GEOSCIENCE NEWSLETTER

Number 14 July 2008

THE GEOSCIENCE RESEARCH INSTITUTE CELEBRATES 50 YEARS

The Early Years, 1958-1964

The group now known as the Geoscience Research Institute (GRI) was first organized by the Seventh-day Adventist Church (SDA) under the direction of an appointed Committee on Teaching Paleontology and Geology. This Committee was chaired by H.L. Rudy, and the first two scientists were Frank Marsh and Edgar Hare, both of whom were hired in July, 1958. The offices were first located over the college press at Emmanuel Missionary College (EMC), now Andrews University, in Berrien Springs, Michigan.

The Geoscience building in Michigan. It was originally the offices of the Lake Union Conference. More recently, it had housed the Siegfried Horn Institute of Archaeology, and was demolished in 2003. Photo courtesy of Institute of Archaeology, Andrews University.

The Committee was established to foster development of expertise in areas where secular scientists were challenging the church's understanding of Genesis, especially relating to the age of the world and the time required for formation of the geological column.

All the earliest members of the Institute participated in the first field trip in 1960. Standing on the top of Specimen Ridge in Yellowstone National Park are (L-R): Richard Ritland, Frank Marsh, Ernest Booth, Harold Coffin, Edgar Hare, and Kendall Marsh. Photo courtesy of Harold Coffin.

In 1960, Richard Ritland joined the scientists, and a nearby building was purchased to house the group, which was now affiliated with the General Conference (GC) Department of Education.

Later the same year, the group led its first field trip, organized by Ritland and Hare, traversed several states, examining sites of geological interest. The participants included Harold Coffin and Ariel Roth, both of whom later worked at GRI for many years.

Also in 1960, a conference was held at La Sierra College (now La Sierra University) in Riverside, California. Several academic leaders were among the conferees, including Harold Clark, who had a large influence in creationist thinking.

The name of the group varied, as recorded in the minutes of the GC Committee. In 1960, the group was referred to as the "Department of Education Geological Science Group." In 1961, both the names "Geophysical Science Research Institute" and "Geo-Science Research Institute" were used, and the name "Geoscience Research Institute" was ultimately adopted. During these years, the Committee was chaired by GC President Reuben R. Figuhr.

Attendees at a 1960 meeting at La Sierra College. Frank Marsh is on the front row, at left. Harold Clark is standing immediately behind Marsh. Richard Ritland is on the front row at the right. Edgar Hare was not in the photo. Photo courtesy of Harold Coffin.

The 1960 field trip involved much camping. The green truck belonged to Richard Ritland. Photo by Ariel Roth.

Subsequent years were spent in field study and conferences in various North American locations. More changes took place in 1964. Harold Coffin joined GRI, and Harold James was sponsored to attend graduate school. By the end of 1964, Marsh had returned to the biology department at EMC and Hare had gone to work for the Carnegie Institution.

Geoscience Newsletter is an e-publication of the Geoscience Research Institute, 11060 Campus Street, Loma Linda CA 92350 USA.
To subscribe, please contact us at newsletter@grisda.org.

Participants in the 1965 field trip exploring Sheep Mountain Gap in Wyoming. Photo by Ariel Roth.

The Ritland Years: 1965-1971

A second field tour was held in 1965, led by Ritland. It was intended for "qualified scientists and theologians," and spent four weeks touring several of the western states.

Don Neufeld (left), editor of the Review and Herald *(now* Adventist Review*), was among the attendees at the 1965 Field Conference. Photo by Ariel Roth.*

The "fossil forests" of Yellowstone National Park were a focus of intense interest and discussion during these years. The question was whether the successive layers of fossil trees were in their original position of growth, or were somehow transported into the region where they formed successive layers. Ritland thought the fossil trees were an insoluble problem for a Biblical chronology, while Coffin advocated a transport explanation. The issue remained unresolved for many years.

Richard Ritland (left) and Harold Coffin (right) discuss the Yellowstone fossil forest on the 1968 field trip. Photo by Ariel Roth.

M.V. Campbell was appointed Chair of the GRI Board in 1966, and Ariel Roth joined GRI half-time, residing at Loma Linda, California and meeting with the rest of the group twice a year. Ritland published a book in 1966, *Meaning in Nature*; an expanded edition followed in 1970. Also in 1970, Coffin published *Creation: Accident or Design?*; later editions, under the title *Origin by Design*, were published in 1983 and 2005.

Early in 1967, Richard Ritland was appointed the first Director of GRI, a position he held for the next five years.

Robert Brown examining a huge fossil tree during the 1968 field conference. Photo by Ariel Roth.

Coffin and James made up the rest of the staff. Ritland's tenure was marked by emphasis on the fossil forests of Yellowstone, and evidence for time in the geological record.

The year 1968 saw the addition of Ed Lugenbeal to the GRI staff, and another field trip through the western United States, again led by Ritland. The

Participants in the 1968 Field Conference looking for fossil fish in the Green River Formation of Wyoming. Participants included GC President Robert Pierson (lower left in pale blue shirt). Photo by Ariel Roth.

1968 Field Conference was a pivotal point in the history of GRI. Church leaders, having been in the field themselves, became better acquainted with the issues, and more aware of their significance. Recognizing the foundational role of Genesis in Biblical doctrines, they felt the need to renew the church's emphasis on the historical validity of Genesis. To facilitate this decision, the Institute was given new leadership.

W.J. Hackett, GRI Board Chair 1969-1975, at Yellowstone National Park on the 1978 GRI Field Conference. Photo by Ariel Roth.

Within three years of the 1968 Field Conference, the Institute had a new Director and a new Board Chair. Willis Hackett became Board Chair in 1969. Ritland joined the biology department at Andrews University in late 1971. Roth joined the Institute full time and was appointed Acting Director after Ritland's departure.

BRISCO attendees, 1993, examining a pegmatite dike in Big Thompson Canyon, Colorado. David Rhys (right) was a long-time editor of Ciencia de los Orígenes.

In February 1971, the first meeting of the Bible-Science Subcommittee was held at Andrews University. Eventually this group became known as the Biblical Research Institute Science Council (BRISCO), and its meetings continued nearly annually for the next 30 years, until 2001. Meetings typically included a series of presentations and a field trip to a site of geological interest.

Brown and the Times of Transition: 1972-1980

Roth continued as Acting Director for two years, until Robert Brown accepted the position in 1973. At that point, the staff consisted of Brown, Coffin, James and Lugenbeal in Michigan and Roth in California. Brown's tenure was noted by renewed attention to the Scriptural view of nature, and to the question of radioisotope dating.

These themes were emphasized in a series of Science and Religion Institutes on SDA college campuses in the United States from 1973-1974.

Part of the group rafting through the Grand Canyon in 1975. Photo by Ariel Roth.

In 1975, the GRI scientists took a raft trip through the Grand Canyon. The trip began as a research project sponsored by GRI. When plans were announced for the rafting trip, the number of participants expanded as other scientists took advantage of the opportunity to explore the geology of the Canyon. The trip remained a topic of conversation for many years.

Participants in the 1975 Grand Canyon rafting trip, hiking through Kwagunt Canyon. Photo by Ariel Roth.

A series of Field Conferences was conducted, in 1976, 1977, and 1978. The Yellowstone fossil forests continued as a center of discussion.

Roth continued to represent the GRI at Loma Linda University (LLU) in California. In 1974, he published the first issue of the Institute's journal, *Origins*, which is still in publication. Kathy Ching assisted with the publication of *Origins* from its inception to the present time. Francis W. Wernick became Board Chair in 1975 and continued until 1985, the longest tenure of any GRI Board Chair.

Crossing the La Mar River to visit a fossil forest locality in Yellowstone National Park during the 1976 Field Conference. Photo by Ariel Roth.

Major changes occured with GRI during 1978 through 1980. James left by the end of 1978, and Lugenbeal at the end of 1979. In July 1980, Brown retired as Director, and GRI relocated its headquarters to the campus of LLU. Brown and Coffin moved as well and continued on the staff, joined by Richard Tkachuck. Ariel Roth was re-appointed as Director.

The Roth Years: 1980-1994

Roth's tenure was marked by an increase in support of scientific research, and an emphasis on studying geological features in the context of the Biblical record of creation and a catastrophic global flood. The staff now consisted of Roth, Coffin, Brown and Tkachuck.

In 1981 a field conference was held in the Alps of Europe, the first such tour outside North America. The following month, a field school for academy teachers was held at Mt Ellis Academy in Montana. Participants recall being stranded in the dark after the complete breakdown of a rented school bus near Dead Indian Pass, a remote area east of Yellowstone National Park, and many hours away from any facilities. This conference was the first of an ongoing series of teachers' field schools; the next one is scheduled for July, 2009 in Denver, Colorado.

Ariel Roth at Zermatt, lecturing during one of the field conferences in the Alps. Photo courtesy of Ariel Roth.

Sunlight Basin, from Dead Indian Pass, a memorable site for participants of the 1981 field school for teachers. Photo by Kathy Ching.

Ciencia de los Orígenes, a newsletter, was started in 1982 and widely distributed throughout Spanish-speaking countries. It was edited by David Rhys for twenty years until 2002, when Raúl Esperante assumed the duties.

Clyde Webster joined GRI in 1983, and another field conference for church administrators was held. At noon one day, an unexpected thunderstorm created the opportunity for the participants to be served their lunch from the luggage compartments under the bus.

Members of the 1983 Field Conference included GC President Neal Wilson, long-time GRI Board Chair Frances Wernick, and other church leaders. Photo by Kathy Ching.

A second Field Conference was held in the Alps of Europe in 1984. Later in the summer, Tkachuck returned to the biology department at La Sierra College (now La Sierra University), and Jim Gibson joined the Institute.

Harold Coffin prepares the 1986 field conference group to visit the Specimen Creek fossil forest locality at Yellowstone.

In 1985, a field trip for newly elected church leaders began in New Orleans, immediately after the General Conference session, ending in Loma Linda. A 1986 field conference for college and university science teachers followed the now-traditional route from the Grand Canyon to Yellowstone.

In 1987, another field conference for academy teachers was held at Brianhead, Utah. It was noted for the large number

Robert H. Brown discusses the bristlecone pine chronology with the teachers at the 1987 FieldSchool..

of attendees and small meeting room. The group was split into two, with lectures and field trips repeated on consecutive days.

Ben Clausen joined the Institute in 1987, but spent his first two years at the University of Virginia doing post-doctoral research.

Roth conducted two field conferences in Australia and New Zealand, in 1988, for church administrators and

Participants of the 1988 Field Conference visiting a series of turbidites at Castlepoint, New Zealand.

teachers. The first started in Australia and ended in New Zealand, while the second started in New Zealand and retraced the route of the first conference.

Four seminars were held at different colleges in South America in 1989. Brown retired for the second time when Clausen completed his post-doctoral research and moved to Loma Linda near the end of 1989. Webster published a

Attendees of the 1989 Creation Conference at Peruvian Union University near Lima, Peru. Seminars were also held in Argentina, São Paulo, Brazil, and northeastern Brazil.

supplementary textbook for science classes entitled *The Earth: Origins and Early History.*

Also in 1989 GRI released its first video entitled "Evidences: The Record and the Flood." The following year it won the Silver Screen Award by the U.S. Industrial Film and Video Festival.

The question of the fossil forests of Yellowstone continued as a topic of research interest through the 1980s. Research by Coffin and others at Spirit Lake

Harold Coffin discovered a "forest" of upright trees floating on the bottom of Spirit Lake.

near Mt St Helens led to new ideas for interpreting the successive layers of fossil trees in Yellowstone. Webster's research on geochemical characteristics of the Yellowstone fossil layers also suggested a possible catastrophic setting for deposition of the fossil forests. Their research, along with others, was presented at a meeting held in Big Sky, Montana in 1991, with the result that the Yellowstone fossil forest issue was no longer considered a major problem for a Biblical chronology. Some of the Yellowstone research is reported in a special issue of *Origins*, (Vol. 24, No. 1, 1997).

Clyde Webster's research on the Yellowstone fossil forests was a significant step in offering a catastrophic explanation.

The year 1991 brought more changes to the GRI staff. Coffin retired, and Elaine Kennedy, who had just completed a PhD in geology, joined GRI.

Elaine Kennedy on a field trip in Brazil, 2005. Photo by Urias Takatohi.

The GRI expanded its international activity by establishing two branch offices. The first, located at Campus Adventiste du Saleve in France, was directed by Jacques Sauvagnat.

Jacques Sauvagnat (foreground), Director of the GRI branch office in Europe, and Raúl Esperante (seated to his right) discussing dinosaur footprints in Portugal in 2005.

A second branch office was established on the campus of Universidad Adventista del Plata in Argentina, with

Unveiling a new display at the David H Rhys Museum at Universidad Adventista del Plata. From left to right: Jim Gibson, Roberto Biaggi, Carlos Steger, and Antonio Cremades.

Carlos Steger as acting director until his retirement in 2000. Antonio Cremades replaced him as Director in July 2001. Since that time, three additional branch offices have been established.

The traditional annual field conferences continued, with conferences in North America in 1991 and 1992 for

Ariel Roth points out gaps in the sedimentary layers at Dead Horse Point, Utah, during the 1992 Field Conference.

church leaders and college administrators both in North America and overseas divisions.

Two conferences were held in 1993, one in Australia and New Zealand, and

Participants returning from a hike at the Fox Glacier on the beautiful South Island of New Zealand during the 1993 Field Conference.

another field school for K-12 teachers convened in Flagstaff, Arizona.

Roth retired as Director in 1994, but remained with the Institute for the next two years to lead field conferences and write a book — *Origins: Linking Science and Scripture* — which was published by the Review and Herald in 1998, with numerous translations in succeeding years.

Art Chadwick (orange vest) and Leonard Brand (seated right) in field research, partially sponsored by GRI. Photo courtesy of Leonard Brand.

GRI sponsored a number of field research projects during this period; among them, studies in the Grand Canyon, Wyoming, and Utah.

On to the Present: 1994 -

Jim Gibson was appointed Director in 1994. The staff now included Gibson, Clausen, Kennedy, Roth and Webster. Gibson's tenure was marked by expansion of international activity, and increased support of research.

GC administrators, including Jan Paulsen, GRI Board Chair 1995-1999, and GC President Robert Folkenberg, visiting a salt mine near Hallstatt, Austria, during the 1996 Field Conference.

The first of three field conferences for Korean teachers and pastors was held in 1994, and led by Coffin and Roth.

The next field conference was in 1996 — the third to be held in the Alps of Switzerland and Austria. The participants were mostly newly elected church leaders.

Choi Chong Geol shows the famous rhino cave in the Columbia River basalts, in central Washington state during the 1997 field conference. Choi later became Director of the GRI branch office in Korea.

The 1997 Field Conference for Korean teachers and pastors followed a route between Mt St Helens and Yellowstone National Park, and was led by Kennedy. She also led the 1998 field conference for teachers, held near Mt Rainier, Washington.

The fourth field conference in the Alps was held in 1998, again led by Roth. Kennedy led a 1999 field confer-

Participants of the 1999 Field Conference. Lowell Cooper, GRI Board Chair 1999-2005, is seated on the upper left.

ence in Arizona and Utah for church leaders from all divisions.

Another major activity in 1998 was the Conference on Science and Faith, held at Andrews University, and attended by approximately 130 scientists, Biblical scholars, and church administrators. The meeting was notable both for the diversity of views and for the civility of the discussions.

After years of being cramped into small spaces in various portions of the LLU campus, GRI moved into its own new building at the end of May, 2000. The building was made possible by contributions from the Alvin L. Ortner

The current GRI headquarters — the Ortner Building — in Loma Linda, California, constructed in 2000.

family and the SDA Church. The two-storied building provided space for staff offices, laboratories and library.

One of the first activities in the new GRI building was a Faith and Learning Seminar, focused on issues in faith and science, and jointly sponsored with the GC Department of Education. Participants represented several overseas divisions as well as North America.

Participants in the Faith and Learning Seminar in the new GRI building, July 2000. Photo by Richard Weismeyer.

Late in 2000, Clyde Webster left the Institute. Within a year, two new staff members joined, Raúl Esperante and Timothy Standish.

In 2001, BRISCO meetings were held in Loma Linda, providing an opportunity for the international GRI staff to meet at the new building. A highlight of the BRISCO meetings was a field trip to Anza-Borrego. This turned out to be the final meeting of BRISCO. Discussion of issues in science and creation continued with the Faith and Science Conferences, and later, to the Faith and Science Council.

The GRI staff in front of the new GRI building in 2001. From left: Jan Williams; Antonio Cremades; Kathy Ching; Elaine Kennedy; Ben Clausen; Jacques Sauvagnat; Tim Standish, Jim Gibson; Raúl Esperante.

A third field conference for Korean teachers and pastors was held in 2002,

Participants on the 2002 Korean Field Conference gather on the bridge on Kaibab Trail in the Grand Canyon.

again led by Kennedy. By the end of the year, a second video had been produced: "Evidences 2: Tale of a Trilobite."

From 2002 to 2004, the SDA church held a series of Faith and Science Conferences, where issues in creation and science were presented, discussed, and evaluated. The meetings ended with a statement affirming the historicity of Genesis. Although these Faith and Science Conferences were not sponsored by the GRI, its members were actively involved in the meetings.

Participants in the 2004 field school for teachers, searching for fossil fish at a private quarry near Kemmerer, Wyoming.

In 2004, Kennedy led her final field school for teachers, starting in Flagstaff, Arizona, traveling as far as Fossil Butte National Monument in Wyoming, and ending back in Flagstaff. Health issues forced her to leave GRI in 2005.

Ben Clausen describes a geological feature during the 2006 field conference in Colorado.

In 2006, a field conference was held in the Colorado Rockies — the first in that locale — and led by Clausen.

In March 2007, Ronald Nalin joined GRI, having recently completed a PhD in geology in his home country, Italy. In July, GRI sponsored a Symposium on Teaching Origins. Thirty-five university teachers in science or education met in Salt Lake City, Utah. A field trip included a tour of the museum at Fossil Butte National Monument.

The GRI research library holdings include 100 current journal subscriptions and a collection of over 10,000 books.

Research Activities

In addition to field conferences and seminars, GRI activities include a commitment to original scientific research and participation in professional meetings.

The fossil forests of Yellowstone remain the largest research project for GRI, but numerous other research has been done. Coffin was a major contributor in the Yellowstone research, but he also studied flotation of horsetails, showing they would float upright in the water for some time before settling on the bottom. This small project provided impetus for a later study of floating tree trunks in Spirit Lake after the 1980 eruption of Mt St Helens.

Roth conducted a major research project in the 1970s, studying the effects of light and temperature on rates of growth of reef-forming corals, concluding that, under ordinary conditions, corals are not growing at their maximum rate. Roth and his graduate students also studied growth lines in bivalves and orientation of fossil corals in reef facies.

Ariel Roth's research on coral reefs involved living in a hydrolab on the seafloor in the Bahamas. Photo courtesy of Ariel Roth.

Another research project undertaken by Roth in the 2000s is a study of sedimentary structures in the Morrison Formation identified as termite nests. Roth showed the structures were composed of microcrystalline quartz, and suggested they were probably a previously unknown type of concretion.

Brown studied the relationship of carbon-14 dates and depth, finding that the number of radiocarbon years per cm of peat increased with depth. Compaction could produce such a result, but density of peat is similar with depth, indicating some other explanation is needed. The most promising potential explanations are changes in the accumulation rate of peat and changes in the ratio of carbon-14 to carbon-12.

Webster joined an expedition to Belize to study sediments on Albion Island, that were determined to be derived from the ejecta curtain produced by the famous end-Cretaceous Chicxulub impactor. Webster analyzed the sediments for geochemical patterns.

Clausen conducted physics research in improving nuclear shell models, collaborating with various scientists at accelerators in New Mexico, Massachusetts, Indiana, New York, British Columbia, Netherlands and Russia.

Kennedy, with Arthur Chadwick and others, studied the depositional environment of the Tapeats Sandstone. Their research suggested that the Tapeats Sandstone was deposited in deep water rather than the conventional interpretation of deposition in shallow water. Kennedy also collaborated with Lee Spencer in studying dinosaur eggshells in Patagonia, Argentina. They found that thousands of fragments of eggshells were not preserved *in situ*, but had been transported in some manner.

Elaine Kennedy studied the distribution of dinosaur eggshell fragments in the sedimentary layers in Patagonia. Photo courtesy of Elaine Kennedy.

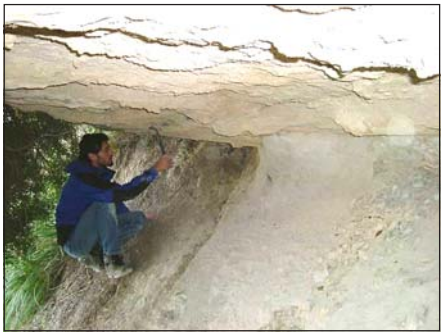
Tim Standish recording data from his DNA experiments. Photo by Kathy Ching.

Standish, a molecular geneticist, compared DNA sequences that had been used to distinguish two species of nematodes, in an effort to explore the genetic basis of species differences.

Research team studying fossil whales in the Pisco Formation, Peru. Photo courtesy of Raúl Esperante.

Esperante, with several collaborators, has studied a concentration of well-preserved fossil whales in the Miocene Pisco Formation in Peru. Their research has raised questions concerning the rates of diatom deposition in the area.

Nalin's research interests focus on the sedimentology of Plio-Pleistocene non-tropical carbonates of the Mediterranean area; the primary objectives of his studies concern paleoecological significance of deposits rich in coralline red algae and stratigraphic models of the response of shallow marine systems to sea level fluctuations.



Ronny Nalin examining an erosional surface in the Val D'Orcia Basin, Tuscany, Italy. Photo courtesy of Ronny Nalin.

Recent International Activities

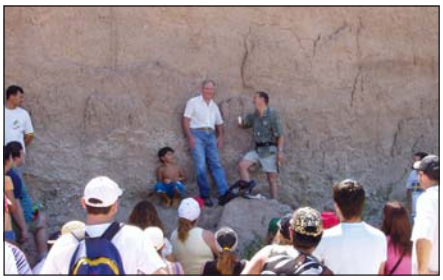
The expansion of GRI activities internationally can be illustrated by the increasing number of overseas seminars and branch offices. GRI personnel participated in three Faith and Science Conferences in Africa in 2003 and 2004. These conferences were held in Abidjan, Nairobi, and near Johannesburg.

Participants in the 2003 Faith and Science Conference near Johannesburg, South Africa. Photo by Phoebe Japp.

Further illustration of the international expansion of GRI is shown in the 2005 and 2006 actions of the GRI

Leaders in the 5th international creation conference in Brazil, 2005. The backdrop is the Uratu Formation, which contains fossil Mesosaurus. *Photo by Urias Takatohi.*

Board. In 2005, the Board voted to recognize the Nucleo de Estudas das Origins (NEO) as an independent "affiliate" of GRI. NEO, led by Marcia Oliveira de Paula has sponsored a series of creation conferences in São Paulo, Brazil. The fifth such conference was held in 2005, and the next one is scheduled for 2009. The Board also appointed Roberto Biaggi as Director of the branch office



Carlos Steger (left), first Director of the GRI Branch Office in South America, and Roberto Biaggi (right), present Director, with a group examining the sediments in Entre Rios province, Argentina. 2008.

in Argentina, replacing Antonio Cremades, who returned to his home in Spain.

Two more branch offices were established in 2006, one at Sahmyook University in Korea with Choi Chong Geol (see photo on page 5) as director.

Teachers in China, 2007, at a conference on issues in science and faith.

Among the numerous activities of this branch office was an "Issues in Science and Faith" conference for teachers at Kunming, China, in 2007.

At the same time, another branch office was established at Montemorelos University in Mexico. Antonio Cremades moved to Mexico as Director of the new branch office. A conference was held at

Grand opening of the GRI Branch Office at Montemorelos University, Mexico, in 2006. Director Antonio Cremades is 5th from the right.

Montemorelos University in 2006, and another is planned for 2008.

The European branch office continues under the direction of Sauvagnat. This office publishes *Science & Origines*, a newsletter in French twice a year. Sauvagnat was also involved in the planning of the 2007 Field Conference

The 2007 field conference group pauses for a photo in Queralt, Spain. GRI staff include Raúl Esperante and Roberto Biaggi in the front, and Ronny Nalin, back row at right end. Photo courtesy of Roberto Biaggi.

for teachers from Europe, led by Esperante in the Spanish Pyrenees. Among the highlights was holding church services in the beautiful Valle de la Pineta, high in the mountains.

The most recent branch office was established at Campus Engenheiro Coelho, Centro Universitario Adventista de São Paulo in Brazil in 2008. Nahor Neves de Sousa is the Director.

Ted Wilson, Board Chair 2005 to present, preaches on Sabbath morning at the 2007 Field Conference in the Spanish Pyrenees.

In addition to the branch offices, other international activities include teaching courses in faith and science, and participating in Faith and Learning Seminars sponsored by the GC Department of Education.

Nahor Neves de Sousa, Director of GRI's newest branch office, at a creation conference in Brazil.

At this writing, GRI operates branch offices on three continents; publishes in English, Spanish, and French; produces a quarterly electronic newsletter, and operates a website at www.grisda.org. Plans for 2008 and 2009 include several seminars, and a field school for teachers. Institute members also teach courses at various universities.

GRI is now celebrating its 50th anniversary. Many individuals have contributed to the work of trying to understand the relationship of Genesis and science. GRI has provided leadership and a locus where the issues could be discussed, but many others, particularly from the academic community, have contributed their energy and expertise. On this 50th anniversary, we take time to salute and thank all who have contributed to GRI's mission. The journey has been both challenging and rewarding.