

The Joint Meeting of the American Scientific Affiliation and the Canadian Scientific Christian Affiliation

August 4–7, 2000

Gordon College, Wenham, Massachusetts

The Oceans: Bearing Witness to the Greatness and Wonder of God's Works



Plenary Speakers:

Ray Gambell, OBE, Secretary, International Whaling Commission

Susan Drake Emmerich, Director, Tangier Watermen's Stewardship for the Chesapeake

"The seas have lifted up. O Lord, the seas have lifted up their voice: the seas have lifted up their pounding waves. Mightier than the thunder of the great waters, mightier than the breakers of the sea—the Lord on high is mighty" —Psalm 93:3–4 (NIV).

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—Psalm 93:3–4 (NIV).

Gordon College Bookstore Hours

Monday–Friday: 10:00 AM–4:30 PM
Saturday: 10:00 AM–2:00 PM

Special thanks to:

Harry Cook, Program Co-Chair
Dick Wright, Program Co-Chair
Jerry McNatt, Local Arrangements Chair

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.

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2000 ASA/CSCA Annual Meeting Schedule

Friday – August 4, 2000

- 12:30 PM Meet at **Tavilla** for Whale Watching Tour– **Bus to leave promptly**
- 2:00–6:00 PM Registration at **Tavilla** Conference Room
- 6:00–7:00 PM Dinner – **Lane** Student Center, Easton Dining Room
- 7:30 PM Welcoming Speakers and Announcements
– Jay Hollman, President, ASA
– Robert Mann, President, CSCA
– Mark Sargent, Provost, Gordon College
– Harry Cook and Dick Wright, Program Co-Chairs
– Jerry McNatt, Local Arrangements Chair
- 8:00 PM **PLENARY ADDRESS** – **Lane**, Easton Dining Room
Introduction – Dick Wright
Managing Creation–Or At Least Whales – Ray Gambell
- 9:15 PM Mixer – **Lane**, President's Dining Room

Saturday – August 5, 2000

- 7:30–8:15 AM Breakfast – **Lane**, Easton Dining Room
- 7:30 AM Publications Breakfast Meeting – Go through serving line, then to President's Dining Room – Roman Miller
- 8:30–9:00 AM Music and Devotions – **Lane**, Easton Dining Room
Music: Larry and Susan Martin
Devotions: Terry Morrison
Announcements – Jerry McNatt
- 9:15–10:30 AM **MARINE I** – **Jenks**, Room 406
Chair: **Daniel Osmond**
Maintaining the Delicate Balance of the Arctic Ocean Circulation – David C. Chapman
Our Changing Oceans: Natural Variability or Climate Change? – Henry Hengeveld

Saturday – August 5, 2000

(continued)

- 9:15–10:30 AM **GENERAL I – Jenks** Learning Resource Center,
Room 112
Chair: **Gary Partlow**
A Revolution in the Understanding of Family Values – John E. LaMuth
A Christian Perspective of Alternative Medicine – James G. Mitroka
From Objective-Realism to Subjective-Relativism:
Can ASA Find a Golden Mean? – Kenell Touryan
- 10:00–4:00 PM **POSTER SESSION – Jenks**, 4th floor Art Gallery
- 10:30–11:00 AM Refreshment Break and Fellowship – **Jenks**,
4th floor Art Gallery
- 11:00–12:15 PM **MARINE II – Jenks**, Room 406
Chair: **Deborah Haarsma**
Aquaculture as a Strategy for Sustainable Food Production and Environmental Stewardship – Steven G. Hall
Oceans: Material, Electromagnetic, and Spiritual Genetic Connections Between Tropical Oceanic and Stream Systems: Considerations for Conservation – Lawrence W. Fagg
– Daniel Lindstrom
- GENERAL II – Jenks**, Room 112
Chair: **Paul Adams**
Infusion of New Genetic Material into an Organism – Gordon C. Mills
Process and Matter Concepts Which Divide Theistic Evolution from Intelligent Design – Philip E. Anderson
Help in Removing a Stumbling Stone – J. David Price
- 12:30–1:30 PM Lunch – **Lane**, Easton Dining Room
12:30 PM Fellows Luncheon – President's Dining Room – Jay Hollman
- 1:45–3:30 PM **HISTORY AND PHILOSOPHY OF SCIENCE I – Jenks**, Room 112
Chair: **Robert Herrmann**
The Copernican Revolution Reconsidered – Owen Gingerich
Science and Religion, Chicago Style, 1922–1931: Popularizing Protestant Modernist Views of Science in the Age of Bryan – Edward B. Davis

Saturday – August 5, 2000

(continued)

- 1:45–3:30 PM **CEST I – Jenks, Room 406**
 Chair: **David Humphreys**
 What is Truth? Creating Scientific Consensus Without Compromising Truth – Ruth D. Miller
 Extending Moore's Law and Enabling Good and Evil – Randy Isaac
 Can There Be an Ethical Foreign Policy? Technology for Morality – David M. Condron
 – Jack C. Swearingen
- WORKSHOP I: Teaching Biology**
 – **MacDonald Hall, Room 109**
 Chair: **Beverley Ruegsegger**
 Biology Goes Retro: A Living History of Biology Teaching – Panel
 – Ray Brand, Moderator; Wilbur Bullock; Harry Cook; and Dick Wright
 Creating a Rich Learning Environment: Reforming the Way We Teach – John Wood
 An Interdisciplinary, Investigative Approach to Teaching Biology – Gerald D. Hess
 Service-Learning Projects in the Sciences: Serving the Community While Teaching the Student – Les C. Eddington
 Scott S. Kinnes
- 3:30–4:00 PM Refreshment Break and Fellowship
 – **Jenks, 4th floor, Art Gallery**
 – **MacDonald Hall, Lobby**
- 4:00–5:45 PM **HISTORY AND PHILOSOPHY OF SCIENCE II**
 – **Jenks, Room 112**
 Chair: **Paul Lapse**
 The Rev. Cotton Mather F.R.S. (1663–1728): *The Christian Philosopher*, Relating Science and Faith in the Colonies – John W. Haas, Jr.
 A Different Voice from the Eve of the Origin: Reconsidering John Henry Newman on Christianity and Science – Mark A. Kalthoff
 Charles Darwin and Asa Gray Discuss Teleology and Design – Sara Joan Miles

Saturday – August 5, 2000

(continued)

- 4:00–5:45 PM **CEST II – Jenks**, Room 406
Chair: **Kenneth Lincoln**
Is the ASA Seeking Truth in Environmental Matters? A Sequel – John M. Osepchuk
Technology and the End of the Nation-State – Dennis L. Feucht
Problem-Solving Methods in Science and Design – Craig Rusbult
Curriculum Guide Development Project for the ASA Science Education Web Site – William W. Cobern
Craig Rusbult
- WORKSHOP II: Teaching Bioethics**
– **MacDonald Hall**, Room 109
Chair: **Brian Greuel**
Teaching Bioethics: Unique Opportunities and Responsibilities – Hessel Bouma III
Teaching Bioethics to Liberal Arts Students and to Biology Majors – Donald W. Munro
- 6:15–7:30 PM Dinner: A New England Clam Bake – **Lawn** in front of Lane Student Center
- 7:45–9:00 PM **PLENARY ADDRESS – Lane**, Easton Dining
Introduction – Dick Wright
Tangier Watermen’s Stewardship for the Chesapeake: Faith-based Stewardship for Environmental Conflict Resolution – Susan Drake
Emmerich
- 9:15–10:15 PM Affiliation Meetings – **Lane**
ACB – Organizations Dining Room – Larry Seward
ACG – Martha Lewis Room – Keith Miller
CEST – President’s Dining Room – Ruth Miller

Sunday – August 6, 2000

- 7:15 AM English Trip Bus 1 Reunion Breakfast – Ann and Dick Wright
– **Lane**, President’s Dining Room
- 7:30–8:30 AM Breakfast – **Lane**, Easton Dining Room
- 9:15–10:00 AM Bible Study – **Lane**, Easton Dining Room
The Wonders of God’s Creation – John Jefferson Davis
Announcements – Jerry McNatt
- 10:30–11:45 AM Worship Service – A. J. Gordon **Chapel**
Worship leader: Fred Hickernell
Speaker: Pablo Polischuk
CSCA Memorial for Doug Morrison

Sunday – August 6, 2000

(continued)

- 12:15–1:30 PM ASA Local Area Luncheon Meetings – **Lane**
See p. 48 for local areas.
- 1:45–3:00 PM **MARINE III – Jenks, Room 406**
Chair: **Ronald Kay**
Pacific Salmon: Ocean Resource or Political Football? – Harry Cook
Teaching About the Oceans in K–12 Schools – Dennis W. Cheek
The Prologue to Biblical Salvation History: The Natural Revelation of the Pre-history of Earth Recorded in the Marine Sediment Record – John F. Bratton
- GENERAL III – Jenks, Room 112**
Chair: **Richard Leo**
Oceans of Wonder: Genesis 1 as Vision – J. Raymond Zimmer
Hermeneutical Lessons From the Heavens – Denis Lamoureux
A Taxonomy of Change Agents in the History of Life: Design, Development and Darwinism – Robert F. DeHaan
- 3:00–3:30 PM Refreshment Break and Fellowship – **Jenks**,
4th floor, Art Gallery
- 3:30–5:15 PM **MARINE IV – Jenks, Room 406**
Chair: **Sara Joan Miles**
Modern Humankind's Noisy Assault on the Sea – Paul T. Arveson
Glimpses of God in the World's Oceans – Peter Heltzel
Management of Large Ocean Programs – Richard Lambert, Jr.
The Sea of Chaos and Creation – George Murphy
- GENERAL IV – Jenks, Room 112**
Chair: **Paul Wason**
Challenging the Secular Mindset of Scientists – Tom Hoshiko
The Kansas Science Standards Debate: Public Misperceptions of Science and Faith – Keith B. Miller
From Mainstream to Periphery: The Rise and Fall of the Gap Theory (Or Chaos-Restitution) from 1650 to 1900. – Michael Roberts
Science and Christian Faith Inside the Former Soviet Union Countries (A firsthand look) – Kenell Touryan
- 6:00–7:00 PM Dinner – **Lane**, Easton Dining Room
- 7:30–8:30 PM Special Presentation – **Lane**, Easton Dining Room
Cosmos and Contact: The Religion of Carl Sagan – Robert Newman

Monday

Sunday – August 6, 2000

(continued)

8:45–10:00 PM	Commission Meetings – Lane	
	Bioethics	– Hessel Bouma III
	– Martha Lewis Room	
	Communications	– Paul Arveson
	– Easton Dining Room	
	Creation	– Robert Newman
	– Easton Dining Room	
	Global Resources and Environment	– John Wood
	– President's Dining Room	
	History and Philosophy of Science	– Edward Davis
	– Organizations Dining Room	
	Physical Sciences	– Loren Haarsma
	– CSD Student Lounge (2d floor Right)	
	Science Education	– J. David Price
	– Chapel Dining Room	
	Social Sciences	– Judith Toronchuk
	– Easton Dining Room	

Monday – August 7, 2000

7:30–8:15 AM	Breakfast – Lane, Easton Dining Room	
8:30–9:00 AM	Music and Devotions – Lane, Easton Dining	
	Music: Larry and Susan Martin	
	Devotions: Dorothy F. Chappell	
	Announcements	– Jerry McNatt
9:00–10:15 AM	WORKSHOP III: Mentoring/Discipling Session	
	– Lane, Easton Dining Room	
	How Do We Help Younger Colleagues	– Panel
	in Both Their Professional Development	
	and Spiritual Growth?	
	–Terry Morrison, Moderator; Wayne Becker;	
	Daniel Hastings; and Judith Toronchuk	
10:15–10:45 AM	Refreshment Break and Fellowship – Lane	
10:45–12:15 AM	ASA Business Meeting – Lane, President's Dining Room	
	Presidential Address: Jay Hollman	
	Members' Questions and Comments	
12:15–1:00 PM	Lunch – Lane, Easton Dining Room	
1:00 PM	Check out — Please return your key	

Papers

Process and Matter Concepts which Divide Theistic Evolution from Intelligent Design

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The purpose of this paper is to explore the nature of the process concepts that divide “theistic evolution” proponents from “intelligent design” proponents. The “theistic evolution” process concepts to be explored are those of Howard J. Van Till, David Siemens, Jr., and Edward B. Davis. These process concepts will be examined to determine if they are philosophical and/or scientific in nature. If the latter, then what specific scientific fields are involved? This paper will also explain the nature of the “intelligent design” process concepts. It is believed that the “intelligent design” process concepts are grossly misunderstood by “theistic evolutionists.” If we are ever going to make any progress in our understanding of the present subject matter, then each side must understand the nature of the process concepts of the other side. When we understand each other’s process concepts, then following Del Ratzsch, we may ask what factors are “legitimate when proper evidence warrants it.”

This paper will also discuss the relevant concepts of matter directed to the above noted process concepts. Methodological naturalism and theistic science related to the process and matter concepts will be discussed. Also, there is a related further division within the intelligent design movement that should not be overlooked. This intelligent design movement division is primarily between those intelligent design advocates who have a physical chemistry background and those who do not have this background.

Modern Humanity’s Noisy Assault on the Sea

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Underwater acoustics has been my field for much of my career. At the Naval Surface Warfare Center, I designed, constructed, and used a variety of systems for measuring underwater sound. Since our business

Notes

was designing ships and especially reducing the noise of ships, I thought it would be worthwhile to make some of my experiences available for the theme of this meeting, namely oceanography.

There is a growing awareness in the scientific community of the impact that manmade noise is having on sea animals. This talk, with an audio demonstration, will invite you to perceive the world from the perspective of a whale, and also to become aware of the impact of humans on the whale's environment within the past century.

(The ASA's first President and one of its founders was F. Alton Everest. His field was electrical engineering, in particular the design of electroacoustic sensors or transducers used for underwater listening and sound projection. Alton Everest has long been retired, but he is still very much with us and I am dedicating this lecture to him.)

The Prologue to Biblical Salvation History: The Natural Revelation of the Pre-history of Earth Recorded in the Marine Sediment Record

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Parts of the Hebrew Scriptures have been with us for over 3,000 years; the Christian Scriptures for nearly 2,000. But what came before, and what has happened in between or since that was not recorded in the Canon? The sediment layers of the ocean preserve a nearly continuous account of 200 million years of earth history. That scroll is continuing to record more recent events like atmospheric testing of nuclear weapons and decreases in environmental levels of lead following the shift to unleaded gasoline. As the Bible preserves the stories of salvation in the face of Noah's flood, Egyptian oppression, Babylonian exile, and mixed persecution of early Christians, so the sediments show God's providence throughout pre-history. At risk was the entire biosphere, including the oceans. The threats were both earthly and extraterrestrial and more dramatic than anything that has happened in historical times.

The sediment record went unread until the advent of the Deep Sea Drilling Project (DSDP) and the Ocean Drilling Program (ODP) in the last few decades. These international sea floor drilling projects have recovered hundreds of kilometers of sediment cores from depths over 7,000 m. Study of those cores, now housed in repositories in Texas, California, New York, and Germany, has shown in great detail extreme episodes in the history of life. Life in the seas and on land has been pushed to the edge of destruction many times in the past, but was spared in the end. This presentation will compare common themes of divine preservation recorded in the revelation of Scripture and sediment.

Maintaining the Delicate Balance of the Arctic Ocean Circulation

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The Arctic Ocean plays several important roles in Earth's climate system: acting as a global heat sink, regulating the global energy budget, and modulating the global water cycle. Crucial to these roles is the relatively thin veneer of sea ice that covers most of the deep Arctic Ocean. Without the ice cover, life as we know it would probably cease.

From an oceanographic standpoint, the Arctic ice cover is maintained in a remarkably delicate balance, the dynamics of which are discussed here. Sea water just beneath the ice cover is, of course, near the freezing point. However, water only a few hundred meters below the ice is several degrees above freezing, with more than enough heat to melt the entire ice cover several times over. This warmer water remains at depth because of an intermediate layer of relatively salty water that is near freezing, called the "upper halocline layer." The only conceivable source for the upper halocline layer is the shallow continental shelves around the perimeter of the deep Arctic basins. There, new ice is formed throughout much of the winter in areas of open water called coastal polynyas. As ice forms, most of the salt in the water drops out, mixes with the water below and thereby increases the water density. The denser water then sinks and moves offshore into deeper water, being carried in rapidly rotating isolated structures called eddies. The dense water eddies eventually enter the deep Arctic ocean and replenish the upper halocline layer, thereby indirectly preventing the melting of the ice cover by the warmer deep waters and maintaining the Arctic Ocean circulation.

**Teaching About the Oceans in K–12 Schools:
A Look at Relevant National Science Education
Standards and Project 2061 Benchmarks for Science
Literacy and Their Implications for
Marine Education Programs**

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There is much that could be taught about marine environments and resources in K–12 schools. One of the most difficult decisions is what to teach and when to introduce it in the K–12 continuum. A subsidiary decision is how to best integrate selected topics into an already overcrowded school curriculum. *Benchmarks for Science Literacy* by Project 2061 of the American Association for the Advancement of Science in 1993 explicitly included matters relating to the oceans in its 855 content standards. *The National Science Education Standards* published by the National research Council in 1996 also provide detailed guidelines about what specific concepts and principles should be taught concerning the oceans and where they should appear in the K–12 curriculum. The presenter, who participated in both projects, will introduce these documents to the audience and summarize their approaches relative to education about marine environments and resources. Specific content standards will be examined along with commentary about the degree to which such topics are currently being addressed in the nation’s schools and the challenges in implementing these topics more fully into the school curriculum.

The workshop will highlight existing initiatives in K–12 schools that are using these documents to develop and promote standards-based school curricula dealing with marine topics. Reflections on how Christians may both contribute to these efforts and use such materials in a Christian context will be shared.

**Pacific Salmon: Ocean Resource or
Political Football?**

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Pacific salmon spend one portion of their life cycle in fresh water and another in the ocean. Thus these species can be important indicators of the wellness of rivers and streams, and of the ocean. Five species of Pacific salmon that migrate into streams of the Western United States and Canada are dependent on acceptable water quality in the ocean, and of the rivers to which they return to spawn. Commercial catches for some salmon species have declined in recent years and fish biologists seek the reasons for these declines. In rivers, high water temperatures, periodic high discharges, and destruction of spawning grounds have been reasons for concern. In this paper, we will attempt to understand factors pertaining to the ocean that may affect salmon populations. Warming of the ocean is thought to affect salmon populations in a particular way: the distribution of mackerel has moved north in recent years, competing for food with salmon stocks, and moving the concentration of these stocks farther North into the gulf of Alaska.

Fishers in waters of Alaska and British Columbia have been at loggerheads over the regulation of fishing days. Demonstrations, bellicose language by politicians from each country, and unregulated fishing have given way to a treaty administered by the Pacific Salmon Commission. As land and water in the Pacific coast of the U.S. and Canada are populated and utilized more heavily, it is in the public interest to manage the valuable resources of the coast in a careful and dispassionate manner.

A Conceptual Bridge Between Intelligent Design and Darwinian Evolution: Phyletic Life Span Processes

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Intelligent Design (ID) and Darwinian Evolution occupy two widely separate depositions in the history of life in the universe. They are almost always treated as being in opposition or unrelated to each other; resulting too often in destructive quarrels, as if there is only an either/or choice between them. The purpose of this presentation is to build a conceptual bridge between the two, and thus provide a larger, more complete explanation of physical and biological reality.

The conceptual bridge consists of a series of processes subsumed under the rubric of Phyletic Life Span Processes. The three processes—ID, Phyletic Life Span Processes, and Darwinian Evolution—occupy overlapping domains of causality in the history of life in the universe.

Phyletic Life Span Processes share their teleological or goal-directed characteristics with ID; which are to insure that major groups of animals attain their full genetic potential and are separated from other groups by following their own developmental paths. Phyletic Life Span Processes provide a biological agency whereby design is transmitted, maintained, and expanded in the biological world. What ID innovates Phyletic Life Span Processes complete.

On the other side, Phyletic Life Span Processes share the ongoing shaping and sculpting of animal morphology with Darwinian Evolution, a process that is carried forward even into the present time by Darwinian mechanisms in order to enhance the survivability of the species. What Phyletic Life Span Processes complete Darwinian mechanisms adapt for survival.

Oceans: Material, Electromagnetic, and Spiritual

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Underlying and energizing the waving motion of every purple fan coral, the darting zig-zag of every cautious crab, and the graceful undulating course of every dolphin is a vast host of quantum electrodynamic events. The forces binding together the atoms and molecules of all ocean creatures, as well as the water they live in, are carried by a myriad of invisible photons, packets of electromagnetic energy.

Almost all (99.97%) of the mass of the oxygen atom in a water molecule resides in its nucleus, which occupies only about one trillionth of its volume. The rest is occupied by eight very light electrons and trillions of invisible photons that transmit the electromagnetic force keeping them in orbit. This nonmaterial space, this quantum vacuum, is also alive with the continual emergence and disappearance of hosts of electron-positron pairs.

This ubiquity of electromagnetic phenomena activating the vast majority of the ocean's space (as well as that of the entire Earth) constitutes an evident and compelling analogue to the ubiquity of God's inner omnipresence. Furthermore, beneath the awesome beauty of the ocean and all its creatures vivifying every color of the rainbow, the substrate of electromagnetism described by equations of exquisite elegance and symmetry bears witness to, and is analogous to, the beauty of God's indwelling. Thus, undergirding the variegated clothing

of the material ocean is the energizing electromagnetic ocean, which is analogous to, and is in turn undergirded by, the ocean of God's immanence.

Aquaculture as a Strategy for Sustainable Food Production and Environmental Stewardship

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Aquaculture, the practice of raising fish, crustaceans, or aquatic reptiles in enclosed or controlled conditions, has been common in certain areas for centuries. In recent decades, as natural fisheries have declined dramatically and aquatic pollution has become a concern, aquaculture has become more popular. In the State of Louisiana, for example, this is now a business which produces hundreds of millions of dollars worth of food and other products each year.

Aquaculture may be one means of providing high quality protein at low prices, something essential in areas where nutrition is limited. In addition, improved control of conditions can improve the quality, reduce toxics, and protect the environment as well. This paper will present some of the background and present work in aquaculture, with particular focus on controlled systems in the southern United States.

Glimpses of God in the World's Oceans

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From ferocious storms to gentle spring rains, the oceans are responsible for producing a wide variety of changes in our weather. The awesome power of the oceans should not be underestimated. Many coastal cities have suffered and people have perished from its uncontrollable fury and acts of random violence. During rough conditions the beach along an ocean is that last place you want to be, yet an ocean sidewalk can provide a most beautiful and awe-inspiring experience on a clear and calm night. The awesome power and magnificent beauty of the oceans is very humbling for any honest human being. This paper will combine the resources of a father and son—a seasoned oceanographer and a young doctoral student in theology—to argue persuasively that the

beauty and power of the world's oceans is reflective of the character of the Triune God as reflected in the narratives of the Bible from creation to consummation.

From the Spirit of God hovering over the waters in the creation account of Genesis (Gen. 1:2) to the "river of life" in the final chapter of Revelations (Rev. 22:1-6), water imagery is prominent throughout the redemptive history recorded in the biblical literature. It is often a sign of judgment like Noah's flood and Jonah's storm. Water is also a sign of hope and salvation, from the parting of the Red Sea in Exodus to Jesus' offering "living waters" to the Samaritan woman in John. Within this framework of biblical theology, this paper will explore contemporary research in oceanography in order to better understand the God who created the oceans.

Our Changing Oceans: Natural Variability of Climate Change?

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Numerous studies over the past decade have provided significant evidence of a global scale change in the ocean environment. Some of these changes appear to be related to long-term natural oscillations in ocean climates. However, there is increasing evidence of residual changes that are difficult to explain on the basis of natural variability only, but are broadly consistent with climate model projections of change due to human influences on the global climate system. These projections imply a dramatically different future ocean environment, including warmer waters, higher sea levels, changed current patterns, altered habitat for marine biology, and large reductions in polar sea ice cover. There are also indications from paleoclimate studies that some of these changes can occur abruptly, thus introducing major surprises. The presentation will review the background science behind these trends and projections and reflect on some of the political and ethical implications.

Challenging the Secular Mindset of Scientists

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As we enter the twenty-first century of the Christian era, it is fitting to reflect on the present status of Christianity. Clearly the challenge to Christian faith has burgeoned enormously over the centuries and today in America, we can ill afford to ignore that challenge. We tend to think “secularization” is the cause and because science is basically “secular,” many are tempted to point a finger at science. But the problem, I would contend, arises elsewhere, namely the materialistic nature of our times. These attitudes are reflected in such phrases as, “here and now,” “concrete examples,” “practical knowledge,” “down to earth,” etc. Moreover public education under state auspices had replaced the Church-related school. Public education once used to include Christian content and activities, but no more.

How can ASA play a role in turning this situation around? Since most scientists are trained in public schools and state sponsored universities, they have received little or no systematic education in things Christian. ASA’s member attendance at its annual meetings, if not the general membership, is overly represented by scientists from church-related institutions. No doubt part of the situation is that members from such institutions can use their official travel funds for attendance at ASA; on the other hand, those from secular institutions must pay their own way (although a tax deduction for expenses may be possible). But the problem is deeper. Perhaps the ASA could consider how the annual meeting could be made more compelling for scientists from secular campuses.

Management of Large Ocean Programs

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Over the last fifty years of federal funding for research, ocean programs have grown substantially, both in size and complexity. Recent growth has affected both the activities of the individual scientists who perform the work, and the activities of the federal scientists whose task it is to provide both financial and managerial support for and reviews and evaluations of these programs. One view of this growth is that support of individual scientists in the form of small grants awarded through the National Science Foundation (NSF) review process led to small collaborations, which further led to larger collaborations, becoming finally what we know today as coordinated, inter-agency, international programs. A crucial aspect of this growth

has been the accompanying increase in required infrastructure. In previous papers, I have focused largely on physical oceanographic work supported by the NSF from the point of view of a program manager. Other disciplines have been included, particularly as they interact with Physical Oceanography. Studies indicated that a progression of large programs actually dominated much of the large-scale oceanographic studies throughout the history of the NSF. While the main goals of these programs are scientific inquiry and the pursuit of knowledge, the focus of this paper is on the management structures needed to allow scientists to accomplish these goals. Particular emphasis will further be put on the personal qualities required of program managers, and the value of a Christian perspective in interacting with the scientists carrying out the research.

Hermeneutical Lessons from the Heavens

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Christians throughout the ages have wrestled with the relationship between the Scroll of God's words and the Scroll of God's works. An examination of the statements referring to the heavens in the Bible offers an opportunity to explore their relationship to modern astronomy. In addition, the interpretation of these passages by St. Augustine, Martin Luther, and Galileo reveals the Church's understanding of the heavens and her approach to the relationship between Scripture and science throughout most of history.

Lexical analysis reveals that the biblical view of the heavens is typical of the Ancient Near East. It is a phenomenological understanding that is composed within the scope of cognitive competence of the Holy Spirit-inspired writer. According to this perception, a solid dome covers the earth and supports a body of water above it. The sun, moon and stars are placed in this so-called "firmament." Throughout most of Church history, the leaders of the Faith accepted the literal reality of a firm heavenly dome.

Concordism is an interpretative approach that seeks to find a correlation or correspondence between the Bible and modern science. The Church, during most of her history, has employed this method with the interpretation for the heavens. However, it is clear that no such accord exists between the Scriptures and modern astronomy. Instead, the Holy Spirit used the biblical writer's ancient understanding of the heavens to reveal his eternal message. As evangelical theologian George Eldon Ladd states: "The Bible is the Word of God given in the

words of men in history.” Application of these hermeneutical lessons from the heavens to the modern origins debate redirects focus on the essence of God’s revelation and not on the ancient science, which acts merely as a vehicle to transport it.

A Revolution in the Understanding of Family Values

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The current interest in family values has undergone a significant revival as of late, a trend dramatized by the perceived decline in morals affecting American culture. The traditional descriptions of the family values, however, are typically treated as isolated entities, lacking any meaningful degree of moral connectedness across the board. Fortunately, the dream of a unified ethical and moral system has finally been realized with the first radical revolution in ethical theory in over two thousand years. Take, for example, the cardinal virtues (prudence-justice-temperance-fortitude), the theological virtues (faith-hope-charity-decency), and the classical Greek values (beauty-truth-goodness-wisdom). When additional groupings of ethical terms are further added into the mix, the complete multi-level hierarchy of terms emerges in full detail, reproduced in the table immediately below:

GLORY	PRUDENCE
PROVIDENCE	FAITH
GRACE	BEAUTY
TRANQUILITY	ECSTASY
HONOR	JUSTICE
LIBERTY	HOPE
FREE WILL	TRUTH
EQUALITY	BLISS
DIGNITY	TEMPERANCE
CIVILITY	CHARITY
MAGNANIMITY	GOODNESS
LOVE	JOY
INTEGRITY	FORTITUDE
AUSTERITY	DECENCY
EQUANIMITY	WISDOM
PEACE	HARMONY

Such superficial resemblances in terms, however, can scarcely claim to be the total picture, for it further proves possible to base this hierarchy of family values entirely within a behavioral foundation; namely, the terminology of operant conditioning proposed by the great American psychologist, B. F. Skinner. Through this purely behavioral style of motivational analysis, the higher virtues and values can alternately be viewed as more advanced metaperspectives on the more basic complement of instinctual states (i.e., reward punishment, appetite, aversion).

Genetic Connections Between Tropical Oceanic and Stream Systems: Considerations for Conservation

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Until recently, little scientific attention has been given to tropical lotic ecosystems. One interesting characteristic of the fauna of these systems is the high occurrence of animals with an amphidromous life history in several phyla (Mollusca, Arthropoda, and Chordata). Adults living in rivers and streams that produce long-lived marine planktonic propagules, which are passively carried great distances by prevailing currents, characterize this life history pattern.

Since most tropical stream ecosystems are located in developing countries on coastlines near river mouths, human impact has a great potential to negatively affect them and their associated faunas. Animals that do not recognize human-defined distinctions between countries and ecosystems can confound practical matters of management of these resources. Future conservation efforts are dependent upon the characterization of species and the genetic connections between sometimes highly distant populations of amphidromous organisms. The relative ease of genetic sequence analysis presents a powerful tool in the discernment of biogeographic patterns that will provide populational information of unprecedented detail.

The present study is focused on a family of fish, Gobiidae, that has evolved the amphidromous life history pattern several times and has a circumtropical distribution. Specimens from ten genera were collected from locations across the Indo-Pacific, both coasts of Panama, and Puerto Rico for taxonomic and genetic comparison. Specimens were identified to species using traditional taxonomic methods. Tissue samples from each specimen were also preserved and sequencing of genetic information was performed. Three mitochondrial (mtDNA)

genes (D-loop, ATPase, and CytB) were sequenced and analyzed for all specimens for comparison of genetic and geographic distances. This information was used to check past taxonomic conclusions based on morphology as well as to draw new information regarding populational relatedness and the discernment of the oceanic forces that could result in such patterns. This new information will allow not only for us to better understand the biology of these animals, but will allow for more informed and wise decisions by those wishing to conserve aquatic resources.

The Kansas Science Standards Debate: Public Misperceptions of Science and Faith

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Aside from the impact on public education, the decision of the Kansas State Board of Education reflects several widely held misconceptions about the nature of both science and religious faith. Those seeking the elimination of evolution see current scientific and theological descriptions as being mutually exclusive and contradictory. The warfare view of science (particularly evolutionary biology and geology) and faith is assumed. This view is supported by faulty understandings of important concepts such as “species” and “chance,” as well as the perception that science’s focus on natural cause-and-effect explanations is a thinly disguised effort to promote a godless world view.

Another major misconception is that science is simply the accumulation of observational fact, and theories are merely unsubstantiated guesses. This “facts only” view of science misses the core of what the scientific enterprise really is. In my opinion, nothing could be more deadly to teaching science than to divorce it from the unifying theories which give observations meaning. They make the world comprehensible, and also generate the testable hypotheses (expectations) that drive further exploration and discovery. When science is taught as only factual observation, then disagreements among scientists and changing scientific views are seen as weaknesses and failings of scientific knowledge. However, the exact opposite is the case. It is the dynamic, changing, self-correcting nature of science that is its very strength. The less science is seen as a body of established knowledge, the more inherently interesting and exciting it becomes.

Infusion of New Genetic Material into an Organism

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In 1995, I proposed that the deity brought about the origin and development of organisms by a continuing provision of genetic information at the level of DNA (*PSCF* 47, 112–22 and *Christian Scholars Review* XXIV, 444–58). I would now like to propose, using the incarnation (Luke 1:35) as an example, how the deity *might have chosen* to infuse genetic information. I suggest that for sexual animals, genetic material would be infused by an intelligent cause into either the ovum or sperm, or both, (or possibly into germinal precursor cells) at the time of fertilization. For mammals, this process would provide a means of nurturing the developing embryo in the mother's womb, and provide a means of caring for the organism during formative years. It should be apparent that there might not be a clear demarcation between those organismal changes brought about by an intelligent cause and those due to natural means (i.e., chance events). The DNA change could involve an event as small as a point mutation, or a portion of a chromosome, or a larger change involving one or more chromosomes. By this means, members of a new species, genus, family, order, or possibly class could be produced.

The author will discuss possible tests that might be used to indicate whether, in any particular instance, specific action by the deity might have been involved. I will also discuss other aspects of this proposal, including its possible extension to other types of organisms. And I will discuss how this design theory relates to current scientific research and to theories of evolution by chance alone. I consider this design proposal to be consistent with the meaning of the term "*bara*" (create) as used in the Scriptures.

A Christian Perspective of Alternative Medicine

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While the new millennium promises to bring forth many revolutionary developments in science and medicine, there exists, especially in the United States, a strong movement away from rational therapeutics toward a mystical concept of Wellness. This trend has been described variously as Alternative, Holistic, and Complimentary Medicine, and it is based in part on the animistic view that all of nature is imbued with a

life-force or Spirit Essence which is not subject to empirical evaluation. This perspective has unknowingly slipped into the thinking of many otherwise rational Christians as they participate in homeopathy, therapeutic touch, and magnetic healing. Understandably, it represents a turning away from the world view of Scientism. The Bible, however, provides little basis for such beliefs. On the contrary, it restricts any notion of Spirit to sentient creatures, and it commends that we test everything and hold on to only that which is good. Thus, as Christians we are expected to evaluate all health claims by asking “Does it work and is it safe?” As stewards of the temples of the Holy Spirit, we are to reject claims proven false through clinical trials or which violate basic laws of physics. Likewise, it is incumbent on us to embrace interventions demonstrated to have a real health benefit, such as eating more fruit and vegetables and exercising more. Much of what comes under the umbrella Alternative Medicine is in reality quackery. As Christians trained in the sciences we have an obligation to ourselves, to others, and to our Maker, to rationally evaluate all health claims, and to follow the maxim, In God we trust, all others must provide data!

The Sea of Chaos and Creation

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The image of God’s victory over the sea monsters “Rahab” or “Leviathan” is found in several places in the Old Testament (Job 26:12–13, Ps. 74:13–14, Ps. 89:9–10, Is. 51:9–10). While the meaning of this symbolic language cannot always be pinned down precisely, it does represent God’s creation of the world as a victory over chaos. The “deep” or “sea” threatening the ordered world is held back and defeated by the creator. Attention to this theme can be useful in several ways in science-theology discussions.

1. The fact that these passages are not to be interpreted as literal historical narratives can help people realize that some care is needed in reading biblical creation texts. They can thus help to prepare for study of the more familiar creation accounts in Genesis.
2. Since the biblical image of chaos is of an enemy defeated by the Creator, attempts to connect biblical texts with the unfortunately named “chaos theory” of modern physics should be viewed with some skepticism.
3. The biblical connections between a primordial defeat of chaos, God’s victory over the sea in the Exodus, and Christ’s walking on

the sea (Mk. 4:35–41) and triumph over “principalities and powers” (Col. 2:15) provide ways of seeing relationships between creation and salvation.

Help in Removing a Stumbling Stone

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One of the main purposes of the ASA is to help Christian scholars more effectively communicate with the scientific community. There is a problem within the Christian gospel message, however, which has become a stumbling stone for many of those working in science. This stumbling stone is the doctrine of “eternal torment,” a doctrine which is based upon a questionable interpretation of the time words used in the Old and New Testaments to determine how long God’s judgment on sinners is to last. The problem with this doctrine is that it cannot be reconciled, logically or scripturally, with a God of love. Charles Darwin commented on this problem by remarking that he did not know why anyone “ought to wish Christianity to be true,” given its “damnable doctrine” that would assign people to be “everlastingly punished.”

By careful examination of the time words used in the Scriptures to describe the length of punishment, it may be possible to preserve a balance between the all-powerful Creator of the universe who loves all of his created beings, and the same God who will in righteousness judge all of humanity. This reconciliation of God’s love and wrath does not violate common sense and should make it possible to better communicate with nonbelievers, by allowing them to view the reality of the living Christ unobstructed by misleading doctrines. Improved communication between ASA members and the scientific community should result from this examination of the biblical and philosophical implications of the doctrine of “eternal punishment.”

From Mainstream to Periphery, the Rise and Fall of the Gap Theory (or Chaos-Restitution) from 1650 to 1900

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As in Kansas, so in Scopus; 4004 BC is the traditional dating of Creation. Or is it? A closer look shows otherwise.

Soon after Ussher wrote in 1656, various theories of the Earth—Burnet, Woodward, Whiston, Ray, etc.—and exegetes allowed more time, with first the creation of chaos and later the re-ordering or restitution in six days. Thus humans were created in c4004 BC, but initial creation was much earlier. “And so it is understood by all interpreters,” said Burnet.

The eighteenth century was more of the same, with Wesley, Edwards, black poet Phillis Wheatly, and Erasmus Darwin following the Chaos-Restitution scenario. There were a few exceptions, mostly Hutchinsonians.

As the heroic age of geology dawned in the 1780s and the Abyss of Time grasped, theologians, e.g., Chalmers in 1802 and Sumner in 1814, were quick to modify the Chaos-Restitution with all geology in the period of Chaos. The Gap Theory was not a desperate and novel remedy to sanctify geology, but was only a minor modification of the traditional exegesis, acceptable to most evangelicals.

Thus “sound” exegesis could cope with the vast age of the earth but limited humans to 4004 BC. This remained the dominant view until 1850. It was eroded away by the absence of a hiatus before humans (Hugh Miller) and the increasing antiquity of humans. By 1870 the Gap theory was left to the most conservative and proto-fundamentalists.

From Objective-Realism to Subjective-Relativism: Can ASA Find a Golden Mean?

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In his Rede Lecture at Cambridge in May 1959, C. P. Snow described two wars: one in the late nineteenth century between religion and science, and the other in the second half of the twentieth century between the sciences and the humanities. In a recent issue of *Science*, Stephen Gould published a provocative article entitled “Deconstructing the Science Wars by Reconstructing an Old Mold,” where he quotes

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the Snow lecture and attempts to find the golden mean between realism and relativism, trying to diffuse the undeclared war between the sciences and the humanities. Attempts by ASAers to find an objective basis to Christianity's truth claims put us in the middle of both wars mentioned by Snow. Can ASA find a similar *aurea mediocritus* (golden mean) and still support the rational basis of the Christian faith? The recent emphasis on Intelligent Design by Dembski, Behe, and Ross (among others), which looks for *empirical evidence* for design at the molecular level of living organisms and in a fined-tuned universe, has provided strong, rational arguments that establish necessary conditions for belief in a Creator. However, a convincing case can be made *if and only if* one adds sufficient conditions to the necessary conditions. This can happen only if we, Christians in the sciences, coherently bring together all evidence, from the empirical-objective to the experiential-subjective arguments. In fact, five such evidences can be identified and put together: starting with intelligent design (God's fingerprints), looking at who humans are, adding archeological and historical evidences in support of Scriptures (God's footsteps,) and capping it with a personal encounter with the Creator (God's heartbeat), to provide necessary and sufficient conditions in defense of Christianity's truth claims.

This paper will briefly present each of these evidences as multiplicity of strands, each necessary for the defense of the case but not sufficient by itself alone, yet unbreakable when woven together. Another analogy could be an equilateral triangle, each side supporting one (or two) of these arguments, from the "objective-realist" approach to the "subjective-relativist," creating a firm base on which to construct the *aurea mediocritas* of Horace.

References: Stephen Jay Gould in *Science* 287, no. 5451 (14 Jan 2000): 253–61; Kenell J. Touryan, "Are Truth Claims in Science Socially Constructed?" *Perspectives on Science and Christian Faith* 51, no. 2 (June 1999): 102–7.

Science and Christian Faith Inside the Former Soviet Union Countries (A Firsthand Look)

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Following the collapse of the Soviet Union, we have witnessed a noticeable transition among intellectuals, from militant atheism to a

keen interest in religion. As the Soviet Union collapsed, the ideology of many prominent scientists and other professionals was shattered, state support dwindled, and their income was reduced to a trickle. Now they face an uncertain future. As a result many are turning to God for answers.

Coincidentally, the U.S. government has shown concern at the possibility of rogue states taking advantage of the plight of many of these scientists and engineers who have worked on weapons of mass destruction, and has implemented several programs to redirect their efforts to commercial applications. One such program that I have been involved in for five years is called "Initiative for Proliferation Prevention." It has provided many opportunities for me to meet and dialogue with scientists and engineers from dozens of higher institutes in Russia, Belarus, Ukraine, and Kazakhstan, including visits to nuclear cities formerly closed to all foreigners. Issues of science and faith have been of great interest to many of these scientists. Many have attempted to rediscover their traditional faith but find it very difficult to grasp spiritual concepts or deal with much of the mysticism exhibited in the Orthodox tradition. Therefore, unlike their jaded colleagues in the West, almost all former Soviet Union scientists get excited when exposed to the possibilities of finding empirical evidence of design in nature and are intrigued with historical evidences that support the Bible. In fact, in one science city, Dubna, north of Moscow, they have started annual seminars on religion, philosophy, and science. My Christian colleagues and I have prepared a 50-page booklet in Russian that presents a rational basis for the Christian faith. Every chance we have, we distribute copies of this booklet and use it as a basis for further discussions about the Christian faith.

Anecdotal examples and general observations will be presented to challenge ASAers to consider the possibility of communicating with some of these key scientists and/or starting an ASA chapter in these countries, especially in Russia and the Ukraine.

Oceans of Wonder: Genesis One as Vision

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Modernism eclipsed the Christian subjective experience of God and of nature when it became evident that the evolutionary record did not correspond to a literal reading of Genesis 1, the Creation Story. However, Genesis 1 may not be a set of propositions, as both scientism

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and literalism assume. Rather, Genesis 1 may be regarded as a series of experiences, the memory of which was encoded as oral tradition until the time it was written. Since the resulting text depicts a sequence of six “days” that resembles the phenomena and the meaning of six epochs of the evolutionary record, one may conclude that the originating experience somehow encountered the evolutionary record. One way to artistically render that encounter is to depict Genesis 1 as a series of visions.

That depiction not only helps us to subjectively experience the two-tiered correspondence between the Creation Story and the evolutionary record, but it evocatively places the visions (and subsequent oral tradition) into Mesopotamian prehistory, giving rise to a new metaphor: “Genesis 1 as archaeological artifact.”

The combination of Genesis 1 “as vision” and “as archaeological artifact” transports us beyond the eclipse of Modernism by placing Genesis 1 in context. On the shore of the ocean of wonder, where Genesis 1 is a sign of nature and of God, we find a message in a bottle, Genesis 1 as map of time that points to where we are.

Plenary Addresses

Tangier Watermen’s Stewardship for the Chesapeake: Faith-Based Stewardship for Environmental Conflict Resolution

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The Tangier Island case study reveals that for the faith-based watermen community of Tangier Island, Virginia, the most successful and legitimate approach to promoting sustained environmental stewardship and communication and partnerships with environmental professionals is one based on their Christian faith—the foundation for their theistic world view. This research tested the degree to which a faith-based community could transform their own behavior and bring it into better accord with their professed belief system in pursuit of

environmental, social, and economic integrity for their island community and the surrounding Chesapeake Bay.

Local and regional environmental groups rarely integrate environmental ethical discourse into discussions about environmental problem solving. In the last decade, however, there is a growing recognition, in the world-at-large, of the need to include religious faith, as part of ethics, in environmental conservation practice. However, many environmental professionals believe that a religious faith system is a cultural barrier, something to be overcome for successful implementation of their projects. In actual fact, faith, in rural, faith-based communities, can be a facilitator of change that promotes environmental stewardship.

Conflict between environmentalists and resource-dependent watermen communities has been escalating over the years in the Chesapeake Bay watershed as pollution increases and fisheries decrease. Since 1991, watermen (an old English term referring to people who crab, oyster, and fish) of the Chesapeake Bay have been in battle over oyster and blue crab regulations set by state boards of fisheries and environmental groups. One-fourth of the Chesapeake Bay, approximately 4100 km², is covered by wetlands, the habitat for the blue crab and other invertebrates. Unfortunately, these fragile ecosystems are being lost at an alarming rate and, as a result, the blue crab, and those who depend on it for their living, are struggling to survive. In 1995, conflict erupted on Smith and Tangier Islands over a blue crab regulation that ended in the burning of a shed owned by the regional environmental group called the Chesapeake Bay Foundation (CBF). Misunderstandings and fear that the environmental groups were trying to get rid of them caused the watermen of Tangier Island to place signs against CBF along the waterways leading to the island for tourists to see.

An ethnography was employed on Tangier Island to better understand the causes of the conflict between CBF and the Tangier watermen and to understand the forces for change in the community. The ethnography revealed that 84% of the islanders consider themselves conservative, evangelical Christians and that their Christian, theistic world view is the basis of their culture. It also revealed that the history and world view of Tangier is integrally related to the history and theology of American Methodism dating back to the 1800s. The New Testament Church (formed on Tangier in 1945) and the Methodist Church were found to be the main institutional forces for change in the community, along with Tangier women being the primary agents for change. In addition, it was found that the Tangier men have an environmental ethic within their Christian belief system.

The ethnography further revealed three primary underlying causes for the conflict between CBF and the Tangier watermen: (1) the watermen's fear of their loss of livelihood and way of life, and mistrust of anyone who appeared to threaten their existence; (2) misperceptions

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and suspicion of the motivations of outsiders—especially environmentalists, scientists, and government officials—who want to institute change in attitudes and behaviors toward the fishery and their island environment; and (3) lack of respect on the part of both groups for the other’s way of knowing either about the fishery or the world-at-large. The majority of the people in the Tangier watermen community have an experiential knowledge of the fishery and a Christian theistic approach to knowing and understanding the world. The environmental professionals, influenced heavily by naturalistic assumptions, know the fishery and the world from a predominantly scientific and academic perspective.

People in conservative, rural communities—particularly faith-based communities—are often unable or, in some cases, unwilling to relate the environmental ethic of “outsiders” to their own environment and way of life because it is not perceived as consistent with their world view. However, many of these communities desperately need to plan for an environmentally-sustainable economic future but cannot move beyond their fear, mistrust, and misperceptions.

Working within the Tangier men’s Christian world view, and employing a methodology called “participatory action research” combined with a “transformative conflict resolution” approach, a biblically-based environmental stewardship initiative was developed by and for the Tangier community that helped to overcome the fear, mistrust, and misperceptions. This led to people’s acknowledgment of their spiritual responsibility to be stewards of God’s creation and, therefore, to obey the civil (i.e., fishery) laws regardless of how just or unjust the laws appeared or how much the Tangier men stood to lose economically. It also led to Tangier men planning and instituting change for the community’s economic sustainability. Last, but not least, it fostered better communication and working relationships with environmentalists and scientists—once considered to be their enemy—to find solutions to fishery and island environmental problems. Fifty-six Tangier watermen pledged to be better stewards of God’s creation through a Watermen’s Stewardship Covenant taken at a joint meeting of both churches on the island. This was followed by community meetings and surveys to determine economic, social, and environmental goals for the community set forth in the Watermen’s Stewardship 2020 Vision. Later, the Tangier stewardship group implemented fishery and wetland projects with CBF and other outside organizations and, within one year, formed the Tangier Watermen’s Stewardship for the Chesapeake (TaSC), a non-profit organization to promote environmental and economic stewardship and preservation of the watermen culture.

What can be learned from this case study is that some environmental conflicts are not just centered on the clash over the harvest and management of resources, but over the differences in world views of the people involved in the conflict. The belief systems, values, ways of

knowing and learning and ways of communicating are often very different between scientists, policymakers, and local people, particularly people of faith. Environmental professionals need to understand that faith-based communities think and act according to a theistic, not naturalistic, world view. The implication is that to institute change of attitude and behavior toward environmental stewardship, there must be a recognition that the community's faith or theistic world view is a respectable and legitimate "way of knowing and learning." Indeed, it is likely to be the only legitimate and respectable approach in the eyes of the local faith-based community.

Managing Creation – Or At Least the Whales

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Whales are a striking illustration of many of the issues concerning the wise use of charismatic megafauna, as well as the general responsibility of humankind to manage the world's natural resources. Whales have been hunted from at least pre-historic times for food and other useful products that can be derived from their bodies, and many of the stocks around the world were successively reduced in numbers. Advances in hunting technology, particularly in the last 150 years, and the associated commercial pressures, meant that this depletion continued even when the scientific evidence was sufficient to confirm the dangers to the stocks. Worldwide concerns about the risks of extinction, the killing methods employed, and the morality of hunting such large sentient mammals led eventually to the introduction of a total ban on commercial whaling from 1986. Some coastal communities feel strong resentment at being deprived of this aspect of their traditional hunting lifestyle, especially when others are still permitted to hunt whales for subsistence and cultural purposes. Now a conservative and scientifically robust management procedure has been developed which could be applied safely to the abundant stocks. However, any resumption of commercial whaling is resisted by a number of governments representing people who advance reasons including the newly perceived values of education and welfare represented by these large mammals, and the alternatives of nonconsumptive utilization such as whale watching.

Posters

New Tools for Teaching Chemistry

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This poster presentation allows for a personal examination of interactive computer exercises made with Toolbook and HyperChem or Chime, a web page plug-in. Toolbook is used to ask discovery questions, present concepts and information, give directions, suggest activities, and it is also used to communicate with and control HyperChem. There is a seamless connection between the information in Toolbook and the work done in HyperChem to complete the activity. These exercises are designed with the intent of having students develop an understanding of a concept by working through the exercises in addition to having the concept explained to them. Different pedagogical approaches are used depending on the nature of the topic and the level of instruction being presented. Chime is used to display molecular structures, and two types of exercises using it have been made. One type depends on the built-in functions of Protein Explorer or Protein Comparator and has text which describes the structure of the protein and suggests commands to be used to change the structure to illustrate the description. The other consists of text which describes the features of the structure and scripted buttons which change the structure to illustrate the description. Exercises include those that demonstrate the general structural features of fibrous and globular proteins as well as ones that illustrate specific structural features of proteins such as hemoglobin.

Fast Evolution

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Darwin described evolution as a slow process, with a natural selection working on the minute variations that we see in nature. However, the fossil record is undeniably discontinuous and the list of modern examples of rapid evolution is increasing. Three such examples are:

(1) A population of guppies were placed in a predation free environment and in seven years they were larger, matured later, had fewer offspring, and put less energy into bearing those offspring (*Science* 275: 1934–6); (2) One thousand years after Polynesians introduced banana plants to the Hawaiian islands, five species of moths evolved there to exclusively feed on those plants (*Evolution* 14:137–8); and (3) In twelve thousand years, cichlid fish of Lake Victoria in Africa speciated three hundred times (*New York Times* [August 27, 1996]: B5).

Jeffrey Schwartz, a paleoanthropologist at the University of Pittsburgh, proposes a new theory to account for the gaps in the fossil record and rapidly changing morphologies in his book, *Sudden Origins* (1999). Central to his theory are mutations of homeobox genes or “hox” genes. These genes are active at specific intervals in specific patterns during the development of animals as diverse as flies and humans. In my presentation, I will scrutinize the Schwartz theory in detail.

Special Presentation

Cosmos and Contact: The Religion of Carl Sagan

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An examination of Sagan’s world view and especially his epistemology as it is revealed in his book and PBS series, *Cosmos*, his science fiction novel and film, *Contact*, and his last book, *The Demon-Haunted World*. The question of recognizing a message from an extraterrestrial intelligence is particularly considered, using a 15-minute clip from the film *Contact*. It is suggested that we have some very impressive messages from the most intelligent being in the Cosmos preserved in the fine-tuning of the universe and in the DNA found in living things.

Symposia

Christian Engineers and Scientists in Technology Symposium

Curriculum Guide Development Project for the ASA Science Education Web Site

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Large school districts have the resources for developing their own curriculum guides based on state documents and national documents such as the *National Standards for Science Education* and *Project 2061* (AAAS). These guides, beyond what textbooks alone can do, provide an overarching, multi-grade perspective on curriculum. The guides help teachers to know what science topics should be taught in what grades and in what sequences. They also provide instructional help.

Many students, however, are outside such districts. These students are home-schooled by their parents, or attend religion- or church-based schools, or rural public schools. Teachers in these educational settings typically lack access to curriculum guides enjoyed by large public school districts. Print documents such as those produced by large school districts could be provided for these teachers, but print documents are relatively expensive. An efficient, inexpensive solution is needed. We have learned through our contact with Christian schools and rural public schools that many teachers have access to the Internet—and the number is growing. Moreover, research on home-schooling shows that more than 83% of home-schooling parents have Internet access. Given that Internet publication is relatively *inexpensive*, an Internet-based science and environment curriculum guide for the elementary grades would be an effective and efficient method of meeting an important educational need.

Our paper presentation discusses a proposal to develop an ASA-sanctioned science/environment studies curriculum guide for the elementary grades. By placing the guide on the Internet, we can make the guide freely and easily available to a very large number of teachers.

Can There Be an Ethical Foreign Policy?

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In human communication, the *Zeitgeist*, or spirit of the age, shapes how a message is understood. In our own culture, the intellectual climate is one of skepticism. Moral and religious reasons for political decisions are increasingly criticized as irrelevant because postmodernism has deconstructed the Judeo-Christian ethic for American society. This poses a significant problem for public officials charged with the governance of our nation. Every action is scrutinized for some potential "hidden agenda" and motives are routinely questioned. Some of this is, of course, part of living in a democracy, which values diversity of opinion. What has become almost crippling to the formulation of coherent foreign policy is the inability of the U.S. government to make a compelling case for continuing world leadership to the American people. Some have commented that the American people are simply returning to isolationism without the Communist threat posed by the Soviet Union. Public outcry over atrocities in Somalia, Rwanda, Bosnia, and Kosovo, however, demonstrates that the American people care deeply about the suffering of people far away. They are simply confused about the proper U.S. response to such tragedies, because their leaders have not given them a common-sense moral argument that would justify shedding American blood in such conflicts. The "moral sense," postulated by sociologist James Q. Wilson, offers one way of communicating universal moral truth to postmodern society. Understanding one possible mechanism for how God may have given humanity a conscience opens public discussion of moral issues, and may be a way to generate consensus to act justly as a nation. Four aspects of the moral sense are discussed and applied to U.S. foreign policy: sympathy, fairness, self-control, and duty.

Technology and the End of the Nation-State

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The age of the nation-state is coming to an end. Technology led to its rise and is driving its demise. How the world-system holds and uses its power is being challenged and changed by technology. This presentation presents a broad overview of the transition to the Information Age, and how technology relates to political and spiritual aspects of it, including the following:

1. How technology ended feudal power of the Middle Ages and led to centralized government and big industry.
2. What are nations, states, and nation-states.
3. How technology is diminishing nation-state borders and is driving regionalization of the world.
4. Who controls the world—the Establishment comprising the world-system.
5. How the Establishment is using environmental issues to effect political consolidation.
6. Technology and the kingdom of God.

Extending Moore's Law and Enabling Good and Evil

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Despite daunting technical challenges looming in the next few years, the rapid pace of progress in information technology, often referred to as Moore's Law, is likely to continue during the next decade. Some of these challenges are lithography and transistor design. Significant advances are expected in fields such as communications technology and computational biology. For many Christians, technology is considered to be morally neutral, and it is not difficult for Christians working in the industry to separate their work from their faith. However, the application of technology will enable new possibilities of

both good and evil. It is our responsibility to actively encourage deployment of technology in such a way as to amplify the good and minimize the evil.

Three of the areas of application of new information technology for “good” are virtual community building, security enhancement, and genetic manipulation to extend life. The corresponding areas of application for “evil” are collusion, fraud, and genetic discrimination. These are examples of how progress in technology will continue to enhance our knowledge of good and evil as we pursue the tree of life.

“What is Truth?” Creating Scientific Consensus without Compromising Truth

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How do we as Christian engineers and scientists present ourselves and our science to the public and policy makers, who assume there is one right answer to their questions? The public has a right to know the prevailing scientific understanding of subjects pertinent to public health and safety, but which side(s) of the story should be told? Science is not a democracy, but the public tends to assume it is. When experts disagree, how should we present our conclusions to the technically naive public?

In January 1996, I became chair of a small group of scientists and engineers—experts in the field—charged with the task of writing an official, consensus statement on the “health effects of power-frequency electric and magnetic fields (EMF).” The group of thirteen that I chaired included five prominent and outspoken advocates of the idea that 60-Hz EMF pose a serious health threat, as well as five of similar prominence and personality on the opposite end of the spectrum.

Bringing productive results from this quandary depended on some human factors beyond our call to depend on God for wisdom, and to recognize him as the ultimate source of all truth. The human factors are: access to a resource base one can trust as an unbiased review of the subject under debate, unquestioned trust of those for whom one is working, and personal stubbornness coupled with sensitivity for the other sides’ positions that must have come from God alone.

Is the ASA Seeking Truth in Environmental Matters? A Sequel

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In 1986, the author presented a paper titled with the above question. In that paper, I noted the painful struggle for truth in my then twenty-years experience dealing with the subject of the bioeffects and hazards of exposure to electromagnetic (EM) energy. Christian belief demonstrably was not linked to truth in that field, as exemplified in a few personal experiences.

In about 1996, there appeared media reports that linked Christian organizations like the IVCF to political activity on the question of reform of the Endangered Species Act (ESA). I then learned of ASA involvement in the Evangelical Environmental Network (EEN) that was involved in this political activity. Both the ASA and the IVCF denied any political involvement despite their "membership" or affiliation with the EEN. Since I knew many good Christians who held opposite views to the EEN on the ESA, I wondered why ASA could not explore both (or all) sides of controversial environmental matters like the ESA, painful as such examination may be.

This is the goal we had espoused for the ASA Industrial Commission (IC) and now one of the goals for the Affiliation of Christian Engineers and Scientists in Technology (CEST). In particular, through CEST, we hope to inject into ASA deliberations a viewpoint lacking in the past history of ASA (and the IVCF)—that of the engineer or scientist involved in the development and application of technology. With a more balanced review of environmental matters, ASA can better provide edification on science and technology for the broader Christian community.

Problem-Solving Methods in Science and Design

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In every area of life, creativity and critical thinking are essential. These mutually supportive skills are integrated in the problem-solving methods used by scientists and by those in a wide range of fields where the goal is to design a product or strategy. The goal-directed process of

designing a theory, product, or strategy involves the generation, evaluation, and execution of problem-solving actions, such as comparing the results of mental and physical experiments with each other and with goals.

Due to the similarities between Scientific Method and Design Method, we can teach both in a unified system of instruction. A “thinking skills” approach to education would begin with design because students are more familiar with this activity, and would use Aesop’s Problems (designed for a specific purpose) to help students learn how to think more effectively. A carefully planned sequencing and coordinating of activities within each course and between courses would produce a synergistic “spiral curriculum” for teaching higher-level thinking skills. Occasionally, students would analyze and compare the methods used in design and science, to explore their similarities and differences, to promote the transfer of skills from one area to another, and to appreciate the benefits and limitations of analogical thinking. Suitably adapted, a “methods for problem solving” approach could also help the Christian community develop a better understanding of science, and a better attitude toward this potentially noble pursuit of truth. For details, check www.sit.wisc.edu/~crusbult/methods

Technology for Morality

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Americans do not feel as safe as they once did, no longer believing that they can escape the threat of violence by moving to suburbs or rural areas. The feeling is not restricted to adults: eight percent of high school students reported in 1997 that they had carried a gun, knife, or other weapon to school during the previous thirty days, primarily for a sense of security. Fear of crime and concerns for security lead parents to spy on their kids and bosses on their employees. In fact, violence is both up and down. Despite a much-publicized recent drop, violent crime in major cities in the U.S. in 1998 was 40% higher than 1969.

Whatever their world view, Americans are increasingly turning to technology to provide security, for domestic, commercial, and government activities. The myriad of security technologies can be grouped by general function, e.g., monitoring, denial, deterrence, identification, assurance, and enforcement. One weapons laboratory has a new public interest mission: transferring *surety technology* from national security to schools. But is surety achieved via technology *benign*? A technology race can ensue, each advance inducing a new

round of attempts to defeat it. Each new surveillance tool admits a loss of privacy. There is risk of impersonalization: discipline reduced to detection and confrontation rather than to changed behavior. This presentation will describe surety technology and offer caution collected from Scripture for trusting technology to provide security and effect morality.

History and Philosophy of Science Commission Symposium

Part 1: "Revolution And Evolution"

Science and Religion, Chicago Style, 1922–1931: Popularizing Protestant Modernist Views of Science in the Age of Bryan

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In February 1922, William Jennings Bryan's popular assault on evolution went upscale, when the *New York Times* published his essay, "God and Evolution." This drew almost immediate responses from Princeton biologist Edwin Grant Conklin, American Museum of Natural History paleontologist Henry Fairfield Osborn, and Protestant pastor Harry Emerson Fosdick. Shortly after this, the essays by Conklin and Fosdick were reprinted as the inaugural numbers in what would become a series of nine "Popular Religion Leaflets" on "Science and Religion," published between 1922 and 1931 by the American Institute of Sacred Literature, a correspondence arm of the University of Chicago Divinity School. Shailer Mathews, dean of the seminary, supervised the series and wrote one of the pamphlets himself; Fosdick later wrote a second. The other five were written by prominent American scientists: Nobel laureate physicist Robert A. Millikan, Harvard geologist Kirtley Mather, Yerkes astronomer Edwin Frost, Columbia physicist Michael Pupin, and West Chester biologist Samuel Christian Schmucker. Although the pamphlets were underwritten by John D. Rockefeller, Jr., and distributed very widely, they are virtually unknown to both historians of science and historians of religion. This paper tells how the pamphlets were found, sketches their history, and briefly analyzes their highly interesting content, placing them in the larger context of the history of Christian thinking about science. Above all, it seeks to understand more fully why evolution was so hotly debated in the early twentieth century, and why it remains so today.

The Copernican Revolution Reconsidered

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Thomas Kuhn's bold attempt to generalize from many quite different cases to general rules of scientific revolutions leaves unanswered some significant aspects of his foundational case, the Copernican Revolution. In contrast to the swift pace of modern astronomy, the revolution initiated by Nicolaus Copernicus' *De revolutionibus* seems slow and unrelated to any new observations; it was an idea "pleasing to the mind." On aesthetic grounds but without empirical proof, Copernicus argued for (1) the perfection of the circle, and (2) the elegance of the heliocentric plan. The first idea met with considerable sympathy from sixteenth-century astronomers, while the second was suspect both because it required "new physics" and appeared to conflict with the Scriptures.

This presentation will argue that the slow acceptance of Copernicus' radical heliocentric cosmology resulted primarily because the Polish astronomer was far in advance of the technological developments needed to test his hypotheses. Tycho Brahe's precision instruments (and his failed campaign to find the parallax of Mars) produced the observational base for Kepler's physical astronomy, while in Galileo's hands the telescope provided evidence from the phases of Venus that disproved the Ptolemaic arrangement.

Once the new instrumentation opened the way for observational tests, Copernicus' insistence on the uniform, circular motion proved to be a sterile dead end, but his other grand aesthetic vision, the heliocentric cosmology, found relatively rapid adoption. The resistance from the Catholic Church in Galileo's day was primarily an argument of who held the keys to truth rather than a fight over cosmological paradigms.

History and Philosophy of Science Commission Symposium

Part 2: "Religion and Science in the Eighteenth and Nineteenth Centuries"

The Rev. Cotton Mather F.R.S. (1663–1728): The Christian Philosopher, Relating Science and Faith in the Colonies

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Cotton Mather was a uniquely important figure in Puritan New England. An effective and influential preacher, courageous defender of freedom, and natural philosopher, he influenced his times through his publications and public health activism. His reputation has suffered as scholars have sought to balance his many positive contributions against his association with the Salem Witch Trials.

In this paper, I will explore Mather's scientific interests as represented in his *The Christian Philosopher* (1721), America's first work on the physical and natural sciences. In it the "design argument" receives new vigor in light of the Newtonian science of the day. His work falls in the line of cleric-scientists from John Ray through John Wesley to William Paley and beyond.

The design argument and (more broadly) natural theology provided one of the main pillars for popular religion in seventeenth century England and New England. For Christianity, the Bible was the pillar of support; for natural religion (belief in God), the design argument was sufficient. The evidence of both celestial and terrestrial phenomena implied an intelligent designer, while the biological adaptation of various organisms to their environment along with the established doctrine of the fixity of the species testified to purpose in nature. I will examine his project and explore how it played out in his generation and suggest implications for today's "intelligent design" endeavor.

A Different Voice from the Eve of the Origin: Reconsidering John Henry Newman on Christianity and Science

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John Henry Newman (1801–1890) was a Fellow of Oxford’s Oriel College and is widely remembered for his role in the Oxford Movement, for his subsequent conversion to Roman Catholicism in 1845, and for being made a cardinal in 1879. Those familiar with his theological pilgrimage are aware of his spiritual autobiography, *Apologia pro vita sua* (1864). Others who know the history of higher education are acquainted with his seminal collection of lectures, *The Idea of a University*. Only very rarely, however, does his name appear in current literature of science and religion. This is unfortunate because Newman had some important ideas regarding the relationship between science and Christian theology that merit consideration.

In 1855 Dublin, Newman, as Rector of the new Catholic University, delivered two lectures: “Christianity and Physical Science” and “Christianity and Scientific Investigation.” These were first published in November 1858 in an anthology of his lectures and essays on “University Subjects,” which were incorporated into subsequent editions of *The Idea of a University*. Although sizable bodies of scholarship deal separately with Newman’s life and with Victorian science, very little has been written about Newman’s views regarding science and religion, and no systematic study of his two important 1855 lectures has been undertaken by a historian of science and religion. This paper begins such a study. After an introduction to Newman and the context of the 1855 lectures, the paper provides a critical summary and analysis of Newman’s thought on science and Christianity as advanced in the lectures. It concludes by suggesting ways Newman’s thought may find application to contemporary issues in science and Christianity.

Charles Darwin and Asa Gray Discuss Teleology and Design

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The concept of “intelligent design” is not new. During the latter half of the nineteenth century, Asa Gray (one of Darwin’s chief advocates in the USA) and Charles Darwin discussed the matter. Darwin had pondered purpose and design throughout his scientific life, vacillating between acceptance and rejection of these concepts. Initially, Darwin seemed not only to agree with Gray’s reading of teleology into the theory of natural selection, but was also pleased that Gray was making known the theory’s teleological nature. However, Darwin again backed away from this position for reasons that may best be described as related to issues of theodicy. The implications of both Gray’s

understanding of natural selection, and Darwin's rejection of the design component, are important for the current discussion of intelligent design.

Workshops

Mentoring/Discipling Workshop

How Do We Help Younger Colleagues in Both Their Professional Development and Spiritual Growth?

Panel members: J. Terence Morrison (Moderator), Wayne Becker, Daniel Hastings, and Judith Toronchuk
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A panel of scientists will speak to the question: How do we help younger colleagues in both their professional development and spiritual growth? Each panelist will provide a brief written statement and will take up to ten minutes to describe his or her concept/philosophy of mentoring/discipling and tell some stories illustrating their practices. Dr. Wayne Becker, Botanist at University of Wisconsin-Madison will be the featured panelist and will describe in some detail his discipling experience with students and colleagues.

Two others will do the same. I will lead off the session with a general paper citing definitions and current needs as well as providing a scriptural base for mentoring/discipling.

Teaching Bioethics Workshop

Teaching Bioethics: Unique Opportunities and Responsibilities

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Issues in bioethics can be found at the forefronts of scientific research, the practice of medicine, and some of the most vexing problems confronting society. These issues affect us at the individual, professional, and societal levels. Opportunities to explore issues of bioethics can be found in academia ranging from high school through post-graduate and post-professional continuing education and beyond academia in institutes of research and health care, to para-church and church groups, and to community forums. Over the last three decades, bioethics has emerged as an interdisciplinary field encompassing biology, medicine, philosophy, and religion and theology; in its broadest sense, it extends to include all the natural and social sciences as well. The interdisciplinary nature of bioethics often is perceived as an impediment to teaching and to addressing issues of bioethics.

This presentation will examine the range of opportunities to teach bioethics in academia and beyond, critique various approaches to presenting and teaching bioethics, and provide some resources for persons interested in teaching or addressing issues of bioethics. It will present one approach to integrating issues of bioethics into a course in human biology for nonscience majors, an approach which increases basic knowledge, develops critical thinking, and fosters citizenship. This approach is applicable also to biology courses for majors and can be adapted to other disciplines. To illustrate this approach, workshop participants will discuss a thought-provoking, undergraduate-level essay on "Animal Rights, Welfare, and Experimentation."

Teaching Bioethics to Liberal Arts Students and to Biology Majors

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The teaching of bioethics requires a fairly broad background in both biology and ethics. That is why the course is often team taught. However, many liberal arts colleges and universities cannot afford the luxury of assigning two faculty members to the same class unless the enrollment is substantial. A large enrollment hinders class discussion and interaction. A second consideration is the background of the students. Is their major outside science or are they biology majors? For nonscience majors a course which fulfills a liberal arts requirement is a prime possibility. For majors the material in bioethics can be worked into the requirements for the major without a separate course. Finally, how does faith enter into the discussion especially in the secular college or university?

Innovative methods of teaching lend themselves to a bioethics course. To allow students to process the information in greater depth, such things as case studies, buzz sessions, position papers, and role playing can be used. These methods can also be worked into biology courses for the major. Bioethics should be broadly interpreted to include environmental ethics and research ethics as well as medical ethics. Following the presentation it is expected that there will be time for discussion and innovative suggestions from other bioethics teachers as well as thoughts on including religious material in courses at secular institutions.

Teaching Biology Workshop

Biology Goes Retro: A Living History of Biology Teaching

Panel members: Ray Brand (Moderator), Wilbur Bullock, Harry Cook, and Dick Wright
Organized by John Wood

One element in discovering where you are going is to remember where you have been. The Scripture often reminds us to look back and reflect on what God has done for us. This session offers a retrospective of biology teaching, with a sharp eye to the future. The Affiliation of Christian Biologists and the ASA are blessed with a number of retired college and university professors. Their careers have spanned one of the most dynamic periods of growth and change in our discipline. Together they have witnessed Watson and Crick crack the genetic code and the birth not just of biochemistry, but of biomolecular technology. And the institutions at which they taught were no less dynamic. Most biology programs have expanded in student and faculty numbers, adding new courses and phasing out once-established sub-disciplines.

Today we stand on the threshold of a new century where biology is projected to lead the way. Beyond the emerging ethical issues stands the challenge of communicating our science to students with widely divergent life experiences. A four-member panel of emeritus professors will survey where biology teaching has been in the last fifty years. Ray Brand will moderate and Wilbur Bullock, Harry Cook, and Dick Wright will reflect on biology teaching. Their combined experience and wisdom will be a valuable element in our thinking about the challenges and opportunities that face biology teachers today.

Service-Learning Projects in the Sciences: Serving the Community while Teaching the Student

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During the last decade the departments of biology and chemistry of Azusa Pacific University (APU) have created a unique series of community outreach programs designed to enhance student learning while providing a needed service to the surrounding community. This concept, called "Service-Learning," has become a widely accepted technique for involving students in service projects that are directly linked to their educational experience.

In examining the needs of our community and our departments' ability to meet them, it became obvious that there was a need to improve science education in the public, private, and home school communities around APU. A program was created that involved freshmen biology majors enrolled in our first-year introductory course. Each student was required to research a specific topic, create a two-hour lab and present it to a community group visiting our campus. A lab was designed specifically with this program in mind with direct outside access and low counter tops. A strong support system involving upperclassmen interested in teaching careers was developed to support the professor and the students while fees charged to home-schooled students covered the costs.

While most students criticized the requirement initially, virtually all rose to the challenge and were enthusiastic about the experience. Assessment of student learning showed increased retention of material for university students doing the teaching. K-12 students, their teachers, and parents have shown unanimous support and appreciation for the project. Latest projects include virtual Internet labs conducted by our students and transmitted to high school students in their classrooms and a science education web site containing curriculum developed by our students.

An Interdisciplinary, Investigative Approach to Teaching Biology

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In an effort to make learning more technology based, student centered, interdisciplinary and investigative, the biology and chemistry faculty at Messiah College have joined forces to institute curricular revisions that we refer to collectively as "Project Inquiry." The following components are included:

1. In their courses, faculty are committed to increased utilization of computer-based, student-centered learning exercises based on CD-ROM, the Internet, and other formats.
2. The first-year biology course and chemistry course taken by our departmental majors (Biology, Biochemistry, Chemistry, Dietetics, Environmental Science) have been restructured so that related topics are taught concurrently. This applies also to the laboratory portion of both the biology and chemistry courses, which focuses on the biology and chemistry of the Yellow Breeches Creek that flows through the campus. Since environmental science and dietetics majors also take these courses, components from these disciplines have been built into the laboratories of the "integrated" courses. A major goal of the "integrated" courses is to help students recognize the interconnectedness of biology and chemistry.
3. Another component of the biology and chemistry courses is an investigative group project related to the biology and chemistry of Yellow Breeches Creek. Student research groups present their findings in a scientific poster format. The intent is to generate an interest in scientific investigation that will result in most majors completing a more extensive individual research project during their undergraduate experience. To that end, significant funding has been directed toward establishing a molecular genetics and a scanning electron microscopy laboratory, both of which will provide significant opportunities for senior year research projects in biology.

Creating a Rich Learning Environment: Reforming the Way We Teach

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Biologists are keenly aware that our discipline is undergoing dramatic change. We must rapidly adapt the content we teach and the way we teach it in a restructured learning environment. The new field of bioinformatics is emblematic of the explosion of biological information. So much genome data is streaming in, for example, that “experiment free” data mining papers are appearing in physiology. We struggle to survey a field where new knowledge pushes out the old, and no one can master the growing body of biological and related knowledge.

But even more challenging is the information technology that drives this change. Our classrooms look very different from those we left as undergraduates or even graduate students. In 1980 personal computers were cutting-edge technology in graduate school biology laboratories. Today they structure everything about our daily routine, including what and how we teach. We are facing a multi-dimensional challenge of keeping up with rapidly changing cultural and technological factors and trying to find ways to fund it.

Building on the insights of the “Biology Goes Retro” panel, I will discuss recent biology teaching reforms. A new paradigm is emerging. The key elements include: creating a community of active learners; commitment to scholarship in broad terms; mentoring students; teaching from nature, not just about nature; and recognizing that science is a human enterprise. This paradigm reflects a number of biblical principles. Christian biologists are uniquely situated to implement this new view of biology teaching. We can meet the challenge of assisting the Church in an age of biocomplexity and globalization.