light Dark Exploration), as well as tests for cognition, learning and memory (Barnes Maze). These results suggest that stimulation of α_{1A}ARs may offer a new strategy for alleviating depression and anxiety, and treating neurodegenerative diseases.

RGS7 PROTEIN SUPPRESSION MODULATES CA3 EPILEPTIFORM ACTIVITY

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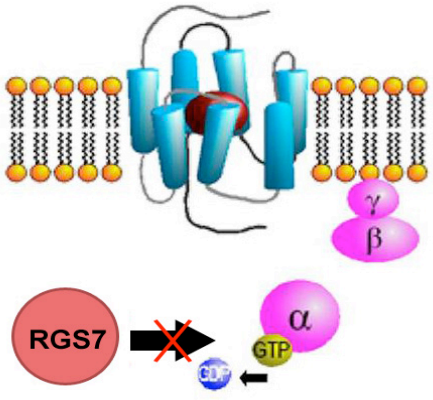
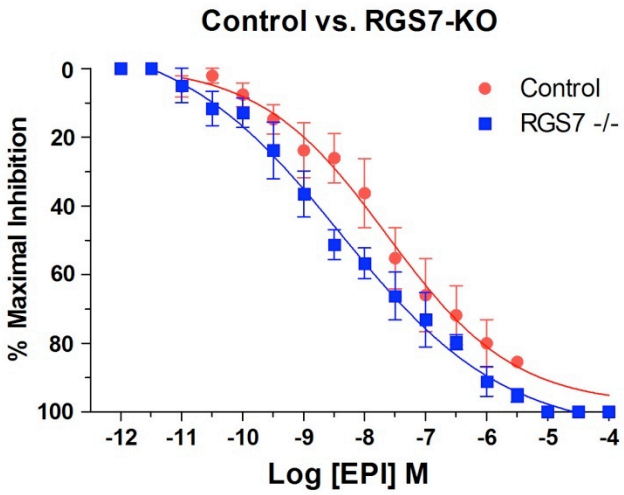
G-protein coupled α_2 adrenergic receptor (AR) activation by epinephrine (EPI) inhibits epileptiform activity in the mouse hippocampal CA3 region. The mechanism underlying this action is unclear. This study investigated which subtypes of α_2ARs, G-proteins ($G\alpha_o$ or $G\alpha_i$), and RGS proteins were involved in this response using recordings of CA3 epileptiform bursts in mouse brain slices. First, we determined this effect was mediated by the α_{2A}AR subtype as the inhibitory actionof EPI on epileptiform burst frequency was abolished in slices from a_{2A}AR, but not α_{2C}AR, knockout mice. Next, using transgenic mice with the G184S Gnai2 allele (knock-ins) which interrupts G-protein a unit binding to regulators of G-protein signaling (RGS), we found α_{2A}AR antiepileptic effects of EPI were enhanced in hippocampal slices from mutant $G\alpha_o$ mice but not $G\alpha_{i2}$ mice. Finally, knockout mice for the RGS7 protein family were found to have increased α_{2A}AR-mediated hippocampal actions compared to their littermate controls. These results indicate that the EPI-mediated inhibition of mouse hippocampal CA3 epileptiform burst activity is through an α_{2A}AR/$G\alpha_o$-mediated pathway under strong inhibitory control by proteins of the RGS7 family. This suggests a possible role for selective α_{2A}AR agonists or RGS7 inhibitors as a novel antiepileptic drug therapy.





THE FOSSIL CARNIVORES OF THE TURTLE BUTTE ASSEMBLAGE (ARIKAREEAN), TRIPP COUNTY, SOUTH DAKOTA

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Introduction – The Turtle Butte Formation, exposed on Turtle Butte in Tripp County, south-central South Dakota, has yielded a diverse paleofauna. The Turtle Butte Formation and Wewela local fauna were first described in 1968 (1). In 1969 and 1973, a field crew from the South Dakota School of Mines and Technology, collected fossil specimens and fossiliferous matrix from the Turtle Butte Formation, which was later studied by Schumaker (2). In 2004, a very small sample of bulk matrix was collected by Bailey (3). On the basis of biostratigraphic analyses completed by Skinner *et al*. (1), Bailey (3), and Schumaker (2), the Turtle Butte Assemblage was determined to be late early Arikareean in age.

Results – Confident identification of the Turtle Butte Assemblage carnivores to the species level is difficult because the fossil specimens are fragmentary or isolated teeth. Five distinct carnivore taxa are represented in the Turtle Butte Assemblage representing two suborders, the Cynoidea and the Arctoidea and are discussed below.
Hesperocyoninae gen. indet. (SDSM 82103) – Wang's (5) diagnosis for the subfamily is based on cranial characters and dental characters of P4, M1, and m1 which cannot be used to determine the identification of the tooth and "the subfamily is mainly defined by its lack of synapomorphies for the other two subfamilies." The lack of the paraconule and metaconule suggest a primitive morphology and support the assignment to the Hesperocyoninae.
Borophaginae gen. indet. (SDSM 82106) – The low, bulbous, robust nature of the tooth suggests that it belongs to the Subfamily Borophaginae, which is typically characterized as having robust teeth for crushing bone. The measurements of SDSM 82106 compare favorably with species of *Archaeocyon* and *Cynarctoides*.
Cynarctoides roii (SDSM 82104) – *Cynarctoides* is characterized by long, narrow premolars, conical and high-crowned cusps in the lower molars, higher metaconids, larger protostylids in lower molars. SDSM 82104 exhibits tall, conical cusps on the trigonid and a nearly identical size and morphology to the paratype specimen.
Amphicyonidae gen. indet (SDSM 82105) –The isolated nature of the tooth and the lack of known deciduous dentition of late Oligocene – early Miocene carnivores does not allow for assignment of this specimen to genus. In general, the P4 of amphicyonids is laterally compressed and the protocone is nearly in line with the paracone and metacone as exhibited by SDSM 82105.
Nothocyon n. sp. (SDSM 8640, 82107) – The genus *Nothocyon* has a complicated taxonomic history. Recent revisions of the monospecific genus, has left two specimens assigned to *N. geismarianus* with other specimens previously assigned to the genus now placed within several other taxa (4 and 5). *N. geismarianus* is characterized by an m1 with a low, short trigonid with the metaconid slightly more posterior than the protoconid, a large talonid, subequal entoconid and hypoconid, compressed m2 trigonid with an anterobuccal cingulid, and a very small paraconid. SDSM 8640 differs from *N. geismarianus* in that the length of the m1 is not as reduced and has a lesser degree of trigonid compression on the m2. These differences are not significant enough to consider assignment of the specimen to any genus other than *Nothocyon*. However, due to the complicated taxonomic history, a heuristic search using parsimony was completed to support the interpretation. The resulting strict consensus tree placed the SDSM specimens as a sister taxon to *N. geismarianus* within the Arctoid clade, supporting the initial interpretation that these specimens belong in the genus *Nothocyon*. The differences between *N. geismarianus* and the SDSM specimens may be attributed to one of two factors. First, small sample sizes do not allow for the assessment individual variation. Second, the SDSM specimens represent a new species of *Nothocyon,* as they exhibit, but to a lesser extent, the derived characteristics of a compressed m2 trigonid and a shortened m1 trigonid as *N. geismarianus*. The differences are significant enough to support the identification of the SDSM specimens as a distinct species of *Nothocyon*. Identification of the Turtle Butte Assemblage specimens as *Nothocyon* represents both age and geographic range extensions for the genus from the early late Arikareean to the late early Arikareean.
Conclusions – Despite the limited identifications, the fossil specimens show that the Turtle Butte Assemblage has a diverse carnivore component with five distinct carnivore taxa. Three canid and two arctoid carnivores are present in the assemblage. The presence of a new species of *Nothocyon* represents an age range extension for the genus.

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Paleontology and Geology of the Fort Randall Formation at Feyereisen Gap, Gregory County, South Dakota

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Introduction – The Fort Randall and Valentine formations of the Ogallala Group (middle Miocene) of central South Dakota have been studied by various authors. In 1967, Skinner and Taylor (1) presented a comprehensive work on both the geology and paleontology of the Fort Randall Formation at South Bijou Hill. Limited work has been done on the Fort Randall Formation since 1967, specifically at Feyereisen Gap, Green (2, 3) and Martin (4), focused on specific taxa of the paleofauna. Herein, both the geology and paleontology at Feyereisen Gap are examined, including descriptions of the lithology and fossil assemblages. The Feyereisen Gap Locality, located in south-central South Dakota, is a road cut that exposes the Fort Randall and Valentine formations.

Results – The Fort Randall Formation consists of predominantly siltstone and claystone beds representing many distinct overbank deposits. The overlying Valentine Formation is predominantly sandstone with a higher degree of induration and represents fluvial bar deposits. Both of the formations were deposited in a meandering stream system. The locality contains two distinct assemblages, both from the Fort Randall Formation, indicative of the middle Miocene. Over 300 specimens representing 29 different species were added to the paleofaunal list from the Fort Randall Formation. From these diverse assemblages, nine species are of great importance, either biostratigraphically or biogeographically, or are rare Great Plains taxa. These species included *Plesiosorex donroosai* (5), an insectivore, the rodents *Umbogaulus galushai*, and *Megasminthus gladiofex* (3), the mustelids *Brachypsalis* sp. cf. *B. modicus* and *Leptarctus* sp. indet., the bone-crushing dogs *Tomarctus hippophaga* and *Cynarctoides acridens*, the horse *Merychippus* sp. cf. *M. insignis*, and fragments from a proboscidean.

The fossil assemblages specifically indicate a Barstovian age, which ranges from 16.0–12.5 Ma. The Barstovian is subdivided into early Barstovian and late Barstovian. The older assemblage at Feyereisen Gap is tentatively assigned to the early Barstovian and is the first reported assemblage of this age in South Dakota. The younger assemblage at Feyereisen Gap has been placed in the late Barstovian. The ages were determined using the identified assemblages at Feyereisen Gap and comparing the two assemblages to known lists of first and last appearances during the Barstovian (6), as well as utilizing similarity coefficients with other Great Plains Barstovian assemblages.

Discussion – The two faunal assemblages at Feyereisen Gap were compared to the other Barstovian assemblages using similarity equations. These comparative assemblages include the Lower Snake Creek (Olcott Formation, Nebraska), the Bijou Hills (South Dakota), and the Norden Bridge (Nebraska). The three similarity equations utilized were the Dice, First Kulczynski Coefficients, and the Coefficient of Community. The earlier assemblage at Feyereisen Gap, is a temporal equivalent of the Lower Snake Creek Assemblage, which is early Barstovian in age. The later assemblage at Feyereisen Gap is a temporal equivalent of the Bijou Hills Assemblage, and the Norden Bridge Assemblage, both of which are late Barstovian in age. The specimens from the assemblages were identified through extensive comparison with other known specimens and through literature reviews. The type specimens of *Plesiosorex donroosai* (4) and *Megasminthus gladiofex* (5) are from the Feyereisen Gap locality. *Umbogaulus galushai*, *Tomarctus hippophaga*, and *Cynarctoides acridens* are all biogeographic range extensions into South Dakota. *Leptarctus* and the proboscidean taxon are both rare Great Plains taxa (for this time interval), and these specimens increase the amount of information that is already known from them. *Brachypsalis* sp. cf. *B. modicus*, *Umbogaulus galushai*, *Tomarctus hippophaga*, and *Cynarctoides acridens* are all indicative of the early Barstovian.

Conclusions – The sediments at Feyereisen Gap were deposited in a meandering stream system. The large, diverse assemblages at the site are represented by seven orders, adding a large amount of information to the Barstovian assemblages of the Great Plains. The Feyereisen Gap assemblage produced nine very important species. Two of these species include type specimens for, *Plesiosorex donroosai* (5) and *Megasminthus gladiofex* (3). The seven remaining species have important biostratigraphic or biogeographic implications, or are otherwise rare for Great Plains taxa. The earlier assemblage from Feyereisen Gap is a correlative of the Lower Snake Creek Assemblage (early Barstovian in age) and the later assemblage is a correlative of the Bijou Hills Assemblage (late Barstovian in age) in South Dakota and the Norden Bridge Assemblage (late Barstovian in age) in Nebraska.

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PROFESSIONAL COMMUNICATIONS

GENES ASSOCIATED WITH IMMUNE RESPONSE AND RISK OF PRE-ECLAMPSIA IN AN AMERICAN INDIAN POPULATION

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The etiology of pre-eclampsia (PE) is unknown; but it has been long acknowledged that normal pregnancy represents a distinctive challenge to the maternal immune system. Maladaptive responses to this challenge are frequently postulated as primary initiators of the multiple subsequent pathways leading to pre-eclampsia.(1, 2). Studies related to immune function have focused on a number of candidate genes such as, mannose binding lectin (*MBL2*), interleukin 1-alpha, (*IL1A*), storkhead box 1 (*STOX1*), and cytoxic T lymphocyte associated 4 (*CTLA4*) with variable results (3, 4).

Objectives: Since population specific prevalences of variants and background genetic effects may influence risk in different communities, our aims were to: 1) determine the prevalence of 4 single nucleotide polymorphisms (SNPs) of these four genes within this American Indian community; and 2) to investigate possible association of these variants with PE.

Methods: A case-control study has enrolled cases confirmed by chart review and controls, matched on date of the index infant's birth. Genotyping utilized a commercially developed, allele specific, real-time PCR method (Applied Biosystems "Taqman" assay).

Results: To date, 104 cases and 200 matched control genotypes have been obtained for at least one of the SNPs. Hardy-Weinberg equilibrium is satisfied for each of the 4 polymorphisms. Among the 134 participants thus far genotyped, analysis of the non-synonymous (T17A) rs231775 SNP of *CTLA4* finds the distribution of AA/GA/GG genotypes to be 23/26/17 and 31/33/4 among cases and controls respectively. Analysis of these proportions yields an unpaired chi square value of 10.04 with 2 degrees of freedom and a p value of 0.007. The estimated population allele frequency of the risk allele (G) is 30% among controls. Conditional logistic regression analysis using an additive model showed an increased odds ratio of 2.20 (p=0.013, CI 1.18-4.10) for each additional G allele in unadjusted analysis. When the model is adjusted for age, nulliparity and BMI the odds ratio is increased to 3.29 (p=0.015, CI 1.26 – 8.58). The MBL2 SNP (rs1800451) is marginally associated with PE in a T allele, dominant model, when adjusted for the above 3 covariates, with an odds ratio of 3.17 (p=0.058, CI 0.96-10.44). The IL1A and STOX1 SNPs showed no evidence of association, whether in univariate, multivariate, dominant or additive models. Using the Bonferroni correction for multiple testing (4 SNPs), would adjust the p value considered statistically significant to p=0.0125.

Conclusions: This *CTLA4* variant has been associated with pre-eclampsia in two other disparate populations (Finnish and Iranian) and is known to be expressed in decidual tissue (4, 5, 6). Since this test of *CTLA4* corroborates earlier findings, the Bonferroni correction may be overly conservative, thus these data further support the role of genetic influences on immune function and resultant risk for pre-eclampsia.

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THE COMPLEX TAXONOMY OF A COMMON CRETACEOUS-PALEOGENE CROSSING SPECIES

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Introduction. "I do not see that any real purpose is served by again changing the generic position of this species of doubtful relationship" (1). Henderson made this statement about the taxon *Bulimus* Meek and Hayden in 1935 and no one, except maybe Taylor (2) has made a compelling argument for inclusion in a higher taxon.

"Bulimus" limneaformis is one of the more common species of the latter part of the Cretaceous and Paleocene of the northern Great Plains and some intermontane basins. Common means both in frequency of occurrence in depositional settings and interpreted paleoenvironments from fossil associations. *"B." limneaformis* is known from current flow regimes of fluvial systems to quiet water settings of behind levee lakes. Although variants have been described (*Thaumastus l. tenuis*, Warren, 1926, and *T. l. procerior* Russell, 1926), its shape is easily recognizable over its 12 to 14 Ma history.

Taxonomy – The Names of *"limneaformis."* Genus-group names applied to Meek and Hayden's taxon are *Bulimus* in 1856, *Thaumastus* in 1877, *Bulimulus* in 1886, *Hyperaulax* in 1923, *Campeloma* in 1929, *Lioplax* in 1930, *Lioplacodes* in 1946, and New Genus A in 1975. These genera are classified as followed (3):

Clade Caenogastropoda;**Informal Group Architaeioglossa**
Superfamily Viviparoidea Gray, 1847; Family Viviparidae Gray, 1847
Subfamily Lioplacinae Gill, 1863
Campeloma Rafinesque, 1819; *Lioplax* Troschel, 1856; New Genus A Taylor 1975
Superfamily Cerithioidea Fleming, 1822; Family Pleuroceridae P. Fischer, 1885
Subfamily Pleurocerinae P. Fischer, 1885
Lioplacodes Meek, 1864
Clade Stylommatophora; **Subclade Orthurethra**
Superfamily Achatinelloidea Gulick, 1873; Family Achatinellidae Gulick, 1873
Subfamily Achatinellinae Gulick, 1873
Bulimus Scopoli, 1877 (Meek, 1876, considered a synonym of *Thaumastus*)
Informal Group Sigmurethra
Superfamily Orthalicoidea Albers, 1860
Family Orthalicidae Albers, 1860 [= Family Bulimulidae Crosse & Fischer, 1873 (*s. l.*)]
Subfamily Bulimulinae Tryon, 1867 (3); Tribe Bulimulini Tryon, 1867
Bulimulus Leach, 1814; *Thaumastus* Albers, 1860
Tribe Odontostomini Pilsbry and Vanatta, 1898 (4)
Hyperaulax Pilsbry, 1897

Historical classification between gill- or lung-bearing snails is nearly equally divided. Earlier authors placed "*limneaformis*" in with terrestrial pulmonates, while later assignments were to aquatic viviparids and pluerocerids. Assignment to Bulimulinae seems unlikely. Such taxa are noted to have apical surface structure, an apertural longitudinal grove or channel, and a parietal wall callous (Pilsbry, 1897-1898). These features are not found on "*limneaformis*" specimens. Taylor (2) reported the confusion with *Cleopatra* (taxa herein assigned to *Lioplacodes*), but that there is a family-level trait difference (relatively large and globose vs. small and acute) embryonic shell structure between pluerocerids and viviparids, with "*limneaformis*" being "like that of *Campeloma*." Interestingly, however, "*limneaformis*" shares little else in the way of characteristic features with the Lioplacinae and fossil *Campeloma* in particular (1).

The Phylogeny of Shells. The working hypothesis for *Bulimus limneaformis* has been that it can be fit into a modern group; historically into a modern genus and at least within a modern subfamily. In the absence of anatomical features, Taylor (1) attempted to ascertain the reproductive process through apical structure (ovoviviparity) and thus a relationship with viviparids. This is a relatively compelling argument, but the lack of sinuous growth lines in "*limneaformis*," a trait that readily distinguishes Viviparinae and Lioplacinae suggests this different graceful little shell may be best placed in its own subfamily, as well as genus, within the viviparids.

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IDENTIFICATION OF AN ASPARAGINE RESIDUE IN THE SEROTONIN NEUROTRANSMITTER TRANSPORTER ESSENTIAL FOR CHLORIDE COUPLED NEUROTRANSMITTER TRANSPORT

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Na+ and Cl- dependent uptake of neurotransmitters via transporters of the SLC6 family, including the human serotonin (5-HT) transporter (hSERT, SLC6A4), is critical for efficient synaptic transmission. Although residues in hSERT involved in 5-HT, Na+ and Cl- coordination have been identified, the role of Cl- in the transport mechanism remains unclear. We present mutagenesis, chemical modification, transport and charge flux studies of hSERT accompanied by molecular modeling of the putative Na+, Cl- and 5-HT binding pocket that reveal special roles for TM1 residue N101 in coupling Cl- binding to concentrative neurotransmitter uptake. Our analysis has found that mutation at N101 results in the ability of other anions such as acetate, methanesulfonate and gluconate to functionally substitute for Cl in assay buffers. These anions are unable to functionally replace Cl in native hSERT. Biochemical analysis using plasma-grade water was performed to eliminate the possible contribution of contaminating anions to the Clindependent phenotype of the N101 mutants. The results refined our hypotheses where N101 mutations may alter the size filter of the anion binding site in SERT such that the ability of an anion to substitute tends to be inversely related to the ion size. However, even under replacement conditions with the larger anion gluconate, which is one of the least effective ions at permitting uptake in the N101 mutants, analysis reveals a Cl-independent component in the mutants in addition to the Cl-dependence observed with native SERT. Furthermore, kinetic analysis of reveals a distinct influence of the N101 mutants on 5-HT Km. These studies highlight the importance of the N101 residue in ion coupling in the human serotonin transporter and these studies could help define this process.

INDUCTION OF LEAF EXPANSION IN ARABIDOPSIS BY INDOLE-3-ACETIC ACID: THE ROLE OF WOUNDING AND LEAF DETACHMENT

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The plant morphogenic hormone indole-3-acetic acid (IAA) controls multiple aspects of plant growth. In the stem it controls aspects of vascular development and leaf initiation. Previous work in the Keller lab and elsewhere has shown IAA to play a role in leaf expansion. Increasing the IAA content of intact expanding leaves of *Arabidopsis* and *Phaseolus*, either through exogenous application or through trapping the endogenous hormone in leaves, results in inhibition of leaf growth.[1] Paridoxicaly, other work has clearly shown that treatment of excised leaf strips from tobacco (*Nicotiana*) with IAA stimulates rather than inhibits growth.[2] IAA treatment, whether of intact or of excised leaf tissue results in epinastic (downward) curvature due to relatively greater growth by the adaxial (dorsal) side of the tissue.

Why do excised leaf tissues grow in response to IAA treatment while the growth of the same tissues in the intact leaf is inhibited by IAA? To address this question experiments in the Keller lab have employed seedlings of the model plant *Arabidopsis thaliana* and have addressed two hypothetical explanations. Perhaps, the reversal of IAA growth sensitivity is a consequence of the changed gene expression background produced by the wound response resulting from tissue excision (possibly involving a wound-induced collapse in endogenous hormone level as has been suggested[3]). Alternatively or additionally, the reversal of IAA growth sensitivity results from detachment from the plant and presumed separation from an ongoing supply of other growth controllers supplied to the expanding leaf from other parts of the plant.

For this 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. For all experiments one of the first two leaves from each plant served as the experimental (IAA treated) leaf and the other leaf served as a paired control. For most experiments, scaled digital images of the individual leaves were prepared for subsequent determination of initial leaf area; for others initial images of excised leaf strips (0.7 mm wide cut transversely across the midpoint of the leaves) were prepared. Either leaf strips or intact attached, detached, or wounded (sliced transversely from leaf edge to near the midvein in three places) attached leaves were treated 24 hours with full strength Murashige and Skoog media (with 10 mM KCl and 0.1 mM Mes/Btp (pH 6.0)) or the same +/- IAA at various concentrations. After 24 hours increased area of leaves and strips was determined from digital images. The effect of wounding and of leaf detachment on endogenous leaf IAA content was determined using a new high-sensitivity high-throughput assay[4].

In a preliminary report[5] we found IAA inhibited growth of intact attached, detached, and wounded-attached leaves while excised leaf strips were induced to grow more rapidly when treated with IAA. Wounding and leaf detachment was found to have no significant effect on the endogenous leaf IAA level which was found to be lower than the effective exogenous concentrations. Two alternative conclusions were possible. IAA-induced growth increase results from a wound response that requires substantial wounding (simple leaf excision is not enough) as well as separation from the plant. Alternatively, only substantial wounding is required to result in IAA-inducible growth as the magnitude of wounding to the wounded attached leaves was less severe than that received by the excised strips. Here I report a test of this second possibility. Detached wounded (three transverse cuts as above) leaves were found to grow more rapidly when treated with IAA than without across a range of concentrations. It is concluded that, in *Arabidopsis*, IAA-induced growth increase results from a wound response that requires substantial wounding as well as detachment from the plant. Possible explanations for the requirement for leaf detachment are discussed.

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Microbial Diversity of the Human Oral Ecosystem

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The oral disease, chronic periodontitis, is a polymicrobial infection afflicting 35% of U.S. adults. The disease may result in loss of teeth and has been implicated in endocarditis, atherosclerosis, stroke, and preterm delivery of low-birth-weight infants (1). Chronic periodontitis has been linked to multiple members of the domain *Bacteria* (2). The ecological role of these bacteria, however, remains largely unknown. Using broad-range PCR primers my lab has investigated the microbial diversity within the human oral flora associated with chronic periodontitis. This report focuses on the ecological role three groups of microorganisms: the methanogenic archaea, treponemes, and putative nitrogen fixers. Currently there is little information on the relationship between *Archaea* and chronic periodontitis. Although methanogenic *Archaea* have been isolated from the mouths of patients with periodontitis, previous studies lacked fundamental controls and were not quantitative, precluding the establishment of a significant or clinically relevant association between *Archaea* and disease. My work has established a correlation between the presence of disease and the presence of archaeal DNA, the severity of periodontal disease and the relative abundance of archaeal DNA in subgingival plaque. Although oral archaeal diversity is severely limited phylogenetic analysis of the two rDNA phylotypes deomonstrates that they were distinct from the previously isolated *Methanobrevibacter oralis*. We hypothesize that *Archaea* and bacteria from the genus *Treponema* play a similar and competing role in oral ecology. This hypothesis is supported by differences in the relative abundance of these two groups of organisms under competitive conditions. Finally, we investigated the diversity of putative nitrogen fixing bacteria within the oral flora. Using broad-range PCR primers for the dinitrogenase reductase gene (nifH), involved in nitrogen fixation, we identified four distinct phylotypes that appear to be widely distributed in specimens from periodontitis patients. All four phylotypes fall within nifH Cluster IV which is comprised primarily of nifH genes from Treponema and methanogens. The translated amino acid sequence of the predominant oral phylotype shared 64% identity and 77% similarity to the most closely related phylotype within the public database. None of the phylotypes shared more than 69% identity and 85% similarity to phylotypes from public databases. Two of the phylotypes were most closely related to sequences retrieved from the gut of termites. The remaining two phylotypes were most closely related to phylotypes associate with deep-sea hydrothermal vents.

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MOLECULAR INTERPLAY OF 'STIM1-TRPC1-CAVEOLIN1' ORCHESTRATE EPITHELIAL CELL PROLIFERATION

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AIM: To investigate the role of TRPC1-mediated calcium signals in cell proliferation.

INTRODUCTION: Calcium (Ca^{2+}) is a major signaling molecule in both excitable and non-excitable cells, where it modulates a variety of cellular functions ranging from cell growth to differentiation to cell death. One of the prime cellular requirements of Ca^{2+} is during cell-cycle progression. Transit of proliferating cells through the synthesis (S) and mitosis (M) phases of the cell cycle require elevated levels of cytosolic Ca^{2+}. Increase in cytosolic Ca^{2+} then engages a variety of local and global changes including, transcriptional regulation coupled to cell proliferation (1). In order to carry out these physiological functions, cells employ plasma membrane (PM) Ca^{2+}channels to facilitate cytosolic Ca^{2+} entry. Transient receptor canonical-1 (TRPC1) constitute an integral component of PM Ca^{2+} channels that initiate Ca^{2+} entry following the depletion of endoplasmic reticulum (ER) Ca^{2+} , a process referred to as store-operated Ca^{2+} entry (SOCE) (2). Recently, Stromal interaction molecule-1 (STIM1) has been identified to regulate SOCE by coupling ER store-depletion to activation of PM Ca^{2+} channels (3). Additionally, we have recently identified that the association of TRPC1 with PM lipid raft/caveolar microdomains and its major structural protein Caveolin1 (Cav1) is a key parameter for the channel activation (4). PM lipid raft/ caveolar microdomains represent a major cellular compartment that facilitates several signal transduction events, including Ca^{2+} influx (5). Thus, we hypothesized that both STIM1 and Cav1 will play a significant role in activating TRPC1-mediated Ca^{2+} entry and thereby regulate cell proliferation.

EXPERIMENTS/RESULTS: In this study, we have evaluated the significance of TRPC1-mediated Ca^{2+} influx in transcriptional activation, cell proliferation and migration of epithelial cells. In human submandibular gland (HSG) cells as well as in human epidermal keratinocytes (HaCaT) we demonstrate that over-expression of TRPC1 augmented cell proliferation whereas, silencing of TRPC1 by siRNA (small interfering RNA) or expression of the channels' pore-mutant significantly inhibited proliferation. Under similar expression condition, comparable modulation of NFkB mediated transcriptional regulation was observed. Pharmacological inhibition of TRPC1 channels reduced the migrating potential of HaCaT cells *in vitro* in response to growth factor stimulation. We have identified a direct association of TRPC1 with caveolar microdomains, Cav1 and STIM1 respectively. Additionally since, TRPC1 is localized to caveolar microdomains and physically associated with Cav1, we hypothesized that over-expression of Cav1 will amplify TRPC1-mediated Ca^{2+} influx and associated physiological responses. On the contrary, however, increased expression of Cav1 significantly inhibited cell migration and progression of cell-cycle. This inhibitory effect of Cav1 on TRPC1 function was circumvented by increased expression of STIM1. Following ER Ca^{2+} store depletion, STIM1 displaced Cav1 from TRPC1 resulting in an increased TRPC1-STIM1 and decreased TRPC1-Cav1 association, thereby activating SOCE. Thus, the relative changes in 'TRPC1-STIM1' and 'TRPC1-Cav1' associations are crucial for Ca^{2+} influx mediated proliferative response of epithelial cells.

CONCLUSION: In conclusion, we propose that the association of TRPC1 with Cav1 is required for targeting the channel to specific PM compartments however, following ER store-depletion, the dissociation of the caveolae-associated 'TRPC1-Cav1' complex by STIM1 is imperative for the activation of SOCE and cell proliferation. Thus, this molecular cross-talk between 'STIM1-TRPC1-Cav1' puts forward a novel regulatory paradigm of signal transduction from PM to nucleus.

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Phototoxicity of fluorescent silica nanoparticles

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A number of fluorescent nanoparticles (NPs) have been used as fluorescent labeling materials for bioanalysis. The biological targets include tissues, living cells, DNAs and protein molecules. As more extensive usages of these NPs, a concern on the toxicity of the fluorescent nanomaterials to living systems is rising. Silica-based fluorescent NPs provide highly photostable fluorescence signals and are widely used in bioanalyses. Previously, we have studied some toxic effects of dye-doped silica NPs to living cells. The results demonstrated an insignificant toxicity of dye-doped silica NPs. In this work, we extended previous study to an investigation of phototoxicity of the dye-doped silica NPs. A widely used fluorescent dopant, Rubpy molecule, was chosen for making silica-based fluorescent NPs. Rubpy is a photosensitive dye molecule. It can react with oxygen in its excited state and generate toxic reactive oxygen species (ROS) when it is exposed to irradiation. The understanding of the phototoxicity of the fluorescent silica NPs will provide useful information for the application of dye-doped silica NPs in bioanalysis. Two cell lines, mouse lung epithelial (MLE12) cells and murine alveolar macrophage (MHS) cells, were employed in this study. After the cells were treated with NPs and irradiation at various conditions, a cell proliferation assay and an apoptosis assay were used to investigate the phototoxicity. The results showed that the Rubpy-doped silica NPs have a considerable phototoxicity when cells were treated with 0.1 mg/mL of NPs for 6 h irradiation. Under these conditions, the cells died through the apoptosis pathway.

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.

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MINUTES OF THE NORTH DAKOTA ACADEMY OF SCIENCE

ANNUAL BUSINESS MEETING 2009

President's note: Given the unusual circumstances no officially recorded minutes are available from the 2009 meeting. The following minutes are presented as the best recollection of the President.

North Dakota State University, Fargo, North Dakota, April 30, 2009, 12:00 PM

The first order of business was to approve the minutes of the previous business meeting from the April 2008 annual meeting in Minot, North Dakota.

A brief financial report was presented by Secretary-Treasurer Detke. At this time, the Academy is financially sound.

Lyle Best from Turtle Mountain Community College volunteered for President-Elect in 2010. He was nominated and elected without opposition by voice vote.

Meeting statistics: 94 Registered attendees 22 professional, 72 student
0 Guests

We had 7 professional talks and 55 Denison papers presented. The Denison Awards were presented by President Prüß.

President Prüß (North Dakota State University) officially ended her duties as President by introducing Paul Lepp (Minot State University). Paul Lepp discussed preliminary plans for the Academy's 102^{ne} Annual Meeting, over which he will preside in Minot on April 23, 2010.

The business meeting was adjourned at 1:00 PM.

Respectfully submitted,
Paul Lepp, President

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