

# Alternate Energy Resources, Conservation and the Environment

60th Annual Meeting of the American Scientific Affiliation  
Messiah College, Grantham, Pennsylvania  
August 5–8, 2005

*featuring a special symposium:*

## Models of Creation: Intelligent Design and Evolution

Plenary Speakers:

**DR. BERNARD AMADEI**

Founder and Director of Engineers Without Borders  
Professor of Civil, Environmental, and Architectural Engineering  
University of Colorado  
Boulder, CO

**DR. STANLEY R. BULL**

Associate Director for Science and Technology  
National Renewable Energy Laboratory  
Golden, CO

**DR. EGBERT SCHUURMAN**

Member of the Senate of the Dutch Parliament  
Professor of Christian Philosophy at the  
Technological Universities of Delft and Eindhoven  
and the Agricultural University of Wageningen  
The Netherlands

**DR. GEORGE M. SVERDRUP**

Technology Manager of Hydrogen, Fuel Cells, and Infrastructure Technologies  
National Renewable Energy Laboratory  
Golden, CO

**DR. ROBERT WAUZZINSKI**

Ordained Pastor in the Presbyterian Church  
Assistant Professor of Religious Studies  
Ball State University  
Muncie, IN

But *God* made the earth

by his *power*;

he founded the world

by his *wisdom*,

and stretched out the heavens

by his *understanding*.

—Jeremiah 10:1, NIV

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

# General Information

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## Bookstore

The Hearts & Minds Bookstore from Dallastown, PA, will set up in Boyer Hall, Room 130. It will feature books of interest to our attendees. Bookstore hours are:

Saturday: 10:00 AM –10:00 PM  
Sunday: 11:00 AM – 9:00 PM  
Monday: 10:00 AM – 2:00 PM

## Emergency Phone Number

Guest Relations Desk: (717) 796-1800 x7065, 7:30 AM–11:00 PM  
Campus security: (717) 691-6005

## Plenary Sessions

Friday 8:00 PM: "Renewable Energy and Energy Efficiency in the 21st Century" –**Stanley Bull**  
Saturday 9:00 AM: "Struggle in the Ethics of Technology" –**Egbert Schuurman**  
Saturday 8:15 PM: "Achieving a Sustainable Hydrogen Economy" –**George Sverdrup**  
Sunday 10:10 AM: "Engineering for the Developing World: Challenges and Opportunities" –**Bernard Amadei**  
Monday 8:15 AM: "Resources in Philosophy and Religion for the Evaluation of the Social Impact of Technology" –**Robert Wauzzinski**

## Special Meetings

Friday 7:30 PM: "Vision for the ASA" –**Randy Isaac**, Executive Director –Hostetter Chapel  
9:00 PM: Fellowship Mixer –Annex, Hostetter Chapel

Saturday 7:30 AM: Publications Breakfast –Eisenhower Student Center, Private Dining Room  
12:30 PM: Women in ASA Luncheon –Eisenhower Student Center, Private Dining Room  
6:30 PM: Banquet: Amish Talk –**Donald B Kraybill** –Eisenhower Student Center, Lottie Nelson dining area  
9:15 PM: Affiliation Meetings  
10:00 PM: Student and Early Career Scientists Ice Cream Social –Larsen Student Union

Sunday 12:15 PM: Fellows Luncheon –Eisenhower Student Center, Private Dining Room  
12:15 PM: Student and Early Career Scientists Luncheon –Eisenhower Student Center, reserved tables  
6:15 PM: Local Areas Fellowship Luncheon –Eisenhower Student Center, Lottie Nelson dining area  
7:30 PM: ASA Business Meeting –Eisenhower Student Center, Lottie Nelson dining area  
ASA Presidential Address –**Marilyne Flora**  
State of the ASA –**Randy Isaac**  
"Getting Acquainted with Randy" Question and Answer Session  
9:15 PM: Commission Meetings

## Many thanks to ...

Program chair **Ken Touryan** with assistance from **Jack Swearingen**, **John Bloom**, and **Walter Bradley** and local arrangements co-chairs **Ted Davis** and **Jerry Hess** for the countless hours they have devoted to developing this program.

We are especially pleased and thankful that the **John Templeton Foundation** has helped to fund the Student and Early Career Scientists' scholarships, the plenary lecturers, and the symposium.

We also thank the **Master's Degree Program in Science and Religion** at Biola University ([www.biola.edu/scienceandreligion](http://www.biola.edu/scienceandreligion)) for co-sponsoring the Models of Creation symposium.

## What would Jesus do?

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.

# 2005 ASA Annual Meeting Schedule

Friday, August 5, 2005			
7:00 AM–8:00 AM	Breakfast –Eisenhower Student Center, Lottie Nelson dining area		
8:00 AM	ACG Field Trip: Geology with <b>Ken Van Dellen</b> . Meet at the Eisenhower Circle.		
9:00 AM	ACB Field Trip: Biology Happening with <b>Jerry Hess</b> . Meet at Kline/Jordan Center.		
9:00 AM	Field Trip to Gettysburg Battlefield. Meet at the Eisenhower Circle.		
12:00 PM–1:00 PM	Lunch –Eisenhower Student Center, Lottie Nelson		
5:30 PM–6:30 PM	Dinner –Eisenhower Student Center, Lottie Nelson		
7:00 PM–7:30 PM	Welcome and Announcements –Hostetter Chapel Introduction: <b>Ted Davis</b> , Local Arrangements Co-chair ♦ Messiah College Provost: <b>Randall Basinger</b>		
7:30 PM–8:00 PM	Welcome: <b>Ken Touryan</b> , Program Chair ♦ "Vision for the ASA" – <b>Randy Isaac</b> , Executive Director		
8:00 PM–9:00 PM	<b>Plenary Session</b> –Hostetter Chapel		
Plenary Session I	Introduction: <b>Ken Touryan</b> ♦ Plenary Address: "Renewable Energy and Energy Efficiency in the 21st Century" – <b>Stanley Bull</b>		
Please note: 9:00 PM	<i>Student and Early Career Scientists will meet in the chapel briefly with <b>Johnny Lin</b> before mixer.</i> <b>Fellowship Mixer</b> –Annex, Hostetter Chapel		
Please note: <i>All meal-time meetings begin at the start of the meal time. Please go through the line promptly and then take your meal with you to the meeting area. Most are held in the Private Dining Room (PDR).</i>			
Saturday, August 6, 2005			
7:30 AM–8:30 AM	Breakfast –Eisenhower Student Center, Lottie Nelson	Publications Breakfast: <b>Roman Miller</b> , presiding –PDR	
8:30 AM–9:00 AM	<b>Morning Devotions</b> –Hostetter Chapel Music Leader: <b>Joseph Lechner</b> Devotions: <b>Jim Ball</b> Announcements: <b>Ted Davis</b> and <b>Ken Touryan</b>		
9:00 AM–10:00 AM	<b>Plenary Session</b> –Hostetter Chapel		
Plenary Session II	Introduction: <b>Jack Swearingen</b> ♦ Plenary Address: "Struggle in the Ethics of Technology" – <b>Egbert Schuurman</b>		
9:30 AM	Spouses meet at the Eisenhower Circle for field trip.		
10:00 AM–10:30 AM	Refreshment Break –Hostetter Chapel		
10:00 AM–10:00 PM	Hearts & Minds Bookstore open –Boyer Hall, Room 130		
10:30 AM–12:30 PM	<b>I-A. Sustainable Energy Options</b> –Hostetter Chapel Session Chair: <b>John Turner</b>	<b>I-B. Technology as a Gift of God</b> –Boyer Hall, Rm 137 Session Chair: <b>Bill Yoder</b>	<b>I-C. Appropriate Technology</b> –Boyer Hall, Rm 131 Session Chair: <b>Walter Bradley</b>
10:30 AM–11:00 AM	The Energy Crisis That Technology, Economics, and Reserved Growth Won't Fix – <b>Glenn Morton</b>	Piezoelectricity: An Enabling Technology for Health and Welfare – <b>Fred S Hickernell</b>	Sustainable Solutions for Rwanda: A Case Study – <b>Peter J Bosscher</b>
11:00 AM–11:30 AM	The Potential of Photovoltaics – <b>Brent Nelson</b>	Energy Savings Achieved by the Use and in the Manufacture of Glass with Solar Control Coatings – <b>Annabelle Pratt</b>	Renewable Energy for Sustainable Village Power – <b>Larry Flowers</b>
11:30 AM–12:00 PM	A Chicken in Every Pot, Solar Panels on Every Roof: Is It Practical? – <b>John A Bloom</b>	Appropriate Technology Now—Two Examples – <b>Paul Arveson</b>	The Rise of Sanitation and the Decline of Pestilence – <b>Joseph H Lechner</b>
12:00 PM–12:30 PM	Fuel Cell Technology and the Sustainable Hydrogen Economy – <b>John A Turner</b>	Use of Autonomous Vehicles for Improved Stewardship of Natural Resources – <b>Steven G Hall</b>	Converting Coconuts into Value-added Products for Developing Countries – <b>Sarah Gibson, Lindsey Mack, Walter L Bradley</b>

12:30 PM–1:30 PM	Lunch –Eisenhower Student Center, Lottie Nelson	Women in ASA Luncheon: <b>Marilyne Flora</b> , presiding –PDR	
Please note: <i>Posters are displayed in Boyer Hall, Howe Atrium for viewing. Poster presenters will be available Sunday, 5:00–6:00 PM, to discuss their work and to answer questions.</i>			
1:30 PM–3:30 PM Parallel Session II	<b>II-A. Sustainable Energy Options</b> –Hostetter Chapel Session Chair: <b>John Turner</b>	<b>II-B. Limits and Emergent Properties</b> –Boyer Hall, Rm 137 Session Chair: <b>Jack Swarengen</b>	<b>II-C. Appropriate Technology</b> –Boyer Hall, Rm 131 Session Chair: <b>Walter Bradley</b>
1:30 PM–2:00 PM	One Answer Is Blowing in the Wind – <b>Jim Green</b>	The End of the Age of Oil – <b>Robert E Sundell</b>	Incentives for Reducing Emissions from Deforestation in Developing Nations – <b>Kevin M Conrad, Ambassador Robert Aisi</b>
2:00 PM–2:30 PM	Cape Wind: Energy Asset or Environmental Threat – <b>Jerrold L McNatt</b>	The Hydrogen Energy Economy: Promise or Illusion? – <b>Kenneth Piers</b>	Called to Care: For the Poor, the Earth, and the Great Commission – <b>Martin L Price</b>
2:30 PM–3:00 PM	Lessons Learned from Field Evaluation of Six High-Performance Buildings – <b>Paul A Torcellini</b>	Geothermal Energy: The Solution, a Contributor, a Diversion, or Part of the Problem? – <b>A J (Chip) Mansure</b>	How Did It Start? Where Has It Been? Where Is It Going? Appropriate Technology in the Messiah College’s Department of Engineering – <b>Carl A Erikson Jr</b>
3:00 PM–3:30 PM	Ammonia Energy for a Better World – <b>John H Holbrook</b>	Making Personal Technology Work Appropriately – <b>William M Jordan, Bill Elmore</b>	Engineering Research Applied to Third World Needs: Case Studies of Applied and Fundamental Work – <b>Matthew G Green</b>
3:30 PM–3:45 PM	Refreshment Break –Hostetter Chapel and Boyer Hall, Howe Atrium		
3:45 PM–6:15 PM Parallel Session III	<b>III-A. Sustainable Energy Options</b> –Hostetter Chapel Session Chair: <b>Robert Kaita</b>	<b>III-B. Limits and Emergent Properties</b> –Boyer Hall, Rm 137 Session Chair: <b>Annabelle Pratt</b>	<b>III-C. Appropriate Technology</b> –Boyer Hall, Rm 131 Session Chair: <b>Walter Bradley</b>
3:45 PM–4:15 PM	Energy: Forbidden Fruit, Holy Grail, Christian Calling? – <b>Ian Hutchinson</b>	Nanotechnology: Its Impact on Society and Our Christian Response – <b>Randy Isaac</b>	International Water Resource Development through an Undergraduate Service-Learning Course – <b>Michael D Guebert</b>
4:15 PM–4:45 PM		The Moral Neutrality of Technology – <b>Jack C Swarengen</b>	Personal Transportation Technologies for Physically Challenged Persons in the Developing World – <b>Dan Dourte, John Meyer, Julie Walsh, David Vader</b>
4:45 PM–5:15 PM	Commitment to Nuclear Fusion as a Sustainable Energy Source in the Developing World – <b>Robert Kaita</b>	Technology and the Bible – <b>Job S Ebenezer</b>	Water Management for Agriculture in Arid Zones: Lessons from Smallholder Production Systems – <b>W Ray Norman</b>
5:15 PM–5:45 PM	Nuclear Energy: Curse or Blessing? – <b>Pavel Hejzlar</b>	Solar Power: The Next Generation of Personal Transportation? – <b>Ruth Douglas Miller</b>	How Students Get Involved with Appropriate Technology Projects around the World: An Example: Water for the World in Guatemala – <b>Dawn Verlander, Carl A Erikson Jr</b>
5:45 PM–6:15 PM	Nuclear Waste Disposal: The Perspective of One Christian – <b>Tjalle T Vandergraaf</b>	Butterflies in the Machine (Or “Renewable” Doesn’t Mean “Harmless”) – <b>Sean M Cordry</b>	
6:30 PM–8:00 PM	<b>Banquet</b> –Eisenhower Student Center, Lottie Nelson Introduction: <b>Jerry Hess</b> ♦ Amish Talk – <b>Donald B Kraybill</b>		
8:15 PM–9:00 PM Plenary Session III	<b>Plenary Session</b> –Hostetter Chapel Introduction: <b>Ken Touryan</b> ♦ Plenary Address: “Achieving a Sustainable Hydrogen Economy” – <b>George Sverdrup</b>		
9:15 PM–10:00 PM Affiliation Meetings	♦ Christian Biologists: <b>Marilyne Flora</b> , presiding –Boyer Hall, Rm 137 ♦ Christian Geologists: <b>Ward Sanford</b> , presiding –Boyer Hall, Rm 131 ♦ Christian Engineers and Scientists in Technology: <b>Bill Yoder</b> , presiding –Frey, Rm 110		
10:00 PM	Student and Early Career Scientists Ice Cream Social: Host, <b>Johnny Lin</b> –Larsen Student Union		

**Sunday, August 7, 2005**

Sunday, August 7, 2005		
7:30 AM–8:30 AM	Breakfast –Eisenhower Student Center, Lottie Nelson	
9:00 AM–10:00 AM	<b>Worship Service</b> –Hostetter Chapel Worship Leader: <b>Jerry Hess</b> Pianist: <b>Roseann Sachs</b> Sermon: “God’s Two Books” – <b>Dennis Hollinger</b> , President, Evangelical School of Theology, Myerstown, PA	
10:10 AM–11:00 AM Plenary Session IV	<b>Plenary Session</b> –Hostetter Chapel Introduction: <b>Walter Bradley</b> ♦ Plenary Address: “Engineering for the Developing World: Challenges and Opportunities” – <b>Bernard Amadei</b>	
11:00 AM–9:00 PM	Hearts & Minds Bookstore open –Boyer Hall, Room 130	
11:15 AM–12:15 PM Parallel Session IV	<b>IV-A. Sustainable Energy Climate</b> –Hostetter Chapel Session Chair: <b>Johnny Lin</b>	<b>IV-B. Biblical Management of Technology</b> –Boyer Hall, Rm 137 Session Chair: <b>Ruth Miller</b>
11:15 AM–11:45 AM	Earth Keeping and the Atmosphere? Where Does Energy Technology Fit In? – <b>Henry Hengeveld</b>	Naming the Elephant: The Precautionary Principle, Science, and Uncertainty – <b>John R Wood</b>
11:45 AM–12:15 PM	Renewable Energy and the Climate Stabilization Challenge – <b>Lynn Billman</b>	What Would Jesus Drive? Biblical and Theological Reflections on Technology as Problem and Solution – <b>Jim Ball</b>
12:15 PM–1:15 PM	Lunch	Fellows Luncheon: <b>Fred Hickernell</b> , presiding –PDR Student and Early Career Scientists Luncheon: <b>Johnny Lin</b> , presiding –reserved tables
1:30 PM–4:30 PM Symposium	<b>Models of Creation: Intelligent Design and Evolution</b> –Hostetter Chapel Session Chair: <b>John Bloom</b> Participants: <b>William Dembski, Loren Haarsma, Keith Miller, John Bracht, Darrell Falk, Richard Sternberg</b>	
4:30 PM–5:00 PM	Refreshment Break –Hostetter Chapel	
5:00 PM–6:00 PM	<b>Models of Creation</b> Question and Answer Session with symposium participants –Hostetter Chapel	
5:00 PM–6:00 PM Poster Session	<b>Poster Session</b> –Boyer Hall, Howe Atrium ♦ A Comprehensive Model of Intelligent Design – <b>Philip E Anderson</b> ♦ Origins Don’t Matter – <b>Paul Arveson</b> ♦ Useful Applications of Time Delay Estimation Algorithms for Noise Source Localization – <b>Marlene M Daneti</b> ♦ The Mitochondrial Endonuclease EndoG Is Dispensable in Embryogenesis and Apoptosis – <b>Karen Kate O David</b> ♦ Toward the Increase of Theism among Scientists: A Doppler-shifted Monoenergetic Neutrinos-Records Science Concept – <b>William S Foulks Jr</b> ♦ Protein Conformational Space and Excluded Volume – <b>Terry M Gray</b> ♦ The Granzyme B Cleavage Site in Tyrosinase Is Critical for Protein Folding and Trafficking – <b>Michelle Lynn Harris</b> ♦ Selection and Analysis of Escape Variant Mutations Affecting Epitope IV Simian Virus 40 Large Tumor Antigen – <b>Anuj Kalsy</b> ♦ The Mountain Pine Beetle Epidemic: Functional Genomics Discovery of Conifer Defense Mechanisms against Beetle Mediated Blue-Stain Fungal Pathogens – <b>Natalia Kolosova</b> ♦ When Little Things Matter: Thoughts from the Study of Climate Dynamics – <b>Johnny W Lin</b> ♦ The Simian Virus 40 Large Tumor Antigen as a Model System for Undergraduate Courses and Research Projects – <b>Lawrence M Mylin</b> ♦ Implicit Learning of Simple Grammatical Rules – <b>Gwen L Schmidt</b> ♦ Establishment of the First SIV/Macaque Model of HIV Latency – <b>Anding Shen</b> ♦ The Statistical Probability That Evolution Could Have Occurred by Chance – <b>Walter L Starkey</b> ♦ Teach Science—Not Evolutionary Theory – <b>Donald R Strombeck</b>	
6:15 PM–7:15 PM	Please note: <i>Find the table with the color napkins of your local area (see p. 34). Meet and fellowship with others from your area. Serving lines will begin after the blessing.</i> Local Areas Fellowship Dinner –Eisenhower Student Center, Lottie Nelson	
7:30 PM–9:00 PM Business Meeting	<b>ASA Business Meeting</b> – <b>Marilyne Flora</b> , ASA President, presiding –Eisenhower Student Center, Lottie Nelson ♦ ASA Presidential Address – <b>Marilyne Flora</b> ♦ State of the ASA – <b>Randy Isaac</b> ♦ “Getting Acquainted with Randy” Question and Answer Session	

9:15 PM–10:00 PM Commission Meetings	<ul style="list-style-type: none"> <li>◆ Bioethics Commission: –<b>Hessel Bouma</b>, presiding –Boyer Hall, Rm 130</li> <li>◆ Communications Commission: –<b>Paul Arveson</b>, presiding –Boyer Hall, Rm 131</li> <li>◆ Creation Commission: –TBA, presiding –Boyer Hall, Rm 134</li> <li>◆ Global Resources and Environment: –<b>John Wood</b>, presiding –Boyer Hall, Rm 137</li> <li>◆ History and Philosophy of Science: –TBA, presiding –Frey, Rm 110</li> <li>◆ Physical Sciences: –<b>J Brian Pitts</b>, presiding –Frey, Rm 110</li> <li>◆ Science Education: –<b>Craig Rusbult</b>, presiding –Boyer Hall, Rm 138</li> <li>◆ Social Science: –TBA, presiding –Frey Lobby</li> </ul>		
<b>Monday, August 8, 2005</b>			
7:00 AM–8:00 AM	Breakfast –Eisenhower Student Center, Lottie Nelson dining area		
8:00 AM–8:15 AM	<b>Morning Devotions</b> –Frey, Rm 110 Music Leader: <b>Joseph Lechner</b> Announcements: <b>Ted Davis</b> and <b>Ken Touryan</b> Introduction: <b>Jack Swaengen</b> Devotions: <b>Robert Wauzzinski</b>		
8:15 AM–9:00 AM Plenary Session V	<b>Plenary Session</b> –Frey, Rm 110 ◆ Plenary Address: “Resources in Philosophy and Religion for the Evaluation of the Social Impact of Technology” – <b>Robert Wauzzinski</b>		
9:00 AM–10:45 AM General Session I	<b>I-A. Creation Model Papers</b> –Frey, Rm 110 Session Chair: <b>John Bloom</b>	<b>I-B. Science/Religion: Historical Perspectives</b> –Boyer Hall, Rm 137 Session Chair: <b>Ken Touryan</b>	<b>I-C. Special Topics: Environment, Ecology, and Conservation</b> –Boyer Hall, Rm 131 Session Chair: <b>Lynn Billman</b>
9:00 AM–9:30 AM	Research on the Deterioration of the Genome and Darwinism – <b>Jerry R Bergman</b>	9:00 AM–9:45 AM Science as Christian Vocation: The Case of Robert Boyle – <b>Edward B Davis</b>	Future Energy Resources: The Terawatt Challenge— Power, Wisdom, and Understanding – <b>Dennis Hardy</b>
9:30 AM–10:00 AM	Chinese Airline Pilot Trainees and Intelligent Design—Observations on Cross-Cultural Evangelism Using Science – <b>William B Collier</b>		One Man’s Effort to Care for the Creation – <b>Kenneth J Van Dellen</b>
10:00 AM–10:30 AM	Your Works Are Wonderful: Darwin and Psalm 104 – <b>Hary Cook, John Wood</b>	9:45 AM–10:30 AM Science as Christian Vocation: The Case of Johannes Kepler – <b>Owen Gingerich</b>	Implications of Evolution for the Conservation of Imperiled Freshwater Animals – <b>David C Campbell</b>
10:00 AM–2:00 PM	Hearts & Minds Bookstore open –Boyer Hall, Room 130		
10:30 AM–10:45 AM	Refreshment Break –Frey Lobby and Boyer Hall, Howe Atrium		
10:45 AM–12:15 PM General Session II	<b>II-A. Creation Model Papers</b> –Frey, Rm 110 Session Chair: <b>John Bloom</b>	<b>II-B. Science/Religion: Historical Perspectives</b> –Boyer Hall, Rm 137 Session Chair: <b>Ken Touryan</b>	<b>II-C. Special Topics: Environment, Ecology, and Conservation</b> –Boyer Hall, Rm 131 Session Chair: <b>Lynn Billman</b>
10:45 AM–11:15 AM	The Story of a Bad Theory with No Alternative – <b>David Snoke</b>	Chance in the Theology of Leonard Hodgson – <b>Thomas W Woolley</b>	Impact of Transgenic ( <i>Bt</i> ) Corn on Longevity and Fecundity of Pollen-Feeding <i>Chrysoperla carnea</i> – <b>Joseph K Sheldon</b>
11:15 AM–11:45 AM	Is the True Creator an “Intelligent Designer?” – <b>George L Murphy</b>	Astronomical Ages and Genesis: Starlight Transit Time and Its Theological Reception – <b>J Brian Pitts</b>	Is It Time to Give Up the Mesopotamian Flood Theory? – <b>Paul H Seely</b>
11:45 AM–12:15 PM	Looking over God’s Shoulder: The Nature and Meaning of “Design” – <b>David L Wilcox</b>	A Critique of the Jupiter-Venus Conjunction Hypothesis for the Identity of the Star of the Magi – <b>Sherman P Kanagy II</b>	
12:30 PM–1:30 PM	<i>Please let those going on the Amish Field Trip get in the front of the line.</i> Lunch –Eisenhower Student Center, Lottie Nelson dining area		
1:30 PM–9:00 PM	Amish Dinner Tour.		
3:00 PM	Check out ends. <b>Please return your key to the ASA registration desk.</b>		

# General Sessions Abstracts

I-A. Creation Model  
Monday, August 8

Frey, Room 110  
9:00 AM–9:30 AM

## Research on the Deterioration of the Genome and Darwinism

Jerry R Bergman

An evaluation of the probabilities of DNA/RNA mutation changes indicate that mutations cannot provide significant new levels of information, but rather will produce degradation of the genome information, the opposite of the predictions of the Darwinists' model.

This degradation is counteracted by natural selection that serves to help maintain the status quo. Degradation results for many reasons, only two of which are reviewed here: (1) There is a tendency for mutations to produce a highly disproportionate number of certain nucleotide bases such as thymine; and (2) Many mutations occur in only a relatively few places of the gene, called hot spots, and rarely occur in others, called cold spots.

A review of the literature fails to reveal a single example of a beneficial information-gaining mutation, and, conversely, thousands of deleterious examples exist, supporting the hypothesis that both degeneration of the genome and the fact of hot spots will result in very few beneficial mutations.

I-A. Creation Model  
Monday, August 8

Frey, Room 110  
9:30 AM–10:00 AM

## Chinese Airline Pilot Trainees and Intelligent Design—Observations on Cross-Cultural Evangelism Using Science

William B Collier

A remarkable evangelism opportunity arose when over one hundred People's Republic of China airline pilot trainees descended on a local aeronautical school to pursue basic flight training. A few of these students were brought to a fledgling "Reasons to Believe" meeting.

Three meetings later we were giving Intelligent Design oriented science

lectures to groups of 15 to 25 pilot trainees. Over the next four months, fifteen of them became Christians. Three ORU engineering faculty members from mainland China, (Dr. Zhang, Dr. Liu, and Dr. Ma) were instrumental in initiating and facilitating the whole lecture series.

After being shocked at the size of the positive response we received, I decided to investigate further by interviewing Dr. Ma, Dr. Liu, and Dr. Zhang. I quizzed them about their own lives and conversion to Christ, and then about their involvement with the pilot trainees.

They offered advice on how to reach out to mainland Chinese scientific and engineering students and professionals.

The responses were both very familiar and also very surprising. The evangelism success was not due to what we thought, but instead opened up a fascinating outreach approach which you can use to reach the mainland Chinese professional or student working in your lab or company.

I-A. Creation Model  
Monday, August 8

Frey, Room 110  
10:00 AM–10:30 AM

## Your Works Are Wonderful: Darwin and Psalm 104

Harry Cook  
John Wood

The theory of natural selection and a naturalistic view of nature are the two pillars that support Charles Darwin's view of nature, many historians of biology suggest. Darwin saw the processes of nature as operating without any influence of God, and he agonized over the cruelty of nature. These were significant factors in his loss of faith in traditional Christianity. The more his theory of evolution was able to explain, the less room Darwin saw for God to have a role.

In Psalm 104, King David presents a different view of nature. He professes that all the processes of nature—he particularly mentions those in the animal world—are controlled by Yahweh, whether we understand these processes

or not. The problem of God's decreasing power in light of our increasing knowledge is also present, we suggest, in the Intelligent Design movement.

This movement has raised important questions about the adequacy of explanations brought forward by evolutionary scientists. But it has also been criticized for a latent dualism that attributes design in natural phenomena to those things that science cannot explain and a lack of design to the processes and structures that science can explain.

A recent book by Del Ratzsch, which discusses the topic of design, suggests that design in biological organisms may be compatible with natural processes.

The viewpoints described above all deal with an interesting and important topic: How does God relate to and interact with this world? The Christian belief of providence has stressed God's involvement in the events of nature and of this world.

Our discussion will examine how Christian thinkers differ in the way they apply this to their disciplines and to their view of the world.

II-A. Creation Model  
Monday, August 8

Frey, Room 110  
10:45 AM–11:15 AM

## The Story of a Bad Theory with No Alternative

David Snoke

In 2002 and 2003, a unique optical effect was discussed and debated at international conferences following the high-profile publication of papers observing the effect in the major scientific journals *Science* and *Nature*.

My research group was one of the two groups producing the experimental data on the effect. I will tell the story of this debate that centered around a basic question of philosophy of science: Is it reasonable and scientific to question a theory even when one does not have a viable alternative predictive theory?

I will compare this to critiques of the Intelligent Design movement, including criticisms of my own recent paper coauthored with Michael Behe, calling into question a particular mechanism of evolution.

**II-A. Creation Model** **Frey, Room 110**  
**Monday, August 8** **11:15 AM–11:45 AM**

**Is the True Creator  
an “Intelligent Designer?”**

George L Murphy

Phillip Johnson has argued (in *Defeating Darwinism by Opening Minds*) that belief in God as “our true Creator” means that God has left observational evidence (“his fingerprints”) for his role in the development of life. If this were true, then it would provide significant motivation and support for the Intelligent Design movement because we could expect that such design could be inferred from scientific study of the world. On the other hand, Martin Luther argued (in his theses for the Heidelberg Disputation, *Luther’s Works* vol. 31) on behalf of the theology of the cross that “true theology and recognition of God are in the crucified Christ.”

Here I examine the concepts of the Intelligent Design movement in the context of the type of theology toward which Luther pointed, a theology of the crucified One. The divine *kenosis* (“emptying”) involved in the Incarnation, if understood to be revelatory of God’s character and manner of working, implies divine self-limitation and the hiddenness of God’s activity in the world. This presents a serious challenge to the type of religious claim made by Johnson.

We will discuss related theological problems with the Intelligent Design movement connected with the topics of providence, divine action, the integrity of creation, and the ways in which Scripture speaks of the creation of life. The types of theology that seem to be implicit in the Intelligent Design program are in some tension with the characterization of God in Isa. 45:15 as One who hides himself. The theological approach which we take here does not, however, simply play a negative role in discussions of design. Belief in creation does mean, among other things, that God has a purpose

for the universe, and Scripture does speak about God’s plan for creation, as in Eph. 1:10. Our approach will help to elucidate what can be said about the divine design.

**II-A. Creation Model** **Frey, Room 110**  
**Monday, August 8** **11:45 AM–12:15 PM**

**Looking over God’s Shoulder:  
The Nature and Meaning of “Design”**

David L Wilcox

At the present time, the Christian scientific community is debating a laundry list of alternative positions on the Design question—for instance, Intelligent Design, Theistic Evolution, Young Earth Special Creation, Old Earth Special Creation, The Robust Formational Economy Principle, and The Cosmogonic Law-Word Concept—all of them opposed to “atheistic” evolution.

Given the level of acrimony in this debate between natural allies, it seems clear that the different groups misunderstand each other. I propose that this misapprehension stems from a lack of clarity about the nature of all “design” processes, and also from a lack of clear vision as to how such “design” might be implemented.

The central reality of “design” is the designer, not a specific design. Design is fundamentally not a structure, nor even a theoretical structure or specification. It is a process, a process that does not take place in the time frame of the “designed” structures (although that time frame is tied to the design process). Unless we can learn to glance over God’s shoulder into the divine designer’s studio, our differing assumptions, our bridge or shaping principles, are going to preclude the possibility of agreement—even the agreement to disagree.

Compounding that confusion, the second misapprehension involves the implementation of design. The problem is the narrowing of accepted possibilities for expressing design. (These possibilities include initiation, guidance and injection.)

The purpose of this paper is to develop a rubric from a consideration of how the design process works in human projects, and then apply that rubric to the question of the methods of creation. Such a rubric

will make it clear which principles are shared by the schools of thought listed above, and what differences in their visions produce their different explanations. (Not one of them completely agrees with each other.) One might call this a taxonomy of creation—or perhaps, a taxonomy of creationists!

**I-B. Science/Religion: Boyer Hall, Room 137**  
**Historical Perspectives**  
**Monday, August 8** **9:00 AM–9:45 AM**

**Science as Christian Vocation:  
The Case of Robert Boyle**

Edward B Davis

Robert Boyle is an outstanding example of a Christian scientist whose faith interacted fundamentally with his science. His remarkable piety was the driving force behind his interest in science, and his Christian character shaped the ways in which he conducted his scientific life.

A deep love for Scripture, coupled ironically with a lifelong struggle with religious doubt, led him to write several important books relating scientific and religious knowledge.

Ultimately, he was attracted to the mechanical philosophy because he thought it was theologically superior to traditional Aristotelian natural philosophy: by denying the existence of a quasi-divine “Nature” that functioned as an intermediary between God and the world, it more clearly preserved God’s sovereignty and more powerfully motivated people to worship their Creator.

**I-B. Science/Religion: Boyer Hall, Room 137**  
**Historical Perspectives**  
**Monday, August 8** **9:45 AM–10:30 AM**

**Science as Christian Vocation:  
The Case of Johannes Kepler**

Owen Gingerich

In 1613 Kepler wrote:

There is nothing I want to find out and long to know with greater urgency than this: can I find God, whom I can almost grasp with my own hands in looking at the universe, also in myself?

This extraordinarily poignant quotation, which resonates with us today, comes from one of the most theologically oriented masters of the Scientific Revolution. After all, Kepler was trained in theology, not in astronomy.

As he wrote to his teacher Michael Maestlin in 1595:

I wanted to become a theologian. For a long time I was restless. Now, however, behold how through my effort God is being celebrated in astronomy!

Out of Kepler's solid theological foundation came an appreciation of the unity and beauty of God's creation. He prayed to God that if the Copernican system was true physical pattern, he could find evidence for it. He saw in the solar system the embodiment of the Holy Trinity.

As a great unifier, he insisted that the earth's orbit should have the same structure as the other planets, and that the same theory should be able to predict both the latitude and longitude of the planets, something that neither Ptolemy nor Copernicus had achieved. His devotion to these unifying principles, an expression of his religious way of looking at the world, resulted in a predictive system two orders of magnitude more accurate than anything that had gone before.

**II-B. Science/Religion: Boyer Hall, Room 137  
Historical Perspectives  
Monday, August 8, 2005 10:45 AM–11:15 AM**

### Chance in the Theology of Leonard Hodgson

Thomas W Woolley

In his now widely-referenced philosophical work *Chance and Necessity* (1972, English translation), biochemist and Nobel Laureate Jacques Monod offered a reasoned, albeit polemical, case for the meaninglessness of human existence. That is, if through the self-organization of matter, the eventual development of life has occurred fundamentally by chance, by way of truly random genetic mutations, then traditional philosophical and theological views of destiny or purpose are undermined. In sum, Monod made the case that chance and purpose are mutually exclusive within the general context of the biochemical evolutionary

process, but more specifically, in human development.

Some six years later, Arthur Peacocke, in his 1978 Bampton Lectures (published under the title *Creation and the World of Science*, hereafter referred to as CWS), and more directly the following year in his *Zygon* paper entitled, "A Chance and the Life Game," attempted the first comprehensive refutation of Monod's primary philosophical thesis. Peacocke suggested the clever metaphor that chance serves as God's "search radar" (CWS, p. 95), arguing that only through chance can the "potentialities of living matter" (CWS, p. 94) be fully and efficiently explored. In 1984, statistician David Bartholomew built on Peacocke's ideas in his thorough treatment of the interface of chance with Christian theology in his book *God of Chance*.

More than two decades before Peacocke's seminal work, however, a now forgotten theologian at the University of Oxford, Leonard Hodgson, strongly argued in his 1955–1957 Gifford Lectures (published in 1956 and 1957 under the title *For Faith and Freedom*) that

(f)or the rational purpose of ensuring fair play we create conditions in which decisions shall be left to chance; for the furtherance of His purpose in creation God gives to His universe a mode of reality which admits of the existence and occurrence of such irrationalities as contingency, freedom and evil (from *For Faith and Freedom*, 1968 republication by SCM Press, p. 150).

Who was Leonard Hodgson, how much of contemporary thinking about the role of chance in creation did he anticipate, and what contributions might his body of work make to the present-day theological discussion about the chance worldview?

**II-B. Science/ Religion: Boyer Hall, Room 137  
Historical Perspectives  
Monday, August 8, 2005 11:15 AM–11:45 AM**

### Astronomical Ages and Genesis: Starlight Transit Time and Its Theological Reception J Brian Pitts

The multibillion year accounts given by contemporary astrophysicists and geologists are in tension with the traditional reading of the Bible, especially Genesis, with its terrestrial history of a

few millennia. Stories about Genesis and geology have been told, but the analogous issue of Genesis and the time scales of modern astronomy has rarely been considered in histories of astronomy and religion, which focus on the Copernican controversy, the nebular hypothesis, and extraterrestrial life. Starlight transit times appear to provide a lower bound on astronomical ages using simple physics, so even laypeople could ponder how such time scales fit with biblical chronology. This paper aims to give an outline of this story.

Several different issues regarding light transit and Genesis chronology can be distinguished. The issue of light transit times cannot have arisen until the speed of light was known to be finite. Roemer's measuring the speed of light in 1675 was therefore a crucial event. The earliest known discussion of light transit times from stars other than the Sun was by William Whiston in 1702, although James Gregory, Isaac Newton, and Christiaan Huygens perhaps could have done so earlier. The question of light transit times arose in the era between Roemer's and Bradley's experiments, as light speed values and some stellar distances started to solidify (1670s–1720s).

While the issue of light transit times and biblical chronology as a problem could have arisen in that time, it seems not to have arisen until after William Herschel's time. Herschel's 1802 claim to see stars whose light was emitted nearly two million years ago was dramatic, but was not accepted immediately, largely due to lack of evidence.

While the rise of uniformitarian geology focused attention on biblical chronology and encouraged schemes for lengthening it, only occasionally was astronomy invoked or addressed as a supporting argument.

Literature employed to trace the reception of deep stellar light transit time among both scientists and nonscientists includes: histories of astronomy; histories of geology; contemporary and 19th-century creation-evolution and Bible-science works; 17th-, 18th-, and 19th-century astronomy or natural theology texts; and a bit of poetry and fiction.

**II-B. Science/Religion: Boyer Hall, Room 137**  
**Historical Perspectives**  
**Monday, August 8, 2005 11:45 AM–12:15 PM**

**A Critique of the Jupiter-Venus  
 Conjunction Hypothesis for the  
 Identity of the Star of the Magi**  
 Sherman P Kanagy II

The Jupiter-Venus Conjunction of 2 BC in Leo has been championed as a hypothesis for the identity of the Star of the Magi by a variety of astronomers, science educators, and theologians such as Griffith Planetarium's John Mosley and Ernest Martin of the Foundation for Biblical Research.

Although relatively superior in some ways to the traditional Jupiter-Saturn Conjunction of 6/7 BC in the Pisces hypothesis which was almost universally favored since the time of Kepler, comparison of the two hypotheses reveals that the Jupiter-Venus conjunction hypothesis is inferior to the Jupiter-Saturn conjunction hypothesis in other ways. For example, although the Jupiter-Venus conjunction was so close as to make these bright, astrologically beneficent planets appear as one, in agreement with Matthew's singular, noncollective word for "star," their exceptional brightness would make quite strange the apparent unawareness of Herod, his scribes, and the people of Jerusalem of the occurrence of this great sign. This unawareness is particularly improbable given the Messianic expectation of the time based on Daniel 9 and perhaps Virgil's 4th Eclogue, Balaam's prophecy of Num. 24:17, and the prevalence of astrology throughout the Middle East.

It can be argued beyond this, however, that neither conjunction is adequate, based on such things as improbable chronology, their need to posit unlikely meanings for Matthew's words ("stood over" = "was at a stationary point in its retrograde loop" for example), unrealistic assumptions about the nature of the Magi (poor eyesight, imprecise use of language), their importing of themes foreign or even antithetical to the context of Matthew 2 (the complete lack of biblical precedent for associating a planetary conjunction with the Messiah, the near complete silence of the Bible on Jupiter [exception: Acts 19:35] and its

alleged identity with Yahweh), and their naturalistic bias ("rising" said to require a natural identity for the Star despite identical terminology being used of the Shekinah Glory in Isaiah 60).

**I-C. Special Topics: Boyer Hall, Room 131**  
**Environment, Ecology**  
**and Conservation**  
**Monday, August 8, 2005 9:00 AM–9:30 AM**

**Future Energy Resources:  
 The Terawatt Challenge—  
 Power, Wisdom, and  
 Understanding**  
 Dennis Hardy

Total annual world consumption of energy at the start of the 21st century is about 120 terawatt-hours (Tw-hr) (1Tw-hr =  $10^{12}$  watt-hour) and the US consumes about 30 Tw-hr of that world total. Some sort of fossil fuel source produces almost all of this energy. Any future replacement or alternate to fossil fuel must ultimately be capable of being annually produced at the Tw-hr level, since all fossil fuels are finite at some limit of continuous use.

In this paper, I will discuss the impact of cheap energy on human population growth and the impact of human population growth on the future of energy production. I will discuss current economic impediments to a switch to any renewable energy sources. I will discuss which of the potential future energy resources are actually capable of meeting the Tw-hr challenge in combination or alone and the pros and cons of each of them. I will briefly describe one possible future energy resource that involves an immense paradigm shift from land to ocean production of energy.

Finally, I will attempt to put the current world situation of *power* sources into a coherent context and show how our ability to make choices by relying solely on our *wisdom* (the facts and our minds) should actually be tempered by our *understanding* (our hearts). This latter interpretation of the use of future energy resources presupposes some sort of consensus about the nature of sustainability of human population on earth and I will offer a simple model for criticism and debate.

**I-C. Special Topics: Boyer Hall, Room 131**  
**Environment, Ecology**  
**and Conservation**  
**Monday, August 8, 2005 9:30 AM–10:00 AM**

**One Man's Effort to Care  
 for the Creation**  
 Kenneth J Van Dellen

I bought my first hybrid car in 2001 and my second in 2004. Hybrids conserve dwindling petroleum and greatly reduce air pollution. These hybrids sold for prices competitive with cars with similar equipment packages, i.e., the hybrid system did not add significantly to the price, so the fuel efficiency has saved money in comparison to many other vehicles.

Now I am building an energy-efficient home. Insulation includes a foundation utilizing I(nsulating) C(oncrete) F(orm) construction, with 2.5" of polystyrene foam forms on both sides of the poured concrete, which gives an R-value of 22+ and excellent sound-proofing (on the exposed part of the walk-out lower level); "green" foam insulation in 2 x 6 walls, which gives an R-value of 28 or more there, and is also applied under the roof of the cathedral ceiling for R-38, along with blown cellulose on flat ceilings for R-47; some additional sheet insulation under the concrete-fiber siding; insulated doors with minimal glass, and triple-pane windows, mostly on the west (view) side, reduce heat loss at these vulnerable locations.

Space heating and some hot water are provided by a geothermal heat pump, which extracts heat from abundant well water that then recharges ground water. It also cools the house in summer. A high-efficiency propane water heater yields supplemental hot water. An energy-efficient propane fireplace serves as a backup heat source in case of a power failure or shut-off of interruptible electrical service.

The tight building requires ventilation, so an E(nergy) R(ecovery) V(entilator), mounted on the furnace and vented to the outside is used. Fluorescent floodlights and "bulbs" and other types of efficient lighting are used as much as possible. In addition, major appliances with high efficiency ratings are in use.

I-C. Special Topics: Boyer Hall, Room 131  
 Environment, Ecology  
 and Conservation  
 Monday, August 8, 2005 10:00 AM–10:30 AM

### Implications of Evolution for the Conservation of Imperiled Freshwater Animals

David C Campbell

Adequate conservation of imperiled organisms requires us to identify what groups of organisms are of concern and how to maintain viable populations. Evolutionary biology impacts both areas.

Using a phylogenetic species concept, we can identify distinct species, which may include forms that had been overlooked using other techniques.

Evolutionary theory suggests that maximizing genetic diversity provides the best chance for maintaining populations. It also suggests that populations may be locally adapted, so mixing populations or preserving only a small regional subset of the original range may result in future problems.

Because of the extensive human impacts on freshwater environments, freshwater organisms such as snails, clams, and fish are often highly imperiled.

My research on molecular systematics provides several important pieces of evidence for conservation planning. For example, certain local forms, currently considered part of a single wide-ranging species, actually represent genetically and evolutionarily isolated populations and require separate protection. A few species currently abandoned as “probably extinct” have remaining relict individuals and should be upgraded to “critically endangered.” Some species are genetically more distinctive than current classification indicates, representing unique evolutionary lineages of high conservation concern. However, evolution in and of itself cannot provide the moral imperative to protect creation.

II-C. Special Topics: Boyer Hall, Room 131  
 Environment, Ecology  
 and Conservation  
 Monday, August 8, 2005 10:45 AM–11:15 AM

### Impact of Transgenic (*Bt*) Corn on Longevity and Fecundity of Pollen-Feeding *Chrysoperla carnea*

Joseph K Sheldon

Genetic modification of organisms is widespread today yet significant ethical and ecological questions and concerns remain. This paper examines issues associated with widespread planting of transgenic corn containing the bacterium *Bacillus thuringiensis* (*Bt*) Cry endotoxin. Mass cultured *Bt* has long been used as a biological insecticide applied to corn fields. Current biotechnology allows the Cry endotoxin gene to be inserted directly into the corn genome thus rendering the entire plant toxic to corn feeding insects in the Order Lepidoptera. Indeed this has resulted in a high level of protection of corn plants against major Lepidoptera pests including the European corn borer, *Ostrinia nubilalis*. But the Cry endotoxin has also been shown to be a threat to some non-target species including monarch butterflies, *Danaus plexippus* and black swallowtails, *Papilio polyxenes*.

This paper reports the results of a study of the impact of transgenic *Bt* corn on longevity and fecundity of pollen-feeding adult *Chrysoperla carnea* in the order Neuroptera, family Chrysopidae. Three varieties of *Bt* corn were tested: Mycogen 2249 (Event 176) and its control, Mycogen 2250; Pioneer 38G17 (MON 810) and its control, Pioneer 3893; and Pioneer 34N42 (Herculex) with its control, Pioneer 34N43. Average life expectancy of both *Bt* fed and control groups were approximately 60 days. No significant negative affect on longevity was found between experimental and control groups, or between sexes for any of the *Bt* event types. The fecundity (oviposition rate), however, was significantly reduced in adults feeding on MON 810 corn pollen compared to its control, but not when fed pollen from events 176 or Herculex. Ethical and ecological implications are considered.

II-C. Special Topics: Boyer Hall, Room 131  
 Environment, Ecology  
 and Conservation  
 Monday, August 8, 2005 11:15 AM–11:45 AM

### Is It Time to Give Up the Mesopotamian Flood Theory?

Paul H Seely

Since various sciences show that Noah’s flood could not have been global, many scientifically educated Christians have adopted the theory that the Flood was restricted to Mesopotamia.

Happily, there is indeed evidence that the biblical account goes back to an actual Mesopotamian flood. This evidence will be briefly presented.

It will be shown, however, that a Mesopotamian flood does not match the biblical description of the Flood as to its extent, depth, or effects. Consequently, neither creation science (a global flood) nor concordism (a local flood) truly harmonizes the biblical account with modern science.

A new approach is needed and will be presented. This new approach will answer the following questions:

- Since the biblical Flood account is not in agreement with the scientific facts of either a global or local Flood, what is its basis for being in Scripture?
- Why do New Testament writers seem to accept it as historically true?
- If it is not accurate history, can we trust any history in the Bible?
- If we cannot trust the flood account as history, on what basis can we trust the faith and morals that are taught in the account?

Each answer will be supported by a biblical rationale.

# Parallel Sessions Abstracts

I-A. Sustainable  
Energy Options  
Saturday, August 6

Hostetter Chapel  
10:30 AM–11:00 AM

## The Energy Crisis That Technology, Economics, and Reserved Growth Won't Fix

Glenn R Morton

Over the past few years, there has been a great debate about the immanent peak in world oil production. Those who claim there is a problem point to Hubbert's 1956 prediction that the US oil production would peak in 1970 (actual 1971) as evidence that the theory behind peak oil is sound. Some think there is no problem and point to hydrocarbon reserve growth and technology, which they say will produce more oil from old fields. Others say that as oil price rises, new investment will result in plentiful oil. These "solutions" to the energy supply issue are questionable.

Oil reserves are the quantities of oil which can be economically produced. Reserves have no bearing on production rate; it is production rate which fuels the world. It does no good to have \$1 billion in the bank if one can only withdraw \$10 per day. The trend in the industry is toward fields that flow poorly. Thus reserves growth will not solve the production problem.

Technology applied to old fields generally adds 5-10% additional oil at rates which are 5% of the peak production rate. Ninian, Murchison, and the Fulmar fields in the North Sea illustrate the futility of believing that technology will save the day. Countries past their peak in oil production have not been observed to increase their production with higher prices. The USA lower-48 production only flattened in 1980–1984 even though prices were at record levels (equivalent to \$80 today) and in spite of 4,500 drill rigs drilling for oil. The oil wasn't there to be found. Hubbert predicted world production peak in 2000. All signs point to him being off by only five years on a 56-year-old prediction.

I-A. Sustainable  
Energy Options  
Saturday, August 6

Hostetter Chapel  
11:00 AM–11:30 AM

## The Potential of Photovoltaics

Brent Nelson

Photovoltaics (PV) is the direct conversion of light to electricity. Electricity is the most expensive type of energy to produce, and PV is the most expensive of the viable technologies that generate electricity. Mostly because of these economics, the total contribution of PV to world electricity production is almost insignificant. However, the total global solar resource is more than large enough to power a sustainable electrical generation system for the world.

The alternatives to PV are tied to finite resources which are not sustainable (e.g., fossil fuels), or do not have the potential to meet the growing needs of world electricity consumption (e.g., hydroelectric), or are security and safety hazards (e.g., nuclear), or emit green house gases (e.g., methane hydrates). When political, sociological, environmental, and sustainability issues are factored with the economics, PV becomes one of the most favorable technologies.

There continues to be technological hurdles to overcome before PV will be a dominant technology in world electricity production. These include increasing cell efficiency while decreasing costs, and solving energy storage and distribution issues. PV has a long way to go to fully live up to its potential. However, the potential of PV is starting to be realized. The PV industry has enjoyed rapid growth during the last several years, especially outside the United States.

In this presentation, we will provide an overview of the various PV technologies and components, how those technologies are being used, and what the future could hold.

I-A. Sustainable  
Energy Options  
Saturday, August 6

Hostetter Chapel  
11:30 AM–12:00 PM

## A Chicken in Every Pot, Solar Panels on Every Roof: Is It Practical?

John A Bloom

Generating electricity by harvesting the sunlight that falls on rooftops around the world sounds like a utopian promise, but is it practical and affordable?

I will review my own experiences at installing, testing, and maintaining a home 2.5 kW photovoltaic grid-tie system, and consider the broader promise of this alternative energy source.

I-A. Sustainable  
Energy Options  
Saturday, August 6

Hostetter Chapel  
12:00 PM–12:30 PM

## Fuel Cell Technology and the Sustainable Hydrogen Economy

John A Turner

Identifying and building a sustainable energy system is perhaps one of the most critical issues that today's society must address. Replacing our current energy carrier mix with a sustainable fuel is one of the key pieces in that system. Hydrogen as an energy carrier, primarily derived from water, can address issues of sustainability, environmental emissions, and energy security (see G. Sverdrup, "Achieving a Sustainable Hydrogen Economy," p. 25).

A key piece of this hydrogen economy is the fuel cell. A fuel cell converts the chemical energy of a fuel directly into low-voltage dc electricity. When using hydrogen as the fuel, the only emission is water vapor. Operationally, hydrogen and oxygen react electrochemically at separated electrodes, producing electricity, heat, and water. An individual fuel cell generates between 0.8-0.6 V, so power specifications are met by connecting a specific number of cells in series to obtain the necessary voltage,

## Parallel Sessions Abstracts

and by sizing the active area of the cells for the current. Because fuel cells use electrochemical processes to generate power, they bypass Carnot Cycle limits and are only subject to Gibbs free-energy thermodynamic limitations. This allows them to operate at ambient temperatures and still have high efficiencies.

While the basic understanding of fuel cell technology has been around since 1839, it has only been with recent advances in materials that fuel cells have shown their potential as an energy conversion device for both transportation and stationary applications.

This talk will briefly introduce the sustainable hydrogen economy and address current materials, issues, and barriers relating to the development and manufacturing of fuel cell technologies.

**II-A. Sustainable Energy Options**  
**Hostetter Chapel**  
**Saturday, August 6 1:30 PM–2:00 PM**

### **One Answer Is Blowing in the Wind** **Jim Green**

Wind power in the US has a venerable history pumping water and charging batteries on farms before electric utility service arrived.

In the 1980s, wind power emerged as a source of utility power generation. Those first grid-connected machines were small, <100 kW, seldom reliable, and heavily reliant on tax credits for financial viability. Today, wind turbines are megawatt-scale giants generating electric power competitive in wholesale electricity markets.

Wind energy is the world's fastest growing source of new electric power generation. Major multi-national corporations have entered the industry including General Electric, Siemens, and Shell.

This talk will provide an overview of wind power history, the current state of the technology, wind farm economics and the influence of public policy, environmental impacts, and future trends.

**II-A. Sustainable Energy Options**  
**Hostetter Chapel**  
**Saturday, August 6 2:00 PM–2:30 PM**

### **Cape Wind: Energy Asset or Environmental Threat** **Jerrold L McNatt**

With only two commercial wind electrical generators with a combined capacity of only 1 MW and an estimated wind energy potential of 2880 MW, it is clear that Massachusetts has not yet taken advantage of, perhaps, the only renewable energy resource that is readily available within the state.

Thus, when Energy Management Inc. of Boston proposed the Cape Wind Project, a 420 MW wind park which would be sited on Horseshoe Shoal (a very convenient five miles off the southeast coast of Cape Cod), a loud "amen" might have been anticipated from state politicians, environmentalists, and citizens who generally rally to the banner of renewable energy whenever it is raised. However, the prospect of 130 wind turbines mounted on 246 ft. lighted towers which support 341 ft. diameter blades has inspired a remarkable amount of opposition which includes several 501(C)(3) nonprofit environmental organizations as well as both Senator Kennedy and Governor Romney.

All of the usual objections against wind power have been raised: wildlife impacts (especially birds and fish), aerodynamic noise, radio signal interference, marine and air traffic hazards, ocean scenery obstruction, and the problem of coping with wind variability. Specific to this particular project are some dire predictions about the effect on tourism and fishing and concerns about leakage of transformer oil into the Nantucket Sound.

In November 2004, the Army Corps of Engineers issued a Draft Environmental Impact Statement (EIS) which was generally favorable. The final EIS will be issued sometime after the public comment period ends (February 24, 2005).

The purpose of this paper will be to give a report of the situation in August 2005 and to discuss how this project illustrates the NIMBY effect.

**II-A. Sustainable Energy Options**  
**Hostetter Chapel**  
**Saturday, August 6 2:30 PM–3:00 PM**

### **Lessons Learned from Field Evaluation of Six High-Performance Buildings** **Paul A Torcellini**

Buildings consume over 39% of the nation's primary energy and over 70% of the electricity. Consequently, it is essential that architects and engineers design new buildings that use considerably less energy than existing building stock. The impact of not changing the future course of building design substantially impacts the infrastructure needs in this country as well as the consumption of fossil fuels, pollution, and other environmental impacts.

Creating low-energy buildings requires appropriate decisions from the building owner, the design team, and the operation of the building. Six buildings were studied in detail—each one set out to be a low-energy building. These buildings were instrumented, monitored, and evaluated based on original design goals as well as to understand the barriers and lessons learned in creating and operating these buildings. The performance of these buildings ranged from 25% to 80% reductions from current code with extensive lessons learned documented.

Publishing performance data and lessons learned encourages others to build low-energy buildings. Someone always has to be first to adopt a technology before the mainstream will follow. Publishing lessons learned can help to prevent the same errors from being repeated.

The technologies that will be discussed include integrated design, photovoltaics, solar load management, advanced HVAC systems, natural ventilation, day lighting, and passive solar design.

**II-A. Sustainable Energy Options**  
**Saturday, August 6**      **Boyer Hall, Room 129**  
**3:00 PM–3:30 PM**

### **Ammonia Energy for a Better World** **John H Holbrook**

Ammonia exists on earth in a natural state from decay of various animal and plant organisms, but not in significant quantities. This ammonia is airborne and dissolved in water, and is more of a nuisance than a blessing. On the contrary, practically all of the ammonia used today is synthesized from nitrogen and hydrogen, the nitrogen taken from the air and the hydrogen produced by decomposition of natural gas.

Currently, about 20 million tons of ammonia is produced and used worldwide on an annual basis. In the US, the annual usage is about 15 million tons, but the annual production is only about 8 million tons, with the balance being imported. The vast majority of current worldwide ammonia consumption is for fertilizer applications, wherein the ammonia is applied by direct injection of liquid ammonia into the soil where it combines with water and is immobilized.

Today only negligible ammonia is used for energy applications, despite the fact(s) that ammonia consists of 18% hydrogen by weight, that a liter of liquid ammonia has 70% more energy content than a liter of liquid hydrogen (and 52% of a liter of gasoline), and that at current prices, ammonia is about 25% cheaper than gasoline.

In power applications, ammonia can be decomposed (“reformed”) into nitrogen and hydrogen, and the hydrogen can be fed to a fuel cell or an internal combustion engine (ICE). Moreover, ammonia can be used directly, without additional decomposition to hydrogen, to power a fuel cell (a different fuel cell than the hydrogen fuel cell), an ICE, or can be used to fuel an efficient, high-temperature heat source to power a Stirling engine or thermoelectric device.

God has given ammonia additional attributes to make it an exceptional fuel for a cleaner, better future. Ammonia can be readily and economically produced from coal, which the US has in tremendous quantities, and ammonia is much easier to store and transport than hydrogen. For the environment, ammonia is not itself a greenhouse gas,

and it contains no carbon to produce carbon dioxide, either in reforming or combustion. Also, ammonia power systems can be engineered to produce negligible quantities of NO<sub>x</sub>, which would contribute to smog and acid rain.

A final and extraordinary feature of ammonia power is that the “exhaust” waste products of energy production, by either reforming/fuel cell or combustion, are simply nitrogen gas and clean, potable water. In fact, a liter of liquid ammonia theoretically produces approximately 4 kWh of energy and nearly 1.6 liters of pure water. This feature could be a real blessing in remote or underdeveloped areas, or in disaster situations, where both energy and drinking water are important.

**III-A. Sustainable Energy Options**  
**Saturday, August 6**      **Hostetter Chapel**  
**3:45 PM–4:45 PM**

### **Energy: Forbidden Fruit, Holy Grail, Christian Calling?** **Ian Hutchinson**

Developing controlled nuclear fusion, the energy source of the sun and stars, as a human resource has been a compelling vision since the start of the nuclear age. The astonishing technical difficulty of “recreating” on the human scale what God has gifted us with, so elegantly and stably, on the solar scale, has proven far greater than was initially imagined. Nevertheless, research now stands at the threshold of a scientific demonstration of a burning plasma.

In this talk, a survey of the present state of fusion research will be given and some reflection on the spiritual dimensions of this challenge. Does God want humans to develop fusion energy? Are we in danger of making it into a fanciful and perhaps idolatrous heroic quest? Or is fusion research an appropriate calling for a Christian?

**III-A. Sustainable Energy Options**  
**Saturday, August 6**      **Hostetter Chapel**  
**4:45 PM–5:15 PM**

### **Commitment to Nuclear Fusion as a Sustainable Energy Source in the Developing World** **Robert Kaita**

The promise of nuclear fusion as a potentially inexhaustible energy source has motivated a large research effort in the industrialized nations of the western world. It is noteworthy that there are a substantial number of developing countries that have made nuclear fusion research a national priority. India and the People’s Republic of China, for example, have growing nuclear fusion programs. In spite of its economic difficulties, South Korea is forging ahead with one of the most technologically advanced facilities for magnetic fusion research.

Interestingly, the US had plans for a similar device about a decade ago. Even though the country had a much stronger economy and technological base, such a device was considered unaffordable. Such decisions clearly do not depend exclusively on technical considerations.

This presentation will consider how a Christian perspective might inform on their relationship to good stewardship and the humility required to have realistic expectations.

**III-A. Sustainable Energy Options**  
**Saturday, August 6**      **Hostetter Chapel**  
**5:15 PM–5:45 PM**

### **Nuclear Energy: Curse or Blessing?** **Pavel Hejzlar**

Nuclear power is one of the most controversial energy sources that humankind mastered. It raises fears and at the same time has enormous potential to supply large and ever growing energy needs without substantial negative impact on the environment. But is it a sustainable energy source?

In this presentation, the current status of the nuclear enterprise will be reviewed and key issues will be outlined, followed by the latest developments and future directions that address these challenges and open up new possibilities beyond

## Parallel Sessions Abstracts

electricity generation, in particular hydrogen production for the transportation sector. But is nuclear energy of assistance or does it hinder the pursuance of our biblical mandate of earth stewardship and is nuclear fission research the right calling for a Christian?

**III-A. Sustainable Energy Options**  
Saturday, August 6

**Hostetter Chapel**  
5:45 PM–6:15 PM

### **Nuclear Waste Disposal: The Perspective of One Christian**

Tjalle T Vandergraaf

Although more than 60 years have passed since Enrico Fermi's group showed that a nuclear fission chain reaction could be sustained, and the first nuclear power reactor, Calder Hall, reached criticality in 1956, nuclear power is still considered by some as an alternate energy resource. Yet, in 2004, the ~440 nuclear power reactors in the world represented a total installed capacity of ~370 GW(e) and generated 2525 billion kWh, replacing 600 million tonnes of oil.

The operation of nuclear power plants generates a variety of wastes, from relative small volumes of highly radioactive spent fuel to larger volumes of low-level radioactive waste such as contaminated rags. Christian stewardship of the Earth and good environmental practices dictate that these wastes must be disposed of safely and in a manner that will not endanger the environment. As responsible Christians, we should also ensure that the legacy of our lifestyle not be left to future generations, but dispose of our wastes in a timely fashion.

In comparison with chemically toxic elements, radioactive fission products and transuranic elements have the distinct advantage in that they have finite half lives and that, given sufficient time, they will decay to stable elements. The key to removing these nuclear fuel wastes from the environment is then to isolate them from the biosphere until they have decayed to insignificant levels or that their reintroduction into the environment can be sufficiently slow to prevent deleterious effects on the environment.

Of the disposal options studies conducted over the last 30 years, deep geological disposal has shown the greatest promise. The assessment of the

environmental impact of this method of disposal over a time frame that exceeds by far that of recorded history has presented an interesting challenge and requires a detailed understanding of geochemical and hydro geochemical processes, contaminant transport, and transfer of nuclear waste components between the geosphere and the biosphere.

Both experimental studies and investigations into natural analogs have led to a better understanding of the long-term behavior of fission products and actinides. In this paper, the results and implications of some of these studies will be presented.

**IV-A. Sustainable Energy Climate**  
Sunday, August 7

**Hostetter Chapel**  
11:15 AM–11:45 AM

### **Earth Keeping and the Atmosphere? Where Does Energy Technology Fit In?**

Henry Hengeveld

God created the Earth and all upon it for his own glory and pleasure—and he created it to be inhabited. The unique services provided by the Earth's atmosphere that make such habitation possible is a testament to his creativeness. It provides the clean air we breathe, the protective ozone layer that screens out harmful UV-C and most UV-B radiation, the transport mechanism for distributing rain and minerals, and an insulating blanket that keeps the Earth's surfaces livable. Yet, although humans have a mandate to be stewards of the Earth, they have also begun to alter these atmospheric services in real and significant ways by releasing large amounts of gases and aerosols into the atmosphere as a by-product of their agrarian and industrial activities. Related concerns include acid deposition, stratospheric ozone depletion, air quality degradation and climate change.

Particularly significant in these deleterious outcomes has been the role of fossil fuel combustion for energy. How can scientists and engineers help to restore humankind's Earthkeeping role while continuing to develop technologies that help deal with humanitarian concerns?

This paper will examine how current technologies impact the sustainability of

the basic life-supporting services of the atmosphere and will consider some of the pros and cons of alternative technologies with respect to their ability to serve our needs to be both Earthkeepers and provider's of Christ's mercy to a needy world.

**IV-A. Sustainable Energy Climate**  
Sunday, August 7

**Hostetter Chapel**  
11:45 AM–12:15 PM

### **Renewable Energy and the Climate Stabilization Challenge**

Lynn Billman

This talk will cover two related topics. First, what impact can renewable energy have on climate change? Studies abound. Is there a consensus? I will summarize the calculations and assumptions involved, survey and summarize recent studies, and discuss what it might take to use combinations of renewables to achieve various levels of stabilization of carbon dioxide concentrations in the atmosphere.

Second, the federal government has a wide portfolio of research on technologies that will have a positive affect on climate change. I will present an overview of the Climate Change Technology Program and the many federally funded activities addressing climate stabilization.

**I-B. Technology as a Gift of God**  
Saturday, August 6

**Boyer Hall, Room 137**  
10:30 AM–11:00 AM

### **Piezoelectricity: An Enabling Technology for Health and Welfare**

Fred S Hickernell

This year, 2005, will be the 125th anniversary of the discovery of the piezoelectric effect by the Curie brothers, Pierre and Jacques, in 1880. The piezoelectric effect, an enabling technology, plays a prominent role in our everyday life. It controls the frequency in your cellular phone and is the timekeeper in your wristwatch. It also enables us to see photos of other worlds via satellites millions of miles in outer space.

Piezoelectricity is the ability of crystals with certain symmetries to produce a voltage when subjected to mechanical stress. The effect is reversible. Subject to

an externally applied voltage, piezoelectric crystals will deform or expand by a small amount on the order of nanometers. It is used extensively in a number of important technologies today, particularly for transducers and frequency control in the realm of ultrasound where frequencies extend from above 20 KHz well into the GHz region. Ultrasonic transducers are used in the fields of wireless communication, medical imaging and non-invasive surgical procedures, non-destructive testing (NDT), cleaning, and military applications. Ultrasonic NDT is used in assuring the structural integrity of buildings and power plants.

Carlisle, Pennsylvania (just down the road from Grantham) was a major center of quartz crystal fabrication for military wireless communication applications during WW II. During the war, quartz crystal plates fabricated for frequency selectivity had a priority second only to the development of the atomic bomb. The important applications of the piezoelectric effect at ultrasonic frequencies promote the safety, security, and health of each of us. Truly it is one of God's unique provisions for our welfare.

**I-B. Technology as a Gift of God**      **Boyer Hall, Room 137**  
**Saturday, August 6**      **11:00 AM–11:30 AM**

**Energy Savings Achieved by the Use and in the Manufacture of Glass with Solar Control Coatings**  
**Annabelle Pratt**

Several aspects of the use of glass with solar control coatings will be considered in this presentation. A solar control coating is a coating which is applied to a sheet of glass to control the transmission of solar energy. In a warm climate, glass may be coated with a solar coating which lowers the solar energy entering the building, thereby keeping it cooler and lowering the power required to cool the building with air conditioning. In a cool climate, a coating may be applied which reduces the solar energy escaping the building, keeping more heat in the building and thereby lowering the energy used for heating. In this way, considerable energy savings may be realized. These products have been used for some time in large commercial

buildings, but are now also available in the residential market.

The basic principles of solar energy transmission through glass with a solar coating will be presented, as well as a discussion of the technology used to apply these coatings. Almost all coatings are applied through a process of physical vapor deposition, also referred to as sputtering. This technology has been available since the 1970s and has experienced explosive growth over the past three decades. Some growth is driven by government mandates, for example, in Germany, while in countries where no regulation exists, such as in the United States, growth is achieved through marketing, appealing to consumers' desire for a lower cost of ownership. The sputtering process requires a vacuum chamber, fed with the gases necessary to create the coating, and high voltage power supplies to ignite a plasma. Further energy savings may be realized by using efficient power supply designs which would minimize the power losses within the supply. It is also argued that, by designing a high quality interface to the electric power distribution system, it is possible to reduce losses within the electric power distribution infrastructure, providing further energy savings.

**I-B. Technology as a Gift of God**      **Boyer Hall, Room 137**  
**Saturday, August 6**      **11:30 AM–12:00 PM**

**Appropriate Technology Now—Two Examples**  
**Paul Arveson**

The most appropriate thing about appropriate technology is that it is ready to use now. It does not need to wait for technological improvements. It does not need to wait for cultural acceptance. It does not need to wait for academics to resolve endless debates about the limits of technology, the impacts of technology, etc.

The tsunami of last Christmas taught the world that the use of advanced technologies is not an option any more, for any culture, no matter how primitive. As a technologically advanced nation, we have a moral obligation to use technology to save lives everywhere, to warn people of dangers as well as to care

for the sick and injured after the fact. Likewise leaders in underdeveloped nations now recognize their obligation to get help in building a modern warning system to protect the lives of their citizens. If a warning system is available somewhere, it is necessary everywhere. If a vaccine is available somewhere, it is necessary everywhere—*now*.

This talk will describe two widely divergent examples of appropriate technology that provide brilliant, cost-effective solutions to major environmental and economic problems: one for developing nations and one for the poorest and most underdeveloped nations. Most importantly, these technologies are available now, not merely marketing hype and future dreams. Nevertheless, for inadequate reasons they are underutilized and they need all the publicity they can muster.

**I-B. Technology as a Gift of God**      **Boyer Hall, Room 137**  
**Saturday, August 6**      **12:00 PM–12:30 PM**

**Use of Autonomous Vehicles for Improved Stewardship of Natural Resources**  
**Steven G Hall**

A series of autonomous vehicles have been developed and used to test water quality and to drive predatory birds from fish ponds. The devices are solar powered, controlled by microchips, driven by dual paddle-wheels, with guidance in the form of physical, magnetic, infrared and/or image based sensors. Concerns related to the use of autonomous vehicles may center on their effectiveness, but ethical aspects are also highly significant. How free should an autonomous vehicle be? What powers should it have? Should there be limits on its potential impacts on the environment or humans? How can such vehicles help humans to carry out biblical mandates of stewardship or healing?

One example of studies-to-date is the use of these vehicles for nontoxic, environmentally friendly reduction of bird predation on cultured catfish ponds. The boats have proven to be effective in this work, and, since they are programmable, may be adaptable as the birds adapt. This can help reduce the need for another technology, while

avoiding fatal confrontations, toxic chemicals or loud noises, which are some of the other methods currently used to drive birds away. Furthermore, these devices are solar powered and highly efficient, and show that technology can be part of the solution to environmental problems. However, care should be exercised as these are used.

One version of the boats uses a water cannon which squirts pond water at predators. More toxic or dangerous weapons were eschewed in this version of the boat, but consideration of autonomous vehicles for military or other purposes has been proposed and unmanned aerial vehicles have been used in military operations. Consideration of what limits engineers may build in or suggest when inventing or designing these devices is needed as further development proceeds.

**II-B. Limits and Emergent Properties**  
**Saturday, August 6**      **Boyer Hall, Room 137**  
**1:30 PM–2:00 PM**

**The End of the Age of Oil**  
**Robert E Sundell**

Expressing his concern about the world's energy supply, David Goodstein says:

Until 200 years ago the human race was able to live almost entirely on light as it arrived from the sun ... We, more or less, left earth's fossil fuels untouched ... Today we are using up the fuels made from the sunlight that the earth stored up for us over those hundreds of millions of years. Obviously we have unintentionally created a trap for ourselves. We will, so to speak, run out of gas. There is no question about that. There is only a finite amount left in the tank. When will it happen?

And, we might add, what are our future options?

This presentation will review current estimates of the world's conventional oil supply. In particular, predictions using "Hubbert's peak" analysis<sup>1</sup> indicate that the world's oil production may peak sometime in this decade or, at the latest, in the next and then decline thereafter. The analysis assumes the crisis occurs when production peaks and begins to decline. This peak will occur when we have depleted approximately half the oil originally contained in the earth.

Other estimates using Reserves/Production (R/P) analysis, popular in the

oil industry, range from 40 to 100 years.<sup>1</sup> The R/P analysis assumes that we continue to consume oil at the current rate (it does not take into account the rising consumption of oil in developing countries such as China and India). Furthermore, it assumes that the crisis occurs when the last drop of oil is pumped.

Other sources of oil such as found in oil sands, tar sands, and shale oil will be considered. Also, the possibility of using the other two primary fossil fuels, natural gas and coal, will be discussed. However, this may be the century we must learn to live without fossil fuels. Goodstein claims:

If we put our minds to it, we could start to kick the fossil fuel habit now, protecting the planet's climate from further damage and preserve the remaining fossil fuels for future generations as the source for chemical goods. (Ninety percent of the organic chemicals we use are made from petroleum).<sup>1</sup>

As a means to this end, selected alternate energy sources and technologies will be reviewed as well as the author's research experience in industry on energy saving appliances. To quote Dietrich Bonhoeffer: "The ultimate test of a moral society is the kind of world that it leaves to its children."

<sup>1</sup>David Goodstein, *Out of Gas* (New York: W.W. Norton & Company, 2004); and Website: www.hubbertpeak.com

**II-B. Limits and Emergent Properties**  
**Saturday, August 6**      **Boyer Hall, Room 137**  
**2:00 PM–2:30 PM**

**The Hydrogen Energy Economy: Promise or Illusion?**  
**Kenneth Piers**

Hydrogen is being promoted as the basis for the energy economy of the future. Its main attraction as a fuel is that when combusted with air in a fuel cell it produces electrical energy which can be used to power an electric-drive vehicle with only water being produced as a chemical product of the reaction. Although the development of fuel cell technology itself still requires very substantial and challenging improvements before commercialization will be possible, already it is being claimed that since hydrogen is abundant on planet earth, we will have a virtually

endless supply of clean energy with which to power modern civilization into the future.

However, it is clear that in a profound thermodynamic sense, hydrogen can never be an energy source; rather, because it needs to be produced from other materials, hydrogen will always be a net energy consumer. Now this fact by itself does not necessarily mean that we should not engage in the exploration of a hydrogen-based energy economy. For example, in North America, food production also is a net energy consumer, but because whole wheat bread both tastes better than a piece of coal and is more nutritious, we deem it appropriate to use primary energy resources for food production. But because hydrogen is being proposed not as a food material but as an energy source—more correctly an energy carrier—it behooves us to ask whether or not the energy used to produce, store, distribute, and deliver hydrogen might not be used in better ways. Moreover, the physical and chemical properties of hydrogen suggest that using it on a massive scale in a consumer society will present extraordinary challenges. Add to this the reality that hydrogen leakages may very well pose serious global environmental risks prompts us to suggest that we carefully review the potential benefits versus potential costs before allocating substantial public resources in the direction of a hydrogen-based energy economy.

**II-B. Limits and Emergent Properties**  
**Saturday, August 6**      **Boyer Hall, Room 137**  
**2:30 PM–3:00 PM**

**Geothermal Energy: The Solution, a Contributor, a Diversion, or Part of the Problem?**  
**A J (Chip) Mansure**

Technology is intrinsically neither good nor evil; it is neither the solution nor the problem. Energy production and utilization technologies are neither good nor evil. All energy technologies, including geothermal energy, have pros and cons, can be helpful or abused.

There is no single simple answer to biblical energy policy. While paramount is "love the Lord thy God ... And ... thy neighbor," strong arguments can be

made that biblical mandates don't end there. We are called to stewardly and caring environmental dominionship. However, the focus is usually on the desired outcome, not the process of choosing and implementing—that too should be biblical. Too often we make energy decisions based on emotion: “Will supporting this position make me feel good?”

The history of geothermal energy shows that emotion does not lead to wise energy choices. There are valid, non-paramount, biblical mandates for how to make biblical choices: “Anyone, then, who knows the good he ought to do and doesn't do it, sins.” Also, ignorance is no excuse—in the Torah we are called to repent of sin committed in ignorance. Furthermore we are told to “silence the talk of foolish men.” Thus, we are called to debate for informed, intelligent energy decisions consistent with other biblical mandates.

Governments, industry, and consumers are making daily energy production and utilization choices and establishing the energy policy. “All have sinned.” But, the biggest hurdle to making biblical energy decisions is not industry or government; it is the need for informed, intelligent consumers and media.

A review of geothermal energy provides evidence of this. Too many dreams of sustainable, renewable, and environmentally friendly energy economies do not consider the transition from here to there. Is the transition nondisruptive, that is, is the transition “just healing, caring, etc.” or does it exasperate inequities? Will the transition support the paramount mandate?

Geothermal energy will be reviewed as a study of making informed, intelligent energy decisions. Geothermal energy is not a diversion. By itself, it is neither the solution nor a compounding of the problem. It is part of a viable path to a biblical energy future.

II-B. Limits and Emergent Properties  
Saturday, August 6  
Boyer Hall, Room 137  
3:00 PM–3:30 PM

### Making Personal Technology Work Appropriately

William M Jordan  
Bill Elmore

As Christians we believe the Bible gives us insight into how we should treat the world around us. Discovering knowledge about our world is consistent with our belief in a reasonable God who has created a reasonable physical world. Part of our culture's increase in knowledge involves the creation and use of technology. How we use technology shows us something about what we really believe is important.

This paper will concentrate on what we call personal technology—technology that is aimed at personal use. This paper seeks to relate the use of personal technology to our Christian world view. We will examine personal technologies whose apparent goal is to improve personal productivity. Among the technologies we will examine are: personal data assistants, notebook computers, communication technologies, voice mail, and cell phones. We will examine several issues related to the use of personal technologies. We are following the general perspective laid out by Stephen Monsma in his book *Responsible Technology*. We agree with his fundamental point that technology is non-neutral. However, his book was published in 1986 and many of these personal technologies did not then exist. Those that did exist at that time were not in as robust a form as we find them today. We will apply this perspective of the non-neutrality of technology to these newer personal technologies.

Richard Swenson in his books *Margin* and *The Overload Syndrome* also has some insight into how to use these technologies without letting them control us. We will examine the intrinsic implications of using personal technology. How do these technologies fit into our calling as Christian engineers? Do these technologies control us rather than have us control them? Are we using these technologies for our own personal satisfaction or gain? Are we using these technologies for advancing God's Kingdom?

III-B. Limits and Emergent Properties  
Saturday, August 6  
Boyer Hall, Room 137  
3:45 PM–4:15 PM

### Nanotechnology: Its Impact on Society and Our Christian Response

Randy Isaac

Nanotechnology, the study of systems with nanometer scale dimensions, is being promoted as the next big surge of high-tech productivity enhancement and a great opportunity for investment. What is the reality behind these claims and what are the likely implications of nanotechnology for our society?

The two areas of nanotechnology to be discussed in this talk include nanoelectronics and biotechnology. Nanoelectronics is the extension of microelectronics into the nanoscale realm and will continue the dramatic advance of computing systems. Innovative concepts using carbon nanotubes, nanowires, or single-electron transistors may someday prove to be viable for computation. Biotechnology, distinct from genomic studies, in the nanoscale regime uses organic molecules and organisms such as phages that may someday begin to be useful in manufacturing techniques. Self-assembly techniques, ubiquitous in nature, may be harnessed for the production of unique materials. The impact on society of these advances include productivity enhancements and new functional capabilities but at the expense of shifts in job skills and at the risk of new unknown environmental hazards.

As Christians, we need to have a measured response that avoids the extremes of ignoring the risks on one hand and alarmist charges on the other hand. We need to address the social needs of job training and thoughtfully assess the risks. Finally, we need to encourage Christian students in science to pursue emerging fields such as nanotechnology so that they can help influence the direction of research and its application.

**III-B. Limits and Emergent Properties** Boyer Hall, Room 137  
**Saturday, August 6** 4:15 PM–4:45 PM

**The Moral Neutrality of Technology**  
 Jack C Swearingen

Western cultures are essentially technological in form and function, and—perhaps not surprisingly—citizens of these cultures hold a quite positive view of technology. The great majority appears to believe that technology is morally neutral and only the user—by selecting the use—can create a moral situation. Consistent with this worldview, engineering students are taught that their profession is “problem solving for the betterment of human lives.” But the good that engineering—and the technology that results—has done for the human race may result from serendipity, providence, and economics as much as it is to the benevolence of engineering as a discipline.

Technology is not inherently more likely to be used for evil purposes than good, nor is it uniquely dangerous per se compared to all other human endeavors. Nevertheless among human endeavors, only technology entrains the capacity to extend human life and make it less laborious, but also to extinguish species (including the human one), decrease self-reliance, destabilize the planet’s life-support systems, transform security into snooping, and associate communication with voyeurism.

Science, engineering, and technology are human endeavors, done by people who hold certain worldviews and have specific intentions. Although engineering is often viewed as applied science, engineering and technology are separate professions from science and have their own methodologies. Engineering projects cannot be value-neutral because designs are developed with integral values, properties, and goals in mind. Furthermore, all engineering has consequences beyond the design intentions—ranging from serendipity to unintended consequences, nasty surprises, and emergent properties. Some of the consequences extend way beyond advances in material and physical well-being, labor saving, defense, and public safety. But engineering and technology endeavors cannot be separated from their applications,

because by definition technology not used has no impact.

In this presentation, I will question the concept of inherent neutrality of technology, by examining the engineering design process and providing examples of unanticipated consequences. The results support the need for a theology of technology.

**III-B. Limits and Emergent Properties** Boyer Hall, Room 137  
**Saturday, August 6** 4:45 PM–5:15 PM

**Technology and the Bible**  
 Job S Ebenezer

The Bible is not a manual on technology. Its teachings however can be used to evaluate technologies. Technologies derive their value from the institutions or persons who invent them, design and manufacture them, and finally put them to use. As human beings and the institutions are sinful, the technologies created and used by these institutions are in need of redemption.

The biblical concepts of justice, peace, and care of creation are useful yardsticks to evaluate technologies. One of the scientists who used this method was Dr. George Washington Carver.

In this presentation, Carver’s theology and his work will be used as a model for Christian engineers to follow.

**III-B. Limits and Emergent Properties** Boyer Hall, Room 137  
**Saturday, August 6** 5:15 PM–5:45 PM

**Solar Power: The Next Generation of Personal Transportation?**  
 Ruth Douglas Miller

This summer, and every alternate summer since 1993, design teams have raced cars powered by nothing but the sun across the North American continent. The most reliable vehicles will travel 300–350 miles in one 10-hour day, carrying one or two people and consuming no fossil fuels whatsoever. People we pass are usually fascinated, and one very common question is, “When will I be able to buy one?”

The idea of an energy-independent personal vehicle is a very appealing one,

whether the motivation is stewardship or purely cost-saving. When we compare racing solar cars with typical gasoline-powered passenger vehicles, we can see the kinds of problems that must be surmounted if we are to convert our fossil-fuel-dependent transportation to something renewable. Passenger cars mass about 1.5 metric tons; solar cars 200–300 kg. Gasoline engines generate 150–250 hp, or 11–20 kW of power; the 8-m<sup>2</sup> (6.5 x 13 ft) solar array allowed on a racing solar car generates 1.2–1.5 kW. The solar car carries one person, or maybe two; the passenger car can carry five, though most of the time it carries only one. Refueling costs the gasoline-dependent driver something like \$20–\$30 or more US; it costs the solar car driver nothing but at least a partially clear sky, but her array cost her \$50,000–\$100,000, and it is extremely fragile. Can solar power be part of the solution to the problem of personal transportation in a fossil-fuel-deficient world?

Improvements in solar cell technology and battery technology are continuing, and it is reasonable to envision personal transportation of the future based partly on solar energy. Purely solar cars for the general public are probably unrealistic because of the cost, size and fragility of their cells; but battery-powered purely electric cars may be feasible, their solar cells on garage roofs, charging land-based batteries while their owners work. Solar energy could also split water for the much-touted “hydrogen economy,” another alternative to fossil fuel energy for personal transportation.

Practical solutions can be envisioned now and may not affect our lifestyle as drastically as many of us have contemplated as we look at “Hubbert’s Peak.” But it is unrealistic to assume that we can continue our consumer lifestyle indefinitely even when the oil runs short.

**III-B. Limits and Emergent Properties** Boyer Hall, Room 137  
**Saturday, August 6** 5:45 PM–6:15 PM

**Butterflies in the Machine (Or “Renewable” Doesn’t Mean “Harmless”)**  
 Sean M Cordry

The notion of “peak oil”—that is, the impending decline in petroleum production—is making inroads into

mainstream and popular thought, which is focusing more attention on renewable energy sources. Generally, discussions of the limitations of renewable energy sources focus on the technological and economic challenges facing industrial-scale deployment of such facilities.

In this paper, I will demonstrate that renewable energy, while likely less polluting to the environment, is not inherently innocuous to the environment on either a local or global scale. The use of renewable energy sources necessarily requires the transfer of energy from one region to another; therefore one region experiences an increase in energy input while the other experiences a decrease in “normal” energy input. Given the scale of current energy use and the unquestioned mantra of growth in developed countries, the energy “relocations” involved in utilizing renewable energy sources pose a threat to “normal” environmental/climatological functioning. Developments in understanding the highly nonlinear and interconnected nature of climate underscore the importance of this issue, which I believe to be novel and essential to the conversation about renewable energy.

In a reasonable creation-care approach to environmental stewardship, we must realize that it is reckless to pursue any energy source with the attitude that it is unbounded and without “cost.” To that end, I will suggest a reasonable upper-bound for regional energy collection that I believe to be in harmony with the way that environmental systems utilize insolation energy.

**IV-B. Biblical Management of Technology**  
Sunday, August 7

**Boyer Hall, Room 137**  
11:15 AM–11:45 AM

### **Naming the Elephant: The Precautionary Principle, Science, and Uncertainty**

John R Wood

The precautionary principle has been widely debated in the United States over the last five years as an alternative to traditional risk assessment practice. The problem we face is how to proceed in the face of ignorance. Is the precautionary principle sufficient for creation care or environmental stewardship? Strong and

weak versions have been proposed, but some commentators have pointed out that it is difficult, even impossible to define the concept. Yet some government agencies and numerous international treaties cite the precautionary principle as a policy guide. So why not extend it to all technology innovations, or should we simply drop it altogether? The answer to uncertainty may not lie in this simple choice.

Technology driven change has been called the “master force of our age.” The pace and scope of this change shapes not only nature and social institutions, but us, too. The debate over precaution illustrates the uneasy relationship of science to society. The wonders of scientific discoveries have brought remarkable benefits, but have raised deep suspicions as well. Some say the reasons for this state of affairs resides in poor communication by the media, or scientists and engineers.

Others blame special interest groups for our anxiety, as the Danish statistician Bjorn Lomborg did recently in *The Skeptical Environmentalist*. Still others point to the failure of the education system to produce informed citizens. But the problem is deeper, and requires a wider framework for decision-making and new kinds of relationships.

The biblical vision of our place includes our kinship not only with each other, but also with the creatures, going beyond the instrumental human use approach associated with modern science. In the wisdom literature, we see justice, trust, and relationship as concomitants of uncertainty. These are not virtues necessarily emphasized in the practice of science and technology. But religious persons may be able to uniquely contribute to better decision making by helping us develop deeper respect for each other, our institutions, and for the rest of creation.

**IV-B. Biblical Management of Technology**  
Sunday, August 7

**Boyer Hall, Room 137**

11:45 AM–12:15 PM

### **What Would Jesus Drive? Biblical and Theological Reflections on Technology as Problem and Solution**

Jim Ball

My paper will offer biblical and theological reflections on the issue of technology’s role in both solving and creating problems for society. The technological areas to be primarily reflected upon will be the energy and transportation sectors and their capacity to both create and reduce air, water, and climate change pollution. Insights from the work of the Evangelical Environmental Network (e.g., our “What Would Jesus Drive?” educational campaign) will inform the paper.

Technological solutions to environmental problems are possible and desirable. But this must be tempered by Christian realism concerning the sinfulness of humanity and our inability due to our finitude of detecting unforeseen problems arising from promising technological solutions. Both individuals and society collectively must respond to the possibilities and perils of technology.

Christians must recognize that sometimes the best solution to a problem is not more technology, but the ultimate spiritual solution—a strong relationship to Jesus Christ and the sense of personal contentment this brings to not ceaselessly strive for more or larger things. But Christians must also recognize that even among believers such personal contentment is rare, and due to human sinfulness cannot be the basis of sound public policy. Nor can the marketplace alone necessarily provide solutions to long-term problems, as demonstrated by pollution being a negative externality. Helpful technologies that offer more choices to reduce pollution must be encouraged by market-friendly government policies.

I-C. Appropriate Boyer Hall, Room 131  
 Technology  
 Saturday, August 6 10:30 AM–11:00 AM

**Sustainable Solutions for Rwanda:  
 A Case Study**  
 Peter J Bosscher

Rwanda is the most densely populated country in Africa and also one of the poorest. The community of Muramba is representative of Rwanda in that the most basic problem facing people is the lack of potable water and available energy sources. Children and adults spend hours every day retrieving dirty water from an outdated gravity-fed system. Tests on the water quality have indicated the presence of coliform and *E. coli*. Frequent illness is associated with the unclean drinking water that the community is unable to purify.

The Engineers Without Borders organization at the University of Wisconsin-Madison traveled to Muramba to assess, design, and implement strategies for improving the quantity/quality of water and identifying alternatives to harvesting firewood which has led to deforestation and soil erosion. The goal is to train local experts to implement sustainable solutions which can be maintained and duplicated in other regions of Rwanda. This paper will describe our experience with this effort.

I-C. Appropriate Boyer Hall, Room 131  
 Technology  
 Saturday, August 6 11:00 AM–11:30 AM

**Renewable Energy for  
 Sustainable Village Power**  
 Larry Flowers

There are more than two billion people without the benefits of electricity, and an equal number with less than reliable, affordable, 24-hr electricity. Electricity provides access to basic health services and education, as well as the opportunity for local economic development.

Renewable energy (RE) has a particularly appealing role to play in providing and expanding electricity and all its benefits to the village power setting; renewables are indigenous, inexhaustible, economically competitive, environmentally superior, and provide a more sustainable solution than the

conventional solutions of batteries, kerosene, diesel, and line extension.

For the most part, the challenge is not technical, rather it is institutional. Getting RE solutions into the mainstream requires a multi-year program that includes addressing such institutional barriers as hidden subsidies, unfamiliarity with RE solutions by the established energy providers, policy inequalities/ disincentives, inadequate knowledge of RE resources, lack of in-country expertise, poor tariff design, lack of local capacity to provide O&M, lack of RE infrastructure, lack of comparative analysis tools that adequately compare RE options to conventional solutions, and lack of experience with RE technologies by responsible government agencies.

A model for successful RE solutions will be presented based on more than ten years of experience in more than ten countries.

I-C. Appropriate Boyer Hall, Room 131  
 Technology  
 Saturday, August 6 11:30 AM–12:00 PM

**The Rise of Sanitation and the  
 Decline of Pestilence**  
 Joseph H Lechner

Until mid-nineteenth century, the streets and waterways of major European cities were choked with refuse, human waste, and domestic animals. Millions of people perished during outbreaks of infectious diseases.

Edwin Chadwick (19<sup>th</sup> century; England) was one of the first to suspect a connection between the two. Convinced that filth in the streets was somehow responsible for the cholera epidemics of 1831–1832 and 1848–1849, Chadwick campaigned for better sanitation.

The Public Health Act of 1848 required a fixed sanitary arrangement in every household. The first sewer system in London was begun in 1858. Although a flushing water-closet had been invented by Harington as early as 1596, only two examples of it were built, and they fell into disuse after the inventor's death.

In contrast, Jennings' *Closet of the Century* (1870s), Hellyer's *Optimus* (1878), Bostel's *Excelsior* (1875) and Twyford's *Unitas*

(1883) were mass-produced and were affordable to middle-class households.

After lavatories and sanitary sewers came into widespread use, the mortality rates from cholera and typhoid dropped precipitously. Medical missionaries to third-world countries have found that the most cost-effective and manpower-effective way to reduce suffering and premature death is to introduce rudimentary sanitation measures.

I will show examples of teaching materials that are being used in Papua New Guinea today. The sanitation practices taught are similar to instructions that were given to the ancient Hebrews:

Thou shalt have a place also without the camp, whither thou shalt go forth abroad: And thou shalt have a paddle upon thy weapon; and it shall be, when thou wilt ease thyself abroad, thou shalt dig therewith, and shalt turn back and cover that which cometh from thee: For the LORD thy God walketh in the midst of thy camp, to deliver thee, and to give up thine enemies before thee; therefore shall thy camp be holy: that he see no unclean thing in thee, and turn away from thee (Deut. 23:12–14; KJV).

I-C. Appropriate Boyer Hall, Room 131  
 Technology  
 Saturday, August 6 12:00 PM–12:30 PM

**Converting Coconuts into  
 Value-added Products for  
 Developing Countries**  
 Sarah Gibson  
 Lindsey Mack  
 Walter L Bradley

The coconut is a very abundant renewable resource in the very parts of the world that are most underdeveloped. Coconut palm will produce batches of coconuts every three months or four batches per year for seventy of the eighty years of their lives. We believe that coconuts can be converted into electric power, food for pigs and chickens, particle board for housing, filters for water, and fuel for cooking.

The challenge is to convert coconuts into these basic human needs of energy, clean water, food, and housing using technology that is inexpensive and sufficiently simple that it can be used and maintained by rural villagers.

**II-C. Appropriate Technology**  
**Boyner Hall, Room 131**  
**Saturday, August 6 1:30 PM–2:00 PM**

### **Incentives for Reducing Emissions from Deforestation in Developing Nations**

**Kevin M Conrad**  
**Ambassador Robert Aisi**

The objective of this paper is ambitious—it is to reconcile forest stewardship with economic development in forested tropical countries. Many of these nations are simultaneously struggling to defeat poverty while challenged with responsibility over a majority of the world's biodiversity.

Our aim is to establish models that will work for all forested tropical countries, using a combination of income streams derived from carbon sequestration (carbon releases avoided by retaining forests), selective logging coupled with vertical market integration, eco-friendly “cash crop” cultivation, biodiversity purchase and leases, community-based venture creation, and reprioritized international grant strategies.

The concept is simple: developing nations must demonstrate leadership and agree to be held accountable for their carbon emissions and forest management policies; in exchange, industrialized nations must encourage such action through *equal* participation in global markets.

Specifically, the Kyoto Protocol presently excludes the utilization of the carbon sequestration and avoided carbon emissions in support of sustainable rainforest management in the tropics. It is important to acknowledge, however, that during the 1990s the IPCC calculates that an estimated 25% of annual global carbon emissions were generated through land-use change, primarily driven by the destruction of forest resources. Therefore, we seek to develop robust frameworks in order to reform international regulations related to carbon emissions trading such that assets based on forest sequestration or avoided-deforestation are included.

Summary: By drawing on economics and conservation biology, it is now possible to develop collaborative frameworks within which developing countries can dramatically improve the long-term global prognosis for rainforest stewardship, biodiversity conservation,

climate stability (via reduced carbon emissions), sustainable development and poverty alleviation. We cannot afford to fail in this endeavor, as this approach provides the best opportunity to reconcile economic development and environmental sustainability in forested tropical regions. If these two outcomes cannot be attained together, it is unlikely that either objective will be attained individually. The stakes are high; we must accept the challenge to think creatively and constructively.

**II-C. Appropriate Technology**  
**Boyner Hall, Room 131**  
**Saturday, August 6 2:00 PM–2:30 PM**

### **Called to Care: For the Poor, the Earth, and the Great Commission**

**Martin L Price**

In this slide-illustrated talk, I explore briefly whether there is a food shortage or food surplus, discuss what kind of problems missionaries encounter when they want to help small farmers, give examples of technical questions missionaries have asked, talk about some of the most interesting underutilized plants in our seedbank and show pictures of methods used to grow gardens in light-weight beds above the ground on pavement or rooftops using recycled or waste materials. I conclude with some personal challenges. Calling and career opportunities are also a theme.

**II-C. Appropriate Technology**  
**Boyner Hall, Room 131**  
**Saturday, August 6 2:30 PM–3:00 PM**

### **How Did It Start? Where Has It Been? Where Is It Going? Appropriate Technology in the Messiah College's Department of Engineering**

**Carl A Erikson Jr**

The concept of Appropriate Technology (AT) as part of the engineering curriculum at Messiah College started in January 1990. AT projects have now sent faculty and students to Venezuela, Burkina Faso, Zambia, Nigeria, Nicaragua, Guatemala, and even, downtown Harrisburg, PA. Several co-curricular groups have been established using the principles of AT

as part of their mission. The future of AT at Messiah College is bright as a new Integrated Projects Curriculum is being developed in the engineering curriculum.

**II-C. Appropriate Technology**  
**Boyner Hall, Room 131**  
**Saturday, August 6 3:00 PM–3:30 PM**

### **Engineering Research Applied to Third World Needs: Case Studies of Applied and Fundamental Work**

**Matthew G Green**

Christians are called to be both globally aware (Mt. 28:19–20) and sensitive to humanitarian needs (Mt. 25:38–40), especially those of the household of faith (Gal. 6:10). What role can engineers in academia play in this important work? Some humanitarian needs may be framed as undergraduate design projects. Undergraduates involved in these projects are challenged equally with the engineering content and with the faith required to fulfill the needs of the project's beneficiaries.

At the other end of the spectrum, however, is the role of academic research. A common perception is that the high-tech nature of engineering research disqualifies it from addressing third-world needs which often call for time-tested and well-established solutions. This paper reports two case studies motivated by a passion to apply engineering research to third-world needs.

The first case study reports the results of MS research, culminating in a how-to manual for remote electricity generation. The variety and complexity of small-scale electricity generation technologies make technology selection difficult for one-off installations. This need motivated development of a seven-step methodology that guides a technician in choosing an appropriate technology to generate 10 kW-hr/day or less of electric power in a remote location. Detailed instructions, worksheets, and case studies suitable for readers with a minimal technical background are freely available for download.

The second case study reports work of a more fundamental nature, improving design methods in order to enhance the ability of engineers to design for frontier design environments such as those in the

## Parallel Sessions Abstracts

third world. An engineer facing a frontier design problem lacks the necessary experience database and design methods. This need motivated work toward a fundamental understanding of how product usage context influences customer needs and desired performance characteristics.

Results of an empirical product study show how customer preferences for product characteristics (such as mass and operating cost) vary with contextual factors (such as transportation mode and usage duty.) Early results suggest this information may be generalizable across multiple product domains. The long range goal is a formal "Design for Frontier Environments" module ready to roll out in the engineering classroom and to faith-based groups working around the world in the name of Christ.

**III-C. Appropriate Technology**      **Boyer Hall, Room 131**  
**Saturday, August 6**      **3:45 PM–4:15 PM**

### **International Water Resource Development through an Undergraduate Service-Learning Course** Michael D Guebert

Taylor University has a strong focus on service, stewardship, and world outreach. In keeping with the university's mission and purpose, the Earth and Environmental Science Department has established a new program combining community service and outreach in a developing country with academic application of environmental stewardship in rural water resource development.

In the fall semester prerequisites, engineering and science students study cross-cultural service and missions, community development, and hydrogeology. During three weeks of Interterm Session in January, students travel to Houston for drill training then to Guatemala for project activities related to water resource development such as drilling a shallow well, teaching hygiene, and designing water treatment and sanitation systems. Students also learn about other appropriate technologies through site visits to several National Non-Governmental Organizations. Examinations and regular reflection

through journaling and discussions optimize students' service and learning experience.

This presentation summarizes the structure and outcome of the current program over two years in Guatemala and presents future plans for other service sites in Central America.

**III-C. Appropriate Technology**      **Boyer Hall, Room 131**  
**Saturday, August 6**      **4:15 PM–4:45 PM**

### **Personal Transportation Technologies for Physically Challenged Persons in the Developing World**

Dan Dourte  
John Meyer  
Julie Walsh  
David Vader

Messiah College students and educators in an organization called Dokimoi Ergatai (DE), which is Greek for "approved workers," have partnered since 1996 with Christians and SIM missionaries in Burkina Faso, West Africa, to develop assistive technologies for the poor and marginalized.

One project team has developed personal transportation systems for persons with physical disabilities. For our disabled friends in Burkina Faso, a hand-powered tricycle is freedom and empowerment. Tricycles provide mobility to farm, care for family, and commute to school or work.

DE teams have improved a pre-existing design for more efficient conversion of human power input to forward motion, to make the tricycle easier to steer and more stable in turns, to reduce mechanical failures, and to improve manufacturability. We also have designed and implemented an electric-powered version of this technology that is suitable for use by persons with disabilities so severe they cannot operate the hand-powered system.

Our goal, however, is not merely to supply new technologies, rather we seek designs that our friends can build themselves and eventually improve and make available to others.

As God enables DE participants to meet real needs today, they seek to deepen

their own lifelong commitments to serve Christ and his Kingdom.

This presentation will review the DE pedagogy, which combines academics with Christian discipleship and active response to God's call on our lives. It also will present the outcome of our work to develop personal transportation technologies for the physically challenged in Burkina Faso.

**III-C. Appropriate Technology**      **Boyer Hall, Room 131**  
**Saturday, August 6**      **4:45 PM–5:15 PM**

### **Water Management for Agriculture in Arid Zones: Lessons from Smallholder Production Systems** W Ray Norman

Issues related to agricultural water management will be examined in the context of development assistance to smallholder farmers and their production systems. Practical concepts for enhancing the planning, implementation, and evaluation of smallholder production (notably among small-scale irrigated systems) will be reviewed; followed by a presentation of several case studies from West Africa and Southeastern Arabia.

Issues and lessons learned from each case study will be reviewed. The presentation will also examine ways in which indigenous knowledge can be understood and utilized in assistance initiatives to improve smallholder production systems.

**III-C. Appropriate Technology**      **Boyer Hall, Room 131**  
**Saturday, August 6**      **5:15 PM–5:45 PM**

### **How Students Get Involved with Appropriate Technology Projects around the World: An Example: Water for the World in Guatemala** Dawn Verlander Carl A Erikson Jr

Students in Messiah's engineering curriculum get to know what Appropriate Technology (AT) is all about during the first week of school every year. Through an Opportunity Fair before classes begin, incoming students are invited to attend specific orientation events such as pizza parties, volleyball

games, and evening presentations where upper division students share their experiences in Dokimoi Ergatai, Water for the World, Landmine Action Program, and other organizations.

In addition, during the Introduction to Engineering course, one lecture is devoted to the principles of AT and a major design project is assigned requiring the use of AT principles.

This presentation tells the story of one student's involvement from getting interested in an AT application to becoming a student leader of an AT project team.

# Plenary Sessions Abstracts

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Plenary Session I  
Friday, August 5

Hostetter Chapel  
8:00 PM–9:00 PM

## Renewable Energy and Energy Efficiency in the 21st Century

Stanley R Bull

From the dawn of human civilization to about 100 years ago, the sources of energy used by humankind were predominately human and animal muscle and wood with lesser amount of solar, wind, hydro, and geothermal. With the discovery of oil, the development of natural gas fields, and the widespread distribution of electricity from coal-powered central power plants, fossil fuels became the predominant sources of energy in the United States and the world. As we move further into the 21<sup>st</sup> century, energy is essential to society to ensure our quality of life and to underpin all other elements of our economy.

Drivers such as national security, air emissions, greenhouse gas concentration, electric reliability, and public sentiment are motivation to increase the use of renewable energy and energy efficiency technologies. Renewable energy technologies offer the promise of clean, abundant energy gathered from self-renewing resources such as the sun, wind, earth, water, and plants. Energy efficiency measures lead to energy not used and, from most perspectives, is the “best form of energy.” Renewable resources currently account for 6% of the energy consumed in the US.

Each of the renewable energy and energy efficiency technologies is at a different stage of development and commercialization, and all have differences in current and future expected cost, industrial base, resource availability, and potential impact on the environment. The technical status, cost, and applications of the technologies and implications for their increased adoption is promising.

Solar and wind energy installations have been growing at the rate of more than 30% per year over the past five years. During this time, a number of nations have adopted aggressive penetration goals for renewable energy, and an increasing number of states in the US have enacted renewable portfolio standards that take a variety of forms. All of this portends optimism for a healthy rate of growth for renewables.

A compilation of recent scenarios and studies show a wide range of prognoses for renewable energy projections. An appealing and simply stated goal of 10% renewables by 2010, 20% by 2020, and 50% by 2050 is very aggressive, but not impossible, given the rate of growth over the past five years. We can look forward to a bright energy future by staying on the path we are on.

Plenary Session II  
Saturday, August 6

Hostetter Chapel  
9:00 AM–10:00 AM

## Struggle in the Ethics of Technology

Egbert Schuurman

The advantages as well as the disadvantages of modern technology, in combination especially with the development of the natural sciences, call in general for philosophical reflection.

There is a struggle going on between the various philosophical movements. What is the content of Christian philosophical thinking about technology and its problems? What are the consequences in relation to the ethics of technology? Such questions are very unusual among Christians. Nevertheless, the potential disastrous effects of technology require an ethics of technology. Such an ethics must concern itself with humankind’s good and responsible conduct in and through technology.

Generally speaking, since modern times, there is a technological control mentality.

All questions relating to spiritual reflection and religious problems are ruled out. The world view has been transformed to a technological world view. Motives, values, and norms are derived from it. This implies a technological ethics which is the cause of many threats and problems. It is characterized by a cosmological deficit and an ethical deficit. It is only possible to overcome these deficits by a reorientation in culture and in ethics.

The “Enlightenment” ought to be enlightened itself by the God-given revelation. The cosmology of the reality as God’s creation and the commandments of love give a possibility for the redirection of an ethics of technology.

A responsible cultural and technological development summons a representation of culture that depicts earth as a garden tended by humans. Technology must be developed within the perspective of the earth as one large garden city.

Technology ought to serve life, not threaten it. Besides, in an ethics of responsibility, attention is given to the central motive of love over against the central motive of power of the technological world view.

For a justified, responsible technology, the ethical challenge is not only finding true motives, but also environmental, technological, and social values. Furthermore, technology must obey a large number of normative principles and related norms.

At the end of the lecture, attention is paid to the consequences for praxis of this ethical-philosophical view and to the differences from those views which are currently held. The perspective of an ethics of technology ought not to focus on doing things right, but on doing the right thing.

Plenary Session III  
Saturday, August 6

Hostetter Chapel  
8:15 PM–9:00 PM

## Achieving a Sustainable Hydrogen Economy

George M Sverdrup

Thanks to abundant, reliable, and cost-effective energy resources and systems, the US has long been a driving force in the world economy, helping to raise people's standards of living at home and abroad. This era is drawing to a close as fossil energy resources dwindle and we begin to recognize the environmental consequences of our heavy reliance on fossil energy.

Today, the US accounts for about one-quarter of the annual world energy consumption of 411 quads. We depend upon fossil fuels for about 86% of our energy needs while releasing about 5,800 million metric tons of carbon dioxide into the atmosphere annually. Currently, the US consumes about 20 million barrels of oil per day of which 60% is imported, and petroleum accounts for 97% of the energy used in the US transportation sector.

Recognizing that our nation can no longer rely exclusively on nonsustainable fossil fuels as our energy needs continue to increase, the US has adopted a new vision for America's energy future—a more secure nation powered by clean, abundant hydrogen. Achieving this vision will enhance our energy security, our environment, and our economic well-being.

In this future energy economy, hydrogen and electricity will work together as integrated energy carriers for our economy. Hydrogen will be produced, distributed, stored, and used in efficient processes that are economically competitive in the marketplace.

Options for producing hydrogen from water, fossil fuels, and biomass employing thermochemical, nuclear, and photolytic processes are in various stages of development. These production technologies, whether used in large centrally located plants or in smaller geographically distributed locations, will be inextricably linked to modes of distribution and storage of hydrogen.

Conversion of hydrogen energy to electricity to power our vehicles or buildings will be accomplished by combustion or electrochemically by fuel cells. The inherently higher efficiency of fuel cells coupled to the promise of hydrogen as a clean, domestic, sustainable energy carrier comprise America's vision for our future energy.

Plenary Session IV  
Sunday, August 7

Hostetter Chapel  
10:10 AM–11:00 AM

## Engineering for the Developing World: Challenges and Opportunities

Bernard Amadei

In the next two decades, almost two billion additional people are expected to populate the Earth, 95% of them in developing or underdeveloped countries. This growth will create unprecedented demands for energy, food, land, water, transportation, materials, waste disposal, earth moving, health care, environmental cleanup, telecommunication, and infrastructure. The role of engineers will be critical in fulfilling those demands at various scales, ranging from remote small communities to large urban areas, and mostly in the developing world.

As we enter the first half of the 21st century, the engineering profession must embrace a new mission statement—to contribute to the building of a more sustainable, stable, and equitable world. In particular, we need to train a new generation of engineers who could better meet the challenges of the developing world and address the needs of the most destitute people on our planet.

Today, an estimated 20% of the world's population lacks clean water, 40% lacks adequate sanitation, and 20% lacks adequate housing.

This lecture will present the challenges and opportunities associated with practicing engineering in the developing world.

Plenary Session V  
Monday, August 8

Frey, Rm 110I  
8:15 AM–9:00 AM

## Resources in Philosophy and Religion for the Evaluation of the Social Impact of Technology

Robert Wauzzinski

This address will be preceded by a short biblical exposition. Not only will this introduce my topic but it will attempt also to focus God's Word on the meaning and importance of modern technology.

In my address, we will center on the resources available in the study of philosophy and religion for the evaluation of the social impact of modern technology.

First we will analyze the developments of the modern philosophy of science and how that study impacts the evaluation of technology.

Next we will proceed to an interdisciplinary understanding of the evaluation of modern technology. We necessarily must move in this direction because reality is coherent rather than fragmented as our separate disciplines suggest.

We then will examine the biblical and religious dimensions of modern technology. What are the depth commitments of modern technology and how does the Bible apply to the growth of modern technology? In this context, we will discuss the "cultural mandate" and the idolatry of modern technique.

Following this, we will discuss the ethics and the redemption of technology. What are the typical norms or principles that apply to the evaluation and development of technology? We will focus especially on the alleged value-free character of modern technology by looking at the automobile culture and how it attempts to surpass the ethical demands needed for our lives.

Finally, we will conclude with a discussion of a typology I developed in the book *Discerning Prometheus: The Cry for Wisdom in an Age of Technology* that helps us understand both the social impact and the biblical evaluation of modern technology.

# Poster Session Abstracts

Sunday, August 7, 5:00–6:00 PM, Boyer Hall, Howe Atrium. Posters are on display beginning Saturday afternoon.

## A Comprehensive Model of Intelligent Design

Philip E Anderson

A comprehensive model of Intelligent Design (ID) involves an integration of science and theology. ID is in the “natural sciences,” and it distinguishes between “operation” and “origin” science. Also, a typological model in nature is followed.

For ID, the processes are in accordance with the 2nd Law of Thermodynamics. Note the “Criteria for Spontaneous Processes” (CSP) is drawn to spontaneous (natural) processes and non-spontaneous (non-natural) processes. Also, March notes:

The thermodynamic requirement for a reaction to occur spontaneously is that the free energy of the products be lower than the free energy of the reactants, that is, that Gibbs free energy ( $\Delta G$ ) be negative.

The chemical association of CSP and  $\Delta G$  produce information containing biopolymers, such as proteins and DNA. CSP applies to both physical changes and chemical changes. These biopolymers are formed by non-spontaneous processes requiring work from outside the system. The basic polymerization process is called “a dehydration step-growth polymerization process.” It is the process for forming nylons and polyesters.

Science is open to theology through non-spontaneous processes. This science is the “Origin of the Universe” and “Origin and Development of Life.”

## Origins Don't Matter

Paul Arveson

The notion of historical determinism has been a deep presupposition throughout the 20<sup>th</sup> century. It has gone unquestioned by both extremes in the creation/evolution debate. On the one hand, there are creationists like Henry Morris, who insisted that our origins determine our nature and our values, so that creationism becomes even more foundational than salvation or any other biblical doctrine. On the other hand, we have the message of sociobiologists like E. O. Wilson, who studied ant societies to discover parallels to human societies. He assumes that ants, a primitive form of life that has been around for a couple of hundred million years, are a good model and explanation for human society, including morals and religion.

We tend to place these people on opposite extremes: Morris as a conservative Christian creationist; Wilson as a secular, atheistic evolutionist. But on the notion of determinism, they are both on the same side. They both describe human nature in terms of its ultimate origins, instead of in terms of our existential situation.

Creationism focuses on natural history as series of acts of God or intelligence. Sociobiology and “consilience” describe natural history as an evolutionary continuum. But both insist that our past is prologue, it determines our station in life here and now.

That is the assumption that I wish to question in this talk. I wish to suggest that the disconnect between natural history and human history is so complete that it makes the subject of natural history utterly irrelevant to matters of human nature, moral values, culture, and religion.

## Useful Applications of Time Delay Estimation Algorithms for Noise Source Localization

Marlene M Daneti

The problem of detecting and locating different kinds of acoustic sources represented a major concern for scientific research for many years. The first important results were achieved in the underwater acoustics field by developing sonar systems designed specially for military purposes.

Two major objectives have been followed in order to improve these systems. The first one was to find suitable signal processing algorithms in order to increase the accuracy of the acoustic source's position estimate. Taking into account that the majority of these acoustic sources are random signals, the processing techniques need to be essentially statistical. The second objective was to develop computer architectures capable of computing these intensive algorithms in a short amount of time. Scientists from various fields of research encountered many successful results while carrying out both of these objectives.

Starting from these achievements, different kinds of new practical applications have been developed in areas such as industry, medicine, communications, geology, seismology, oceanography, constructions, etc. A new scientific branch is coming into view: the possibility of diagnosing different systems using some of these “noise” based techniques. Through this, indestructible measurements are made on the supervised systems.

The central problem of all these applications is the capacity of estimating the time delay between two noisy versions of the same signal received at spatially separated sensors.

The purpose of this paper is to survey the applications where these algorithms can be used and to show how we as scientists can encourage finding and developing positive things among the priceless

patrimony of knowledge already existing. We observe that none of these techniques is “new under the sun” but they were inspired from God’s creation, which can always be a very rich source of inspiration. What we are trying to do is only a pale imitation of the things surrounding us. We can only bow down in adoration in front of him exclaiming, “How Great Thou Art!”

### **The Mitochondrial Endonuclease EndoG Is Dispensable in Embryogenesis and Apoptosis**

Karen Kate O David

The mitochondrial endonuclease EndoG is one of the endonucleases implicated in DNA fragmentation during apoptosis. Upon cell death stimuli, it has been shown to translocate from the mitochondria to the nucleus. These observations support a role for EndoG as a mitochondrial cell death effector, possibly a cell death nuclease like DNA fragmentation factor.

To understand the role of EndoG in embryonic development and apoptosis, we generated EndoG null mice by homologous gene targeting without disruption of the overlapping gene D2Wsu81e. The EndoG null mice are viable and develop to adulthood with no obvious abnormalities.

Fibroblasts from the EndoG null mice show no difference in susceptibility when induced to die by intrinsic and extrinsic apoptotic stimuli. Additionally, EndoG null mice are equally sensitive to excitotoxic stress. These data suggest that EndoG is not essential for early embryogenesis and apoptosis.

### **Toward the Increase of Theism among Scientists: A Doppler-shifted Monoenergetic Neutrinos-Records Science Concept**

William S Foulks Jr

This concept is offered to counter atheism and agnosticism. Approximately 40% of American scientists believe in God, according to a survey a few years ago. More scientists could become believers in God once they consider a concept from science which supports a theological belief. My physicist brother, Edwin, and I originated this science concept which was presented at the

57th Annual Meeting of the American Scientific Affiliation, 2002.

It proposes that a perpetually-existing record of the movements of each individual human is propagating out through the universe. These records, existing unhindered for all perpetuity, relate to the theological belief in what God would review on the Judgment Day.

Scientists concur that neutrinos, from the moment of their release, travel on for perpetuity—unstopped and undeflected—except for the rarest occasions. Matter is transparent to their passage.

We think that, as a consequence of electron-capture decays of potassium-40 found naturally in every human, monoenergetic neutrinos exit the human constantly with the human’s movements, placing characteristic Doppler energy-modifications on some monoenergetic neutrinos. Potassium-40 ions, when traversing cellular membranes, are held tightly and then are given distinguishable, directed velocities. An example of records can be physical acts of altruism, as in a spouse helping an invalid. Neutrino records preserve the occurrence of this altruism perpetually.

An individual’s record is uniquely distinguishable from another’s, because of its unique neutrino-trajectories, unique Doppler-shifted energies. Merely to state the obvious need for both unique trajectories and unique energies, that is how distinguishable images are formed with visible light, which is easily absorbed and deflected by matter, of course. Distinguishable images are formed from unique trajectories and energies of the rays. Neutrino records of movement of individual human beings propagate, undeflected and unabsorbed, through all the matter in the universe.

### **Protein Conformational Space and Excluded Volume**

Terry M Gray

Predicting protein structure remains the Holy Grail of structural biochemistry. The number of possible conformations, even for a small peptide, is extremely large, yet in real proteins, only a few structures (even only one) are represented by a given sequence of 5–7 residues. Many conformations are eliminated by simple excluded volume considerations.

We are performing a lattice-like calculation of every conformation (in 60° increments for single bonds) of a given peptide and assessing whether or not it is an allowed conformation based on a simple distance criterion: Are any nonbonded (nonhydrogen) intra-atomic distances shorter than the specified cutoff? Fixed bond length and bond angles are assumed. The peptide bond is fixed at the trans conformation.

One goal is to generate a library of allowed conformations for a given short sequence which then can be used to construct larger structures.

### **The Granzyme B Cleavage Site in Tyrosinase Is Critical for Protein Folding and Trafficking**

Michelle Lynn Harris

When the immune system reacts against self tissues rather than foreign antigens autoimmune diseases can develop. This breakdown of self tolerance could occur if self antigens are presented as novel structures within an inflammatory environment. A majority of autoantigens, but not nonautoantigens, are cleaved by the cytotoxic lymphocyte granule protease granzyme B (grB).

While the significance of this strong association between autoantigen status and grB susceptibility is not clear, it has been suggested that generation of unique antigen structures during cytotoxic lymphocyte induced death might promote the development of autoimmunity. Tumors might also be sources of altered-self antigens which could activate anti-tumor immunity or autoimmune diseases.

In support of this hypothesis, melanoma patients sometimes develop autoimmune vitiligo spontaneously or in response to anti-melanoma immunotherapy. The targeted antigens are melanocyte specific enzymes involved in melanin production, such as tyrosinase.

We have found that *in vitro* transcribed and translated mouse tyrosinase is susceptible to cleavage by grB. Aspartate (D) to alanine (A) mutation confirmed that ICTD249 is the grB cleavage site. When transfected into mouse B16 melanoma cells, this mutant ICTA-tyrosinase is not processed as it should be through the Golgi to melanosomes, but instead is retained

in the endoplasmic reticulum (ER) and degraded. A cysteine (C) to glutamate (E) mutant (IETD-tyrosinase) is also retained in the ER, indicating that C247 is involved in a critical disulfide bond. These observations suggest that the ICTD249 sequence is required for tyrosinase folding and trafficking.

In normal cells, the wild type, fully processed form of tyrosinase is resistant to grB cleavage. In contrast, the ER-retained form of tyrosinase is preferentially expressed in human melanoma tissues and is susceptible to grB-cleavage.

Our data offer the first description of a grB site being required for protein folding and suggest that the grB-cleavage site in tyrosinase could be unveiled in a disease relevant environment, namely melanoma.

### **Selection and Analysis of Escape Variant Mutations Affecting Epitope IV of Simian Virus 40 Large Tumor Antigen** Anuj Kalsy

The Simian Virus 40 large tumor antigen (SV40 T ag) contains four distinct epitopes, I, II/III, IV, and V, that are individually recognized by one or more H-2b-restricted cytotoxic T lymphocyte (CTL) clones. The SV40 T ag induces cellular immortalization and tumor formation, but epitopes within the T antigen induce CD8+ T lymphocyte responses that can effectively control the growth of T antigen-expressing tumors *in vivo*. In fact, epitope IV-specific CD8+ T cells have been shown to control endogenous, SV40 T ag-induced tumors in a transgenic mouse model.

We are interested in how naturally occurring mutations that affect epitope IV will allow for the survival of T antigen-expressing tumors in the presence of epitope IV-specific CD8+ T cells. Because epitope IV is located within a region of the T ag that is essential for cellular transformation, only substitutions, or small in frame deletions, are expected to permit escape while maintaining cellular proliferation.

Escape variant populations have been selected by repeated exposure of murine B6/K-0 T- ag transformed cells the epitope IV specific CTL clones, SV2168 Bcl6 and SV2168 Tcl2. Variant epitope

sequences were amplified by PCR, individual amplification products were subcloned to generate recombinant libraries, and the nucleotide sequences of the epitope regions harbored by multiple, randomly chosen recombinant plasmids remain to be analyzed.

The results of this study will be discussed in light of previous epitope IV selections that utilized the epitope IV-specific CTL clone Y-4.

### **The Mountain Pine Beetle Epidemic: Functional Genomics Discovery of Conifer Defense Mechanisms against Beetle Mediated Blue-Stain Fungal Pathogens** Natalia Kolosova

Fungal pathogens cause a lot of damage in forests and agricultural crops. The current mountain pine beetle epidemic in British Columbia, Canada is affecting millions of hectares of lodgepole pine causing massive economic problems. Bark beetles infect trees with beetle associated blue-stain fungi that play a key role in killing the host tree and thus in successful colonization of tree and development of beetle larva.

I demonstrated that recently developed by Genome BC Forestry project spruce cDNA microarray that contains sixteen thousand unique gene transcripts can be applied for functional genomics studies of lodgepole pine and several other conifer species. Using large-scale gene expression analysis provided me an opportunity to investigate multiple pathways and genes that are differentially expressed in pathogen attacked lodgepole pine trees.

Expression of several transcripts of one of the pathogenesis related proteins chitinase was upregulated in lodgepole pine affected by fungi. Potential role of involvement of ethylene signaling pathway in activation of lodgepole defense mechanisms was demonstrated. Microarray analysis revealed that methyl jasmonate treatment elicited defense related responses in lodgepole pine that share some similarities with defense responses activated by fungi. These microarray results provided a set of target genes and pathways for further characterization of their role in lodgepole pine defense mechanisms against fungal pathogens.

Understanding of genomic mechanisms involved in tree defense is critical for the development of pathogen control strategies and breeding programs that are essential for efficient protection and regeneration of forestry resources.

### **When Little Things Matter: Thoughts from the Study of Climate Dynamics** Johnny W Lin

Whether expressed in clichés (“the devil is in the details”) or in biblical principle (“the last shall be first”), wisdom tells us that often it is the “little things” that matter. Resonant systems (such as music or a playground swing) and “tipping points” (as are found in epidemics) are two common ways small perturbations can have large effects. The field of climate dynamics provides some additional descriptions: sensitivity of initial conditions and stochastic scale-interactions.

In this paper, I describe ways this principle is expressed in creation, with a focus on mechanisms found in climate dynamics. Implications are discussed.

### **The Simian Virus 40 Large Tumor Antigen as a Model System for Undergraduate Courses and Research Projects** Lawrence M Mylin

The Simian Virus 40 large tumor antigen (SV40 T ag) can be used to introduce undergraduate research and immunology students of tumor control by cellular immunity, specifically by CD8+ cytotoxic T lymphocytes (CTL). These studies often require new derivatives of the T ag that can be generated by site directed mutagenesis (usually of its CD8+/CTL epitopes) by students in the molecular biology course laboratory. SV40 T ag immortalized murine cells grow well in culture, and are useful in training cell biology students in the fundamentals of mammalian tissue culture.

The SV40 T ag contains four distinct epitopes that are individually recognized by one or more established cytotoxic T lymphocyte clones (CTL) or transgenic CTL lines. Because the SV40 T ag induces cellular immortalization and tumor formation, we are interested in these epitopes as targets for the

immunotherapy of SV40-induced model murine tumors.

We want to study how these sequences can be used to effectively immunize against SV40 T ag-induced tumors, and how these targets may be altered by mutation to allow SV40 T ag expressing tumors to escape from CTL-mediated destruction.

Research projects that investigate mutational escape from SV40 T ag-specific CTL clones by selection of mutants *in vitro* followed by molecular analysis of the mutated epitope sequences provide students with solid training in mammalian tissue culture and molecular techniques.

### Implicit Learning of Simple Grammatical Rules

Gwen L Schmidt

One view of language acquisition would suggest that grammar is far too complex to be readily learned through a general learning mechanism, and thus at least some grammar knowledge must be innate (Chomsky 1959, 1965; Pinker, 1991, 1994). However, more recently, it has been suggested that an abstract grammar representation is not necessary for the learning and use of language, but that connectionist learning networks can explain both the acquisition and use of language (Rumelhart & McClelland, 1986; Seidenberg, 1997).

This connectionist view implies that language syntax is not learned and used by abstracting rules but by exploiting probabilistic relationships. Thus more complex learning may not be taking place, since no abstract rule need have been learned, only a series of exemplars.

Within cognitive psychology, implicit learning has generally been defined as knowledge gained without awareness or the intention to learn it (see Seger, 1994). One claim has been that acquired knowledge of the structure of language (i.e. grammar) is an everyday example of implicit learning (e.g., Cleeremans, Destrebecqz, & Boyer, 1998; Frensch & Runger, 2003).

Two studies examined the incidental learning of rules underlying the order of nouns and verbs in three-word sentences. Self-timed reading speed decreased as a result of practice with a rule (words ordered either as "verb noun noun" or

"noun noun verb"). The same pattern of results was also found for new words ordered according to the previously encountered rule, suggesting learning generalized beyond the specific instances encountered.

A second experiment showed such rule learning could also occur when the nouns were replaced with pronounceable pseudo words. Learning was therefore possible in the absence of any pre-existing relationships between the items. However, participants did not show any explicit knowledge of the language patterns in the stimuli.

Thus, overall, the results suggest that implicit learning is at least one plausible mechanism by which the structure of language can be learned. Furthermore, the learning was tied to abstract forms of representation rather than the specific exemplars encountered, suggesting that it is not probabilistic patterns that are learned but actual "rules." Thus the current results are consistent with an innate view of language learning.

### Establishment of the First SIV/Macaque Model of HIV Latency

Anding Shen

HIV/AIDS is a global pandemic which has affected about 60 million people in the world. In the United States, with the development of Highly Active Anti-Retroviral Therapy (HAART), the biggest medical challenge in eradicating HIV is viral latency, particularly the latent reservoir in resting T lymphocytes. In latently infected T cells, the virus remains silent until the particular T cell is activated. The silent virus cannot be eliminated by anti-retroviral drugs, and long life of resting memory T cells results in the life-long persistence of the virus.

In this study, we report a SIV/Macaque model that was established to study viral latency. Pigtailed macaques were infected with SIV/17E-Fr, a derivative of SIVmac239, and at viral set-point treated with reverse transcriptase inhibitors PMPA and FTC.

In treated animals, viremia was suppressed to below the limit of detection. The persistence of latent SIV was then demonstrated by the isolation of replication competent virus following the activation of resting CD4+ T cells. In addition, integrated viral DNA was detected in both treated and untreated

animals, demonstrating the existence of a stable viral reservoir in the SIV/maacaque system similar to HIV in humans. Various compartments were examined, and reservoirs were detected in the blood, lymph nodes, and spleen, but not in the thymus.

In the process of developing the animal model, a novel way to re-activate the latent virus was discovered. 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 lymphocytes. TCR MHC class II interaction does not seem to be involved in the activation pathway, whereas co-stimulatory molecules, such as CD58, CD80/86 seemed to be involved in the process. The same cell lines do not re-activate HIV in human resting T cells, suggesting a xenogenetic reaction.

This is the first animal model to study HIV latency that closely resembles HIV patients on HAART. It is being used to evaluate the effect of therapeutic vaccines on latent reservoir, to examine various tissue/organ compartments for additional latent reservoirs, and could possibly be used to test potential therapies to attack the latent reservoirs.

### The Statistical Probability That Evolution Could Have Occurred by Chance

Walter L Starkey

There is absolutely no way that evolution could be accomplished other than by the movement of atoms, by chance, to new positions in the DNA molecule of a predecessor animal. Let's first consider an analogy to such movements

Let's assume that a teacher is going to have 15 children in her class for the next school year. Before school starts she decides to assign a particular seat to each child. Now assume that she elects to have the children all come into the room at the same time and she will let the children, themselves, select their own seats. What is the statistical probability that each child will, by chance, select the seat that she had intended to assign to that child?

There will be one chance in 15 that the first student will take his assigned seat. Then there would be one chance in 14 that the next student would select the

right seat. This procedure would then continue and it should be apparent that the statistical probability that all of them would select their teacher-assigned seats would be the following: One chance in (15)(14)(13)(12)(11)(10)(9)(8)(7)(6)(5)(4)(3)(2)(1), which equals one chance in 1.3 trillion. From this, we can conclude that the probability of getting the 15 students into their assigned seats by chance is essentially zero.

The evolution of animals is identical in essence to the seating of the students, except that, for the case of animals, DNA atoms correspond to the students, and the correct placement of these atoms in the DNA molecule corresponds to the correct placement of the students in their seats in the room.

In the cases of the evolution of animals, the number of atoms that need to be properly seated in the new array is not fifteen, but a substantial percentage of the numbers of atoms in the DNA molecules. There are about 68 million atoms in the DNA of a single-cell animal, and about 200 billion atoms in the human DNA. A typical multi-cell animal, such as an insect, a bird, or an elephant would have billions of atoms in its DNA.

If the statistical probability that 15 atoms could be properly moved is one chance in 1.3 trillion, what do you think would be the statistical probability that millions or billions of atoms could be correctly moved in a DNA molecule by chance? The answer is that the probability is essentially zero! And this means that

evolution, based on chance, could not ever have taken place, on earth or on Mars!

### **Teach Science— Not Evolutionary Theory** Donald R Strombeck

Scientific literacy is an essential goal of general education. Before science is taught, educators must understand what science is so that theory, ideology, and metascience, posing as scientific facts, are not taught as science. Yet teaching metaphysics is promoted with the argument that “evolution should be a recurrent theme throughout biology courses.”

Only scientific facts prepare students to think carefully, critically, and for themselves. Without facts students have nothing but common sense to evaluate science’s theoretical concepts. Darwinism and Synthetic Theory are not facts. They must not be taught as scientific facts in pre-college school curricula.

The greatest threat to evolutionary ideologies is change by inheritance of acquired characteristics. Scientific facts now show that biological life can insure survival by adapting to its environment with newly-acquired characteristics. Acquired characteristics are imbedded in germline DNA and epigenetic DNA alterations for transmission to subsequent generations. The alterations are responses to environmental influences that include nutrient availability and exposure to chemicals.

Conscious activities can also alter human DNA to produce controlled mutations whereby humans can co-create themselves. Co-creative changes can be initiated by activation of immediate early genes. Mutations can also be determined by rates of DNA damage and repair, some of which humans can control. Epigenetic alterations of DNA can be inherited adaptive determinants of responses to the environment.

Scientific literacy’s goal must be to teach practical science that is essential to creating and maintaining a healthy existence based on living in a nature that is cooperative and not competitive. That goal is not possible by teaching metaphysics and ideologies.

Pre-college curricula allot insufficient time for teaching a basic foundation of essential facts. Incomplete understanding of scientific core knowledge leaves students unprepared to think critically for evaluating any conceptual ideas. If pre-college education cannot make students scientifically literate, they must not be taught forms of metaphysics they are unprepared to understand.

Only practical science, not any theoretical concepts, can provide the knowledge to improve human health, welfare and nutrition; to maintain reverence for creation’s goodness; and to be the responsible stewards God enables us to be.

# Symposium Abstract

Sunday, August 7, 1:30 PM–4:30 PM; Question and Answer Session, 5:00 PM–6:00 PM –Hostetter Chapel

## Models for Creation: Intelligent Design and Evolution

This symposium will discuss the strengths and weaknesses of two creation models: Intelligent Design and Theistic Evolution. Speakers sympathetic to both positions will clarify where these models agree with each other, where they potentially conflict, and where further work is necessary to determine which model best correlates with how God actually acts in nature. Basic questions such as the scientific nature of the ID model, ID's potential to benefit research, and the most significant evidence for ID and TE will be addressed.

The format will provide a friendly and open discussion among Christian brothers, and is not intended to be a hostile or divisive debate.

The participants will share their presentations among each other beforehand to insure that they do not talk past each other on key questions.

Following the invited talks, the symposium will include an extended

question and answer time with the panel of speakers in order to promote fruitful discussion of these issues.

This symposium intends to foster a critical dialog in the evangelical academic community between scientists who hold to differing perspectives on macro-evolution and the nature of God's interaction with the physical world. It is hoped that this event will build rapport and encourage a humility and appreciation for the range of evangelical views regarding creation.

Topics and Speakers:

### #1 Is Intelligent Design "Scientific?"

A discussion of the nature and definition of science, the detectability of design in nature, and the appropriateness and need for ID.

- **William A Dembski**, Conceptual Foundations of Science, Baylor University.
- **Loren Haarsma**, Physics & Astronomy Department, Calvin College.

### #2 What is the best evidence for macro-evolution? The best evidence for design?

- **Keith B Miller**, Department of Geology, Kansas State University.
- **John Bracht**, Biology (graduate student), UC San Diego.

### #3 Does the existence of a Creator benefit (inform) scientific research programs which focus on origins?

- **Darrel R Falk**, Professor of Biology, Point Loma Nazarene University.
- **Richard M Sternberg**, Staff Scientist, National Institutes of Health.

Session Organizer and Moderator: **John A Bloom**, Professor of Physics, Director of the Master's Degree Program in Science and Religion, Biola University, 13800 Biola Ave., La Mirada, CA 90639; john.bloom@biola.edu; (562) 903-4861.

Sponsored in part by Master's Degree Program in Science and Religion at Biola University and the John Templeton Foundation.

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# *Local Areas Fellowship Luncheon*

*Sunday, August 7, 2005, 6:15 PM –Eisenhower Student Center, Lottie Nelson. Find the table with the color napkins of your local area.*

<b><u>Napkin Color</u></b>	<b><u>Local Area</u></b>	<b><u>Area Conveners</u></b>	<b><u>Areas Included</u></b>
white	Canada/ International	John Wood	–Canada, Romania, The Netherlands
blue	Chicago, Greater	Dorothy Chappell	–Illinois, Iowa, Minnesota, North Dakota, South Dakota and Wisconsin
turquoise	Indiana/Kentucky/ Michigan/Ohio	Loren Haarsma	–Indiana, Kentucky, Michigan and Ohio
gold	Northeast	Jerry McNatt	–Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont
pink	Pennsylvania	Jerry Hess Joe Sheldon	–Delaware, Pennsylvania and New Jersey
orange	Rocky Mountain	Keith Miller Ruth Miller	–Colorado, Kansas, Nebraska, Utah and Wyoming
yellow	Southeast	Martin Price Jay Hollman	–Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, North Carolina, South Carolina and Tennessee
red	Southwest	Fred Hickernell Margaret Towne	–Arizona, Nevada and New Mexico
purple	Oklahoma/Texas	Walter Bradley	–Oklahoma and Texas
lavender	Washington, DC/ Baltimore	Paul Arveson Susan Daniels	–District of Columbia, Maryland, Virginia and West Virginia
silver	West	Paul Seely Anita Seely	–Alaska, California, Hawaii, Idaho, Montana, Oregon and Washington

# *ASA Business Meeting Agenda*

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*Sunday, August 7, 2005, 7:30–9:00 PM in Eisenhower Student Center, Lottie Nelson dining area.*

1. Call to order and opening prayer –Marilyne Flora
2. Recognition of ASA staff and meeting chairs –Randy Isaac
  - A. Staff: Carol Aiken, Lyn Berg, Jonathan Chechile, Dan Fales, and Robyn Leet
  - B. Newsletters Editors: David Fisher and Margaret Towne
  - C. PSCF/Book Review Editors: Roman Miller and Richard Ruble
  - D. Web Master/Editor: Terry Gray and Jack Haas
  - E. Program Chair and Assistant: Ken Touryan and Jack Swearengen
  - F. Local Arrangements Co-chairs: Ted Davis and Jerry Hess
3. Future meetings –Walter Bradley
  - A. **2006, July 28–31:** Calvin College, Grand Rapids, MI  
Program Chair: Hessel Bouma III  
Local Arrangements Chair: Larry Molar  
Topic: Embedding Christian Values in Science and Technology
  - B. **2007, August 3–5:** Joint ASA/CiS meeting in Edinburgh, Scotland
  - C. **2008** and beyond
4. Report of Student and Early Career Scientists' Activities –Johnny Lin
5. Nominees for 2005 Council vacancy –Hessel Bouma
6. Secretary/Treasurer Report –Ruth Miller
7. State of the ASA –Randy Isaac
8. Introduction of Newly Elected Fellows –Randy Isaac
9. Recognition of Fifty Years of ASA Membership –Randy Isaac
10. Remembrances –Randy Isaac
11. Offering for the ASA
12. President's comments/interview with Randy –Marilyne Flora
13. Members' questions and comments –Marilyne Flora
14. Closing prayer –Marilyne Flora

# *Future Meetings of the ASA*

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**61<sup>st</sup> Annual Meeting of the ASA**  
Calvin College  
Grand Rapids, MI  
July 28–31, 2006

## **“Embedding Christian Values in Science and Technology”**

Science and technology are driven and guided by many different values. The Christian faith traditions place a special value on humans as “created in the image of God” and our special role to be caretakers or stewards of God’s creation. At this meeting, we will explore how these values ought to be expressed in science and technology in the academy, business and industry, society, and public policy.

Program Chair: Hessel Bouma III, boum@calvin.edu

Local Arrangements Chair: Lawrence A Molnar, lmolnar@calvin.edu

**62<sup>nd</sup> Annual Meeting of the American Scientific Affiliation  
in conjunction with the Christians in Science**  
Edinburgh, Scotland  
August 3–5, 2007