

61st Annual Meeting of the American Scientific Affiliation
Prince Conference Center, Calvin College, Grand Rapids, Michigan
July 28-31, 2006

Embedding Christian Values in Science and Technology

PLENARY SPEAKERS:

DR. FRANCIS COLLINS

National Human Genome Research Institute
Bethesda, MD

DR. CELIA DEANE-DRUMMOND

University of Chester
Chester, United Kingdom

DR. VERNON J. EHLERS

US House of Representatives
Washington, DC

DR. RUDOLF JAENISCH

Whitehead Institute, MIT
Cambridge, MA

DR. KAREN LEBACQZ

Formerly Bioethicist in Residence
Yale University Interdisciplinary Center for Bioethics
New Haven, CT

SYMPOSIA:

Human Stem Cells: Science, Ethics and Public Policy
Stewardship, Conservation and Land Management: A Cross-Campus Checkup
Science and Technology in Service to the Poor
Models for the Teaching of Origins: Case Studies and Pedagogy
Science in Context: "Putting Science in Its Place"
Christian Values in Biotechnology
Christian Values in Engineering, Technology and the Physical Sciences

...**be transformed**

by the *renewing* of your **minds,**

so that you may *discern*

what is the **will** of **God—**

what is **good**

and **acceptable**

and **perfect**

—Romans 12:2b.

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*Student or early career scientist presenting a paper or poster through donated scholarships.

General Information

Bookstore

A bookstore featuring books of interest to attendees will be in the Hickory Room, Prince Conference Center. Bookstore hours are:

Saturday: 9:30 AM – 9:30 PM
Sunday: 12:00 PM – 4:00 PM
Monday: 9:00 AM – 1:30 PM

Emergency Phone Numbers

Prince Conference Center: (616) 526-7200; or toll free (800) 526-7200
Residence Hall: (616) 526-6452

Plenary Sessions

Friday 7:15 PM: "Pandemic Justice" –**Karen Lebacqz**
Saturday 8:20 AM: "Nuclear Cloning, Embryonic Stem Cells and Cell Therapy: Promise, Problems, Reality" –**Rudolf Jaenisch**
Saturday 8:00 PM: "The Language of God: A Believer Looks at the Human Genome" –**Francis Collins**
Sunday 10:15 AM: "A Recovery of Wisdom As Virtue for an Ethics of Genetics" –**Celia Deane-Drummond**
Monday 8:20 AM: "Religion, Science and Politics" –**Vernon Ehlers**

Special Meetings

Friday 8:30 PM: Fellowship Mixer –Fireside Room, Prince Conference Center

Saturday 12:00 PM: Women in ASA Luncheon –Northeast Patio, Prince Conference Center
7:00 PM: ASA Business Meeting –The Great Room, Prince Conference Center
9:00 PM: Ice Cream Social –Fireside Room, Prince Conference Center

Sunday 7:00 AM: Publications Breakfast –Commons Dining Hall
12:15 PM: Fellows Luncheon –Commons Dining Hall
7:00 PM: Expanding ASA's Reach –The Great Room, Prince Conference Center
9:00 PM: Movie: "The Mission" (with Robert De Niro and Jeremy Irons; 1986, rated PG)
–Bytwerk Theater, DeVos Communication Building

Many thanks to ...

Program chair **Hessel Bouma III** and local arrangements chair **Larry Molnar** for the countless hours they have devoted to developing this program.

We are especially pleased and thankful for the **Donors** who contributed to the Students and Early Career Scientists' Scholarship Fund as well as for support from the **John Templeton Foundation**.

The ASA Spirit

The American Scientific Affiliation encourages thoughtful and provocative scientific presentations and discussions. Presenters and discussants are expected to maintain a humble and loving attitude toward individuals who have a different opinion.

2006 ASA Annual Meeting Schedule

Friday, July 28, 2006				
8:00 AM–9:00 AM	Breakfast –Commons Dining Hall (Prince Conference Center for those staying there, 6:30 AM–10:00 AM)			
9:30 AM	Departures for two field trips from the Prince Conference Center ♦ Ecology & Geomorphology of Sand Dunes at PJ Hoffmaster State Park on Lake Michigan (9:30 AM–4:00 PM) ♦ Gerald R. Ford Presidential Museum (9:30 AM–12:00 PM)			
12:00 PM–1:00 PM	Lunch –box lunch only (pre-paid)			
1:00 PM	Departures for two field trips from the Prince Conference Center ♦ Meijer Gardens & Sculpture Park (1:00 PM–4:00 PM) ♦ Urban Geography (1:00 PM–4:00 PM)			
5:30 PM–6:30 PM	Picnic Supper –DeWit Manor House Lawn/Seminary Pond, generously provided by Calvin College President Gaylen and Susan Byker in absentia			
7:00 PM	Welcome and Announcements –The Great Room, Prince Conference Center ♦ Hessel Bouma III , Program Chair and ASA Executive Council President – Larry Molnar , Local Arrangements Chair ♦ Uko Zylstra , Calvin College Academic Dean			
7:15 PM Plenary Session I	Plenary Session –The Great Room, Prince Conference Center ♦ "Pandemic Justice" – Karen Lebacqz ♦ Randy Isaac , ASA Executive Director, moderator			
8:30 PM	Fellowship Mixer –Fireside Room, Prince Conference Center			
Saturday, July 29, 2006				
7:00 AM–7:45 AM	Breakfast –Commons Dining Hall (Prince Conference Center for those staying there, 6:30 AM–10:00 AM)			
8:00 AM–8:20 AM	Morning Devotions –The Great Room, Prince Conference Center ♦ Donald W Munro , former ASA Executive Director, Joseph H Lechner , accompanist			
8:20 AM–9:30 AM Plenary Session II	Plenary Session –The Great Room, Prince Conference Center ♦ "Nuclear Cloning, Embryonic Stem Cells and Cell Therapy: Promise, Problems, Reality" – Rudolf Jaenisch ♦ Hessel Bouma III , Program chair, moderator			
9:30 AM–10:00 AM	Refreshment Break –Fireside Room, Prince Conference Center			
10:00 AM–12:00 PM Parallel Session I	I-A. Science & Technology in Service to the Poor – Peter Bosscher , moderator Maple/White Pine Room	I-B. Stem Cells: Science, Ethics & Public Policy – James Rusthoven , moderator Oak Room	I-C. General Session: Values in Health and Healthcare – Janel Curry , moderator Elm/Blue Spruce Room	I-D. General Session: Conservation and Sustainability – Dorothy Boorse , moderator Bunker Interpretive Center
10:00 AM–10:30 AM	Using Science and Technology in Service to the Poor: Where Does One Begin? – Martin Price	Pluripotent Cells from Other Sources than Embryos: Fact or Fiction? – Rudolf Jaenisch	Christian Ethics and Psychology: Professional and Scientific Axiology – William L Hathaway	A Walk Down Memory Lane: Using History to Improve Our Understanding of Biological Invasions – Jonathan W Schramm
10:30 AM–11:00 AM	Using Immunoassays to Create Affordable Diagnostics – Alyne MacLean	Stem Cell Therapy for the Heart – Jay L Hollman	Anabaptist Ethics of Relationship: Nature, Family, and Community – Roman Miller	Optimization of Urban Land As a Resource to Sequester Carbon – David L Dornbos Jr
11:00 AM–11:30 AM	Learning About Life and God in West Africa – Francis S Collins	Male Germline Stem Cells and Infertility – Kyle E Orwig	The Paradox of Pain and Suffering: Withdrawal of Pain Sensation Leads To Suffering – Bruce McCallum	Native Habitat Plantings: Benefits, Assessments, and Best-Practices – Daniel Spalink
11:30 AM–12:00 PM	Converting Coconuts into Renewable Energy and Other Value-Added Products in Developing Countries – Walter Bradley	Human Stem Cells in the Treatment for Parkinson's Disease: Current Status – Brian T Greuel	Five Centuries of Religious Response to Tobacco – Joseph H Lechner	Sustainability: The Challenge to Liberal Arts Education – Kenneth Piers

12:00 PM–1:00 PM	Lunch –Prince Conference Center		Women in ASA Luncheon with Susan Daniels presiding –Northeast Patio, Prince Conference Center	
Please note: <i>Posters are displayed in the Willow Room for viewing. Poster presenters will be available Sunday, 11:15 AM–12:00 PM, to discuss their work and to answer questions.</i>				
1:00 PM–3:00 PM Parallel Session II	II-A. Science & Technology in Service to the Poor (continued) – Martin Price , moderator Maple/White Pine Room	II-B. Stem Cells: Science, Ethics & Public Policy (continued) – Brian Greuel , moderator Oak Room	II-C. General Session: Science & Religion – Marilyne Flora , moderator Elm/Blue Spruce Room	II-D. Stewardship, Conservation & Land Management – Randall Van Dragt , moderator Bunker Interpretive Center
1:00 PM–1:30 PM	Antimalarial Activity of Two Varieties of Papaya (<i>Carica papaya</i>) Extracts – James F Mahaffy	Embryonic Stem Cells As Tools for Genetic Manipulation: Current Science and Future Prospects – Stephen Matheson	From Scientific Method to Methodological Naturalism: The Evolution of an Idea – Harry Lee Poe	Finding Our Way to a Green Future on Campus – John R Wood
1:30 PM–2:00 PM	Antibacterial Activity of Isolated Compounds Extracted from <i>Moringa oleifera</i> Seeds – Jennifer R Bonina	Stem Cells, Embryos and Ethics: Is There a Way Forward? – William B Hurlbut	The Nature and Value of Scientific Apologetics – Richard A Carhart	Stewardship of Aquatic Habitats on the Campus of Oral Roberts University, Tulsa, Oklahoma – John Korstad
2:00 PM–2:30 PM	Facilitating the Use of Velvetbean as Food and Feed – Rolf V Myhrman	The Ethics of the ANT Proposal To Obtain Embryonic Stem Cells: What Does It Resolve? What Does It Not Redress? – James C Peterson	Intelligent Design, Methodological Naturalism, and the Star of the Magi – Sherman P Kanagy II	Infiltrating the Manicured with the Natural: Strategies for a Kinder, Gentler Campus Landscape – David P Warners
2:30 PM–3:00 PM	Enabling Engineering Design in Frontier Contexts: A New Design Method with Humanitarian Applications – Ryan Norton	Stem Cell Ethics: The Neglected Issues – Karen Lebacqz	The Impact of In-Class Devotions About a Christian Worldview on Student Views of Science and Faith – Bryan J Isaac	Gordon College Land Stewardship: Past and Future – Dorothy F Boorse
3:00 PM–3:15 PM	Refreshment Break –Fireside Room, Prince Conference Center			
3:15 PM–5:15 PM Parallel Session III	III-A. Science & Technology in Service to the Poor (continued) – Martin Price , moderator Maple/White Pine Room	III-B. Stem Cells: Science, Ethics & Public Policy (continued) – James C Peterson , moderator Oak Room	III-C. General Session: Science & Religion (continued) – Sara Miles , moderator Elm/Blue Spruce Room	III-D. Stewardship, Conservation & Land Management (continued) – Randall Van Dragt , moderator Bunker Interpretive Center
3:15 PM–3:45 PM	Achieving Sustainable Health Benefits for Community Water Systems in Ecuador – Bruce V Rydbeck	Ethical Issues Involving Embryonic Stem Cell Research and New Drug Development: Weighing Urgency against Prudence and Risk – James Rusthoven	The Significance of Creation Theology in True and False Prophecy – Steve Delamarter	Prairie Restoration at Cedarville University: Land Stewardship Draws Benefits from a Well Field – John E Silvious
3:45 PM–4:15 PM	Sustainable Health Care Costs? – Gerald Hess	A Public Policy Proposal for Human Embryonic Stem Cells – Hessel Bouma III	God, Time, and Creation in Christian Thought – David F Siemens Jr	Land Stewardship at the University of Michigan's Matthaei Botanical Gardens and Nichols Arboretum – Robert E Grese
4:15 PM–4:45 PM	The Kingdom and Sustainability Principles – Peter Bosscher	Panel discussion of symposium speakers with audience	The God-Fearing Life of Leonhard Euler – Dale L McIntyre	Stewards of a Legacy: Tending an Off-Campus Land Preserve – Luke A Gascho
4:45 PM–5:15 PM	Panel discussion of symposium speakers with audience			Panel discussion of symposium speakers with audience
5:30 PM–6:45 PM	Banquet –Commons Dining Hall			
7:00 PM–8:00 PM Business Meeting	ASA Business Meeting –The Great Room, Prince Conference Center – Hessel Bouma III , ASA President, presiding ♦ Everyone invited			
8:00 PM–9:00 PM Plenary Session III	Plenary Session –The Great Room, Prince Conference Center ♦ “The Language of God: A Believer Looks at the Human Genome” – Francis Collins ♦ Hessel Bouma III , 2006 ASA Executive Council President, moderator			
9:00 PM	Ice Cream Social for Everyone –Fireside Room, Prince Conference Center ♦ Students and Early Career Scientists are invited to take their ice cream and gather with Gwen Schmidt and Johnny Lin on the patio.			

Sunday, July 30, 2006				
7:15 AM–8:15 AM	Breakfast –Commons Dining Hall (Prince Conference Center for those staying there, 6:30 AM–10:00 AM) ◆ Publications Breakfast with Roman Miller presiding, Commons Dining Hall			
8:30 AM–9:45 AM	Ecumenical Worship Service –The Great Room, Prince Conference Center ◆ Scott Hoozee , minister; David Van Baak , liturgist; Sara Miles , intercessory prayer; Susan Daniels and Robin Pals-Rylaarsdam , Scripture readers; Carol Petter , accompanist; offering for Christian Reformed World Relief Committee; service conducted under auspices of Church of the Servant Christian Reformed Church			
9:45 AM–10:15 AM	Fellowship –Fireside Room, Prince Conference Center			
10:15 AM–11:15 AM Plenary Session IV	Plenary Session –The Great Room, Prince Conference Center ◆ “A Recovery of Wisdom As Virtue for an Ethics of Genetics” – Celia Deane-Drummond ◆ Ruth Douglas Miller , 2006 ASA Executive Council Vice President, moderator			
11:15 AM–12:00 PM Poster Session	Poster Session –Willow Room ◆ Implications for Pre-Biotic Proteins from Enzyme Hydrolysis by α -amylase – Robert M Bartholow ◆ Regulation of cGMP-dependent Protein Kinase (PKG) Enzymatic Activity – Jennifer L Busch ◆ Production of Sperm and Male Pheromone in the Giant Kelp <i>Macrocystis integrifolia</i> – Grace Cho ◆ The Role of Noncleavable Poly(ADP-ribose) Polymerase-1 in Excitotoxicity – Karen K David ◆ Ethical Solutions to the Multifetal Pregnancy Problem – Jonathan C Dudley ◆ Environmental Auditing in Peru: A Way to Monitor Stewardship of Nature – Oscar Gonzalez ◆ Is Atomic Force Spectroscopy an Effective Method for Determining the Binding of Drugs to DNA? – Jennifer L Headley ◆ Localizing mDia1 and mDia2 in Rat Primary Neuronal Cultures – Sarah Hofman ◆ JAR1, a Dominant Gene Conferring Resistance to Amphotericin B in <i>Saccharomyces cerevisiae</i> – Joyce R Iwema ◆ Enhancement of Plant Biodiversity during the Early Stages of a Prairie Restoration Effort – Amanda Joswig ◆ Migration of Mesenchymal Stem Cells (MSC) under the Influence of SDF-1 α and MIP-1 α – Jacquelyn N Kamp ◆ Polysialylated-Neural Cell Adhesion Molecule (PSA-NCAM) in the Hippocampus – Heather J Kooiman ◆ Specificity of Male Brown Algal Pheromones – Sun-Yong Lee ◆ Residues Affecting Nuclear Import of Galectin-3 – Andrew G Lohse ◆ GTPase Defect Associated with McCune-Albright Syndrome – Laura S Ooms ◆ The Activation of Glucose Transport is Reduced by the Removal of Membrane Cholesterol – Janelle Rekman ◆ High Throughput Measurements of Cardiac Cell Graft Size – Thomas E Robey ◆ A Novel Pathway for Inducing Latent Virus from Resting CD4+ T cells in the SIV Model of HIV Latency – Anding Shen ◆ Understanding the Roles of Nonduplex Regions in RNA Folds – Alyssa L Smith ◆ Verapamil Inhibits Glucose Uptake in Mouse Muscle Tissue and L929 Fibroblasts – Nathan Stehouwer ◆ Cinnamon Extract Inhibits Glucose Uptake – Andrew Tidball ◆ Expression Patterns of mDia1 and mDia2 in Developing Mouse Brains – John D VanderHeide ◆ An Ecological Study and Mitigation of a Woodlot: Stewardship in Action – Rachel L Vannette ◆ Histological Analysis of Cux-1 Expression during the Development of Postnatal Mouse Testes – Engela S Viss ◆ Land Use Management and Stewardship on North American Christian Campuses – John Wood			
12:15 PM–1:15 PM	Lunch –Commons Dining Hall		Fellows Luncheon with Dorothy Chappell presiding	
1:30 PM–3:30 PM Parallel Session IV	IV-A. Christian Values in Biotechnology – David S Koetje , moderator Maple/White Pine Room	IV-B. Models for Teaching of Origins – Dorothy Chappell , moderator Oak Room	IV-C. Christian Values in Engineering, Technology & Physical Sciences – Steve VanderLeest , moderator Elm/Blue Spruce Room	IV-D. Stewardship, Conservation & Land Management (continued) – John R Wood , moderator Bunker Interpretive Center
1:30 PM–2:00 PM	On Genetically Modified Organisms in Agriculture: The Peril and the Potential – Ming Y Zheng	Developing and Implementing an Interdisciplinary Origins Course at a State University – Keith B Miller	Christian Values and Nuclear Energy – Tjalle T Vandergraaf	Connecting the Campus to the Watershed – Janel Curry
2:00 PM–2:30 PM	Galileo, Biotechnology and Epistemological Humility: Moving Stewardship Beyond the Development-Conservation Debate – Charles C Adams	Six Easy Pieces: One Pedagogical Approach to Integrating Science/Faith/Origins into College-Level Introductory Physics Courses – Sean M Cordry	Weaving Wonder and Wisdom: Developing a Christian Face for Values in Science – Celia Deane-Drummond	The Ivory Tower and the Bulldozer: Colleges As Accidental Developers and Urban Planners – Mark D Bjelland
2:30 PM–3:00 PM	Transgenic Biotechnology and the Shalom of Creation – Tony N Jelsma	Religion and Science in Modern America: An Interdisciplinary Course on Origins – Edward B Davis	Professional Engineering Ethics and Christian Values: Overlapping Magisteria – Gayle E Ermer	A Tale of Oaks, Salmon and Snails: Land Stewardship at Trinity Western University – Karen M Steensma and David Clements
3:00 PM–3:30 PM	Gratuity in Nature and Theology – Paul Arveson	Using Case Studies to Teach Evolutionary Biology – Robin Pals-Rylaarsdam	Teaching a Christian Engineering Ethics – William M Jordan	Toward a More Sustainable Stewardship of Campus Lands – Randall G Van Dragt
3:30 PM–3:45 PM	Refreshment Break –Fireside Room, Prince Conference Center			

3:45 PM–5:15 PM Parallel Session V	V-A. Christian Values in Biotechnology (continued) – Craig Story , moderator Maple/White Pine Room	V-B. Models for Teaching of Origins (continued) – Uko Zylstra , moderator Oak Room	V-C. Christian Values in Engineering, Technology & Physical Sci. (continued) – Ruth Douglas Miller , moderator Elm/Blue Spruce Room	V-D. Stewardship, Conservation & Land Management (continued) – John R Wood , moderator Bunker Interpretive Center
3:45 PM–4:15 PM	Systems Biology: Emergence of a New Approach? – Hank D Bestman	Students Formulate Views on Viruses and Their Place in Creation or the Fall – Arlene J Hoogewerf	Assessment and Noise Reduction Technologies for Civilian Aircraft – James W Gregory	Panel discussion of symposium speakers with audience
4:15 PM–4:45 PM	Acetate Metabolism in <i>Chlamydomonas reinhardtii</i> : Attempting a Systems Approach – Janina Mobach	Teaching Christian Students About an Old Universe – Deborah B Haarsma	What Is Chemistry? The Impact of Science and Technology on Culture and the Environment – Carl P Fictorie	
4:45 PM–5:15 PM	Post-Genomic Biosciences and Biotechnologies: A Timely Paradigm Shift in the Making? – David S Koetje	Theories of Origins: A Multi- and Interdisciplinary Course for Undergraduates at Wheaton College – Stephen O Moshier	Science and Engineering in Public Policy: Getting Out of the Boat in Washington, DC – Randall J Brouwer	
5:15 PM–5:45 PM	Panel discussion of symposium speakers with audience	Teach the Controversy over Darwinism: Sample Curricular Modules – Mike N Keas	The Biblical Basis for Technology Assessment – Jack C Swearengen	
5:45 PM–6:45 PM	Supper –Commons Dining Hall			
7:00 PM–8:30 PM	Focus Groups: “Expanding ASA’s Reach” –The Great Room, Prince Conference Center			
9:00 PM–11:15 PM Movie	Movie: “The Mission” (with Robert De Niro and Jeremy Irons; 1986, rated PG) –Bytwerk Theater, DeVos Communication Building			
Monday, July 31, 2006				
7:00 AM–7:45 AM	Breakfast –Commons Dining Hall (Prince Conference Center for those staying there, 6:30 AM–10:00 AM)			
8:00 AM–8:20 AM	Morning Devotions –The Great Room, Prince Conference Center ♦ Randy Isaac , ASA Executive Director; Deborah B Haarsma , accompanist			
8:20 AM–9:20 AM Plenary Session V	Plenary Session –The Great Room, Prince Conference Center ♦ “Religion, Science and Politics” – Vernon Ehlers ♦ Edward Davis , 2006 ASA Executive Council, moderator			
9:20 AM–9:45 AM	Refreshment Break –Fireside Room, Prince Conference Center			
9:45 AM–12:15 PM Parallel Session VI	VI-A. Science in Context: “Putting Science in Its Place” – Arie Leegwater and Edward B Davis , moderators Maple/White Pine Room	VI-B. Models for Teaching of Origins (continued) – Dorothy Chappell , moderator Oak Room	VI-C. Christian Values in Engineering, Technology & Physical Sci. (continued) – Steve VanderLeest , moderator Elm/Blue Spruce Room	
9:45 AM–10:15 AM	John Calvin, Natural Science, and the Principle of Accommodation – Davis A Young	Using Survey/Response Writing Assignments to Stimulate Classroom Discussion – Loren D Haarsma	Beyond Stewardship: A Franciscan Look at the Christian Engineer as Mediator – Sister Damien Marie Savino	
10:15 AM–10:45 AM	Beliefs in Natural Science: Then and Now – Christopher B Kaiser	Using Galileo to Teach Darwin – Craig A Boyd	Constraints and Criteria in the Conceptual Design Process – Kamalini A Martin	
10:45 AM–11:15 AM	Protestant Modernism, the Warfare Thesis, and the Religion of Science – Edward B Davis	Teaching the “Science and Theology of Origins” at Montreat College – Lloyd J Davis	Project Connect: Connecting the Disconnected – Keith N Vander Linden	
			VII-C. General Session: Science & Religion (continued) – Steve VanderLeest , moderator	
11:15 AM–11:45 AM	Putting Science in Its Place: The Culture of Scientific Practice – Arie Leegwater	The Coming Demise of Intelligent Design and Implications to Teaching About Origins – Richard P Aulie	Pedagogy: Teaching the Whole Is Greater Than the Sum of the Parts – Robert M Bartholow	
11:45 AM–12:15 PM	Contextual Responsibility in Scientific Work – Matthew Walhout	Evolution Wars: A Failure to Communicate – Uko Zylstra	A New Vocabulary for Teaching Biological Origins – Fredric P Nelson	
12:00 PM	Check-out at Prince Conference Center			
12:15 PM–1:15 PM	Lunch –Commons Dining Hall			
3:00 PM	Check-out at Kalsbeek/Huizenga Residence Hall			

Parallel Session I Abstracts

I-A. SCIENCE & TECHNOLOGY
IN SERVICE TO THE POOR
Maple/White Pine Room

Saturday, July 29, 2006 10:00 AM

Using Science and Technology in Service to the Poor: Where Does One Begin?

Martin Price

We have been unbelievably blessed in our personal and national lives by benefits brought to us by advances in science and technology. Most of these benefits become available to us because we, our parents, or our government spend considerable amounts of money. What would research in science and technology look like if the goal was to help the extremely poor, especially in underdeveloped countries? What can I as a scientist or engineer develop that a person earning a few hundred dollars a year could take advantage of? The bottom line is that the result of our work must be something that costs almost nothing to the end user.

This talk will give brief examples of several research efforts (or research opportunities) that meet this criterion. The talks to follow in this symposium will give concrete examples of scientists and engineers who are already involved in just this kind of work.

10:30 AM

Using Immunoassays to Create Affordable Diagnostics

Alynn MacLean

In the poorest regions of the developing world, there is often no electricity or refrigeration, and no running water. Lack of these basic amenities makes diagnosing diseases very difficult. Daily, people are dying from preventable diseases due to not being

diagnosed. A number of years ago, the lack of diagnostics was less of an issue—simply because doctors did not have medicine to dispense even if a patient was properly diagnosed. Now, there is a new situation arising. There are medical professionals with medicine, but without an adequate means to know who needs which medicine.

Within the US, the majority of tests to diagnose diseases require expensive equipment, electricity, trained technicians to run the equipment, and maintenance personnel to repair the equipment and replace worn parts, etc. Hence, we cannot simply “transplant” typical US technology to the developing world. This is why we need an appropriate new technology brought to these regions for diagnostics.

An appropriate diagnostic is one that is affordable, does not require refrigeration or electricity, can withstand heat and humidity, and can be performed quickly. Immunoassays can meet all of these needs.

This talk will take you through the development of a rapid diagnostic test for malaria. Every single day, more than 3,000 people die from malaria—and 75% of those who die are children under the age of five. According to the World Health Organization, “a prompt and accurate diagnosis is the key to effective disease management in malaria patients.”

Each aspect of the diagnostic test will be discussed: from production of polyclonal and monoclonal antibodies, conjugation of antibodies to dyed latex micro particles, and striping antibodies on membranes, to preparing sample and conjugate release pads.

At the end of the talk, we will see how these tests are being used in the Himalayan Mountains of

Nepal in Community Health Evangelism efforts, in Mexico by mobile medical teams, in a hospital in Haiti, and in clinics in the Democratic Republic of Congo.

11:00 AM

Learning About Life and God in West Africa

Francis S Collins

Following a longstanding urge to do more for the developing world, I have volunteered on two occasions to serve as a physician in a Christian mission hospital in the delta area of Nigeria. To add to the significance of the experience, I was accompanied both times by my daughter, who has subsequently gone on to become a practicing physician. The experience was exhausting, terrifying, and life-changing.

Faced with overwhelming poverty and medical needs in the clinic and hospital, separated from my familiar environment of high-tech medicine, and challenged by the need to diagnose and treat tropical diseases I had never seen before, with little to go on except my hands, eyes, and ears, I was forced to lean on God and not my own inadequate abilities. Looking around me, I learned to appreciate the incredible blessings that I had taken for granted in living in a country of great abundance. But I also was sobered and inspired by the courage and spiritual strength of the Christian Nigerians I spent time with—they seemed to have so little, and yet their abiding trust in God put my own to shame. In one particular instance, an encounter with a critically ill Nigerian farmer who had come to seek my care left me with an unforgettable lesson about God’s love.

11:30 AM

Converting Coconuts into Renewable Energy and Other Value-Added Products in Developing Countries

Howard Huang, Jason Poel, and
Walter Bradley

Cocos nucifera trees, otherwise known as coconut trees, grow abundantly along the coast line of countries within 20° of the equator, since they prosper in sandy soil and salt water. A single coconut tree will produce more than 120 watermelon-sized husks per year, each with a coconut imbedded inside. There are three constituents of the *Cocos nucifera* that can be used for fuel; the husk, the coconut shell, and the coconut oil that is in the white coconut “meat,” or copra as it is usually called. Thus, the coconut tree is a very abundant, renewable resource for energy.

We have been investigating the production of energy from these three constituents of coconuts.

1. The white inside of the coconut, called the coconut meat or coconut flesh, can be removed from the shell and subsequently squeezed to expel the coconut oil. It takes about 10 coconuts to make one liter of coconut oil. The coconut oil can be processed using lye as a catalyst and methanol as a reactant to convert the coconut oil into a bio-diesel fuel, with a processing cost of \$0.69/gallon. The coconut bio-diesel has been found to run very nicely in a diesel generator, allowing the conversion of coconut oil into electricity.
2. The coconut shell has a specific gravity of 1.2, which is very dense compared to hard woods which usually have a specific gravity of 0.6 and soft woods which are between 0.2 and 0.4. This much greater density suggests that the coconut shell should have a greater density of energy as

well, which it does. Ten kilograms of coconut shell produces 3 kg of charcoal and 5.5 kg of combustible gases, giving a remarkably high yield of fuel compared to wood, which typically gives only 1 kg of charcoal from 10 kg of wood.

3. The coconut husk can also be used as a fuel. It can be processed in a biomass system where it is converted to combustible gases that are then used in a gas turbine to generate both electricity and heat for warming homes or offices and for making hot water. One coconut husk can be used to make about 0.25 kW of electricity.

In this paper, both the technical details of the conversion of the three constituents of *Cocos nucifera* into various fuels will be presented along with an economic analysis of the feasibility of using *Cocos nucifera* as the primary source of renewable energy for rural villages.

The hardness of the coconut shell also makes it a likely additive for stiffening and strengthening engineering plastics as a filler. Grinding it into suitable fine particles is required to make this possible. Recent results from our labs will be presented.

The husk can also be pressed in to excellent particle board, with the pith acting as a polymer matrix and the fibers acting as the reinforcing agent. Recent results from our lab for this process will also be presented.

**I-B. STEM CELLS: SCIENCE,
ETHICS & PUBLIC POLICY**
Oak Room

Saturday, July 29, 2006 10:00 AM

**Pluripotent Cells from Other
Sources than Embryos:
Fact or Fiction?**
Rudolf Jaenisch

The derivation of embryonic stem (ES) cells that could be used for research or for therapy of degenerative diseases is controversial because the isolation procedure

of ES cells involves the use of human embryos. For this reason alternative sources such as adult stem cells or alternative procedures such as cell fusion were used in an attempt to generate pluripotent cells. In this talk, I will summarize these attempts and discuss whether the published data support the notion that "cell plasticity" or "trans-differentiation" are viable alternatives to embryonic stem cells.

10:30 AM

**Stem Cell Therapy
for the Heart**
Jay L Hollman

Human clinical studies at present use adult stem cells only. The potential advantage for human embryonic stem cells (hESC) is limited since genetic defects that could take advantage of homologous recombination are relatively rare. Hypertrophic cardiomyopathies are single gene defects that might be treated with cloned hESC. However, the slow cardiomyocyte turnover and acceptable alternative treatments would likely limit this application. Familial hyperlipidemia in the heterozygous state is well treated with current drugs, homozygotes might benefit from hESC but this occurs in only 1 in a million.

Current stem cell therapies for the heart involve cell replacement for myocardial infarction (MI) and congestive heart failure (CHF). CHF protocols have used myoblast stem cells isolated from the patient's skeletal muscle, grown in cultures and infused directly into scarred myocardium. Although there is evidence of efficacy, these myoblasts do not transform into functioning cardiac tissues and are proarrhythmic. MI protocols are most widely used and involve mobilization of stems from the blood or more commonly from the bone marrow through cytokinin infusion or direct marrow aspiration. These cells are then infused intravenously (nonselectively) or more commonly directly in the

coronary artery or into the myocardium.

TOPCARE-AMI (historical controls) and BOOST (randomized) are two small human studies that demonstrate modest benefits without significant complications. Granulocyte-colony stimulating factor (G-CSF) to mobilize progenitor cells from the bone marrow has been used in several trials. G-CSF in some trials was associated with a higher incidence of recurrent stenosis at stent implantation. REVIVAL-2, the first randomized study of G-CSF in human MI, demonstrated no benefit. In MI it is unclear that hESC would be of much value. "Off the shelf" allogeneic, matched stem cells from embryos infused at the time of coronary reperfusion would be convenient but not worth the risk of rejection and likely not the optimal time for infusion.

At the current phase of research, there are more questions than answers.

11:00 AM

**Male Germline Stem Cells
and Infertility**
Kyle E Orwig

Stem cells have become the focus of intense investigation due to their essential role in embryonic and adult tissue development and their capacity to regenerate unhealthy or damaged tissues. Male germline stem cells are adult tissue stem cells that are located in the testis and are responsible for generating sperm throughout the adult life of men.

A technique for transplanting male germline stem cells was developed about 10 years ago and this technology has now been used to restore fertility in infertile mice, rats, and goats. Responsible development of the transplantation technique for human application will require extension to species with greater relevance to human physiology.

Current research is focused on developing a nonhuman primate

(nhp) model of cancer survivorship. Infertility is a common side effect of cancer therapy and male germline stem cell transplantation may offer fertile hope to cancer survivors.

A study was designed to identify a dose of the chemotherapeutic drug, busulfan, that was compatible with long-term survival, but caused infertility. Weekly blood and semen analyses demonstrated that busulfan treatment (8–12 mg/kg) caused both hematopoietic and spermatogenic deficits. However, while white blood cell counts returned to normal by 10 weeks after treatment, sperm counts have remained 0 for several months.

Prior to chemotherapy, biopsies or hemicastrations were performed to produce testis cell suspensions. These suspensions, which contain male germline stem cells, were cryopreserved for eventual autotransplantation back into the animals from which they were obtained. Also, part of each suspension was transplanted into the testes of immune deficient nude mice to evaluate stem cell activity. We recently retransplanted cryopreserved testis cells back into the testes of two treated monkeys and are evaluating their sperm production and fertility status.

11:30 AM

**Human Stem Cells in the
Treatment of Parkinson's
Disease: Current Status**
Brian T Greuel

Parkinson's disease (PD) is a neurodegenerative disorder characterized by the progressive loss of dopaminergic (DA) neurons in the *substantia nigra pars compacta* and a reduction in striatal dopamine. Conventional treatments for PD are aimed primarily at dopamine replacement and the alleviation of disease-associated motor deficits rather than at effecting a cure for the disease. Over time, however, this pharmacological approach generally becomes less effective

as the disease progresses and troubling side effects (e.g., dyskinesia) often develop. This has prompted an interest in the development of cell-based therapies for restoring the damaged DA system in PD patients.

Initial studies suggested that transplantation of fetal DA neurons into the brains of PD patients would be successful in reducing their motor symptoms, but subsequent double-blind, placebo-controlled clinical trials failed to demonstrate significant benefits of this approach. Other limitations of this approach included difficulties in obtaining large amounts of fetal brain tissue (needed if widely implemented), inconsistencies in generating a reliable reservoir of DA neurons, and variability in the clinical outcome of patients who received this therapy. The use of fetuses as donors is also controversial on ethical grounds.

This has led many researchers to investigate the feasibility of using human stem cells for cell-based therapies in PD patients because of the capacity of these cells for self-renewal and their ability to differentiate into physiologically normal cell types (including DA neurons).

Among the stem cells that have been studied (or proposed for study) in cell-based therapies for PD are: (1) embryonic stem cells (ESCs), which are derived from the inner cell mass of the blastocyst and have the greatest developmental potential of all stem cells; (2) neural stem cells or their precursors; (3) stem cells from bone marrow and umbilical cord; and (4) embryonic germ cells, which are derived from fetal primordial germ cells and appear to have many of the properties of ESCs.

In this paper, I will summarize the progress that has been made with each of these cell types in animal studies and *in vitro* studies as it relates to their potential use in the treatment of PD.

**I-C. GENERAL SESSION:
VALUES IN HEALTH AND
HEALTHCARE
Elm/Blue Spruce Room**

Saturday, July 29, 2006 10:00 AM

**Christian Ethics and
Psychology: Professional
and Scientific Axiology
William L Hathaway**

Honorific ethical codes have been associated with the healing arts for millennia. However, the development of delineated standards of conduct is a relatively recent innovation that has quickly burgeoned into the typical way that Western professions have self-promulgated their ethical self-understandings over the last century. This presentation will briefly review the development of Percivalian ethical codes and their connection with Christian ethical concerns.

The ethical foundations for the basic aspirational principles of the American Psychological Association will be explored as an example of this modern codification of professional ethics. It will be argued that a theistic meta-ethical foundation provides a better support to professional ethics than naturalistic alternatives. The presentation will conclude with a discussion of the truncated notions of well-being and dysfunction that characterize the social sciences.

Psychological research tends to construe well-being in primarily hedonic terms. However, this is a normative presupposition and not an inductive finding of empirical science. While some psychological scientists seem to assume that psychology speaks in a straightforward way to numerous societal issues, they ignore the vital mediating role of the normative criteria used to organize and evaluate the significance of empirical findings.

A range of nonhedonic characterizations of “proper functioning” will be briefly considered. It will be suggested that psychological research may appear to generate different

conclusions if these broader range of potential well-being facets were routinely tracked in scientific investigations. Although a Christian world view should not be insensitive to hedonic concerns, Christian accounts of well-being as Shalom call for a broader and multi-faceted model of aspects of human functioning.

10:30 AM

**Anabaptist Ethics of
Relationship: Nature, Family,
and Community
Roman J Miller**

Our relational ethics express, both individually and collectively, what we are. While relational ethics may be humanitarian based, a specific religious perspective may dramatically impact what a moral relationship should be. In this paper, an Anabaptist world view will be described as a way forming and maintaining relationships that empower bioethics. Originating in the Radical Reformation of 16th century Europe, Anabaptism continues to thrive through the “children” of that lineage and is illustrated by the relationships fostered in contemporary Mennonite, Amish, Brethren, and a few other smaller religious groups.

A loving and compassionate lifestyle, committed community connections, and choosing peace are core Anabaptist values that have both a theological and experiential basis and have the power to transform relationships.

Historically, advocates of Anabaptism established homes and livelihoods that supported a stewardship ethic of natural resources. Nature was viewed as a valued gift from the Creator that required human caretaking. Human initiative in nature was understood to be bounded and limited. The traditional family unit was the inviolate core wherein the next generation first developed meaningful relationship experiences. The validity of those relationships was expressed most visibly in daily routines in the

home, and interactions in the local community, especially in response to the pressures of society.

In this presentation, contemporary bioethical issues—abortion, *in vitro* fertilization, euthanasia, genetic engineered plants and animals, cloning, and stem cell research—are evaluated in a new way from this Anabaptist relational perspective, which dramatically contrasts with a perspective where autonomy reigns as the superior value. Virtue is most completely expressed in a loving and caring relationship ethic. A covenanted community becomes the place for ethical discernment and direction.

11:00 AM

**The Paradox of Pain and
Suffering: Withdrawal of
Pain Sensation Leads to
Suffering
Bruce McCallum**

Chronic or neuropathic pain is difficult to treat and harder to explain; except for those suffer from it. Modern mechanistic models of pain inadequately describe chronic pain as pathological sensory perception in the absence of any other underlying pathology, accompanied by disabling behavior that serves no adaptive purpose.

The inadequacy of mechanistic models is reflected in various attempts to redefine pain to include affective aspects. Chronic pain defies mechanistic analyses for two reasons. Experimentally, it is difficult to distinguish between protective pain responses and maladaptive behavior, and classic modes of blocking or ablating painful sensory transduction are ineffective in chronic pain. Unfortunately, the inability to detect or treat chronic pain has led some to equate chronic pain with phantom pain.

Animal models of neuropathic pain have shown, however, that sensory neurons recovering from partial injury undergo massive changes in protein levels and function of receptors and ion

10:30 AM

channels, and these changes outlast or even increase after injury. These findings pose a paradox insofar as one must lose some sensation to become a candidate for chronic pain.

Previous work in our lab identified and characterized a substantial loss of calcium currents in the injured peripheral neurons from rats exposed to partial nerve injury, and we established the excitatory consequences of this loss. We have explored the novel and clinically relevant theory that chronic pain results from a prolonged withdrawal of afferent sensory traffic associated with axotomy and limb disuse, and suffering is an attempt to recover lost painful stimuli.

This claim will be supported with behavioral results in a rat model of neuropathic pain, as well as electrophysiological and immunohistochemical data that demonstrate the role of Ca²⁺/calmodulin-dependent protein kinase II (CaMKII) as a feedback mechanism in the development of chronic pain. These findings suggest that a distinction between pain and suffering, as an adaptive response, is a better model for explaining chronic pain.

The significance of these findings is that suffering is a finely tuned adaptive response that transforms pain into emotive and volitional characteristics eventually emerging as concern for the meaning of life in the midst of perpetual perishing.

11:30 AM

Five Centuries of Religious Response to Tobacco

Joseph H Lechner

Obedience to God's Word is good for our health. Hundreds of Bible verses either explicitly command us to do something that is beneficial, or else forbid us to do something that is harmful. Scripture usually does not specify the tangible benefits that will result from

obedience, but we can discern them using scientific knowledge.

Soon after tobacco was introduced to Europe during the sixteenth century, churches began warning against its use. Smoking was not mentioned in the Bible, since tobacco was not known in the Middle East during either the Old Testament nor the New Testament eras. Nevertheless, many Christian groups applied scriptural principles to arrive at a doctrinal position against tobacco. Many evangelical Christian denominations officially oppose smoking. Islam teaches that it is wrong to smoke. Since the 1990s, many Jewish rabbis have concluded that smoking is contrary to the Torah.

I will summarize Bible passages that have been used by various religious groups to justify anti-tobacco stances. These will support the view that Scripture is a living document that God's Spirit can use to lead his people into truth.

I-D. GENERAL SESSION: CONSERVATION AND SUSTAINABILITY

Bunker Interpretive Center

Saturday, July 29, 2006 10:00 AM

A Walk Down Memory Lane: Using History to Improve Our Understanding of Biological Invasions

Jonathon W Schramm

Invasion of natural systems by nonnative invasive species has moved rapidly into the public eye as one of the foremost ecological issues of our times, with such charismatic examples as the zebra mussel, tamarisk tree, and Brazilian water pepper grabbing headlines in the US alone. Yet many other invasive species are quietly altering ecosystem composition and processes, and academic researchers, as well as land managers, are focusing large amounts of research on attempts to understand and control the effects of these species.

Despite this concentration of effort, overarching properties that make a species successful at, or a community vulnerable to, invasion have been difficult to find. One such explosive invader altering forest communities throughout the eastern and southern US is Japanese stilt-grass (*Microstegium vimineum*), an annual C4 grass native to Asia. The species is highly tolerant in its growing requirements, thriving from moderate to low light levels, and across a range of pH, nutrient, and water concentrations. These requirements alone, though, are insufficient to explain the current distribution of the plant, since many suitable sites are currently unoccupied.

In an attempt to understand these patterns, I have used field and GIS techniques to analyze stilt-grass distributions at larger spatial scales than have been typically used. Locations of stilt-grass patches correlate well with intermittent and perennial waterways which apparently serve as its primary mechanism for seed dispersal. Furthermore, the highest abundances of stilt-grass are centered in younger forest stands, which are also often those stands with the least developed shrub layers, deepest soils, and highest light.

This research suggests that a forest's age and land use history may contribute greatly to the relative effects of invasion by nonnative plants therein. Such knowledge could allow land managers, whether of a few or a few thousand hectares, to more effectively focus invasive species control and eradication efforts, as well as to inform and improve efforts at habitat restoration. Perhaps most importantly as Christian stewards, analysis of land use history serves to remind us of our inheritance from past generations, and our responsibility to future generations.

Optimization of Urban Land As a Resource to Sequester Carbon

David L Dornbos Jr

The rapid increase in atmospheric CO₂ concentration is believed to be driving global warming and a number of attendant issues. At the same time, productive land is being consumed in the United States at a rate exceeding 1% per year, largely a consequence of urban sprawl. Not only is productive agricultural land lost as a consequence of urbanization, but the steady increase of atmospheric CO₂ concentration can be attributed in part to increased transportation requirements resulting from sprawl.

Through culture, the church is inextricably tied to these sustainability issues. Potential exists for the academy to mentor a broader view of stewardship in the church by constructively addressing these issues in the urban community, modeling an appropriate view of the cultural mandate by reducing incentives for sprawl and increasing CO₂ sequestration rate.

The objective of this research is to model the development of plant communities on campus to optimize CO₂ sequestration rate, improve biodiversity and aesthetic beauty of urban green space. The literature offers some evidence that forest canopies sequester larger quantities of CO₂ than turf or agricultural canopies. Data collected during the summer of 2005 produced CO₂ uptake and transpiration rates of eight native and one non-native plant species at varying light intensities in the Calvin College Ecosystem Preserve.

Application of these data to computer models founded on physiological processes of plant growth enables simulation of a multitude of interactive effects relating soil, climate, and atmospheric CO₂ levels to plant development and carbon sequestration capacity at

individual plant and canopy levels. In the future, this information will be used to design forest canopies—considering composition, organization, and density of native plant species—that maximize CO₂ sequestration rate, biodiversity level, and aesthetic beauty. Field experiments are planned in the Ecosystem Preserve to validate the most promising model simulations by comparing CO₂ sequestration rates, for example, of managed forest ecosystems with turf and mature forest canopies. Development of functional and attractive alternative environments on the urban academic campus could exemplify a broader sense of stewardship by the church while providing valuable models for urban citizens and planners.

increasingly employed practice (i.e. rain gardens, butterfly gardens, natural habitats, etc.). To promote the success of native gardens, it is vital to have a means to critique the relative success of the planting. To our knowledge, there is no generalizable method with which to assess the performance of such efforts.

In this presentation, I will develop a generalizable assessment tool that can be used to determine the success of a native planting. I will discuss the importance and benefits of such an assessment and present data from an assessment of 12 plantings that Calvin College has sponsored in the Grand Rapids area. In addition, I will present a suite of best practices for the implementation of future plantings highlighting themes that emerged from our assessment.

My objective for this presentation is threefold. First, I hope to encourage participants to promote native gardens on their campuses by naming the many benefits of such efforts. Second, I will present the assessment tool that we developed to determine the relative success of a native

garden. Finally, I will leave attendees with a list of best practices that they can utilize to help ensure a high level of success if they decide to undertake similar projects.

11:30 AM

Sustainability: The Challenge to Liberal Arts Education
Kenneth Piers

Thomas Malthus, a relatively obscure 18th century English economist, in 1798 published an essay for which he remains famous, if much maligned. In *An Essay on the Principle of Population*, Malthus predicted that, because population grows exponentially and the means of food production does not, human population would soon outstrip its own ability to provide for itself with possible disastrous consequences.

Now, with the world's population at about 6.5 billion with prospects to reach nearly 10 billion by 2050, Malthus' claims gain renewed relevance—especially so since most of the growth in human numbers will occur in already populous and mainly poor countries. It is becoming

increasingly clear that humans are already in great danger of exceeding the carrying capacity of the earth.

Despite obvious and increasingly urgent threats to the long range sustainability of modern civilization, the modern liberal arts academy remains peculiarly aloof from any meaningful address to this impending peril.

In this presentation, I will review two of the most urgent threats (population, energy supply) to long-range creaturely well-being. I will then examine the underlying worldview issues that make addressing sustainability issues difficult in our culture. Finally, I will argue that the reductionistic disciplinary model of curriculum building in the modern liberal arts academy prevents us from seriously addressing these issues in the liberal arts setting. To rectify such curricular failures will require essential structural change to the modern college curriculum.

11:00 AM

Native Habitat Plantings: Benefits, Assessments, and Best-Practices

Daniel Spalink

The use of native species to recreate small patches of natural habitat is becoming an

Parallel Session II Abstracts

II-A. SCIENCE & TECHNOLOGY IN SERVICE TO THE POOR
 (continued)

Maple/White Pine Room

Saturday, July 29, 2006 1:00 PM

Antimalarial Activity of Two Varieties of Papaya (*Carica papaya*) Extracts

Amy (Groeneboon) Herdegen and James F Mahaffy

Both aqueous and ethanol extractions of the leaves of two varieties of Papaya (*Carica papaya*) decreased the levels of *Plasmodium falciparum* 3D7 parasites (*parasitema*) in human red blood cells (rbc) cultured *in vitro*.

Treatments were added to an rbc culture at 0.8 percent *parasitema*. After 120 hours, the untreated control rose to a level of 1.4 percent while the level of *paristema* decreased to 0.7 percent in the sample treated with an aqueous Red lady variety leaf extract and to 0.1 percent in an aqueous treatment from Tainung #1 variety.

This was the senior directed research project of Amy Groeneboon (now Herdegen) at Dordt College in 2005. The idea for this research came from a suggestion of ECHO that papaya might have some antimalarial properties since Papaya tea is used as a traditional medication for malaria in parts of Indonesia.

The positive results suggest the potential for further work in identifying the compounds in papaya and perhaps finding dosages of papaya leaves that are effective in mice models.

This was an ambitious project for an undergraduate at a small college. This presentation will illustrate this as it describes the steps that enabled Amy to do this study.

1:30 PM

Antibacterial Activity of Isolated Compounds Extracted from *Moringa oleifera* Seeds

Jennifer R Bonina

Moringa oleifera is a fast growing tropical tree with medicinal properties and high nutritional content. The aim of our research was to determine if the compound 4-Rhamoxy-phenyl isothiocyanate, an antibacterial compound isolated by Eilert, et al., in *Moringa oleifera* seeds are present in our delipidized seed fractionations. Thin Layer Chromatography is being used to determine the fractions in which the

4-Rhamoxy-phenyl isothiocyanate is present. An amine-FCNP/nitroprusside spray reagent specific for the phenyl-isothiocyanate was developed to locate the known antibacterial compound in our fractions on TLC.

Based on analogous studies, we screened fractions to show if other compounds that were antibacterial could be isolated and identified. Data showed that crude extracts as well as several of the fractions exhibited antibacterial inhibition when incubated with *Staphylococcus aureus*. To determine the best inhibition of the fractions, a titrating technique was used for each fraction. The storage life of the bioassay was determined by comparison of a 60-day-old bioassay and a freshly prepared bioassay.

The intent of this study was to determine where the known antibacterial compound was in our delipidized seed fractionation bioassay and to isolate any other compounds that showed bacterial inhibition. Future work is planned to investigate other bacterial pathogens that may also be inhibited by the crude extract.

This project was conducted at a small liberal arts college and is an excellent example of how important research can be conducted in this setting. There is great potential for furthering study of antibacterial activity in *Moringa oleifera* and relating other studies to this work through undergraduate research at Gordon College.

2:00 PM

Facilitating the Use of Velvetbean As Food and Feed

Rolf V Myhrman

The velvetbean (*Mucuna pruriens*) grows readily in tropical climates around the world, and represents a significant potential source of human food and animal feed in areas where malnutrition is a chronic issue. *Mucuna* is exceptionally resistant to drought and insects, and produces seeds

(“beans”) with high (25–30%) protein content. It also conditions depleted soils by replenishing nitrogen, trapping moisture, and inhibiting weed growth. In western Africa, dramatic increases in corn yield are observed in fields intercropped with *Mucuna*.

However, in spite of these advantages, the use of *Mucuna* as food, feed, and soil enriching “cover crop” has been relatively limited. The major impediment has been the presence in the beans of L-dopa (best known for the treatment of Parkinson’s disease) at levels as high as 7–8% by mass. Consumption of untreated *Mucuna* can produce sensations of nausea or intoxication, and psychotic abnormalities were reported in a population in Mozambique for whom *Mucuna* was the primary source of food.

In order to develop practical methods for detoxifying *Mucuna* at the farm or village level, one must have a way to track the removal of L-dopa at various stages of treatment. This in turn requires analytical expertise and specialized instrumentation that are typically not available to food scientists working with malnourished populations in developing countries.

Over the last fifteen years, our laboratory at Judson College has responded to this need by providing analytical services to university scientists and NGOs in Central America, Africa, and India. M. Versteeg and collaborators at the International Institute of Tropical Agriculture in Benin showed that 95% of the L-dopa could be removed from *Mucuna* beans by a combination of powdering, soaking, boiling, and sun drying.

T. Berhe and collaborators at Sasakawa Global 2000 and the Ministry of Agriculture in Guinea have adapted this method to their locale, and have developed methods for the preparation of animal feed that do not require firewood for boiling. They have developed a variety of *Mucuna*-based recipes for human

consumption, and have trained over 2,000 women in their use. More than 10,000 people have enjoyed demonstration buffet suppers made from these dishes.

2:30 PM

Enabling Engineering Design in Frontier Contexts: A New Design Method with Humanitarian Applications

Ryan Norton, David Camperman, Adam Noble, Matthew G Green¹

The importance of both globalization and social needs is a clear priority in engineering curricula and of the engineering profession.² However, the majority of engineering students are not familiar with the contexts in which vast needs exist, such as among the physically disabled or the 4 billion people living on less than \$2 a day (PPP).³ These conditions represent a formidable *frontier design environment*, outside the experience and expertise of most engineering students.

Currently taught design methodologies advocate gathering customer needs, and many mention the importance of doing so within the context of use. However, sufficiently understanding design needs within the actual context of use is notoriously problematic in frontier environments where data and contextual experience are not readily available. This is a challenge faced by organizations such as Engineers for a Sustainable World, Engineers without Borders, Christian mission organizations, and NGOs engineering high human-impact solutions in these unfamiliar contexts. In response to this need, a basic but powerful Design for Frontier Environments methodology has been developed to improve discovery and application of contextual information vital to successful frontier design.⁴

Grounded in empirical product-context studies, the new contextual needs assessment method supports gathering,

documenting, and applying contextual design information. The method is expected to increase the successful application of engineering to high human-need environments such as poor areas of developing countries and persons with disabilities. It can also improve the design of everyday consumer products to provide greater benefit to humanity with lower consumption of resources. The method enhances the use of context-specific resources and knowledge within the frontier environment and provides a common template for collaborative communication among geographically diverse groups.

Evaluation under controlled conditions suggests the method is not only extremely effective, but it is easy to use and well received by students. Classroom testing has shown very positive preliminary results, signifying broad applicability in education as well as field practice.

We will present the essence of the new method and how it has been applied to the design of low-cost prosthetic arms for use in developing countries. Templates, lecture slides, and examples supporting the use of the method will be freely available in electronic format.

¹Corresponding author: MatthewGreen@letu.edu

²M. G. Green, *Enabling Design in Frontier Contexts: A Contextual Needs Assessment Method with Humanitarian Applications* (Ph.D. diss., The University of Texas-Austin, 2005).

³C. K. Prahalad, *The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits* (Philadelphia, PA: Wharton School Publishing, 2004).

⁴“As a Professional Engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare . . .” (NSPE Code of Ethics for Engineers)

II-B. STEM CELLS: SCIENCE, ETHICS & PUBLIC POLICY
(continued)

Oak Room

Saturday, July 29, 2006 1:00 PM

Embryonic Stem Cells As Tools for Genetic Manipulation: Current Science and Future Prospects
Stephen Matheson

Human embryonic stem (ES) cells are, at present, the focus of intense political discussion due to significant ethical questions regarding their isolation from human embryos. Public debate has tended to weigh the moral status of these early human embryos against the likely therapeutic value of ES cells. This therapeutic value derives from the developmental potential of ES cells, which are referred to as pluripotent because they are capable of generating nearly every known cell type.

Recent findings suggest, however, that pluripotent stem cells can be generated without the destruction of an embryo, and even without the creation of an embryo.

When such procedures are established, moral objections to the creation of ES cells (or their equivalents) will likely vanish.

Here I argue that the recent preoccupation with the derivation of ES cells has displaced consideration of the major role played by these stem cells in two decades of research on mammalian genetics and development. Specifically, Christians must carefully consider the fact that ES cells are—and have always been—potent tools for the manipulation of mammalian genetics.

Standardized procedures exist for the addition and deletion of genes to and from ES cells, and creative modifications of these tools enable researchers to include “switches” that enable conditional addition or deletion of genetic components within an experiment. Most importantly, genetically

modified ES cells can be transferred back into the embryo, enabling establishment of genetically-modified organisms. These techniques have been perfected in mice, and are so widely employed that modern research facilities are commonly equipped with core facilities for the genetic modification of ES cells and their transfer into mouse embryos.

ES cells form the bridge that links the toolkit of recombinant DNA technology with the toolkit of reproductive biology. The bridge has already been used to create thousands of strains of genetically-altered mice. While examining the technical feasibility of such techniques being successfully applied in humans, Christians would be wise to (for once) consider in advance the ethical tools that humanity will need if and when human ES cells are used for the purpose of genetic manipulation of humans.

1:30 PM

Stem Cells, Embryos and Ethics: Is There a Way Forward?

William B Hurlbut

The present conflict over the moral status of the human embryo reflects deep differences in our basic convictions and is unlikely to be resolved through deliberation or debate. A purely political solution will leave our country bitterly divided, eroding the social support and sense of noble purpose that is essential for the public funding of biomedical science. While there are currently no federally legislated constraints on the use of private funds for this research, there is a consensus opinion in the scientific community that without NIH support for newly created embryonic stem cell lines, progress in this important realm of research will be severely constrained.

Notwithstanding this seemingly irresolvable impasse, there may be ways to obtain embryonic stem cells or their equivalents without

the destruction of human embryos. Four such proposals were discussed in a May 2005 publication by the President’s Council on Bioethics, entitled, “Alternative Sources of Pluripotent Stem Cells.”

One of these methods, Altered Nuclear Transfer, proposes to use the technology of somatic cell nuclear transfer (SCNT), but with a preemptive genetic or epigenetic alteration that precludes the integrated and coordinated organization essential for natural embryogenesis. Altered Nuclear Transfer is a broad concept with a range of possible technical approaches. The scientific feasibility of this project has received support from recent research by MIT stem cell biologists Rudolf Jaenisch and Alexander Meissner. Likewise, a variation of Altered Nuclear Transfer (Oocyte Assisted Reprogramming) put forward by stem cell biologist Markus Grompe has received wide endorsement from leading moral philosophers and religious authorities.

In this presentation, President’s Council on Bioethics member William Hurlbut (the author of the proposal for Altered Nuclear Transfer) will discuss the scientific, ethical, and political dimensions of this project that seeks a technological resolution of our difficult national debate over embryonic stem cell research.

2:00 PM

The Ethics of the ANT Proposal to Obtain Embryonic Stem Cells: What Does It Resolve? What Does It Not Redress?

James C Peterson

Countless protocols are investigating whether human stem cells can be coaxed into replacing tissue lost to disease or injury. What has been ethically controversial is the source of those cells. One prominent proposal has been to alter a human oocyte so that any resulting embryo would not develop

into a fetus. The claim is that lacking potential, the otherwise intact embryo would not warrant protection as a fellow human being and so could be taken apart as a ready supply of embryonic stem cells. Would such Altered Nuclear Transfer (ANT) meet the concern about stopping the development of a human individual? What other ethical issues might ANT resolve for procuring embryonic stem cells and what would it not redress?

2:30 PM

Stem Cell Ethics: The Neglected Issues
Karen Lebacqz

The debate about human stem cells has focused almost exclusively on the status of the blastocyst from which stem cells are derived. The unfortunate consequence of this focus is the neglect of other significant ethical issues. I will address some of these issues, such as whether women should be paid for egg donation, how we can assure justice in access to stem cell therapies, how language is used to mislead both sides of the debate, and whether the use of adult stem cells would solve ethical issues or raise new ones.

II-C. GENERAL SESSION: SCIENCE AND RELIGION
Elm/Blue Spruce Room

Saturday, July 29, 2006 1:00 PM

From Scientific Method to Methodological Naturalism: The Evolution of an Idea
Harry Lee Poe

This paper will explore how the term “methodological naturalism” gained popular acceptance, but how it actually undermines Bacon’s aspirations of a scientific method free of metaphysical prejudices. In the science and religion dialog, the term “methodological naturalism” refers to the need for science to proceed as though God did not exist. The term serves to

remind scientists and theologians of the need for objectivity in research.

The reason for using a term like “methodological naturalism” is to create a neutral mindset that leaves theological consideration out of science. But is “methodological naturalism” a neutral term that promotes objectivity?

The word “nature” is a poetic synonym or metaphor for the physical world of phenomenological experience with a number of metaphysical connotations not found in the more scientific term “physical.” The word “naturalism” takes the concept of nature one step further.

On the surface, it may appear to suggest the idea of objectivity when, in fact, it suggests something quite different. Naturalism is the philosophical view that all phenomena can be explained entirely by “natural” or physical causes without reference to any metaphysical explanations.

The scientific method had long since established that science is concerned only with the examination of the physical world and what can be learned from observing physical phenomena. Naturalism does not contribute to the scientific method which already restricts science to the examination of physical phenomena. Instead, it tells us that “natural” or physical causes explain all phenomena. The problem with naturalism is that it contributes nothing to enhance scientific knowledge but discourages the exploration of other kinds of knowledge.

Methodological naturalism suggests that scientific study should be conducted with the perspective that God plays no part in the physical world. If the scientific method is only concerned with observation and description of the physical world, why raise the issue of God at all? With methodological naturalism, the scientist accepts a metaphysical philosophical

position that does not involve the scientific question under examination.

1:30 PM

The Nature and Value of Scientific Apologetics

Richard A Carhart

In the ASA, we inform and challenge one another where our science and our faith in Christ intersect, and we develop ways to explain the harmony we see to those who do not accept our beliefs. Our outward focus has both private and public aspects, which can be broadly labeled “scientific apologetics.” Part of the task involves creating a public voice of Christian apologetics to put our case before the public mind. Scientists are now more deliberately entering public dialogue, because we have unique knowledge and authority to show the validity of the Christian worldview against certain wrong ideas.

Paul said it this way: “We demolish arguments and every pretension that sets itself up against the knowledge of God, and we take captive every thought to make it obedient to Christ” (2 Cor. 10:5, NIV). But Peter cautions us to do it “... with gentleness and respect ...” (1 Peter 3:15b, NIV).

This paper defines the concept of “scientific apologetics.” Seven of the most important claims are discussed, along with resources we can use to answer them. These seven claims are (1) Science explains everything and there is no need for the hypothesis of a Creator; (2) Science has rescued humanity from the pre-scientific superstitions of Christianity; (3) The Bible’s account of the origin of the universe is inconsistent with our scientific knowledge; (4) The account of creation in Genesis 1–3 contradicts the findings of science; (5) The laws of nature just exist by themselves and continue like a well-oiled machine forever; (6) Science can know and control

nature completely with no reference to God; and (7) Science has shown that moral values are relative.

Examples of several forums and formats to carry out scientific apologetics are given within the cultures of Europe, which come from my 3½ years’ experience serving as Coordinator of the European Scientific Network (ESN). This is a network of evangelical scientists committed to equip, encourage, and assist one another in doing public scientific apologetics. The experience also includes extended lecture tours, and participation in international conferences and seminars. The ESN presently operates in twelve countries.

2:00 PM

Intelligent Design, Methodological Naturalism, and the Star of the Magi

Sherman P Kanagy II

It is important to distinguish two main facets of the debate over the scientific status of “Intelligent Design” (ID) which are often unjustly conflated. On the one hand is the general issue of whether intelligent agency of any sort is a legitimate explanatory hypothesis in science. The second is the question of the acceptability of the particular criteria for recognizing ID proposed by such notables of the “Intelligent Design Movement” as Dembski and Behe. Note that a negative answer to the second does not entail a negative response to the first.

Closely associated with the first issue is whether methodological naturalism is a necessary procedural assumption of science and whether, if so, ID is necessarily not science. I will argue that: (1) ID in the first sense can be a legitimate scientific hypothesis whether or not one believes that intelligence ultimately is a natural or supernatural entity because, as with Newton’s “hypothesis *non fingo*,” it is not in the legitimate purview of science to deal with

such causes; and (2) mainstream Christianity has erred in opposing physicalist conceptions of “spirit.” Because of this error, many important Christian claims have been classed incorrectly as “not subject to validation by objective criteria” and mere matters of “personal belief,” leading to unfortunate legal and educational consequences that eventually must damage science itself. Consideration of the controversy over the scientific status of SETI will be used to illustrate these points.

Finally, application will be made to the science education controversies surrounding the propriety of Star of Bethlehem programs in planetariums associated with secular schools.

2:30 PM

The Impact of In-Class Devotions About a Christian Worldview on Student Views of Science and Faith

Bryan J Isaac

Students entering college commonly have strongly held views on science-faith issues. More often than not, those views are shaped by their parents and by their own faith background—not by any direct study of the issues involved. At conservative Christian colleges, this can make coverage of certain essential topics, such as the Big Bang Theory, a challenging and sometimes divisive undertaking. Some students want to know more about such theories, and some close their minds to any possible consideration of them. Others ask questions to probe the elegance and intricacies of these theories, while others seek to undermine the theory before it has been presented.

Over the past eight years, I have put together a semester-long series of 5–8 minute devotional thoughts aimed at exploring what might be a Christian world view of the sciences. In addition, since most of my students are professing Christians, we consider the value

of the evidence in the universe relative to the value of the Scriptures. We cover the various explanations of origins (both of humans and of the universe) held by scientists and Christians.

One underlying framework I impose on these discussions is that they do not focus on advocating for or against any specific view (especially since a large majority of those in my classes hold to a single view of origins), though we occasionally probe the merits and implications of certain arguments. Instead, I aim for the perspective that the natural evidence can be used as a witness for the presence and character of God, and work to illustrate the use of the natural evidence as such a witness.

Data showing students' responses have come from assigned written papers and more recently from surveys administered both on the first day of class and at the end of the term. These illustrate the success of this method in increasing students' willingness to explore the issues at the intersection of science and faith.

**II-D. STEWARDSHIP,
CONSERVATION & LAND
MANAGEMENT**

Bunker Interpretive Center

Saturday, July 29, 2006 1:00 PM

**Finding Our Way to a
Green Future on Campus**

John R Wood

Campus land management and stewardship is undergoing profound change. Many are calling for sustainable campuses and university leadership toward a "green destiny." Whether for ideological or political reasons, or purely pragmatic and practical economic motives, the academy is moving toward more sustainable practices on campus. Environmental management systems have been developed and we are seeing the emergence of a new "land ethic" on campus. But the contours of that ethic are not yet fully mature.

Educational organizations need to consider four key questions in the drive to develop sustainable institutions. First, what is the mandate and mission of education? Or, as Wendell Berry and David Orr have asked, "What is the university for" at its core? Second, what policies flow from this mandate? Third, how is the institution faring as both symbol and example to the community? Finally, are we pedagogically consistent? Are the life lessons taught in the formal curriculum matched by institutional practices outside the classroom?

Brief reflection shows that most of the attention to campus sustainability and stewardship has focused on human actions "inside the walls." The landscape, or place where Environmental Management Systems, Environmental Audits, or Campus Master Plans occur is almost taken for granted.

To answer these questions, we need to have a better understanding of the place of our institutions on the land. We lack even a survey of the basic metrics of land use to help us gauge the impact of educational institutions on land. How much land do universities own? Where is this land? And what is being done on it? We can find no comprehensive survey or extended consideration of such questions.

I sought to investigate how a small, homogenous, sub-set of Christian universities and colleges has expressed their sense of place on the landscape. I will report on a survey of the land use and stewardship practices for 45 colleges in the Council of Christian Colleges and Universities and consider the barriers and bridges they face to effective land stewardship on campus.

1:30 PM

**Stewardship of Aquatic
Habitats on the Campus of
Oral Roberts University,
Tulsa, Oklahoma**

John Korstad

Science faculty and students have worked with administrators and grounds keepers for better environmental stewardship on the campus of Oral Roberts University for over 25 years. We've done that starting with Lake Evelyn (a 1 hectare pond near the center of the campus) and more recently with Fred Creek, a permanent stream which meanders through the campus.

A 1995 report to the administration demonstrated that Lake Evelyn was accumulating about 0.3 m of sediment per year and concluded that the lake would start looking like a meadow in 5 years unless various remediation principles were implemented. Several simple and inexpensive recommendations were implemented, such as not fertilizing the grass near the pond and catching the lawn clippings when mowing near the pond. More complex and expensive recommendations were also given as essential for proper long-term management. These recommendations included the possibility of rebuilding the pond to include draining, dredging, adding rip-rap to stabilize the shores, and adding two fountains to aerate the hypolimnion. We also asked the Student Association officers to use their end-of-the-year money to purchase picnic tables and benches for the area around the lake. All of these recommendations were implemented by August 1996.

The result has been that the rate of cultural eutrophication of Lake Evelyn has been considerably slowed down in the last decade, the lake is more aesthetically pleasing, and the area around the lake is used more often for social activities like departmental and campus-wide picnics.

Last year, science faculty began offering recommendations for improved environmental stewardship of Fred Creek. Two science faculty members were asked to serve on the Municipal Planning Committee that is working closely with an engineering firm to carry out the mandates outlined in a multi-million dollar city bond package for drainage improvements of the creek.

2:00 PM

**Infiltrating the Manicured
with the Natural:
Strategies for a Kinder,
Gentler Campus Landscape**

David P Warners

Much of our traditional North American urban landscape relies heavily on energy inputs, chemical additives, and non-North American plants. This is perhaps seen most clearly on university and college campuses, where a "country club model" seems to prevail.

In this presentation, I will develop a landscaping model based on ecological principles and a broad, shalomic vision for the creation. Practical guidelines will be presented, emphasizing initial small changes that can be easily introduced. Emphasis will also be placed on how this type of effort can be undertaken within an academically-based, service-learning context, utilizing the invaluable contributions of students. I will also discuss the value of natural areas (preserved or restored) embedded within a campus landscape and address the points of inertia that present challenges to such an approach.

In the end, my objective is to leave attendees with hopeful, practical measures with which they can return to their home campuses. Case studies from our efforts at Calvin College during the past ten years will be highlighted, including a recently produced Sustainability Statement for our college.

2:30 PM

Gordon College Land Stewardship: Past and Future

Dorothy F Boorse

Behind a cluster of buildings, and next to a highway, lies a premier piece of conservation land in an increasingly developed area north of Boston, Massachusetts. The Gordon/Chebacco Woods is conservation land held by Gordon College and a group of conserva-

tion nonprofits. With more than 400 acres of woods, vernal pools, five great ponds, and many hiking trails, this land is used recreationally and educationally.

Efforts to use and preserve the natural facilities of Gordon go back to the efforts of professor emeritus Dick Wright, who helped the college stop using tile fields for sewage (which had promoted eutrophication in ponds) and helped begin a recycling program. Current efforts include the use of

the trails and ponds as educational sites, research on vernal pools and invasive species, and an effort to promote "love of land" through a two-year grant.

This year 400 elementary students will visit Gordon to do outdoor field trips through a General Electric grant. Eventually, we hope to start a nature center with an interpretive trail and to plant a native plant garden.

We need a coherent land management plan for the removal of inva-

sive species and protection of water bodies from road salt run-off. Interest in the nonbuilding property fluctuates and depends on a driving individual. Management planning and research are limited by money and personnel.

Parallel Session III Abstracts

III-A. SCIENCE & TECHNOLOGY IN SERVICE TO THE POOR

(continued)

Maple/White Pine Room

Saturday, July 29, 2006 3:15 PM

Achieving Sustainable Health Benefits for Community Water Systems in Ecuador

Bruce V Rydbeck, Brad Quist,
Kathryn H Jacobsen, and
Priscila Ribeiro

One of the UN Decade Objectives is to reduce the child mortality rate (at age five) two-thirds by the year 2015. Water transmitted disease is the most frequent cause of death for young children. Diarrhea is the biggest single killer of children in the world's poorest countries. The World Health Organization asserts that 65% of infant deaths from diarrhea in developing countries could be prevented by providing safe water and sanitation. It is crucial that the benefits of clean water and better health be sustainable.

The following emphases have been employed in the community water system projects of Desarrollo Comunitario Vozandes in Ecuador for the past 25 years to achieve sustainable benefits:

- Commitment of the benefitting community

- Catalytic contributions by facilitating organizations
- Leadership and training of the benefitting community
- Appropriate level of technology
- Appropriate level of economy
- Positive value changes based on biblical principles

In 2005, an epidemiology study was conducted by Calvin College in collaboration with Desarrollo Comunitario Vozandes to measure the health impact of this program.

Intestinal parasite prevalence in young children was assessed in twenty rural Quichua communities in the highlands of Ecuador in August 2005. The caregivers of 293 children between the ages of 12 and 60 months were interviewed about household and child health status, socioeconomic and environmental factors, and water use practices, and requested to collect a fecal sample from the study child. A data sample of 203 of 293 (69.3%) children whose caregivers were interviewed provided fecal samples that were tested for the presence of parasites. Over 85% of the children were infected by one or more intestinal parasites. Parasite prevalence increased with age. Water storage, water treatment, consistent latrine use, and participation in a community water project were not strongly associated with parasitism, although having dirt floors was

a risk factor. Continuing studies are need to determine the exact impact of using a cleaner water source and to improve the hygiene teaching emphasis of the program.

3:45 PM

Sustainable Health Care Costs?

Gerald Hess

The burgeoning costs of health care should have a sobering effect on Christians living in 21st century Western cultures. Of greater concern, there is no apparent end in sight and the causes of the spiraling health care costs are illusive at best. What role does the relentless pursuit of progress in medical technology play in this concern has long been an issue for bio-medical ethics. Biologists, Christians in particular, have preached the necessity of sustainability for many years. But this has focused on energy consumption for transportation, electricity generation, and the high energy input required by current agricultural production techniques in the West.

In this paper, the concern for sustainability is expanded to include consideration of the health care cost dilemma. Daniel Callahan presents some challenging thoughts in his book, *False Hopes: Overcoming the Obstacles to a Sustainable, Affordable Medicine*. He argues

that the costs—psychological, economic, and social—of pursuing the modern medical dream "in an unaltered form are no longer sustainable." The dream itself is not the problem says Callahan. Rather the problem lies in the form the dream has taken.

Progress in medicine has long been defined in terms of "curing illness" by applying the wonders of modern technology. Callahan calls for a redefinition of the idea of (medical) progress, since the present form of progress generates escalating costs and typically outruns whatever level of health care that becomes available.

The goal of this paper is to explore the question—in what ways can an emphasis on sustainability realistically extend to health care costs? This is a difficult question to face for those who are engaged in biomedical research and pre-medical education. Nonetheless, the potential impact of this new paradigm for biomedical technology calls for further exploration.

4:15 PM

The Kingdom and Sustainability Principles

Peter Bosscher

Sustainability is slowly but surely finding its way into university

curricula. In Engineering education, an overview of the progress from 1992 to 1997 is contained in the report *The Engineer's Response to Sustainable Development*, dated February 1997, and published by World Federation of Engineering Organizations (WFEO). In the US many engineering colleges have developed extensive programs with special courses on the environment and sustainable technologies. Internationally, other institutions have also integrated these concepts into their courses.

Is the topic of sustainability morally neutral? Can the principles embedded in sustainability be arrived at from multiple worldviews? How should a Christian respond to the motivations for sustainability? Is sustainability a Kingdom value? This paper explores the principles of sustainability from several worldview perspectives and finds some worldviews are notably silent on sustainability while others speak loudly.

III-B. STEM CELLS: SCIENCE, ETHICS & PUBLIC POLICY
(continued)

Oak Room

Saturday, July 29, 2006 3:15 PM

Similar Ethical Issues Involving Embryonic Stem Cell Research and New Drug Development: Weighing Urgency Against Prudence and Risk

James J Rusthoven

One stated justification for engaging in medical research involving the destruction of human embryos for harvesting human embryonic stem cells (hESCs) is a perceived urgency of need to find medical therapies for debilitating or life-threatening diseases. Such urgency has been used to justify preferentially diverting limited resources toward hESC research rather than research involving stem cells from other sources.

Ethical parallels can be seen in early new drug development

wherein patients with advanced cancer resistant to approved therapies urgently seek any promising therapy even if unproven. Pharmaceutical companies frequently make investigational drugs available to such patients through compassionate release programs.

Ethical concerns have been raised that such patients, driven by their urgency for better therapy, are seldom rewarded by clinical benefit while the risks of being physically or psychologically harmed by such unproven treatments can be high. In addition, demand may consume drug resources and reduce patient availability for clinical trials, potentially jeopardizing the timely completion of clinical trials in the regulatory agency-approved drug development program. In both settings, urgency becomes a motive for diverting resources from other research that may involve greater ethical prudence.

In early drug development, the ethical weight of urgency may not justify resultant delays in regulatory approval due to limited drug supplies and the loss of timely information from clinical trials if large numbers of patients receive the drug outside of clinical trials. Such delays may deprive later patients, who may derive more benefit, from receiving the drug later if it is proven effective in clinical trials.

In hESC research, the ethical weight of urgency may not override factors such as the moral value given to the embryo compared to other potential sources of stem cells, the risk of failure to develop effective treatment later, and the potential anxiety or loss of future effectiveness for patients who feel compelled to refuse treatment based on ethical concerns that the therapy was derived from destroyed human embryos.

Urgency of need must be carefully weighed against other ethical or therapeutic risks when used as a motive for deciding how to use limited research resources.

3:45 PM

A Public Policy Proposal for Human Embryonic Stem Cells
Hessel Bouma III

Ever since their discovery in the late 1990s, human embryonic stem cells (hESC) have been shrouded in ethical controversy. Is it permissible to isolate and utilize embryonic stem cells obtained upon the destruction of a human embryo, and if so, under what circumstances and regulatory policies? Are there reasonable alternatives to deriving stem cells from human embryos? If not, considerable interest will remain for a better public policy on hESC.

Ideally, public policies ought to be consistent with commonly held, important moral values. It is informative to note how several countries have made concerted efforts toward such cohesive moral and public policies involving embryos. In the US, however, we long have emphasized the ethical principles of autonomy and utility with respect to both assisted reproductive technologies and exploring the frontiers of scientific research. Furthermore, persons in communities of faith and our society as a whole have been unable to achieve consensus on the appropriate moral status of the unborn. As a consequence, we have attempted to make key distinctions between (a) already-derived versus the continued derivation of human embryonic stem cell lines, and (b) private versus publicly-funded research. These are political solutions that allow research to progress albeit very slowly and in all likelihood, inadequately if even only a few of the projected applications ever materialize.

It likely is impossible to attain a suitable and morally cohesive public policy predicated either on full protections or no protections for human embryos. Are there reasonable public policy alternatives? Might we accept modest limits on autonomy and utility with respect to assisted

reproductive technologies to provide greater affirmation of at least some moral status for human embryos? If so, could it allow for the derivation of additional lines of human embryonic stem cells from human embryos otherwise destined to be stored indefinitely or discarded from fertility clinics by precluding the intentional creation of human embryos destined for destruction? Would such a public policy achieve greater moral consistency and meet projected needs for human embryonic stem cells?

III-C. GENERAL SESSION: SCIENCE AND RELIGION
(continued)
Elm/Blue Spruce Room

Saturday, July 29, 2006 3:15 PM

The Significance of Creation Theology in True and False Prophecy
Steve Delamarter

The Hebrew Bible sets forth two categories of false prophets: (type I) those that advocate following another god; and (type II) those that speak in the name of the LORD a word the LORD has not commanded. The latter type of false prophet is given much more treatment in the Hebrew Bible than the former. In fact, type II false prophets are quoted so often that it is possible to reconstruct the general contours of their theological outlook. This theological outlook can then be compared to the theological outlook of the true prophet and differences noted.

When such an analysis is performed a key difference emerges: true prophets found their theological outlook on a much more developed understanding of creation theology. Creation theology provides the framework to understand God's relation to the world in a fundamentally different way than those prophets whose entire theological outlook is founded only on salvation theology. In fact, it becomes clear that a theological outlook founded

only on salvation theology is nothing more or other than type II false prophecy.

After sketching the biblical evidence for these conclusions, we will offer a few observations about the importance of creation theology for a theological perspective in the modern world and how this affects the way in which we formulate our views on cosmology.

3:45 PM

God, Time, and Creation in Christian Thought

David F Siemens Jr

Creatio ex nihilo is clearly a Christian notion with Hebrew roots. It was unconditionally denied by the ancient pagan philosophers, who declared *ex nihilo nihil fit* (from nothing can nothing be made). They also declared that the world we sense has an irrational element.

But Christians hold that the universe is rationally ordered because God knows what he is doing. This universe is intimately connected to time, along with space and matter. While Scripture does not develop the interrelation between the Creator and time, Christian philosophers and theologians expanded them at length.

The first person to puzzle over time, St. Augustine, understood that the deity must be outside of time and space in order to create them, though he obviously did not think of a space-time continuum. This ancient insight is not fully recognized by some contemporary thinkers, who either connect God to the time of the universe or claim that there must be a divine time.

At the extreme, this produces process theology, which is not considered here. Open theology, which claims to be orthodox, does not go so far. But they claim that God cannot know the future.

Arguments to support these possibilities include: that God needs to act in the world,

especially in answering prayer; that he needs to know our kind of experiences; that foreknowledge would require strict deterministic control of the creature; that God can't be impassive; that Scripture speaks of God changing; and there are additional minor variants. However, some of these arguments were answered long ago. Others manifest a misunderstanding of technical terminology. All lead to incoherence. The sole placing of the deity in time involves the Son emptying himself and becoming incarnate. In addition to the logical contradictions that disprove all attempts to place God in time, Einstein's interpretation of relativity supports the timeless foreknowledge of the deity.

4:15 PM

The God-Fearing Life of Leonhard Euler

Dale L McIntyre

The steps of a good man are ordered by the LORD, and He delights in his way (Ps. 37:23).

For the past three centuries, it has been fashionable among philosophers and academicians to deny that God and religious faith play a part in serious intellectual inquiry. The Enlightenment and Postmodernism teach that no scholar of highest repute regards God as anything more than a First Cause if, indeed, God exists at all. Yet Leonhard Euler, the greatest mathematician and theoretical physicist of the Age of Reason, was a deeply religious man and a passionate defender of the Christian faith. He emphatically asserted that "the works of the Creator infinitely surpass the productions of human skill" and unabashedly contended for "the divinity of the Holy Scripture," "the divine sending of Christ into the world," and "the truth of the Christian religion." That a God-fearing man would gain such stature and reputation in Europe during the man-centered days of the Enlightenment is indeed noteworthy.

What were the religious beliefs of this remarkable man? What were their origins and their effects upon him and how he related to others? What has been his influence?

To answer these questions, we first present a brief account of his life as a whole; next we view elements of his character through the lens of his life's experiences; then we unveil tenets of his theology, as gleaned primarily from his *Letters to a German Princess on Different Subjects in Natural Philosophy* and his *Defense of the Divine Revelation against the Objections of the Freethinkers*; finally, we reflect upon his legacy, how his life has impacted persons of his day and of today.

III-D. STEWARDSHIP,
CONSERVATION & LAND
MANAGEMENT(continued)
Bunker Interpretive Center

Saturday, July 29, 2006 3:15 PM

Prairie Restoration at Cedarville University: Land Stewardship Draws Benefits from a Well Field

John E Silvius

In 1975, Cedarville University acquired approximately 61 acres of agricultural land adjoining the existing campus. Eleven acres were developed as a residential subdivision and 15 acres were converted to turf grass to serve as an intramural field which has persisted to the present. The other 34-acre portion was reserved as crop land.

In the 1990s, four wells were drilled to supply underground water for the growing campus population which had begun to overtax the Cedarville Village water system. The Ohio EPA prohibited agricultural activity on the well field. This change in land use led to a post-agricultural succession of annual and perennial weedy plants which were simply mown several times each year from 1990 to 1999.

In 1999, a proposal was accepted by the campus grounds department to begin the

establishment of a prairie community on the well field. In the Spring of each of the first three years, this "old field succession" community was seeded with a mix of prairie grasses and dicots using a no-till drill. Controlled burns in the Spring of 2001, 2003, and 2005 were utilized to enhance prairie-related plant species and suppress agricultural weeds. The site exists in a region of Ohio that, prior to European and African American settlement, consisted of a mosaic of forest and prairie.

As part of an undergraduate research program, we are using a combination of fire, soil disturbance, seeding, and transplanting of plant species from nearby prairie remnants to establish and promote prairie plant populations and wildlife habitat. This prairie restoration project has transformed a portion of the university campus with limited apparent value into one which contributes, ecological, historical, economic, athletic, aesthetic, and land stewardship values to the educational program at Cedarville University.

3:45 PM

Land Stewardship at the University of Michigan's Matthaei Botanical Gardens and Nichols Arboretum

Robert E Grese

The University of Michigan's Matthaei Botanical Gardens and Nichols Arboretum encompasses nearly 700 acres of natural areas, gardens and plant collections in and around the University of Michigan's Central Campus and the Ann Arbor area. After many years of supporting Matthaei Botanical Gardens and Nichols Arboretum as two separate entities, the University rejoined us as one administrative unit in 2004. As a newly combined unit, we have chosen to center our mission themes of sustainable technology and environmental stewardship. Increasingly, we see our mission as one of promoting

a sense of environmental stewardship through our gardens and collections, our management activities, the research and teaching that is done on our properties, and the programs that we offer. In the face of vexing environmental problems, we want to be a place of hope that encourages action and learning that showcases what people can do in response.

Included in this talk will be an overview of our programs and activities around the following themes of environmental stewardship and sustainability:

- Collaborations—examples include partnering with the Residential College Theatre Program for “environmental” productions of Shakespeare plays; designing and building of an amphitheatre with an architecture class focused on sustainability, working with faculty from the Dance Department on a performance to celebrate the rejuvenation of a woodland garden area, and locating an experimental solar house (MISO House) built by architecture faculty and students on our grounds.
- Demonstration gardens—examples include the creation of an entry garden that slows and

infiltrates stormwater runoff, repair of an eroding riverfront as a demonstration of “soft” engineering technology, green roof demonstration and displays, and a “closed loop” recycling program that composts food scraps from dormitory cafeterias and raises vegetables and herbs in a student garden.

- Ecological restoration activities—these include over 18 years work to restore prairie, oak savanna, and oak woodland habitats on our properties and current work to restore a prairie fen that has been over-run with glossy buckthorn (*Rhamnus frangula*). Both of these activities have engaged numerous classes from the University and thousands of student and community volunteers in volunteer workday efforts.

4:15 PM

**Stewards of a Legacy:
Tending an Off-Campus
Land Preserve**
Luke A Gascho

Merry Lea Environmental Learning Center was donated to Goshen 25 years ago. The 1,150-acre preserve in northeastern Indiana contains a wonderful complex of

wetlands, bogs, lakeshores, upland and lowland forests, prairies and meadows. Caring for these diverse systems—some formerly used for agriculture—is a major focus of the mission of Merry Lea. Land management objectives and actions give attention to creating healthy ecosystems.

During the last 15 years, attention had been given to landscape scale prairie and wetland restoration projects. Merry Lea is located 30 miles away from the Goshen College campus. The distance and financial expectations can create a sense of detachment and independence. Several models of governance and leadership have been used to guide Merry Lea during the 25 years of operation by Goshen College. A foundation established 10 years ago assists with funding operations at Merry Lea. Objectives in the foundation documents also state intended directions for fulfilling the mission.

Historically Merry Lea has provided K–12 environmental education opportunities for students from a six-county region. While this is a strong program, strategic planning during the last eight years has identified new opportunities that build on the

synergistic potentials between a college and an environmental learning center. Undergraduate courses in environmental science, natural history and agroecology have been added that employ hands-on learning in the field setting at Merry Lea. A master’s program in environmental education has been designed to utilize the diverse ecosystems, the K–12 programs, and the expertise of the faculty at Merry Lea.

A facility—designed to meet the platinum rating of the US Green Building Council—is being constructed to accommodate the onsite learning experiences. Key learnings from the Merry Lea and Goshen College relationship include the following: (1) The intersection of values between the two entities has produced mutually beneficial outcomes; (2) Land preserves that are managed well provide a model for creation care and land stewardship; and (3) The principles used in restoring a wetland or prairie ecosystems are helpful designs for forming healthy human relationships within organizations.

Parallel Session IV Abstracts

IV-A. CHRISTIAN VALUES IN BIOTECHNOLOGY
Maple/White Pine Room

Sunday, July 30, 2006 1:30 PM

On Genetically Modified Organisms in Agriculture: The Peril and the Potential
Ming Y Zheng

In recent years, transgenic technology has become one of the most important yet controversial means by which crop plants are genetically modified. GMOs so produced are at the center of an intense debate regarding their roles in agriculture. Proponents

argue that GMOs may offer unmatched potential for crop breeding and food security.

Crop plants may be modified for higher nutritional values, better resistance to diseases or other environmental stresses, greater tolerance to herbicides, higher efficiency to use fertilizers and even ability to self-synthesize fertilizers, etc. All these advances would potentially increase the food availability while curtail agriculture’s long standing reliance on synthetic chemicals, fertilizers and higher energy input, thus reduce the pollution to the environment.

Critics, however, are less optimistic about GMOs. First, some fear that we do not have sufficient knowledge and wisdom to manage a technology that offers direct access to recombining genetic material from two naturally incompatible species. Second, some argue that the price of employing genetic engineering could be the “cheapening of life” and the loss of what it means to be human. Third, some contend that GMOs may pose grave threats to the sustainability of agriculture and bring unforeseen harms to the environment and ecosystems. Fourth, some are concerned with

the food safety and public health stemming from the GMO consumption by both farm animals and humans. Finally, others worry about the unintended outcomes as a result of using GMOs to satisfy human selfish ambitions.

To address the GMO controversies in a more fair and constructive manner, I set out to review how plants have been modified since the dawn of civilization. The objective analyses of plant breeding and agriculture evolution will allow us to set the discussions of GMOs in a proper context. By peeking through the agriculture evolution

beginning with the domestication and selective breeding of crop plants about 12,000 years ago, one would learn how humans have guided and manipulated plant genetics to serve their various needs.

I will also briefly review how the development of more efficient agriculture is related to human population growth and the building of cultures and societies. I will then extend my discussions to GMOs. Since many of the issues related to GMOs are complex, I will focus only on several controversial aspects surrounding them, present critical evaluations on opposing claims, and highlight some ethical conflicts and religious perspectives concerning GMOs in agriculture.

2:00 PM

Galileo, Biotechnology and Epistemological Humility: Moving Stewardship Beyond the Development-Conservation Debate

Charles C Adams

Modern technology—biotechnology in particular—confronts the Christian community with a plethora of complex issues and questions for which there are no simple answers. Some of those issues—stem cell research, for example—are relatively specific and immediate. Others are more hypothetical. Genetic therapy for lengthening life-span is one example.

One particular issue that is both theoretical and immediate is the question of stewardship. What does the Lord require of his image-bearing creatures with respect to their relationship to the rest of creation? Some Christians have argued that we are called by God to respect and conserve the created order, and we do that by seeking ecological understanding and promoting actions that minimize human disruption and/or intervention of those ecological patterns that we discover. Other Christians, hearing God's call to

“be fruitful and increase in number, fill the earth and subdue it,” understand stewardship more in terms of development. The former group raises many concerns with respect to biotechnology. The latter group is eager to promote biotechnological advancement. Far too often representatives of both groups are influenced by naturalism as much as by careful biblical thinking.

Using a relatively novel interdisciplinary approach, this paper will advocate for the embrace of epistemological humility as a way of avoiding the pitfalls of naturalistic thinking and for remaining faithful to traditional Christian understandings of the nature of creation and of what it means to be human. Starting with basic biblical tenets that have been accepted by Christians for centuries, it will seek to articulate a relationship between the human and nonhuman creation that encourages careful biotechnological advance within the context of creation care, and which transcends the polarization between unbridled development and stagnating conservation. The approach is to incorporate insights from the history of science (e.g., Galileo, Descartes) and the philosophy of technology (e.g., Egbert Schuurman) with basic Christian doctrine (e.g., the Apostle's Creed) to infer a posture of epistemological humility suitable as a common foundation from which to approach specific issues and problems in biotechnology.

2:30 PM

Transgenic Biotechnology and the Shalom of Creation

Tony N Jelsma

The cultural mandate is expressed in the two-fold command in Gen. 2:15 where the man is commanded to work and take care of the garden. This sanctions the use of biotechnology, including appropriate transgenic technology, to develop the creation. “Take care of” indicates that such

development should not be at the expense of what was created by God and is therefore good. Part of this goodness is Shalom, or right relationships and interdependence. These associations exist not only in the human creation, but also in the nonhuman biotic creation, from intracellular to ecological relationships. Human relations, including those with the nonhuman creation, have been cursed by the Fall, but are restored in Christ. Thus Christians may use transgenic technology to develop creation but must use it obediently to build up Shalom.

Molecular biology (on which transgenic technology is based), despite being rooted in reductionistic thinking, has provided much understanding of the components of the biotic creation. More recently however, advances in bioinformatics and systems biology have caused a growing awareness of the interdependence of living systems and have seriously challenged this reductionistic thinking.

Transgenic technology for the most part still ignores this interdependence by inserting heterologous genes, whose control of expression and gene products are not designed to integrate into the host environment. This can lead to unforeseen negative consequences at a variety of levels. For example, at the molecular level, this distortion is frequently seen by the improper production and insolubility of the products of transgenes. At the organismic level, transgenes can adversely affect the growth of the organism. At the ecological level, transgenic organisms reduce biodiversity, which provides a selective environment for the development of pests. In many cases, this loss of Shalom in the nonhuman creation is justifiable by improved human relationships, e.g., by treating disease and improving agriculture. However, a biotechnology that is obedient to the cultural mandate should also consider Shalom in the nonhuman creation to minimize the possibility of unintended

consequences. This may be done by more careful regulation of transgene expression, better containment of transgenic organisms, and maintenance of biodiversity in transgenic organisms.

3:00 PM

Gratuity in Nature and Theology

Paul Arveson

The concept of “levels” or “layers” of explanation is commonly used in descriptions of widely different systems (e.g., the cell, the brain, ecosystems, computers, economics etc.). There seems to be a general sense that such systems are “layered,” or at least they are best described and analyzed in such terms. In 1998 I published an article (*J. Washington Academy of Sciences* 85, no. 4 [Dec. 1998]) that described parallels between layered descriptions in biology and in computer networks. This article suggested that an underlying formal similarity among such systems is Jacques Monod's concept of “gratuity.”

Monod's insight was that a living cell is a very special kind of machine, in which its information content (DNA) is free and unconstrained by the cell's chemistry. In DNA, there is no energetic preference for one sequence of nucleic acids over any other; the sequence is an arbitrary code as far as the cell is concerned. So we are faced with a system that cannot be described in simple mechanistic terms of cause-and-effect. Its behavior is governed not from “below,” but rather from “above.”

The aforementioned article did not dwell on gratuity's philosophical or theological implications. This paper will suggest some of these implications. It is believed that a better understanding of “levels” and “gratuity” can help to prevent misunderstandings and needless conflicts in discussions of science and faith.

IV-B. MODELS FOR TEACHING OF ORIGINS

Oak Room

Sunday, July 30, 2006 1:30 PM

Developing and Implementing an Interdisciplinary Origins Course at a State University

Keith B Miller

As part of the mission of the new “Center for the Understanding of Origins” at Kansas State University, a new undergraduate general education course entitled “Origins: Humanity, Life, and the Universe” was developed and implemented in Fall 2005.

The objective of the course was to provide students with a truly interdisciplinary learning experience in which the conclusions of modern science were taught in their historical and cultural context. The course would emphasize the dynamic and historically embedded processes by which new scientific views are proposed and ultimately accepted.

A major goal was also to help students understand the nature and limitations of science, and the similarities and differences between scientific investigation and other ways of knowing. Philosophical and literary reflections on the scientific enterprise were a critical part of meeting this goal.

For nearly a year, faculty from both the sciences (Physics, Biology, Geology) and the humanities (Philosophy and English) met regularly to discuss the objectives and structure of the course. Much of the early discussion among the faculty focused on understanding our diverse perspectives and pedagogical approaches. This was critical in helping us better understand each other, and the institutional and professional barriers to cross-disciplinary learning. We had to learn first from each other before we could attempt to teach an interdisciplinary course.

The most challenging aspects of implementing the course were overcoming the inherent problems with a team-taught course (six teaching faculty), and helping students see connections between the diverse topics and ideas presented. Assessment of student learning proved to be the biggest practical difficulty.

2:00 PM

Six Easy Pieces: One Pedagogical Approach to Integrating Science/Faith/Origins into College-Level Introductory Physics Courses

Sean M Cordry

In this presentation, I will compare my experience having taught two different “stand-alone” Science/Faith/Origins classes with my experience at trying to integrate Science/Faith/Origins issues into my introductory physics courses. Each setting has its own unique goals and challenges. (Both sets of experiences have been in the context of Christian liberal arts colleges.)

The “integration” setting has proven to be far more challenging; I have tried several approaches to meet this challenge: the assignment of readings from an auxiliary text, having students collect Science/Faith articles from various sources and then “journal” about them, and simply presenting a limited number of topical lectures. This third approach has been the most “successful” by far. Part of the success of these topical lectures has been due to their intriguing and nonthreatening nature; in the order of presentation they are:

1. What do we do with biblical descriptions of nature that we know to be factually wrong?
2. *Tohu wabohu* and the search for order and pattern in Genesis One and physics;
3. Transitions to chaos and parameter sensitivity;
4. The great “anthropic coincidences” of nature;

5. An infinite number of unobservables or a single infinite unobservable? and
6. Layer by layer, decay by decay—or *The Physicist’s Guide to Dating a Planet*.

I will present a synopsis of each lecture, when each occurs during the physics course, the pedagogical structure of the presentation order, and reasons why I think this approach has been the most successful of those I have tried.

2:30 PM

Religion and Science in Modern America: An Interdisciplinary Course on Origins

Edward B Davis

For several years, I have taught a general education course at Messiah College called “Religion and Science in Modern America.” Designed for a 3-week January term, the course focuses on biblical, historical, and theological issues related to origins. This presentation explains how the syllabus and the most important assigned readings are designed to cause students to reflect critically on their own beliefs, while helping them to understand in some depth a range of approaches to origins issues. The course is always over-enrolled, and student interest and enthusiasm are unusually high.

3:00 PM

Using Case Studies to Teach Evolutionary Biology

Robin Pals-Rylaarsdam

Evolutionary biology is a difficult topic for many students at Christian colleges. The very term “evolution” raises defenses for many, and misconceptions for nearly all. In an effort to help students better grasp the true methods, observations, and working hypotheses in evolutionary biology, I have turned to using case studies in my introductory majors’ biology course.

One case, focusing on speciation, asks students to develop field and laboratory experiments that can address whether two populations of stickleback fish are a single species, in the process of becoming reproductively isolated, or two species. Students are given the experimental data, asked to interpret it, and to refine their hypotheses. The populations are behaviorally isolated but the hybrids are not yet infertile, illustrating the difficulty of defining them as separate populations or species.

The second case study puts students in the role of a high school biology teacher who is asked by her principal to consider including intelligent design into the biology curriculum. Students learn about the intelligent design movement, gather arguments for and against its merits, and develop a position statement describing the propriety of its inclusion in their curriculum. Advanced students follow this activity with a team-based debate about Behe’s irreducibly complex flagellum. This case study is currently being used as part of an educational research project to determine if using it affects students’ knowledge of and attitudes toward intelligent design differently than standard lecture sessions.

Students from a Christian college (Trinity Christian College) and a state university (Western Illinois University) are participating in this work. Preliminary results from these surveys will be described.

IV-C. CHRISTIAN VALUES IN ENGINEERING, TECHNOLOGY & PHYSICAL SCIENCES

Elm/Blue Spruce Room

Sunday, July 30, 2006 1:30 PM

Christian Values and Nuclear Energy
Tjalle T Vandergraaf

To some, linking “Christian values” and “nuclear energy” in one sentence may appear to be ill-

advised. After all, nuclear energy was created in the crucible of a war effort dedicated to produce weapons of mass destruction. The memory of the disastrous nuclear reactor malfunction at Chernobyl and the perceived dangers of long-lived radioactive nuclear reactor wastes all suggest that humankind has been playing with more than just fire.

However, in the context of increasing energy demands by developing nations, in particular China and India, and the rapid depletion of oil and gas reserves, society needs to take all energy generation and energy conversion processes into consideration in the development of a sound energy policy.

There are many facets of the movement of uranium from an ore deposit to final geological disposal that need to be scrutinized from the perspective of Christian stewardship. These include the use of fissile and fertile isotopes in the production of energy and the demand by society for an ever increasing supply of energy. Questions that can be raised include whether it is responsible to use a potentially hazardous technology to meet the energy needs of a rapidly growing and increasingly wealthy society, and what acceptably safe operating conditions of commercial nuclear power stations are. Questions that pertain to the final destination of spent nuclear fuel include a fundamental one of defining spent fuel as a waste form or as a resource, postponing a decision for reprocessing or disposal to future generations, and the validity of environmental safety assessments of geological disposal that have to predict performance over millennia. In many cases, decisions are not made in a vacuum but in the context of competing technologies, each with its own environment impact.

The argument will be made that Christian scientists and engineers not only have an opportunity to contribute to all aspects of the safe application of nuclear power, but a duty to do so and, in that

way, apply the principles of Christian stewardship to this vital technological sector.

2:00 PM

**Weaving Wonder and Wisdom:
Developing a Christian Face for Values in Science**
Celia Deane-Drummond

This seminar will suggest that it is through wonder and wisdom that a deeper spirituality can surface that serves to awaken an integrated knowledge in theology and science, without skating over the tensions between them. If wisdom is the voice for theology at the boundary of science, so wonder reminds theology that science, too, offers its own wisdom that needs to be taken into account.

Wonder is gradually becoming rehabilitated as integral to the experience of the practice of science and technology.

If wonder is common to both scientific discovery and religious experience, wisdom offers a way of distinguishing where that wondering leads away from the truth.

I do not deal in this seminar specifically with professional ethics in terms of particular scientific practices, but more general values that I argue need to be fostered and encouraged in scientific practice from a Christian point of view. It is in this sense that a distinctive Christian approach to scientific work emerges by way of orientation, rather than specific outcomes.

This seminar will explore what might be the distinctive aspects of scientific wisdom, drawing particularly on facets of cosmology and ecology. Science requires the imaginative ability to pay attention to *what is in a way that is somewhat analogous to prayer*. Theological wisdom parts company from scientific wisdom, however, in as much as cosmology and evolutionary biology resist purpose in the universe. Theological wisdom

points to a future that is informed by hope in the resurrection. I argue, in particular, for an alignment of scientific practices with the natural world through fostering an attitude that is the opposite of mastery. It expresses a creativity informed by wisdom that is analogous to God's creative work through Wisdom. I suggest that particular practices such as environmental ethics and sustainable development need to be informed by wonder at the natural world and wisdom understood as expressing human, creaturely wisdom. If truth is only ever a dim reflection in a mirror, then wonder at the Wisdom of God points to a future hope where perfected knowledge becomes possible. Above all, both wonder and wisdom are accompanied by love, love of God for creation, love of humanity for God interwoven with love of humanity for the universe and life in all its rich diversity and plenitude.

2:30 PM

**Professional Engineering Ethics and Christian Values:
Overlapping Magisteria**
Gayle E Ermer

Many faith-based colleges and universities with engineering programs find themselves trying to simultaneously satisfy two educational objectives: (1) meeting ABET's requirements to produce graduates who have "an understanding of professional and ethical responsibility" and (2) meeting the institutional goals for student spiritual formation and development of Christian moral values. This paper will describe and analyze several approaches to understanding the relationship between these two objectives and the implications of these approaches for engineering education.

It could be argued that the two goals mentioned above are mutually exclusive. Since professional ethical standards arise out of a secular context and by means of purely logical

reasoning, they bear no relationship to personal religious commitments. The implication of this view would be that all engineers need to be taught the engineering code of ethics disregarding any commitments they might have to religiously-determined moral absolutes. It could also be argued that the two goals mentioned above are one and the same. Each individual appropriates an all-encompassing system of values and this system is operative in all situations, including professional engineering work. The implication of this view would be that engineers do not need to know the engineering code as long as their parents, early school experiences, church, and devotional life had contributed to a strong moral conscience.

This paper will argue that while each of the two areas has its own distinctiveness, each overlaps the other in content and depends on the other for successful ethical decision-making and action. This argument will be based on the Reformed Christian philosophical perspectives expressed by Abraham Kuyper and Herman Dooyeweerd. The paper will conclude with some practical suggestions for emphasizing both goals in the engineering curriculum. Some methods for integrating engineering ethics into the curriculum within the context of a Christian world view will also be presented.

3:00 PM

Teaching a Christian Engineering Ethic
William M Jordan

Teaching engineering ethics in a Christian university has some unique opportunities and challenges. Students need to be exposed to issues that all engineers face. At a Christian university, we have the opportunity to add additional insights into the analysis process. This paper describes the author's efforts to teach a Christian Engineering Ethic.

Baylor's engineering programs require all students take an ethics course. We encourage them to take the engineering ethics course. For this course, I am using two different textbooks. The first one is a traditional engineering ethics text: *Engineering Ethics: Concepts and Cases* by Harris, Pritchard, and Rabins. The second one is a Christian ethics text: *The Moral Quest: Foundations of Christian Ethics* by Stanley Grenz. Additional material is used from other sources. One useful source is the book, *Fundamentals of Ethics for Scientists and Engineers* by Seebauer and Barry, that advocates a virtue ethics approach to engineering ethics.

Each week the students read about one chapter in each book. The lectures for the two books are interweaved so that the students see how a Christian ethics perspective can relate to engineering practice. Many different ethical theories, such as virtue ethics, respect for persons ethics, and utilitarian ethics are presented in both books, but with obviously different perspectives. As one of their assignments, the students are asked to write a paper on their personal ethical system. They also are required to use some Christian ethics insights when they write about different engineering ethics dilemmas that have been presented to them.

Ethics is also related to all of an engineer's life, not just the part done during the working day. As part of this class, the students watch videos where the main character faces one or more serious ethical issue. Sometimes the character responds well, and sometimes poorly. The students use the insights they have gained from this course in this analysis. Some of the movies analyzed include: *Citizen Kane*, *Chariots of Fire*, *Crimes and Misdemeanors*, *Out of Africa*, and *Quiz Show*.

**IV-D. STEWARDSHIP,
CONSERVATION & LAND
MANAGEMENT(continued))
Bunker Interpretive Center**

Sunday, July 30, 2006 1:30 PM

**Connecting the Campus
to the Watershed**

Janel M Curry

Calvin College is on a divide between two watersheds, one of which is the Plaster Creek Watershed. The college has a great deal of interest in the watershed due to the impacts of its activities and because 50% of its staff, and over 3200 alumni live within the watershed. The twelve-mile long creek passes through a range of land use zones and through a broad range of neighborhoods of different income levels. Plaster Creek is both the spawning ground for Lake Michigan salmon and the only place in Kent County where the state-threatened Beak Grass is found. However, fish and macro-invertebrate communities are poor and the state has issued a warning that the Plaster Creek waters are not safe for even partial immersion.

Calvin College has been active in bringing together representatives from a variety of constituencies to discuss the problems of Plaster Creek. The college has four major programs that provide the basis for this initiative. The Calvin Environmental Assessment Program (CEAP) involves courses in collecting data to contribute to an assessment of the environment. The science education program at Calvin is involved in community K-12 science education and is beginning to partner with local high schools in monitoring the health of the watershed. The Department of Geology, Geography, and Environmental Studies has made this initiative part of its strategic plan to both focus on watershed issues and increase its engagement with secondary education.

Finally, the recently created Office of Community Engagement, builds on Calvin's

long history of community involvement. The Office of Community Engagement has been created within the Provost's office to serve as a catalyst for Calvin's efforts in engaged scholarship and to bring oversight to the college's growing numbers of programs and projects with community agencies, schools, and organizations. It has identified environmental issues as one of the foci for Calvin in its efforts at contributing to the local community. The Plaster Creek project shows how a college can become the catalyst for increased attention being paid to a piece of God's good Earth which is close at hand.

2:00 PM

**The Ivory Tower and the
Bulldozer: Colleges As
Accidental Developers and
Urban Planners**

Mark D Bjelland

The ivory tower image of collegiate existence is far removed from that of the construction worker or the big city real estate developer. Yet, growth, change, and keeping up with the competition means that colleges across North America are firing up the bulldozers and becoming—often without a great deal of forethought—major real estate developers.

Colleges are major land users. They often occupy large tracts of land, generate significant traffic and activity, and influence the social, economic, and ecological well being of their host community. Further, the physical design and the way land is managed at a college plays an important, but under-recognized, pedagogical role for students and society. Rather than falling into their role accidentally, colleges need to be more deliberate in thinking about the tasks of landscape planning, design, and development, for, to paraphrase Socrates, "the unconsidered bulldozer is not worth driving."

In this paper, I draw upon two strands in urban planning theory: collaborative planning and eco-communities, and suggest how they might inform a more thoughtful, inclusive, and environmentally sensitive approach to managing growth and change on the college campus.

2:30 PM

**A Tale of Oaks, Salmon and
Snails: Land Stewardship at
Trinity Western University**

*Karen M Steensma and
David Clements*

Trinity Western University (TWU) in southwestern British Columbia, Canada, owns 60 acres of multiple-use natural area, 57 acres of additional sensitive habitat, and 73 acres on a marine island. Acquired over 40 years, these lands include salmon-producing streams, wetlands, second-growth temperate rain-forest, agricultural land, an endangered oak-meadow ecosystem, and various rare, threatened, and endangered species.

The campus stewardship model actively developed since 1990 began with formation of a multi-departmental Ecological Stewardship Committee and naming of a 60-acre Ecosystem Study Area (ESA) on the main campus. Rules were developed and informational signage was placed at all entrances to the ESA, which has trails open to both on- and off-campus users. An additional 57-acre former farmstead adjacent to the main campus, added in 1999, is open only for approved course projects and research, with development currently curtailed by inclusion in the provincial Agricultural Land Reserve. The Crow's Nest Ecological Preserve of 73 acres on Salt Spring Island was acquired in 2000, and is open only to approved course projects and research.

TWU biology, geography, and environmental studies faculty routinely use the various natural areas as outdoor laboratories, and

have spearheaded collection of baseline data on species inventory and mapping with students in advanced courses. Two staff positions, an ESA manager and a field resources coordinator, have been funded through academic and facilities budgets and through partnership with A Rocha Canada—Christians in Conservation. Up to 15 students per year either volunteer or are directly employed in related activities.

The resulting knowledge of these natural resource areas is used to influence overall campus planning decisions. Research programs on Garry oak (*Quercus garryana*) meadow ecology at the Crow's Nest and on life history of the Oregon forest snail (*Allogona townsendiana*) in the ESA, collaboration with community groups on salmon habitat restoration and educational

outreach, and cooperation with TWU education, human kinetics and recreation programs have all provided stewardship benefits.

Culmination of these efforts led to a public naming and dedication ceremony for the Salmon River Trail loop on the main campus in 2005. Development pressures, vandalism, and pollutants are among the most serious ongoing challenges.

3:00 PM

Toward a More Sustainable Stewardship of Campus Lands Randall G Van Dragt

It has been widely noted that our actions, whether individual or corporate, embody both effective and affective content; that is, each action creates direct impacts on the world around us and indirectly

influences those who view and interpret what we do and how we do it. Since colleges are both educational institutions and major land holders, developers and managers, campus stewardship practices affect relatively large land areas and communicate eloquently institutional attitudes toward the land. A new campus parking lot thus not only reduces local water retention, accelerates runoff, and raises the potential for flooding downstream but also affirms to campus residents and visitors the high esteem granted automobility in our culture.

Traditional campus landscapes exact high environmental costs and communicate that such costs are tolerable, if not desirable. Furthermore, both of these impacts are frequently at odds with messages of environmental stewardship professed within the institution's walls. To achieve

greater consistency in institutional practice and profession in this day of increasing concern for sustainable living, the question facing today's colleges is how best to move from traditional, environmentally costly landscapes to campus lands that are more environmentally sustainable.

In this presentation, I will draw on the experience of several colleges to frame practices that can help campuses move in the direction of more intentional and sustainable land use policies and planning. Such practices include academic focus on campus lands, communal planning, and active community involvement in the campus landscape. Each practice will be examined from the perspective of the opportunities it presents and the issues that constrain it.

Parallel Session V Abstracts

V-A. CHRISTIAN VALUES IN BIOTECHNOLOGY

(continued)

Maple/White Pine Room

Sunday, July 30, 2006 3:45 PM

Systems Biology: Emergence of a New Approach? Hank D Bestman

The newly re-emerged discipline of systems biology takes a different approach to the study of organisms. Its central paradigm is that biological function arises from the interaction of macromolecules over time. Its goal is to understand living organisms at a systems level, combining quantitative information on individual components in order to understand the emergent behaviors that result.

The practice of systems biology involves (1) obtaining and integrating large sets of biological

data from as many hierarchical levels as possible (i.e., DNA sequences, RNA and protein measurements, protein-protein interactions, protein-DNA interactions, signaling and gene regulatory networks, metabolic flux, etc.), (2) establishing comprehensive computer databases in which these data are warehoused and annotated, (3) develop visualization programs and detailed mathematical models that reflect these data, and (4) refine these models by hypothesis-driven, iterative systems perturbations and subsequent data integration.

Once the final model is sufficiently accurate and detailed, it can be used to predict the behavior of the biological system given any perturbation. As such, the model serves as an explanation for the emergent properties of the biological system under investigation. Systems biology revisits the themes

articulated by Von Bertalanffy who argued for establishing a systemic understanding of cells and organisms. Fundamentally it strives to augment the reductionistic molecule-by-molecule accounts of cells by embedding the components within the broader contexts of cells and cell systems.

The three basic concepts of emergence (properties not demonstrated by their individual parts and which cannot be predicted even with a full understanding of the parts alone), robustness (maintaining phenotypic stability in the face of diverse perturbations), and modularity (sets of interactions with a common function) are deemed to be crucial to understanding the complexity of biological systems. Heavily influenced by electrical and systems engineering, systems biology desires to express these concepts mathematically. The

underlying question is if systems biology is a euphemism for gathering ever more details on an ever larger scale, or does it truly represent the study of biological systems as systems rather than as collections of components? Examples of the systems biology literature and of the author's metabolic flux research will be discussed.

4:15 PM

Acetate Metabolism in *Chlamydomonas reinhardtii*: Attempting a Systems Approach Janina Mobach

In the light, the photosynthetic unicellular freshwater alga *Chlamydomonas reinhardtii* uses carbon dioxide as its carbon source. In the dark, this organism grows heterotrophically, using the two-carbon compound acetate as its carbon source. Acetate triggers

the induction of the glyoxylate shunt, the pathway that enables the organism to synthesize carbohydrates from acetate. The rate of carbon flux through the central carbon metabolic network (glycolysis, citric acid cycle, pentose phosphate pathway, and gluconeogenic pathway) and through the glyoxylate shunt under steady state conditions is measured with carbon labeling experiments.

Algae are exposed for 48 hours to constant concentrations of either ¹³C-labeled glucose or ¹³C-labeled acetate under a range of nutritional and environmental conditions in computer-controlled mini-chemostats. The distribution of the ¹³C-label in the amino acids (derived from the cellular proteins) is measured using GC-MS. An elaborate MatLab software program calculates the relative flux rates on the basis of the mass isotope distribution ratios of the proteinogenic amino acids, according to a model of the intracellular central carbon metabolic network of *Chlamydomonas*. The resulting flux maps are correlated with the activity of enzymes in the citric acid cycle and the glyoxylate shunt.

Mutant strains of *Chlamydomonas* can be used to verify the appropriateness of the model of the intercellular carbon metabolic network. By conducting steady state metabolic flux analyses under a range of conditions and/or mutations, we should be able to generate, in an iterative fashion, a robust model that is able to predict metabolic phenotypes quantitatively.

4:45 PM

Post-Genomic Biosciences and Biotechnologies: A Timely Paradigm Shift in the Making?

David S Koetje

Popular criticisms of molecular biology and biotechnology focus on a key value-laden claim: molecular biosciences and bio-

technologies are too reductionistic and deterministic. By focusing so narrowly on molecular mechanisms, the argument goes, we ignore (and thereby threaten) the rich contextual/interrelational aspects of life. Reductionism also fosters deterministic thinking that genes dictate phenotypes, a notion that offends deep-seated human values. These underlying concerns fuel many controversies in biotechnology. Moreover, because reductionistic science drives biotechnology innovation, many of these issues cannot be adequately resolved by regulatory systems based on "sound science."

There are legitimate reasons for questioning the wisdom of the reductionistic paradigm. While it may yield significant insights into molecular interactions that enable cells to divide and differentiate in response to environmental cues, purely reductionistic explanations cannot produce a full scientific account of life nor provide sufficient insight into current controversies.

As we embark into the post-genomic era in molecular biosciences and biotechnology, we find ourselves awash in a sea of "omics" data. How do we make sense of the millions of genetic and biochemical permutations? How do we find the meaning in the reams of data? How do we study properties of living systems that are recalcitrant to purely reductionistic science?

Systems biology is emerging in the post-genomics era as a way to overcome the limitations of reductionism. With its focus on molecular and cellular interactions, systems biology makes use of computation and modeling to study emergent and irreducible properties of living systems. I contend that this development affords us a unique opportunity in biotechnology and molecular bioscience to shift to a more holistic paradigm, one in keeping with a Christian perspective that life is fundamentally interrelational. I will conclude with examples in biotechnology where this

systems-oriented paradigm offers insights into sustainability concerns.

V-B. MODELS FOR TEACHING OF ORIGINS(continued)
Oak Room

Sunday, July 30, 2006 3:45 PM

Students Formulate Views on Viruses and Their Place in Creation or the Fall

Arlene J Hoogewerf

When were bacteria and viruses created, and for what purpose? Based on microfossils in rocks and examination of highly-conserved genes, scientists suggest that bacteria were the first living organisms on earth. Scientists have found less physical evidence for viral origins, and currently hypothesize that viruses are derivatives of intracellular parasites or subcellular components, or that viruses co-evolved with cells. Genesis does not describe the creation of microbes.

Because we understand the beneficial role of bacteria in nutrient cycling, decomposition, food production, and digestion of foods in the gastrointestinal tract of animals and humans, it is easy for many Christians to assign a God-ordained purpose for bacteria and view them as part of the original good Creation. For many, placement of viruses in the original Creation is not as easy. Many think of viruses and the diseases they cause as a direct consequence of the Fall. But if viruses are part of the original, good Creation, then we dishonor God if we malign this aspect of creation.

I desire for students in a Medical Microbiology course to wrestle with how viruses fit with their Christian world view. In 2005, as part of a larger writing assignment on viral diseases, students were asked to write about whether viruses were part of a good Creation or part of the Fall. Students were instructed to include at least one outside source for this part of their paper. 74% of

students (n = 66) stated that viruses were part of creation, and that the Fall has perverted their beneficial, God-ordained purpose to a pathogenic one. 26% of students indicated that viruses were of the Fall, stating that viruses are always pathogenic and produce negative consequences. 73% of students used the Bible as their outside resource. Students either emphasized God as sovereign Creator of things, or used verses to support the idea that God uses pathogenic viruses to punish sinful people.

Based on these observations, the assignment in 2006 will include a pre-paper small group discussion of some positive roles of viruses and the dynamic nature of host-virus relationships. Changes in student responses will be examined.

4:15 PM

Teaching Christian Students about an Old Universe

Deborah B Haarsma

Some students at Christian colleges and universities enter their science courses with deeply held opinions about the age of the universe, often deeply intertwined with their Christian faith. This makes issues of age different from other course topics (students typically don't arrive with a strong, faith-based opinion about star colors or galaxy collisions!). If students' views about age and time-scales are ignored, they may resist learning the scientific information about age, distrust the teacher's faith commitment, and/or feel forced to choose between their faith and a career in science.

A properly designed curriculum leads students through a sequenced encounter with the issues and gives them space to work through them on intellectual, emotional, and spiritual levels. Key elements of such a curriculum include establishing lines of communication and trust with the teacher, and providing students with information about the range of views held by Christians. I will

share the techniques I use in my introduction astronomy courses at Calvin, with a focus on their underlying pedagogical motivation. As time allows, I will discuss variations appropriate for advanced physical science courses, for courses at secular colleges and universities, and for church presentations.

4:45 PM

Theories of Origins: A Multi- and Interdisciplinary Course for Undergraduates at Wheaton College

Stephen O Moshier, Raymond J Lewis, Larry L Funck, William R Wharton, and John H Walton

Theories of Origins is an upper division science course for undergraduates at Wheaton College, designed to explore a range of theories for the origin of the cosmos, earth, life and diversity of life and humankind. It is a four-credit, full semester, nonlab course in the general education curriculum, intended to follow completion of a lab course (e.g., freshman geology, biology, chemistry, or physics). Most students in the course are non-science majors.

This multi- and interdisciplinary course incorporates physics, geology, chemistry, biology, and biblical studies in an examination of scientific theories of origins. In this way, students get a broad education in the sciences as well as a sustained consideration of origins from scientific and theological perspectives. The course is team-taught by faculty representatives from each science department and the Bible-Theology department.

Scientific origins theories are controversial, indeed often considered antagonistic to biblical faith, for many people in the evangelical subculture. Surveys of students entering the class reveal a range of positions on origins questions, often tracking the results of national polls. Mainstream scientific approaches to origins are emphasized in the

course, but alternative or “anti-establishment” approaches such as creation science and Intelligent Design are presented in the course because of their influence among Christians. Science and Bible professors present models for relating scientific and biblical accounts of creation.

A course objective is to give students a background for evaluating the merits of scientific and theological claims for origins theories. Students’ understanding of scientific content is measured by exams and homework assignments. Students’ critical thinking on matters of faith-science integration is assessed by their work on study questions relating lecture and assigned reading material. This course embodies the educational purpose of Wheaton College to “combine faith and learning in order to produce a biblical perspective needed to relate Christian experience” to the needs of contemporary society.

5:15 PM

Teach the Controversy over Darwinism: Sample Curricular Modules

Mike N Keas

Since 1999 I have worked with Discovery Institute to develop AP and college biological origins curriculum. Some of this curriculum will be published in 2006. I would like to demonstrate samples of this new curriculum and explain why this supplementary material is critical scientifically and pedagogically.

One way to motivate students to study science and to think critically is to examine case studies of scientific controversy. Through case studies, students will gain insight into the standard scientific procedure of inferring the best explanation from among multiple competing hypotheses. Charles Darwin argued: “A fair result can be obtained only by fully stating and balancing the facts and arguments on both sides

of each question” (*Origin of Species*, p. 2).

In today’s climate of public educational policy, this would mean, at a minimum, teaching not just the strengths of Darwin’s theory, but also the evidence that challenges it. For example, any complete theory of biological origins must examine fossil evidence. The fossils of the “Cambrian explosion” show virtually all the basic forms of animal life appearing suddenly without clear precursors. It is not merely the geologically sudden appearance that is notable, but the observation that major categories (animal phyla) appear before the multiplication of small differences among species. Darwin’s theory predicts the opposite: small differences multiplying, and by means of natural selection, later giving rise to major anatomical differences. Students ought to know about this evidential challenge to Darwinism, but few biology textbooks mention it.

A “teach the controversy” approach presents biology in a livelier and less dogmatic way. Students will learn science as it is actually practiced. Scientists often debate how to best interpret data and they even argue over what counts as legitimate “scientific explanation.” Controversy is normal within science (not just an intrusion). Students will learn to distinguish better between evidence (factual data) and inference (reasoning to conclusions). Students need these skills as citizens, whether they choose careers in science or other fields. Teaching multiple sides in an “issues approach” to science has, of late, been recognized as a superior educational approach.

V-C. CHRISTIAN VALUES IN ENGINEERING, TECHNOLOGY & PHYSICAL SCIENCES (continued))
Elm/Blue Spruce Room

Sunday, July 30, 2006 3:45 PM

Assessment of Noise Reduction Technologies for Civilian Aircraft

James W Gregory

This paper presents a survey of contemporary and future noise reduction technologies and operational strategies for civilian aircraft. The challenges associated with each candidate technology are discussed, as well as the potential implementation cost.

The unique contribution of this paper is an assessment of the relative merits of each technology or operational technique; as well as a Christ-centered, realist approach to candidate technology selection. Motivations for aviation noise reduction will be discussed, as well as an outline of the societal costs of aircraft noise.

Noise reduction technologies ultimately will not be implemented without sufficient economic benefit to the aircraft manufacturers or airline operators. This is because historical regulatory controls of aircraft noise have not driven the effort in aircraft noise reduction; rather they have followed the current state of the art. Historical reductions in aircraft noise emissions have primarily been driven by economic factors such as aircraft efficiency and fuel burn, with noise reduction being a beneficial side effect. Thus, it is incumbent upon aircraft designers and researchers to invent and select technologies that improve performance and reduce operating costs while reducing noise at the same time. Dual-benefits must be considered from the outset of technology development; otherwise, the candidate technology will fail to be implemented.

This paper discusses potential dual-benefit technologies, and the

processes that should drive a successful research program for aircraft noise reduction.

4:15 PM

**What Is Chemistry?
The Impact of Science and
Technology on Culture and
the Environment**

Carl P Fictorie

Students of chemistry need to learn about an extensive range of chemistry, including the phenomena, the science, the perspectival foundations, the industry, and its cultural and environmental impact. Chemistry textbooks and curricula generally do not provide a complete picture, focusing primarily on the science and phenomena. Those who address perspectival issues in the sciences, both Christians and non-Christians, have tended to overlook chemistry, focusing on foundational questions in physics or biology, based on an assumption that chemistry is reducible to and explicable in terms of physics.

This presentation will provide a more complete description of chemistry. Using the reformed doctrines of creation, the Fall, and redemption to provide context, a unique picture of chemistry is described that addresses a larger range of issues than typical philosophies of science have addressed. Chemistry will be shown to be more than a pure science because of the unique nature of chemical synthesis. Chemical synthesis spans the

traditional polarity between science and technology. As such, chemistry is an example of how a discipline uses an understanding of creational structure (science) to develop creation and human culture (chemical technology). The implications of this analysis for understanding the place of chemistry in a larger scientific, cultural, and environmental context will then be sketched out.

4:45 PM

**Science and Engineering in
Public Policy: Getting out of
the Boat in Washington, DC**

*Randall J Brouwer and
Steve E Watkins*

Science and technology are at the forefront of many public policy issues. Many politicians, scientists, and engineers recognize that governmental organizations, and in particular the legislative branch, benefit greatly from the advice and involvement of those with a technical background. Many avenues exist for executive branch agencies and the Congress to obtain advice from the professional community on issues related to science, engineering, and technology.

During the last several decades, there have been a number of new initiatives for increasing the level of advice. Some of these programs continue to be used and some of them have been dismantled. This paper will give a brief overview of the involvement of scientists and engineers in the political process,

will describe the need for Christian scientists and engineers to be active in public policy, and the experience of the authors as participants in the Congressional Science and Engineering Fellows Program.

5:15 PM

**The Biblical Basis for
Technology Assessment**

Jack C Swearingen

Western societies expect technological solutions for increasingly difficult and expansive problems. Some of the problems have moral origins, but others are consequences of previous technologies. Many proposed solutions contain ethical-moral dilemmas as complex as the problems they are attempting to resolve. Unmanaged growth of technology may lead to utopia or contain seeds of destruction. We may be able to avert some malevolent uses, but unintended consequences may not be recognized before the causative technologies are irreversibly disseminated into culture.

The attempt to forecast emergent properties and manage the pace of technology insertion is called technology assessment (TA). Is there a biblical framework for TA? Technology expedites the cultural mandate—God’s original directive for human endeavor. Technology also facilitates other scriptural mandates and commandments, e.g. worship, stewardship, community, ministry, and mission.

Technological developments that are manifestly ethics-laden, or whose use or misuse portends grave consequences, are readily critiqued on scriptural grounds.

A “theology of technology”—if such were to be developed—would permit biblical assessment of existing technologies and new ones as they emerged. But a biblical mandate for such a pursuit has not yet been developed, because the Church is not persuaded that technology assessment is important to discipleship. Moreover, the notion that innovation or technology insertion should be managed is offensive to technological and economic determinists—whether Christian or secular. Yet Christians are God’s agents for carrying out his purposes of redemption and restoration. The agent’s handbook contains instruction and guidance for culture development, ministry, and mission, and for using technology as a principle means for so doing. Both technology and culture must be evaluated with biblical norms.

The Church needs to know how to live biblically in a culture that is substituting technology for faith in God. Biblical TA is critical for doing so. The capability would help us discern the “arrow” of technological progress and develop means to steer that progress toward the biblical norms of spiritual, social-cultural, aesthetic, and environmental sustainability.

Parallel Session VI Abstracts

VI-A. SCIENCE IN CONTEXT: "PUTTING SCIENCE IN ITS PLACE"

Maple/White Pine Room

Monday, July 31, 2006 9:45 AM

John Calvin, Natural Science, and the Principle of Accommodation

Davis A Young

Clinton Ashley, Ford Lewis Battles, and David F. Wright have drawn attention to the pervasive role played by the principle of divine accommodation in the biblical exegesis of John Calvin. Reijer Hooykaas emphasized Calvin's use of accommodation in the interpretation of texts with apparent bearing on scientific matters. In addition, many discussions of biblical faith and the natural sciences commonly appeal, by way of example, to Calvin's interpretation of Gen. 1:14–19 in which he explicitly contrasted 16th-century knowledge of the relative sizes of Saturn and the Moon and the textual reference to the two great lights.

Because 16th-century "astrologers" claimed that Saturn is much larger than the Moon, Calvin attributed the text's disparity with scientific truth to the idea that Moses had accommodated his language to the "unlearned" and "rude." For the benefit of his readers, Moses employed popular rather than philosophical language. Despite the clear link between Calvin and accommodation, conservative scholars have generally failed, or been unwilling, to acknowledge the extent to which the concept of accommodation pervades Calvin's approach to Scripture.

To my knowledge, apart from Paul Seely, conservative biblical commentators, theologians, and scientists have rarely tried to go beyond Calvin by venturing their own applications of Calvin's idea

of accommodation to the interpretation of texts with apparent relevance to the natural science of our own day.

I review Calvin's use of accommodation, a concept that he invoked not only in his handling of scriptural talk about God, but also in his handling of texts that particularly concern astronomy and geography. For Calvin, accommodation could take place by Scripture's use of phenomenal language, as in Gen. 1:14–19, but in other instances, he implied that Scripture was accommodated to concepts about the natural world that were erroneously entertained by the Israelites as in Ps. 58:4. I propose some additional texts that seem to contain outmoded scientific ideas to which Calvin's idea of accommodation might fruitfully be applied.

10:15 AM

Beliefs in Natural Science: Then and Now

Christopher B Kaiser

Some 19th-century historians and philosophers portrayed the relationship between science and religion as one of open warfare. By the end of the 20th century, this warfare model was largely abandoned by historians of science. It is now generally recognized that early modern scientists were motivated by various religious beliefs. However, historians and philosophers still often assume that the beliefs of early scientists either were abandoned by later scientists or became peripheral to scientific work. Any beliefs that scientists rely on today are thought to be merely common-sensical and secular in spirit.

What seems to have escaped the notice of historians and philosophers alike is the fact that some of the beliefs of early modern scientists have persisted

in surprisingly consistent forms. These beliefs are so basic to scientific endeavor that they it could not be sustained without them. Modern science actually turns out to be a faith-based enterprise.

In support of this revisionist position, I shall identify two distinct beliefs having to do with the comprehensibility of the natural world that occur in the writings of early modern scientists like Johannes Kepler. I shall discuss some of the forms those beliefs took in medieval Christianity and in Reformers like Philip Melancthon in order to show their specifically theological character. Finally, I shall illustrate the survival and vitality of these beliefs in modern scientists like Albert Einstein and Paul Davies.

10:45 AM

Protestant Modernism, the Warfare Thesis, and the Religion of Science

Edward B Davis

In the early 20th century, the "Chicago school" of Protestant modernist theologians uncritically adopted A. D. White's "warfare" view of religion and science. Like White, they held that traditional theology was utterly incapable of a positive, fruitful conversation with modern science. They rejected the moderate approach of the prominent theistic evolutionist Asa Gray, who had separated theology from science and who held that evolution and the Nicene Creed were fully "compatible." Instead, they reshaped theology along "scientific" lines, discarding divine transcendence and defining "religion" in functional rather than doctrinal terms.

This has important parallels with the emerging "religion of science," which has its roots in Comtean thought. Two Americans gave early, alternative definitions of the

"religion of science" in books using that title. One, the libertarian publisher Calvin Blanchard, sought to advance popular irreligion and "free love." The other was Paul Carus, editor of *The Open Court* magazine. Carus was influenced by Charles Carroll Bonney, a Swedenborgian who served as president of the World Parliament of Religions. Carus went on to develop a "religion of science," involving a view of God he called "Entheism." Like the Chicago theologians, Carus uncritically accepted the warfare thesis.

11:15 AM

Putting Science in Its Place: The Culture of Scientific Practice

Arie Leegwater

My goal in this paper is to contextualize science, to highlight its situated-ness and the local interpretations that necessarily constitute and inform its practices. What can we learn from the concerted effort of the past forty years to see science as part of culture? And does this extensive effort provide a window of interpretation which is open to a Christian understanding of scientific activity?

We are often presented with two differing modes of describing the natural world: one is "discovery," the other is "construction" or "invention." The language of discovery suggests that the "laws of nature" are immanent in the world, written, as it sometimes is said, in the Book of Nature. Over against the language of discovery is that of "construction" or "invention," which suggests that scientists create linguistic constructs, different vocabularies that are more or less useful in different ways for predicting and controlling what happens.

I intend to explore the metaphor of nature as text, and the questions surrounding interpretation that adhere to such a metaphor. Two specific examples will be analyzed: (1) "If I had a Hammer": The Great Devonian Controversy, and (2) "If I had an AFM": The Question of the Chemical Bond. The antinomic character of science displayed in these cases gives rise to the temptation to overemphasize either its objectivity (its invariant structure) or its subjectivity, its social construction.

I will discuss efforts by Robert Crease (and others) to overcome this temptation and suggest that we do not need to be fearful of interpretation: it reflects our finitude as creatures and the goodness of creation. A modest answer is to affirm a robust Christian view of creation, creation as revelation that invites interpretation, daily surrounds us, and speaks to the believing heart in all its trustworthiness and faithfulness.

11:45 AM

Contextual Responsibility in Scientific Work

Matthew Walhout

In this paper, I question certain lines of argument meant to shore up the status of science within a Christian world view, and I try to offer an alternative way of affirming the importance of scientific practices and claims. My critique is aimed at Christian storylines that too readily connect the affirmation in Genesis of creation's goodness with a general affirmation of modern science.

I am particularly wary of plot elements in these storylines that rely on humans resembling God in creativity, knowledge, and rationality. These plot elements appear in simple form when the biblical description of humans "created in the image of God" is translated into a description of humans "able to think as God does." They can be introduced more subtly when the cultural

mandate is presented in terms of its fulfillment through scientific exploration, when creation is described as "the book of nature," or when this "book" is portrayed as being translatable into scientifically delimited language.

I have hope for an alternative story of how scientific investigation finds a legitimate and important place within faithful Christianity. It begins not with the goodness of creation, nor with the fall into sin that hid goodness from human sight, but with the recognition that humans have been called forth as important participants in God's creation. In our special role, we have been called not simply into existence, but into responsibility. In the present age, our existence and therefore our responsibility are entwined with scientific activity and its technological products. In their daily work, scientists themselves face moral decisions of many sorts. This fact alone is reason enough to think it important for Christians to participate in the scientific process.

The critique and the alternative proposal offered in the paper will draw on the theological vision of W. H. Vanstone. They will also make critical use of recent work in hermeneutic philosophy of science, such as that of Joseph Rouse. I consider Rouse's work important for two reasons: first, it has the potential for radically changing the way in which philosophical naturalism is conceived; and second, much of it resonates with Vanstone's theological vision, which I take to be both affirming and usefully critical of the Reformed Christian tradition to which I belong.

VI-B. MODELS FOR TEACHING OF ORIGINS (continued)

Oak Room

Monday, July 31, 2006 9:45 AM

Using Survey/Response Writing Assignments to Stimulate Classroom Discussion

Loren D Haarsma

In general physics courses for science majors and education majors at Calvin College, some time is dedicated to perspectival issues. Because of the limited time available, it can be difficult to induce many students to participate in classroom discussion—or even to share their opinions.

For the last several semesters, I have used brief survey/response writing assignments on topics such as methodological naturalism, Scripture and nature, determinism and chance, historical science, philosophical interpretations of science, looking for scientific evidence of miracles, and the development of first life on earth. Students are presented with statements or questions (e.g., whether they would prefer that abiogenesis of life on earth would ultimately be shown to be scientifically explainable, or would ultimately be shown to be scientifically impossible) and asked to write their opinion in one or two short paragraphs. The statements and questions are crafted to induce a substantial amount of disagreement amongst the students. I have found that when students begin discussion with their own writings in front of them (I don't collect the writing assignments until the end of class), many of them are far more likely to share their ideas and opinions, and they seem more engaged with the subsequent discussion and lecture.

10:15 AM

Using Galileo to Teach Darwin

Craig A Boyd

Professors at Christian Colleges and Universities often dread

teaching Darwinian theory of evolution because it has the potential to cause distress among students, parents, faculty and administrators. Theories of evolution, it is assumed, challenge Christian views of creation—and maybe more importantly—the idea that the Bible is the uniquely inspired Word of God. However, Darwin's advocacy of evolution was not the first great crisis to confront people who were both scientifically literate and deeply religious. Galileo's famous encounter with the Church provides a helpful model for faculty members in negotiating the science-religion terrain since there are so many similarities in the two cases.

Ernan McMullin's use of the "principle of accommodation," "the principles of the priority of scripture," and "the principle of prudence" help us to understand Galileo's principles of interpretation but we can also apply them to the Darwinian controversy. Since the geo-centric model of the cosmos is no longer widely accepted, it presents a fairly safe starting place for professors who wish to discuss issues concerning the broader science-religion relationship but also the more specific issues of evolution and the Christian faith. This approach to teaching Darwinian evolution has the following advantages: (1) it considers the issue within its historical context (2) it helps faculty and students attempt to see that both religious texts as well as the natural world require interpretive tools, and (3) it introduces the materials in an appropriate developmental manner.

10:45 AM

Teaching the "Science and Theology of Origins" at Montreat College

Lloyd J Davis

"The Science and Theology of Origins" course was taught at Montreat College in the spring 2005 semester for the first time. While student interest was high,

only 16 students from a wide variety of majors were able to fit the course into their schedules. Lloyd Davis (physics/mathematics) was the lead professor but was accompanied by Dr. Brad Daniel (life sciences) and Dr. Darwin Glassford (Bible). All three met with the class for all sessions which were once a week for three hours.

Three major Christian approaches to origins as well as naturalism were presented and discussed throughout the semester. The only text was *Three Views on Creation and Evolution* edited by J. P. Moreland and John Mark Reynolds but various other readings were assigned to supplement the text.

The main goal of the course was to demonstrate the complexity of the issue and cause the students to think more deeply about how to understand and interpret nature and Scripture. To this end, the students were required to read two books, one by a scientist and one by a theologian, and write a review of each. One of the major components of the grade for the course was a research paper expressing and defending the student's position on origins. These papers were submitted in writing and read before the class with discussion ensuing.

At the end of the course, the students were grouped into debate teams and a debate was held between the three main Christian views and one made up by the fourth group. In an effort to ensure the engagement of the students, another major factor in grading was class participation. While we were moderately successful at reaching our goal for the course, there were some obvious ways that it can be improved before it is taught again. My presentation will provide the details of the course and what we would do to improve it in the future.

11:15 AM

The Coming Demise of Intelligent Design and Implications for Teaching About Origins

Richard P Aulie

The increasing public approval of Intelligent Design (ID) prompts questions about the best way to teach origins. For many, it is an antidote to secularism and a synonym for God. The public exerts pressure, and numerous biology teachers skip evolution altogether. Life is so complex, we are told, that it cannot be explained by evolution, but by an inner, nonmaterial agent.

All the same, ID will inevitably fade away, and it is instructive to remind ourselves why. This is because it stands outside and contrary to the rich heritage that flows fruitfully to us from the Christian Renaissance. Science arose when our Christian forebears, among them Kepler, Galileo, Bacon, and Newton, piously believing that nature is created, believed that nature therefore is wholly material, entirely separate from God.

Today, biological evolution is a logical consequence because Darwin was an intellectual descendant of the Christian Renaissance.

ID stands contrary to this tradition because of its two theological defects. The ID movement admits that much of nature can be explained by the scientific method, but that only an intelligent agent can explain the complexity of nature. ID therefore implies, first, that God created two kinds of nature: one kind explained by the scientific method; the other by an intelligent agent. Second, because this "agent" is said not to be God, it must be a proxy or surrogate that acts in place of God. This agent is nonmaterial, arises from Aristotelian thought, and has no biblical warrant. ID therefore promotes an unorthodox view of creation.

The best way for a biology teacher to deal with origins is to teach good biology. To do this,

one should remember that (1) modern science arose in the Renaissance, (2) science arose when our Christian forebears, believing devoutly that God creates nature, understood that to invoke God or a nonmaterial agent would get a person nowhere in understanding the material connections that explain how nature works, (3) evolutionary theory, arising from biblical roots, released biology from its Aristotelian sources, and (4) ID stands contrary to this tradition, and for this reason cannot survive.

11:45 AM

Evolution Wars: A Failure to Communicate

Uko Zylstra

It is my contention that a major contributing factor to the "evolution wars" as *Time* magazine refers to the ongoing debate about the teaching of evolution and Intelligent Design is a failure to properly define the meaning of evolution. The term evolution really has multiple meanings. Yet, when people talk or write about evolution or even the theory of evolution, they seldom distinguish between the various meanings of evolution. So when someone asserts that "evolution is a fact," it is not clear in what sense evolution is a fact. Further probing will generally make obvious the different degrees of empirical evidence that supports the different meanings of evolution. The result is a deep failure to communicate because the different parties talking about evolution do not always use the same meaning of evolution.

This also holds for classroom discussions about evolution. If we are to think "critically" about the discussion of evolution, creation, and Intelligent Design, then we need to communicate more effectively by making these important distinctions with regard to the different meanings of evolution.

VI-C. CHRISTIAN VALUES IN ENGINEERING, TECHNOLOGY & PHYSICAL SCIENCES (continued)
Elm/Blue Spruce Room

Monday, July 31, 2006 9:45 AM

Beyond Stewardship: A Franciscan Look at the Christian Engineer As Mediator

Sister Damien Marie Savino

In light of increasing technological demands and the global ecological threat, there is a need to explore new paradigms for the role of humans in nature and new ways of integrating technology for sustainable development. This paper focuses on the notion of human persons as mediators and the positive implications of this notion for contemporary views of technology and the human person. Specifically, the research looks at mediation through the lens of the medieval Franciscan, Saint Bonaventure.

For Bonaventure, humans as mediators stand "in the middle" between the nonhuman creation and God; they are members of creation yet unique in having the capacity for God. Key aspects of his notion of human mediation are exemplified in the analogy of "upright posture." In assuming upright posture as no other animal can, humans become aligned with things "above" and things "below." They become a reconciling or healing ladder between nature and God. But in the fallen state humans are "bent over and curved," their gaze fixated on the earth. They stoop and subordinate themselves, becoming slaves to creation. They fall into ignorance, concupiscence, and a pride that leads to hubris—and all creation is off-balance as a result. Only by aligning themselves with Divine truth, goodness, and power, says Bonaventure, will the proper relationship between humans and nature be restored. In his view, creation is subject to humanity, but only when humanity is subject to God. His notion of mediation

involves a Franciscan kind of co-creatorship with God that calls persons to develop not only the material but also the spiritual senses.

This research examines the implications of the concept of mediation for contemporary environmental engineering. The idea of the engineer as mediator is practically explored in the context of an urban river restoration case study on the Anacostia River in Washington, DC.

Three types of mediation—practical, scientific, and sapiential—are proposed. Does the notion of mediation introduce something new into the environmental engineer’s attitudes toward technology and creation? Would it change the engineering design process and final design elements? These and related questions are addressed.

10:15 AM

Constraints and Criteria in the Conceptual Design Process

Kamalini A Martin

The functions of the mind seem to relate or be interdependent on the physical and external environment. There seems no way to access the mind of a person except through actions (visible/tangible behavior). Engineering design is an expression of the human mind, realized in the environment through key cognitive faculties of knowledge, creativity, and learning. The success of engineering design is measured by the degree of satisfaction—the synthesized result must satisfy the initial requirements and

unseen, unrealized concepts. Thus, the original need or system design requirements is the goal which both drives the design process and evaluates the effect.

In most human design that has a significant degree of novelty, the unique individual stamp of the designer is also perceivable. Engineering design, being a technical solution to a human need, must also embody the ideals of service and stewardship. The object of design must effectively aid humanity, in particular, the needs of underprivileged or suffering humanity. The design should be accountable in the tradeoff between cost and benefit at all stages—precious resources cannot be irresponsibly depleted for the benefit, satisfaction, or comfort of a few humans.

In summary, the human designer should follow the divine example and express a human mind which itself reflects divine nature and thus contributes to the glory of God. The easiest stage to evaluate and/or correct design decisions is during initial conceptual design. However, conceptual design is not effectively taught since there is a large amount of tacit knowledge. A novice designer should learn from an expert mainly by tracing crucial decisions against appropriate criteria so that the values that drive design are clearly visible. The structure and function of every designed object can be evaluated against the Christian values in two ways: (1) the familiar cost-benefit analysis along with the accurate socio-economic assessment of the specific target population which will use the designed object (macrolevel); and (2) the place of

such Christian values throughout the conceptual design process, i.e., planning, search, conflict resolution and decision making (microlevel). The second is explored and presented in this paper.

10:45 AM

Project Connect: Connecting the Disconnected
Keith N Vander Linden

Project Connect¹ is a program that provides technology training classes and free computers to at-risk groups in the Grand Rapids area. Its vision is to connect families to the information communication technology (ICT) literacy and resources that they can use to support themselves. It is an attempt to bridge the so-called digital divide,² a goal that it shares with other programs and projects.³

The Department of Computer Science at Calvin College has offered a basic computer administration course through Project Connect every summer since 2001, serving roughly 20 families each year (70% African-American, 10% Hispanic, 20% Caucasian), and has provided limited computer support for these families throughout the year. The program is based on six two-hour training classes, which cover the basics of PC hardware setup, operating systems and applications, connecting to the Internet, using the World-Wide Web, and system administration.

The classes are taught by faculty and students from the Department of Computer Science. The computers provided in the

course are machines being rotated out of the department’s labs after four years of service; they are functional machines that include basic hardware, but usually not modems, flash drives, or printers. They have valid licenses for Microsoft Windows, but are otherwise configured with open source or freely available utilities. The machines are free to those families who take the training course.

We’ve found the following factors to be crucial to the success of the program:

- The class is much more effective when we have established relationships with the families before they attend the class. This generally includes community liaisons and translators where appropriate.
- The sources of hardware, instruction, and support must be sustainable. The department is currently initiating a service learning course that will allow students to get course credit for participating.
- The training and support services are more important than the free machines. As computers and connectivity become more available, the digital divide is more heavily characterized by literacy than by equipment.

The department plans to continue administering this program and is looking for additional local partners.

¹<http://cs.calvin.edu/activities/connect/>

²http://en.wikipedia.org/wiki/Digital_divide

³E.g., www.digitaldivide.net/; www.msu.edu/user/jackso67/homenetto/

Parallel Session VII Abstracts

VII-C. GENERAL SESSION:
SCIENCE AND RELIGION
(continued)
Elm/Blue Spruce Room

Monday, July 31, 2006 11:15 AM

Pedagogy: Teaching the Whole Is Greater than the Sum of the Parts

Robert M Bartholow

It is well-established pedagogy to give an overview of the topic before breaking the subject into smaller elements. Yet academics, western medicine, and news reporting attempt to reduce the overall picture to a single element. What are some of the consequences of this approach? Consider an academic discussion of the origins of life. A chemist may begin with the basic in an area of expertise, and develop one possible sequence:

properties of elements →
formation of amino acids →
formation of proteins →
random formation of life.

Given a partial understanding in any one step, is it any wonder that subsequent steps become more difficult and speculative?

An alternative is to speculate on the overall picture, then an examination of elements may provide a better understanding of the whole. One possible sequence is:

intelligent design →
formation of building blocks →

formation of designed building blocks →
formation of a designed, complex whole.

An accompanying poster session gives a specific example of ends-directed research. A typical hydrolytic protein must incorporate both acidic and basic amino acids to react correctly. However, the two specific types of amino acids cannot be explained by random formation of amino acids.

The typical justification of reducing questions to the lowest common elements has been defended by Stephen Jay Gould. He pictures reality separated into two domains, like oil and water. Gould maintains that theology has nothing to do with science. However, separation of reality into compartments is flawed. Both oil and water obey the same rules, and an investigation of one helps with an understanding of the other. Fill a bottle with cooking oil and dyed water. Cap and shake. In a turbulent world, you cannot see the dividing line between the science of elements and the theology of the bigger picture. Looking at the whole helps to teach that the whole is greater than the sum of the parts.

11:45 AM

A New Vocabulary for Teaching Biological Origins

Fredric P Nelson

The teaching of biological origins requires a vocabulary that mirrors scientific facts. Evolution originates at the level of DNA, not species. Microevolution is best defined as the alteration of existent, functional DNA. Macroevolution is best defined as the assembly of DNA, which codes for a new, complex, functional, integrated protein or enzyme. These definitions say nothing about causation, which could be a naturalistic agency or an intelligent agency.

The unique categories of evolution, which are of general interest, are the naturalistic assembly of the first cell, naturalistic microevolution, naturalistic macroevolution, evolution by intelligent agency and progressive creation. Fossils, homologous structures, proteins, and DNA give no clue concerning the causative agency behind the assembly or alteration of DNA. No scientific data uniquely and unequivocally supports a naturalistic macroevolution. Natural selection always reduces the total gene pool.

Natural selection only should refer to the elimination of inferior individuals and never to the production of abundant protein variations. The overall probability of naturalistic macroevolution is

directly related to the maximum number of tries rather than to time. The probability of the naturalistic assembly of a complex, functional, integrated enzyme composed of 100 amino acid residues is about 1 chance in 10^{65} per try, yet the maximum number of tries ever existent for all of naturalistic macroevolution is far less than 10^{50} .

Scientists state that *Homo sapiens* evolved from a common ancestor with the chimpanzee about seven million years ago. During this time span, the equivalent of more than 200 genes was assembled in the human genome, but the maximum number of individuals or tries was less than 10^{17} , which is totally insufficient to account for a naturalistic assembly.

The naturalistic macroevolution of one enzyme or one gene is a highly irrational scientific hypothesis and, of all enzymes or genes, an absurdity. No scientific theory of evolution exists, because naturalistic macroevolution fails to qualify as a scientific theory.

Biology is not a natural science in its totality. Biology is composed of biological systems, which belong to natural science, and biological origins, which belong to biotechnology and genetic engineering.

Plenary Sessions Abstracts

PLENARY SESSION I

The Great Room

Friday, July 28, 2006 7:15 PM

Pandemic Justice

Karen Lebacqz

Whether it is the current avian flu or the next strain, almost all experts agree that a flu pandemic is coming and that it is likely to overwhelm our medical system. There is no vaccine demonstrated effective against the current strain. Only five companies manufacture pediatric vaccines in the US today. World-wide government support for vaccine development has eroded. Under these conditions, a flu pandemic poses serious questions of justice. Who should get vaccines? How will decisions be made regarding scarce hospital beds?

In this address, I will examine a Christian approach to distributive justice in light of the harsh realities of pandemic flu.

PLENARY SESSION II

The Great Room

Saturday, July 29, 2006 8:20 AM

Nuclear Cloning, Embryonic Stem Cells and Cell Therapy: Promise, Problems, Reality

Rudolf Jaenisch

An emerging consensus is that somatic cell nuclear transfer (SCNT) for the purpose of creating a child (also called "reproductive cloning") is not acceptable for both moral and scientific reasons. In contrast, SCNT with the goal of generating an embryonic stem cell line ("therapeutic cloning") remains a controversial issue.

Although therapeutic cloning holds the promise of yielding new ways of treating a number of degenerative diseases, it is not acceptable to many because the derivation of an embryonic stem

cell line from the cloned embryo (an essential step in this process) necessarily involves the loss of an embryo and hence the destruction of potential human life. It is crucial that the ongoing debate on the possible therapeutic application of SNCT is based on biological facts.

The purpose of my talk is to provide such a basis with the hope that this should contribute to a more rational discussion that is founded on scientific evidence rather than on misconceptions or misrepresentations of the available scientific data.

In the talk, I will develop two main arguments that are based on the available scientific evidence.

1. In contrast to an embryo derived by *in vitro* fertilization (IVF), a cloned embryo has little if any potential to ever develop into a normal human being. This is because, by circumventing the normal processes of gametogenesis and fertilization, nuclear cloning prevents the proper reprogramming of the clone's genome, which is a prerequisite for development of an embryo to a normal individual. It is unlikely that these biological barriers to normal development can be solved in the foreseeable future. Therefore, from a biologist's point of view, the cloned human embryo, used for the derivation of an embryonic stem cell and the subsequent therapy of a needy patient, has little if any potential to create a normal human life.

2. Embryonic stem cells developed from a cloned embryo are functionally indistinguishable from those that have been generated from embryos derived by *in vitro* fertilization (IVF). Both types of embryonic stem cells have an identical potential to serve as a source for therapeutically useful cells.

Finally, I will describe a proof of principle experiment of the

"Altered Nuclear Transfer" (ANT) approach, a modification of SCNT that has been suggested by Hurlbut. The purpose of ANT is to avoid the generation of embryos that have any potential for fetal development but still can be the source of "customized" embryonic stem cells for cell therapy.

PLENARY SESSION III

The Great Room

Saturday, July 29, 2006 8:00 PM

The Language of God: A Believer Looks at the Human Genome

Francis S Collins

Arguments about the theological consequences of Darwin's Theory of Evolution show no sign of diminishing, despite the passage of almost 150 years since the publication of *The Origin of Species*. In fact, polarization between the scientific and spiritual world views seems to be on the rise, with the current battle over Intelligent Design and the teaching of evolution in the schools as just one example. Having had the privilege of leading the Human Genome Project, and watching the DNA sequence of our own species emerge over the past few years, I find its elegance and intricacy an object of wonder. Comparisons of our own genome with that of other species leave no doubt as to the conclusion of a common ancestor for all living things on this planet. But none of that explains the unique nature of humankind, especially the knowledge of right and wrong that distinguishes us from all other species, and that cannot be fully accounted for by evolution.

Here is my thesis: God, who is not limited in space or time, created the universe, and established the natural laws that govern it. Seeking to populate this otherwise sterile universe with living

creatures, God chose the elegant mechanism of evolution to create microbes, plants, and animals of all sorts. Most remarkably, God chose to utilize the same mechanism to give rise to special creatures who would have intelligence, a knowledge of right and wrong, free will, and a desire to seek fellowship with him. This perspective is compatible with everything I know as a scientist, and everything I believe as a follower of Christ.

PLENARY SESSION IV

The Great Room

Sunday, July 30, 2006 10:15 AM

A Recovery of Wisdom As Virtue for an Ethics of Genetics

Celia Deane-Drummond

Why is there so much interest in ethical issues in genetics compared with other areas of science? What form does this ethical discussion take, and what might be the contribution of theological ethics to this discussion? This lecture attempts to set out the scope of ethical discussion in genetics, and offer a commentary on its secular development in the light of the relevance of a theologically informed virtue ethics.

Genetics, especially human genetics, intuitively seems to equate with our distinctive nature as individual humans, but it also reaches out beyond this to wider social and political questions. It is therefore relevant not just for individual ethics, or ethics in a family setting through the new reproductive technologies, but also reaches out to significant issues of public and political concern.

In facing such diverse issues, the temptation for medical science is to resort to a case-by-case approach and rely simply on ethical principles such as patient

autonomy and informed choice. Yet it is clear that the practice of medicine is itself being re-shaped by the new genetic technologies, changing the ethos of medicine, with social and political repercussions far beyond the limits of medical science.

Drawing particularly on the work of the medieval theologian Thomas Aquinas, I will argue in this lecture for a recovery of prudence, or practical wisdom, alongside the other cardinal virtues of justice, fortitude, and temperance. I will also suggest that the classical understanding of these terms offer fruitful avenues

for exploration in the light of particular issues raised by contested issues in genetics individual, familial, and political contexts. While I argue that these virtues have relevance for decision-making by individuals and social and political communities, in the specific instance of the Christian community, they also need to be understood as fully integrated with the theological virtues of faith, hope, and charity. Moreover, prudence as practical wisdom is aligned with divine Wisdom, understood as integral to a Christian understanding of God as Trinity.

PLENARY SESSION V

The Great Room

Monday, July 31, 2006 8:20 AM

Religion, Science, and Politics

Vernon J Ehlers

As a child, I learned that one should never discuss religion and politics if one hopes to keep conversation civil. Add science to the mix and your discussions may become even more complex, and at times, heated. If one dares to include the environment in the discussion, the temperature may become downright uncomfortable!

This talk will discuss the interrelationship between politics, science, and religion and emphasize the need to have an integrated world view which combines all three and gives each its due.

I will explore the difficulties some scientists have reconciling religion with their science and that some Christians have reconciling science with their beliefs. I will also discuss the possibility of a peaceful equilibrium between seemingly contrasting world views.

Poster Session Abstracts

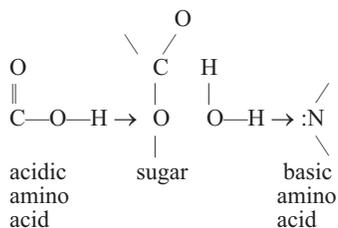
Sunday, July 30, 11:15–12:00 PM, Willow Room. Posters are on display beginning Saturday afternoon. —Stephen Matheson, coordinator

Implication for Pre-biotic Proteins from Enzyme Hydrolysis by α -amylase

Robert M Bartholow

In the last century, the understanding of hydrolytic enzymes has moved from the addition of water to a substrate to a detailed description of the micro environment at the active site. For example, an x-ray crystal of pig α -amylase has been refined to a fraction of a nanometer. Work shows how the histidine residues at sites 101, 201, and 299 form a hydrogen bond in the protein-inhibitor crystal.

Structural information from a variety of enzyme active sites is consistent with a complex geometric structure with an acidic amino acid protonating the substrate, and a basic amino acid accepting part of the product. A general sequence is:



Detailed crystalline structures of hydrolytic enzyme indicate that each enzyme includes both acidic and basic amino acid residues to hold the substrate in specific position and initiate the addition of water.

Yet, today a list of amino acids formed in bench top experiments designed to simulate early earth environments shows a limited number of amino acids. The variety of amino acids needed to control the secondary structures of enzymes and basic amino acids needed to quickly accept part of the product of hydrolysis are not present.

Analysis of amino acids from Stanley Miller's classic experiments do not show many of the amino acids that are needed to control the geometric specificity needed for effective catalytic proteins. Perhaps, more importantly, basic amino acids, such as histidine, lysine, and arginine, are not reported. Analysis of deep space clouds of primitive molecules also show no detectable amounts of over half of the amino acids, including any basic amino acids, needed for any

enzyme that would be expected in catalysis.

Regulation of cGMP-Dependent Protein Kinase (PKG) Enzymatic Activity

Jennifer L Busch, Thomas M Bridges, Sharron H Francis, and Jackie D Corbin

Physiological homeostasis relies on detection of stimuli, cell-to-cell communication, and signal transduction—the conversion of an extracellular signal (e.g., hormone or neurotransmitter) into an intracellular response. In nearly all cells, transduction relies on phosphorylation, the transfer of a phosphate molecule from ATP to another protein. Enzymes that mediate this event are known as kinases.

Cyclic GMP-dependent protein kinase I alpha (PKG-I α) is located in smooth muscle cells and neurons in specific parts of the human body and regulates numerous physiological activities including blood pressure, gastrointestinal motility, and learning and memory. Due to the physiological importance

of PKG-I α , understanding mechanisms by which its activity is regulated is crucial. Whereas it is known that PKG-I α activation occurs through cGMP-binding or autophosphorylation, many details about these processes are unknown.

According to earlier work, an amino acid (serine-64) in the regulatory domain of PKG-I α decreases cGMP-binding affinity and helps hold the enzyme in its inactivated state. Current research focuses on potentially important amino acids in the catalytic domain with which serine-64 may interact.

In this study, three amino acids in the catalytic domain—glutamine-401, histidine-404, and cysteine-518—were targeted because of their important roles in cAMP-dependent protein kinase (a close protein family member to PKG-I α). Each amino acid was mutated, sequenced, and ligated into a baculoviral-compatible vector. Co-transformation of this vector and baculoviral DNA yielded baculoviruses containing the mutant PKG-I α cDNA. Insect (Sf-9) cells were

transfected with the respective baculoviruses, and the respective proteins were expressed and harvested. Protein kinase activation studies and cGMP-binding studies were performed, and the data of mutant PKG-I α were compared with that of nonmutated (wild-type) PKG-I α .

Production of Sperm and Male Pheromone in the Giant Kelp *Macrocystis integrifolia*
Grace Cho and Raymond J Lewis

Sexual reproduction in brown algae involves the transfer of pheromones between male and female gametophytes. The female pheromone induces sperm release and attraction while the male pheromone enhances oogenesis. This experiment examined the correlation between sperm production and male pheromone production in one species of brown algae, *Macrocystis integrifolia*.

Male gametophytes were cultured at 6, 8, 10, 12, and 14 days under conditions optimal for sperm production. The seawater medium was removed and female pheromones produced by *Laminaria japonica*, a different brown algal species, were added to each of the male culture groups. The sperm that were released from the male gametophytes were preserved and counted. The male pheromone production was measured through the pheromone's effect on oogenesis. Female cultures were prepared and treated with four separate treatments of seawater medium from the male cultures and the number of eggs and fertile female gametophytes were counted.

An increase in sperm production was observed with an increase in the time the male gametophytes were kept in culture. Egg production also increased with an increased amount of time the males were in culture. These results indicate that sperm production and male pheromone production are correlated.

The Role of Noncleavable Poly(ADP-ribose) Polymerase-1 in Excitotoxicity
Karen K David

Poly(ADP-ribose) Polymerase-1 (PARP-1) is a nuclear enzyme important for cellular processes such as DNA repair, genomic stability and cell death. PARP-1 forms poly(ADP-ribose) polymers using NAD⁺ as a substrate, and overactivation of PARP-1 can lead to depletion of energy. PARP-1's cleavage by caspases during apoptosis may be needed to conserve energy for apoptosis to proceed.

To determine how PARP-1 cleavage by caspases affect PARP-1's function in neuronal cell death in experimental models of ischemia-reperfusion and glutamate toxicity, we generated a PARP-1 knock-in (PARP KI) mouse model in which the caspase cleavage site of PARP-1 was mutated. The PARP KI mice are viable and the ratios of offspring from heterozygotes matings are consistent with Mendelian inheritance.

We are currently assessing general morphology of major organs of PARP KI mice. We will then subject these mice to ischemic stroke and glutamate toxicity to obtain insights into the function of caspase cleavage of PARP-1 in neuronal excitotoxicity.

Ethical Solutions to the Multifetal Pregnancy Problem
Jonathan C Dudley

Since the Advent of *in vitro* fertilization in 1978, the number of multiple pregnancies has increased dramatically. In 2001, twins occurred with a frequency three times higher than expected to occur naturally and quadruplets and higher order pregnancies with a frequency one thousand times greater than normal. Largely responsible for this increase are the rise of fertility drug use and of *in vitro* fertilization-embryo transfer (IVF-ET), the latter

contributing to roughly 70% of multifetal pregnancy cases. Due to the low embryo implantation rate, IVF-ET specialists transfer multiple embryos in about 95% of IVF-ET cycles. As a result, high pregnancy rates can be achieved, but over half of IVF-ET-born infants come in multiples.

Multifetal pregnancies pose a serious threat to the health of the mother and to that of her fetuses. Intrauterine restrictions on fetal growth lead to premature delivery, known to cause severe birth defects, such as cerebral palsy, and death. Triplets are 20 times more likely to die during infancy and over 40% of quadruplets develop cerebral palsy. Solutions to this problem have focused primarily on preventative measures, such as transferring less embryos of higher quality to the potential mother's womb. In the process of selecting high quality embryos, however, many fertilized embryos are frozen or destroyed. Secondary solutions have been retrospective in nature, seeking to deal with the problem of a multiple pregnancy after it occurs.

The main method currently used to prevent premature birth is multifetal pregnancy reduction, in which one or more of the developing fetuses are aborted to increase the chance that the mother and remaining fetuses will survive. Needless to say, both the prospective and retrospective solutions are laden with ethical difficulties.

My research, conducted for an honors senior thesis in a course entitled "Perspectives in Medicine," seeks to investigate ethical solutions to this problem. Considering prospective solutions, I will be focusing on a method for freezing oocytes called vitrification that has only become promising within the last year. Considering retrospective solutions, I will explore from an ethical standpoint whether multifetal pregnancy reductions are ever justifiable.

Environmental Auditing in Peru: A Way to Monitor Stewardship of Nature
Oscar Gonzalez

I had the opportunity to work as a biodiversity consultant for the Office of Environmental Affairs in the Supreme Audit Institute of Peru from 2003 to 2005. This office decreed an audit to the National Institute of Natural Resources, which is the government institution that cares for nature in Peru. One of its duties is to manage State Protected Areas in a special system.

In theory, Peru has 13.74% of its territory "Legally Protected" into a system of protected areas, but it is known that most of these areas are on paper only and the environmental policy is not applied. Lack of resources limit the duties of protected areas' chiefs and the rangers cannot patrol the entire areas.

The Audit Institute selected some areas well known in Peru to audit the management of the National Institute of Natural Resources. They were the National Sanctuary of Machu Picchu, famous for its Inca citadel and a cloud forest with several endemics; Paracas National Reservation, at the time, a unique marine area protected in Peru; Huascarán National Park, a harbor for glaciers and highland ecosystems with the most extensive Polylepis forest in the country; and Bahuaja-Sonene National Park, a hotspot where the highest diversity of birds and butterflies in the world has been detected.

The auditing process consisted in analyzing the main documents that manages them, starting with the Master Plan which is the main document that manages the area. Then we carefully studied the internal reports and the programs that deal with conservation. There were also field visits to look into how the authorities were doing their job. A common failure in all these areas was the lack of a plan for monitoring and research. The ecosystem approach was not considered in some of these areas.

The auditing process has coincidences with the prophetic warnings in the Bible. The prophet came, established the general status of the people, pointed out their failures, and declared, "Amend your ways" (Jer. 7:3). Doing a good environmental audit should improve the job of the audited institution so that it can become a better steward of God's creation.

Is Atomic Force Spectroscopy and Effective Method for Determining the Binding of Drugs to DNA?

Jennifer L Headley

Many therapeutic agents used as treatment as anti-cancer drugs or antibiotics function by binding to DNA. The binding of small molecules to DNA has been studied for several decades, and two binding mechanisms (intercalation and minor groove) have been generally recognized. However, the exact mode of binding of small molecules to DNA is not well-defined. With the advent of techniques such as atomic force microscopy (AFM), there has been a renewed interest in understanding the binding of small molecules to DNA at the molecular level.

In this poster, we present how atomic force microscopy can be used as a tool to measure rupture forces between short DNA oligonucleotide duplexes. We then show how these rupture forces change upon the binding of small molecules to these duplexes either at the intercalation or minor groove position. The AFM technique involves attaching a short DNA oligonucleotide to a cantilever and briefly bringing it into contact with the complementary DNA strand tethered to a surface and pulling the two strands apart. The resulting force curve provides a quantitative measure of the rupture force. However, we have determined that the initial contact force between the DNA functionalized probe and surface

has a significant outcome on the rupture forces.

In our poster, we will demonstrate for single molecule studies, contact forces less than 150 pN's are required to reliably predict rupture forces arising from single molecule unbinding events. By using this very low contact force and specifically targeting the minor groove and intercalating positions of a specific DNA sequence, we demonstrate that small molecule binding to the intercalation position has a significant effect on the DNA rupture forces, while molecules binding at the minor groove position show little effect on the DNA rupture forces at the single molecule level. The poster will present possible reasons for the changes or lack of changes in the rupture forces in the single molecule study.

Localizing mDia1 and mDia2 in Rat Primary Neuronal Cultures

Sarah Hofman and Stephen Matheson

The regulation of the cytoskeleton in neuronal cells is essential in cell differentiation in the developing brain. The Rho small GTPases help in the stabilization of the cytoskeleton while a group of proteins called Diaphanous related formins, which include the mDia proteins, are down stream effectors of the Rho GTPases. In order to determine a clearer role for these mDia proteins in neuronal development, our experiments sought to localize both mDia1 and mDia2 in the rat cortical neurons from the 18th day of gestation and examine their effect on neurite outgrowth.

Through the use of immunofluorescence, our experiments localized both mDia1 and mDia2 in neurons fixed after varying periods of cell culture growth, from a period of 24 hours up to 11 days. Staining was performed using rabbit antibodies raised against mouse mDia1 and mDia2 and a Cy2 secondary antibody along with rhodamine

phalloidin; in addition, double labeling was performed with antibodies to other proteins of interest.

Throughout growth, the presence of mDia1 was not only evident in the cell body but was found throughout both the axons and dendrites of cells fixed at various time points. Similarly, mDia2 staining was apparent in both processes, indicating that mDia1 and mDia2 have largely overlapping domains. Furthermore, both proteins were observed in the growing tips of the neurons at each time point. The presence of mDia1 in primary neurons was further confirmed by the presence of clear bands on a western blot, although similar probing for mDia2 presented unclear results.

The presence of these two mDia proteins throughout the growing tips as well as the shaft of developing neuronal processes suggests their involvement in not only stabilization of the cytoskeleton but also in promoting neurite outgrowth. These findings hint at the essential role of the mDia proteins in various stages of development and neuronal differentiation.

JAR1, a Dominant Gene Conferring Resistance to Amphotericin B in *Saccharomyces cerevisiae*

Joyce R Iwema

Infectious diseases are the cause of death for over one million people a year in the US alone. Drug resistance in infectious microbes is an increasing problem. This study focuses on antibiotic resistance in fungal infections, using *Saccharomyces cerevisiae* as the model of study.

Spontaneous mutations in this yeast resulted in a yeast strain with the ability to grow in the presence of the antifungal drug amphotericin B. This yeast isolate, named JAR1, was genetically analyzed to determine how many mutated genes were responsible for the resistant

phenotype, and whether the allele was dominant or recessive. The results indicate that the ability of JAR1 to grow in the presence of amphotericin B is due to a single dominant mutation.

Enhancement of Plant Biodiversity during the Early Stages of a Prairie Restoration Effort

Amanda A Joswig, Lacy L Sposato, Jason C Stephens, Mallory A Waters, and John E Silvius

The approximate locations and extent of pre-settlement Ohio forest and prairie communities have been documented from 18th-century land survey records and the journals of explorers. Today, only a few surviving prairie remnants remain in western Ohio. Therefore, prairie restoration efforts in western Ohio contribute ecological, historical, educational, and land stewardship value.

In 1999, we began an effort to restore a prairie community in a 14-hectare abandoned agricultural field in an early stage of old field succession using a combination of no-till seeding, transplanting of species from nearby prairie remnants, and fire to establish prairie plant and wildlife populations.

Controlled burns in the Spring of 2001, 2003, and 2005 were utilized to enhance prairie-related plant species and suppress agricultural weeds. However, the result was that fire favored Indian grass (*Sorghastrum nutans*) and enhanced the residual population of tall goldenrod (*Solidago altissima*) which combined to suppress establishment of prairie plant species. We hypothesized that moderate soil disturbance such as chisel-plowing will reduce the area covered by the two dominant plant species and allow space for new species to be established.

Following the Spring 2005 prairie burn, we established six adjacent 0.40-ha plots. Three plots were chisel-plowed, disked, and seeded

with a prairie seed mix (i.e., “disturbed plots”); and, three alternating adjacent plots were “undisturbed” controls. A late-summer, plant species survey involving 123 randomly placed 0.25-m² quadrat samples estimated that percent cover of *S. nutans* decreased from 20% in “control” plots to 5% in “disturbed”; and *S. altissima* cover decreased from 28% to 16%, respectively. Meanwhile, disturbance increased percent cover of the annual species, *Ambrosia artemisifolia* from 6% to 18%, and *Setaria faberii*, from 0.5% to 33%.

It is expected that space and resources commanded by these early succession annuals will become available to prairie-related perennial species in subsequent years. Disturbance increased mean per-quadrat species richness from 9.9 to 11.7, and did not diminish the total number of “conservative” plant species (13) commonly identified with prairie communities.

Migration of Mesenchymal Stem Cells (MSC) under the Influence of SDF-1 α and MIP-1 α

Jacquelyn N Kamp

Previous studies in our lab have shown that murine MSC from the bone marrow significantly improve cardiac function when intravenously injected in mice one hour after coronary artery occlusion. This recovery occurred without a change in the nature of the infarction or transdifferentiation of the stem cells into cardiomyocytes. Questions remain regarding the signals that cause homing of the MSC to the heart following injection.

Other investigators have shown that stromal-cell derived factor-1 α (SDF-1 α) is present in the heart at elevated levels after myocardial injury, and this is believed to have a chemoattractant effect on bone marrow stem cells due to its interaction with the CXCR4

(CD184) receptor. In addition, we have observed that the cytokine macrophage inflammatory protein-1 α (MIP-1 α) is elevated in neonatal myocyte culture.

The purpose of this laboratory study was to determine if the factors SDF-1 α and MIP-1 α play a role in the homing of the stem cells to the heart. To accomplish this we used an *in-vitro* migration assay in which we seeded 600,000 murine MSC in Mesencult media into 10mm diameter Nunc tissue culture inserts with a 3mm pore polycarbonate membrane. The inserts were placed in 24-well dishes containing Mesencult or media plus either 250ng/ml SDF-1 α or 100pg/ml MIP-1 α . After six hours of incubation, the cells were stained with 30mM acridine orange. The inserts were removed and the average number of cell nuclei on the underside of the membrane in 10 visual fields (20 x objective) was determined using fluorescent microscopy (n=5).

This data showed significant (p<0.05) difference in the migration of MSC in the presence of cytokines when compared to the control group. MSC migration in the controls was 10.6 \pm 1.1 (mean \pm SE) whereas migration under the influence of SDF-1 α and MIP-1 α was 32.6 \pm 9.3 and 16.6 \pm 2.2, respectively.

In addition, SDF-1 α mRNA was detected using RT-PCR analysis of RNA from mouse hearts one and three hours after coronary artery occlusion. These data suggest that SDF-1 α may be involved in the homing of MSC to the heart after coronary artery occlusion.

Polysialylated-Neural Cell Adhesion Molecule in the Hippocampus

Heather J Kooiman

Polysialylated-Neural Cell Adhesion Molecule (PSA-NCAM) appears to play roles in synaptic contacts on postsynaptic dendrites and regulation of the activity of

neurotransmitter receptors (Dityatev, 2004; Kleene, 2004). PSA-NCAM is required for neurite growth and synaptic activity and may play a critical role in a number of neurological and psychiatric disorders.

In schizophrenia, the number of neurons immunoreactive for PSA-NCAM are decreased in the hippocampus (Barbeau, et al., 1995). In light of structural changes in the brain in depression and alcoholism, we hypothesize that there will be a decrease in PSA-NCAM in the hippocampus in Major Depressive Disorder (MDD) and alcoholism.

The hippocampal formation was removed at autopsy from ten subjects each with MDD or alcoholism, and psychiatrically normal control subjects. Cohorts of subjects were matched for age, gender, postmortem interval, and tissue pH. Informed consent was obtained from the legal next-of-kin with a protocol approved by the Institutional Review Board. Psychiatric diagnoses were determined based on interviews of informants using the Structured Clinical Interview for DSM-IV Disorders. The left hippocampus was fixed in formalin, embedded in celloidin, and sectioned (40 μ m). Triplicate sections 400 μ m apart were selected in the body of the left hippocampus for immunohistochemistry. Celloidin was dissolved from the sections and they were incubated with an antibody to PSA-NCAM (5A5 mouse monoclonal IgM antibody) as described (Barbeau et al., 1995). Labeled sections were mounted on slides and images were captured within the hippocampal hilus using Stereo Investigator software. The images were analyzed with Image J software from NIH. The immunoreactive area within the hilus, greater than nonspecific background (areal fraction), was assessed. Areal fraction was compared across the cohorts, controlling statistically for age, postmortem interval and tissue

pH. (This research was supported by PHS grant MH67996.)

Land Use Management and Stewardship on North American Christian Campuses

Themis-Marie Laffitte,
Ben Peterson, Jonathan Bakker,
Ike Asagwara, and John R Wood

When we enroll in a university or college, we expect the teaching to take place within its dry walled classrooms. However, there is behind the scenes a form of education that is not part of the standard curriculum. The landscapes surrounding our universities teach us about our connection with the environment. This passive learning is a vital part of an educational experience and is an integral step towards becoming well-rounded, environmentally aware individuals.

Christian universities have substantial holdings of both developed and undeveloped land. We surveyed sixty-seven North American Christian universities and colleges on their land use and management practices. We quantified the amount of land at each institution, and looked at the land stewardship, campus design.

The 23 reporting schools had a total of 9,469 acres of land, 61% or 5,764 acres is “developed” (with built-structures). The remaining 3,705 acres was classed as “undeveloped.” The primary purposes for this undeveloped land were “future development,” “natural area,” or “outdoor classroom.” The typical school is located in a suburban setting. On average, a college owns 0.22 acres per student for a density of about 17 students per acre.

All institutions have master plans for the buildings and expansion. We found no institution with a policy describing how land can be used as part of the curriculum.

Specificity of Male Brown Algal Pheromones

*Sun-Yong Lee and
Raymond J Lewis*

Reproduction in the large marine brown algae known as kelps includes a microscopic gametophyte stage. Female gametophytes of these algae produce a pheromone, lamoxirene, that activates sperm release and chemotaxis of sperms toward eggs that emit this pheromone. This same pheromone is produced by species amongst four families: Alariaceae, Costariaceae, Laminariaceae, and Lessoniaceae. Male gametophytes apparently produce a pheromone that increases oogenesis.

In this research, specificity of pheromones produced by male brown algal species was tested. Individual male and female gametophytes from 14 species within each of these families were cultured together in paired combinations to determine the effectiveness of the male pheromone. This effect was quantified by comparing the amount of oogenesis produced by cross cultures to those that did not include males within cultures.

The presence of males increased oogenesis in some cases within the same species, in different species in the same genus, in different genera of the same family, and in different families. The male pheromone activity appears to be non-specific across the four families of brown algae.

Residues Affecting Nuclear Import of Galectin-3

Andrew G Lohse

Galectin-3 (Gal3), a carbohydrate-binding protein consisting of two distinct domains, shuttles between the nucleus and cytoplasm of many cells types. In cultured mouse 3T3 fibroblasts, the endogenous protein is found predominantly in the nucleus. The DNA for Gal3 was engineered into a construct that expresses a fusion product with Green Fluorescent Protein. Previous studies using this

reporter system showed a cytoplasmic shift in localization when deletions were made on either the N- or the C-terminal portion of the Gal3 polypeptide.

Using site-directed mutagenesis, we have now identified a nuclear localization sequence (ITLT) in residues 253–256 responsible for the import of Gal3 into the nucleus. This corresponded to a similar sequence, IXLT, previously reported to be required for the nuclear import of the *Drosophila* protein Dsh (disheveled).

Further study also found two other residues (R242 and D252) likely connected with the nuclear import of Gal3. The nuclear localization of Gal3 appears to be regulated by these amino acid residues, as well as by a nuclear export signal located in a nearby region of the amino acid sequence.

GTPase Defect Associated with McCune-Albright Syndrome

Laura S Ooms

McCune-Albright Syndrome (MAS) causes a variety of bone and endocrine abnormalities including café-au-lait skin pigmentation, precocious puberty, and/or polyostotic fibrous dysplasia of bone. These symptoms are due to the post-zygotic mutation of the alpha subunit of the stimulatory G-protein Gs α . This mutation causes signal-independent activity of the G-protein in the affected cells.

The mutation most commonly found in MAS patients substitutes a conserved arginine residue at position 201 with histidine or cysteine. This residue is involved GTP hydrolysis and therefore, the mutation of this residue blocks GTPase activity of the protein and leads to constitutive activation of adenylyl cyclase.

We report the development of a system to study the effects of MAS mutations using *Saccharomyces cerevisiae*. Haploid yeast respond to mating pheromones via G-protein

coupled receptors, which inhibits cell division. Thus, an active G-protein prevents colony formation. We introduced the MAS mutation into the analogous site in the yeast G α gene, GPA1, and identified active and inactive mutants in the G-protein based on the ability of the yeast to form colonies. Random mutagenesis identified a mutation of R297H, L318P/D319V in GPA1 that acts as an intragenic suppressor of the MAS defect.

Further biochemical analysis will be needed to determine how the suppressor mutations prevent the constitutive activity of the initial MAS mutation. Current therapies for MAS patients are not very effective and have significant side effects. Further exploration of the molecular defect in MAS may provide data in the rational design of new drugs to treat the source of the biochemical problem by blocking signaling through activated G-proteins.

The Activation of Glucose Transport is Reduced by the Removal of Membrane Cholesterol

Janelle Rekman, Nathan Stehouwer, Andrew Tidball, and Larry Louters

Glucose deprivation and other metabolic stresses activate glucose uptake in L929 cells within minutes, although the mechanisms to account for these rapid activations are not known. One possibility is that the activity of the transporter is affected by its location in the plasma membrane or its lipid environment. Mammalian membranes are composed of different microdomains. One of these microdomains, the lipid raft, is enriched in cholesterol and sphingolipids and has been associated with cell signaling and cell transport proteins. The specific purpose of this study was to disrupt these lipid rafts using the chemical methyl- β -cyclodextrin, which absorbs cholesterol from the membrane, and determine if this disruption affects glucose

uptake either under normal or glucose deprived conditions.

Glucose uptake was measured in L929 fibroblast cells by using a radiolabeled glucose analog, ^3H -2-deoxyglucose, which can be transported and phosphorylated which traps the radiolabel in the cell. The cells were then digested and the amount of radioactivity taken up by the cell was measured by scintillation spectroscopy.

Results reveal that glucose deprivation dramatically activates glucose uptake (6.9X) and that removal of cholesterol significantly reduced this activation (3.9x). This suggests that full activation of glucose transport requires intact lipid rafts. We were unable to detect a difference in either the amount or location of GluT-1 (the only glucose transporter in L929 cells) by immunomicroscopy. However, we did detect an increase in ^3H -cytochlasin-B binding caused by glucose deprivation (cytochlasin-B specifically binds to glucose transporters).

Methyl- β -cyclodextrin treatment reduced the ^3H -cytochlasin-B suggesting that the removal of cholesterol reduces the number of GluT-1 proteins capable of binding cytochlasin-B. These data provide evidence that the activation of glucose transport by glucose deprivation is dependent on membrane cholesterol content.

High Throughput Measurements of Cardiac Cell Graft Size

Thomas E Robey

Each year in the US, one million people suffer from a heart attack. Cellular grafting, including cells derived from embryonic stem cells, may restore cardiac function in the infarcted heart, but it is technically difficult to produce sufficiently large grafts. Many cells are lost immediately after delivery, and most of those that remain die in the days following engraftment.

We designed two high-throughput *in vivo* assays enabling rapid

testing of cell survival and delivery strategies. Several pro-survival interventions were tested including heat shock and erythropoietin (EPO) treatment. Heat shock has been shown by histology to increase graft size, and EPO limits myocardial ischemia-reperfusion injury.

In the first assay, mouse skeletal myoblasts stably expressing β -galactosidase (β -gal) were injected into mouse hearts infarcted by coronary ligation. Three days later, hearts were extracted and homogenized. The resulting whole heart extract was evaluated for β -gal content by a luminometric assay.

The second assay employed quantitative PCR to measure the number of human embryonic stem cell derived cardiomyocytes injected into the mouse heart. In place of β -gal measurement, specific human Alu sequences were quantified. Two-tailed paired t-tests with unequal variance were performed to assess statistical significance.

Muscle cells treated with heat shock generated graft sizes 3.7-fold greater than control treated cells ($p=0.01$) using the β -gal assay. Stem cells measured by the Alu technique indicated a 2.8 fold increase in graft size ($p=0.04$). These are comparable to the 3-fold increase determined by histology of grafted cells at four weeks. By the β -gal method, EPO also increased graft size by a factor of 2 ($p=0.03$). Furthermore, heat shock and EPO treatment together was additive for both skeletal muscle cells and the human ES cells ($p<0.01$). RT-PCR showed that C2C12 cells expressed the receptors associated with EPO-induced cytoprotection. The elapsed time from cell treatment to completion of data analysis for each of these studies was six consecutive days. This screen will permit rapid identification of promising graft improvement interventions to be tested for physiological benefit in more complex models.

A Novel Pathway for Inducing Latent Virus from Resting CD4+ T Cells in the SIV Model of HIV Latency

Anding Shen

Although highly active anti-retroviral therapy (HAART) allows suppression of HIV-1 viremia to below the limit of detection of current assays, eradication of the infection has not been achieved because the virus persists in cellular reservoirs, particularly the latent reservoir in resting CD4+ T lymphocytes. Therefore, we previously established an SIV/Macaque model to study viral latency under suppressive antiretroviral therapy.

We describe here a novel mechanism for the reactivation of SIV from latently infected resting CD4+ T cells. Several cell lines were determined to be able to activate resting cells and re-activate the latent virus, including CEMx174 and EBV-transformed human B-lymphoblastoid cell lines (LCL). Cellular factors and TCR MHC class II interaction do not seem to be involved. Antibody blocking assays show that co-stimulatory molecule CD2-CD58 interaction is involved in the process.

Combination of specific CD2 antibodies also induced T cell activation and virus re-activation in human resting CD4+ T cells with latent HIV virus. This is the first time co-stimulatory molecules are implicated in the process of latent virus re-activation without co-engagement of the TCR, and this study might provide insights into potential target pathways to eliminate the latent virus.

Understanding the Roles of Nonduplex Regions in RNA Folds

Alyssa L. Smith and Dorothy Caplow

Ribonucleic acid (RNA) can form many complex structures, which function in messaging, transport, and protein synthesis.

The discovery of the Tetrahymena thermophila ribozyme in 1982 proved that RNA can also function in catalysis, which offered support to the theory of the primordial "RNA World." Ribozymes seemed to provide the link between inorganic material and the beginnings of life on Earth. The Tetrahymena ribozyme is self-splicing and self-folding, involving cooperative interactions between its helices to form detailed structural arrangements.

This complex process of an autocatalyzing RNA offers provides evidence to an evolutionist of the innate ability of RNA to be the original bearer of the genetic code, being self-sufficient without involvement of DNA or proteins. Yet, is self-catalysis and folding merely a result of the sum nucleotide sequence and energetics in this ribozyme? Is there evidence of design or any intelligence in RNA folding?

The experimental work presented here examines the junctional, non-duplex segments of the Tetrahymena ribozyme. The motivation of this study is to explain the folding of RNA molecules by measuring the nucleotide-specific dynamics at single-stranded, mismatched, or bulged sites. Using site-directed spin labeling (SDSL) and electron paramagnetic resonance (EPR), we can sample the motion of RNA or DNA across an extraordinarily large timescale—nanosecond to microsecond. EPR is a powerful technique for analyzing complex anisotropic motions in spin-labeled biomolecules; however, to date, there is no comprehensive method for obtaining motional parameters of nucleic acids from EPR spectra. Moreover, there has been no study of the relationship between spin-lattice relaxation rate (R_{1e}) and nucleic acid dynamics. Unifying magnetic resonance theory and practice is necessary to improve techniques for measuring RNA folding.

We present preliminary experimental EPR data from two

different types of experiments, and show how it can be combined with existing theory to create a more complete picture of dynamics than has been achieved previously.

Verapamil Inhibits Glucose Uptake in Mouse Muscle Tissue and L929 Fibroblasts

Nathan Stehouwer, Andrew Tidball, Janelle Rekman, and Larry Louters

Verapamil is a calcium channel blocker commonly used to treat hypertension, angina pectoris, and some types of arrhythmia. Patients who overdose on Verapamil experienced hypoinsulemia (low insulin) and hyperglycemia (high blood glucose.) These patients often require abnormally high amounts of insulin (6–12 times the amount required to treat diabetics) to bring blood glucose levels back to normal. Thus it appears that Verapamil's toxic effects compromise peripheral glucose uptake.

We investigated this possibility by measuring the effects of Verapamil on glucose uptake in striated muscle—both in slow twitch (soleus) and fast twitch (epitrochlearis) muscles. Verapamil (150mM) inhibited uptake by 34% in the soleus and by 51% in the epitrochlearis.

The major glucose transporter in muscle tissue is GluT-4 (Glucose Transporter 4) which is sensitive to insulin. We were interested to determine if Verapamil would also inhibit glucose uptake in cells not sensitive to insulin. Therefore, we measured the effects of Verapamil on glucose uptake in L929 fibroblast cells which have only a single type of glucose transporter (GluT-1)

GluT-1 is significant because it is nearly ubiquitously expressed in mammalian cells. GluT-1 is also known to be activated by glucose deprivation, and thus under conditions of hypoinsulemia/hyperglycemia, cell starvation would lead to activation of GluT-1. Thus we tested

Verapamil's effect on GluT-1 in both a normal and activated state.

Results show that Verapamil inhibits glucose uptake in a dose dependent fashion both in cells under normal conditions and cells under starved conditions, although this effect was much more evident when the cells had been activated by glucose deprivation. This inhibition by Verapamil appears to be independent of Verapamil's calcium channel blocking activity since both with and without added Ca^{2+} (5mM) Verapamil inhibited GluT-1 in a similar dose-dependent manner.

The results of this study suggest that Verapamil has a direct effect on glucose transport activity of GluTs, which offers a partial explanation for the hyperglycemia observed in patients with a Verapamil overdose.

Cinnamon Extract Inhibits Glucose Uptake

Andrew Tidball, Janelle Rekman, Nathan Stehouwer, and Larry L Louters

With the ever increasing threat of type 2 diabetes, many researchers have begun analyzing the validity of using plant-derived, diabetic supplements as treatment aids. Cinnamon is one of the products receiving a great deal of attention in the literature. In clinical studies, a diet containing cinnamon has been found to reduce serum glucose levels, and in cell cultures, a cinnamon extract has been found to have insulin-like effects.

We were interested in determining whether a cinnamon extract would activate the glucose transport process itself. Our experimentation focused on the effects of cinnamon on L929 fibroblasts, a non-insulin sensitive cell line. Cinnamon was extracted with 70% ethanol, and L929 cells were incubated with increasing amounts of the extract for 30 minutes. Glucose transport activity was then measured as the incorporation of ^3H -2-deoxyglucose, into L929 cells over 10 minutes.

Surprisingly, results demonstrate a dose-dependent inhibition, not activation, of glucose uptake rates in the presence of cinnamon extract. Parallel experiments on the flavonoid, quercetin, have revealed a similar dose-dependent inhibition. Quercetin and other flavonoids are thought to bind directly to the glucose transport protein (GluT), therefore, competitively inhibiting the uptake of glucose. Correlatively, cinnamon contains flavonoids similar to quercetin called catechin and epicatechin. These compounds may also bind to GluT decreasing the transporters rate of uptake. Interestingly, the insulin-like effects of cinnamon have also been narrowed down to a polymer of these same compounds. Therefore, it appears that cinnamon contains compounds that inhibit glucose transport and other compounds that activate an insulin response.

Expression Patterns of mDia1 and mDia2 in Developing Mouse Brains

John D VanderHeide

The mDia proteins are members of a group of proteins called Diaphanous related formins. This family of proteins are downstream effectors of the Rho small GTPases that aid in regulating and stabilizing the cytoskeleton. Our lab focused on their role in the regulation of the cytoskeleton of neurons as they differentiate in the developing mouse brain. We used immunofluorescence to locate where in the brain mDia1 and mDia2 were localized most significantly. We found mDia1 to have a large area of expression, most notably in the undifferentiated and newly differentiated portions of the brain, as well as in the growing axon tracts such as the corpus collosum. It was also noted that in the adult brain the corpus collosum was notably void of mDia1.

The staining patterns associated with mDia2 proved to be very difficult to elucidate from background staining and therefore

mDia2 appears to be present only in very small quantities in the developing brain. These experiments were conducted on the brains of mice varying from the 14th day to the 18th day of gestation, and on the brains of adult mice over three months.

We also used western blot analysis of the protein content of brain homogenates to observe changes in the expression of these proteins. The brains were homogenized and fractionated into soluble and insoluble fractions.

We found that mDia1 would show up in both the soluble and insoluble fractions, while mDia2 would barely show up in the soluble fraction and not at all in the insoluble fraction. This indicates that both are found in the cytosol and that mDia1 is also associated with either the plasma membrane or the cytoskeleton.

Our conclusions are that mDia1 plays a developmental role in the formation of axon tracts in the mouse brain and that it also is involved with very early differentiation. In the future, we hope to continue to explore these expression patterns and to study the patterns of other proteins, such as the Rho GTPases, that interact with the mDias.

An Ecological Study and Mitigation of a Woodlot: Stewardship in Action

Rachel L Vannette

In this study, we describe the ecological parameters and composition of an old wooded site on the Calvin College campus, slated to be cut down for the college's new health and wellness center. We found that this nearly 200 year-old oak-hickory forest has remained surprisingly ecologically intact despite many encroachments upon it.

Through this study of the ecology and composition of the forest and through the description of various soil and light parameters, our main goal is the development of a mitigation plan for this woodland

and adjacent lawn area. We also focused on native shrub propagation, mainly cuttings, to generate identical material to wood lot flora for this mitigation project.

We found hormone levels needed to stimulate rooting for six shrub species important to this habitat type, and focused especially on the propagation and ecology of *Staphylea trifolia*, one of the more significant shrubs growing in the woodlot. Using environmental parameters from this wooded area, we have developed specific goals for the mitigation plan.

Following hydrological modification of new sites and removal of invasive species, we will transplant propagated plants and forest soils containing flora to mitigation areas. This project illustrates the necessity of ecological evaluation prior to construction to allow for stewardship of natural areas.

Histological Analysis of Cux-1 Expression during the Development of Postnatal Mouse Testes

Engela S Viss

The homeobox protein Cux-1 has been shown to play an important role in kidney development and disease. Cux-1 functions as a transcriptional repressor, inhibiting the expression of the cell cycle proteins p27 and p21, and thus stimulating cell proliferation in the kidney. Cux-1 is also expressed in the testes, but there an alternatively spliced mRNA produces a protein that lacks the N-terminal half of the protein, including the first two Cut repeat sequences.

This study examined Cux-1 expression in neonatal mice during testis development. Germ cells were first seen in the seminiferous tubules at postnatal day 14 but did not express Cux-1 until day 21, when round spermatids first formed. Expression in spermatids was cyclic, appearing to correlate with a specific stage in spermatid

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development. Periodic acid-Schiff (PAS) staining for acrosomes first appeared at day 28, indicating that Cux-1 expression in spermatids precedes acrosome formation. Sertoli cells expressed Cux-1 at all ages examined. However, with the appearance of round spermatids at day 21, Cux-1 expression in Sertoli cells switched from

continuous to a cyclic expression, suggesting that Sertoli cell gene expression also changes during sperm development.

By contrast, expression of the Wilm's tumor antigen (WT1) in Sertoli cells was continuous at all ages examined. Spermatogenesis is known to occur in waves along the seminiferous tubules, and

fluctuations in Cux-1 expression in the Sertoli cells and round spermatids may correspond to different stages of spermatogenesis.

Proliferating cell nuclear antigen (PCNA) was widely expressed at early stages but was confined to spermatogonia and spermatocytes in later stages. This lack of

correlation between Cux-1 and cell proliferation contrasts with the kidney and suggests that the testis-specific form of Cux-1 functions in roles other than cell proliferation. Thus, Cux-1 may be involved in the regulation of spermatogenesis, specifically in the appearance and subsequent maturation of round spermatids.

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ASA Business Meeting Agenda

Saturday, July 29, 2006, 7:00–8:00 PM in the Great Room, Prince Conference Center

1. Call to order and opening prayer –Hessel Bouma III
2. Recognition of ASA staff and meeting chairs –Randy Isaac
 - A. Staff: Carol Aiken, Lyn Berg, Marta Isaac and Jim Hill
 - B. Newsletter Editors: David Fisher and Margaret Towne
 - C. PSCF/Book Review editors: Roman Miller and Richard Ruble
 - D. Web Master/Editors: Terry Gray and Jack Haas
 - E. Program Chair: Hessel Bouma III
 - F. Local Arrangements Chair: Larry Molnar
3. Future meetings –Walter Bradley
 - A. **2007, August 2–5:** Joint ASA/CiS Meeting at the University of Edinburgh, Edinburgh, Scotland
Ruth Bancewicz
 - B. **2008, August 1–4:** George Fox University, Newberg, OR
4. Nominees for 2006 Council vacancy –Ruth Douglas Miller
5. Secretary/Treasurer Report –Walter Bradley
6. Introduction of Newly Elected Fellows –Randy Isaac
7. Recognition of Fifty Years of ASA Membership –Randy Isaac
8. Remembrances –Randy Isaac
9. State of the ASA –Randy Isaac
10. Offering for the ASA
11. President’s comments –Hessel Bouma III
12. Closing Prayer –Hessel Bouma III