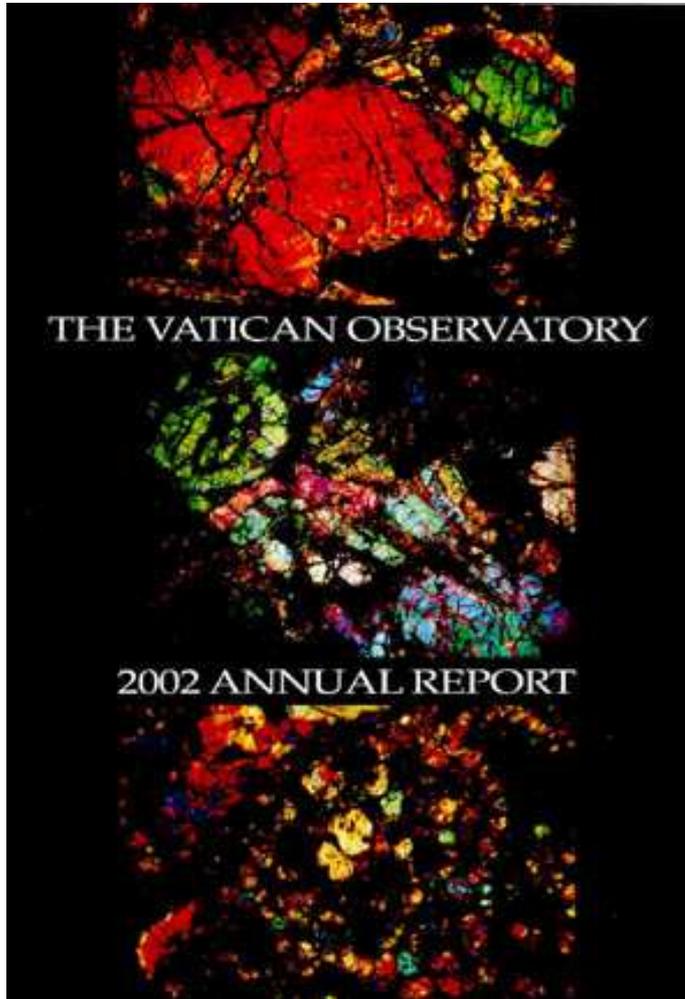


Cover: Thin Sections of Meteorites

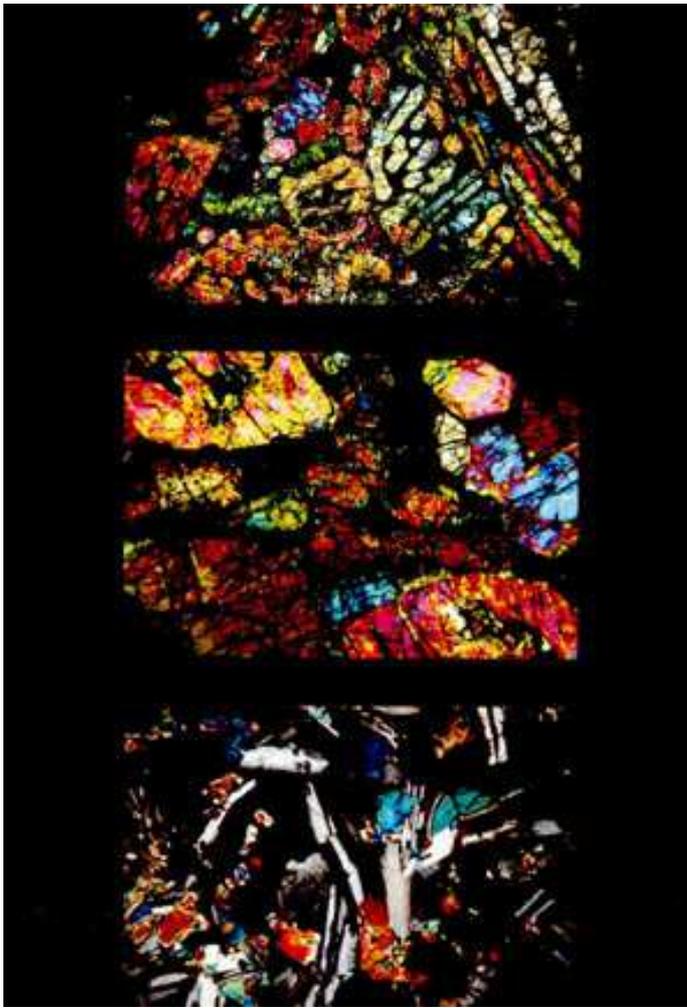


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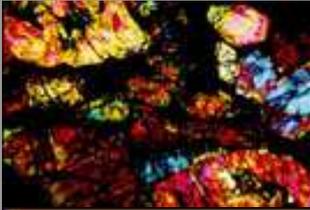
Magnified images of thin sections of meteorites from the Vatican collection. The beautiful colors, created by polarized light, reveal information about a meteorite's structure and chemical composition, including its shock history. These images were made using the VO Meteorite Laboratory's new petrographic microscope.

Front cover (top to bottom): The Martian meteorite Say al Uhamir; the ordinary chondrite Knyahinya; and the rare CK5-class meteorite Dar al Gani 412.

Back cover (top to bottom): A new technique for measuring the magnetic properties of meteorites, pioneered at the Observatory's Meteorite Laboratory, found that the meteorites shown here were originally misidentified. The top two thin-section images, originally labeled as the H-chondrite Luponnas, are actually a L5 or L6 chondrite. The bottom image, originally labeled as the E chondrite Daniel's Kuil, is in fact either a basaltic achondrite or a mesosiderite.



Cover Artist: **Dave Fischer**



THE VATICAN OBSERVATORY
2002 ANNUAL REPORT

Staff & Directors

From Director

Editor: Elizabeth J. Maggio

2002 ANNUAL REPORT

Cover

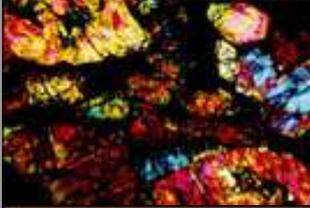
Vatican Observatory
Annual Report 2002



Vatican Observatory
(Castel Gandolfo)
V-00120 Città del Vaticano
Rome ITALY

Vatican Observatory
Research Group
Steward Observatory
University of Arizona
Tucson, Arizona 85721 USA

Editor: Elizabeth J. Maggio
Cover Artist: Dave Fischer



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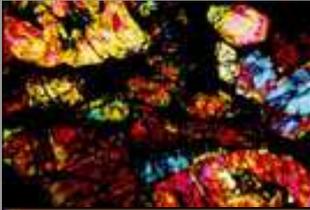
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From the Director

From the Director

Diffusing Hatred Through Shared Knowledge

This has been a year of profound reflection by the world at large. The events of 11 September 2001 changed dramatically our view of planet Earth and in the year since our last Annual Report, little has emerged as a consensus of what to do to remedy the increasingly perilous situation. In that Report, I attempted to show how the Observatory's scientific research and all that flows from it can make a contribution to nourishing the peace and harmony that are essential elements for developing a shared view of life on this planet. Since ignorance is always at the source of hatred, shared knowledge of whatever kind must be a remedy.

The Vatican Observatory is entirely dedicated to a common search for a scientific understanding of our universe and to sharing that knowledge with peoples of all ethnic and religious backgrounds, whether our colleagues in astronomy or the interested public. It is for others to judge, based partly on this year's Annual Report, how well we are accomplishing that task. In that regard, I would like to direct your attention to *Section III. Observatory and Staff Activities*, especially to the subsection on *Public and Educational Outreach*.

There has also been growing interest in the Observatory's work in the science–religion dialogue. In response, staff members have given many public talks on this work as well as collaborated in the publication of popular articles for newspapers and participated in interviews for radio and television. These activities have occurred around the world • in Africa, Asia, the Americas, Europe, and Oceania. In many cases, they have been conducted in collaboration with various government agencies, with Catholic diocesan offices, and in a setting of ecumenism. We are especially proud of the Symposium on Astrophysics Research and on the Dialogue Between Science and Religion that the Observatory held in July. The Symposium brought together 40 alumni and faculty of the Vatican Observatory Summer Schools (VOSS), drawing participants from 24 different countries and with diverse ethnic and religious backgrounds. A complete description of the symposium is found in *Section III. Observatory and Staff Activities*, in the subsection on *Conferences*.

Reflections from an Italian Hillside Retreat

In the spirit of a year full of reflections, a noteworthy event in the life of the Observatory occurred in July in a hillside monastery at Calascio in the Abruzzi region of central Italy. I had asked the Observatory's professional and support staff to gather there for three days of programmed reflection on the past, present, and future of the Observatory. We were favored with the presence of Father Delegate (Guillermo Rodríguez– Izquierdo, S.J.) who is responsible for our work to Father General (Peter–Hans Kolvenbach, S.J.) the worldwide leader of the Jesuits. Guy Consolmagno, S.J. and José Funes, S.J. planned the program. They also surveyed our scientific colleagues, Church leaders, and other Jesuits to evaluate the Observatory's performance over the 25 years of my directorship. I would like to share with you some of what transpired at Calascio.

Sabino Maffeo, S.J. provided an excellent review of the Observatory's history up to 1978, when I became director, and his account set the stage for our reflections at Calascio. In particular, Maffeo showed how the Observatory was initially founded in an apologetic spirit of defense of the Church,

which had been accused of being anti-science, but that this changed over time to one of dialogue by the Church with the world of science.

The lessons learned from this early period were many, but the one that stands out is that the Observatory must conduct quality research in astronomy if it is to represent the Church in any significant way to the scientific world.

When I became director, the Observatory faced several problems that hampered the quality of its scientific research. Since the early 1970s my predecessor (Patrick Treanor, S.J.) and his associates had realized that the light pollution from Rome that was encroaching on the skies over Castel Gandolfo would no longer permit observational astronomy to continue in any significant way. And, in fact, Treanor had been investigating a new site for the observatory before he died. A further problem was staffing. There were only two active research astronomers working at the Observatory. But there was hope out there, in the four young Jesuit astronomers lurking in various corners of the world. They had agreed, if I were appointed director, to join the staff and work together to make the Vatican Observatory once more a modern research institute. Three of them, no longer so young (and who will remain anonymous), are still on staff. As to relocating the observatory, a decision was made to open a research institute in Tucson, Arizona. You all know this today as the Vatican Observatory Research Group (VORG), founded in 1980 at Steward Observatory, University of Arizona.

Other changes came swiftly after VORG was established. In 1985 we agreed to collaborate with the University of Arizona to build the Vatican Advanced Technology Telescope, which was inaugurated in 1993. In 1986 we held the first Vatican Observatory Summer School in Observational Astrophysics. In 1987 the Vatican Observatory Foundation was established as a tax exempt corporation in the State of Arizona to assist with fundraising to support our new telescope. In 1988 we awarded the first Martin F. McCarthy Jesuit Community Scholarship for doctorate studies at the University of Arizona by a candidate from a developing country.

All of these activities, occurring over more than two decades now, were evaluated during the Calascio retreat. We are encouraged by the feedback, but the evaluation showed that there is still much left to be done. I've highlighted here a few problematic areas:

- *Vatican relations* We have not succeeded in establishing a cultural rapport with the Vatican that would allow us to exchange ideas on the nature of our work and its contribution to the life of the Church.
- *Rome vs. Tucson* We are not satisfied with the interactions between our headquarters at Castel Gandolfo (Rome) and VORG (Tucson). While our work in Tucson offers us contacts with a large international community of astronomers, we have neglected more specific contacts with European and especially Italian astronomers.
- *Fundraising* The Vatican Observatory Foundation is our first experience in soliciting money to support our research. Fundraising has been necessary, and it has created a community of dear friends who share our vision and communicate it in turn to others. But it places an additional burden on the Observatory that has not been completely absorbed.
- *Staffing* Our small staff of eleven Jesuit and two non-Jesuit astronomers, with six of them over 60 years old and only seven active in research, must carry on the scientific programs, administration, and an ever-increasing amount of public outreach. Fortunately, we have identified five young Jesuits as future staff members to help with our work. They come from the Republic of the Congo, the Czech Republic, Italy, India, and the United States. Their presence will expand the international nature of our work. We will meet with them in July 2003 to discuss their futures with the Observatory.
- *Public outreach* As I noted earlier, we are making great strides in communicating our work to the public, but this takes valuable time away from our astronomers' research. So as not to sacrifice one for the other, we are discussing the desirability of designating one staff person to conduct public outreach. We all agree that we can only speak to the public in a meaningful way if we are successful in our scientific research.

During our retreat, I was asked why I had chosen this time to call for an organized reflection on our work. My reply was that I had come to realize that in a rapidly changing world, we might run the risk of being driven by forces that were not consistent with our mission. We had to rethink our mission in order to reinforce it.

Over the past decades Jesuits have increasingly been called to apostolates that respond more immediately to the need for peace and justice in the world. We needed to reflect on whether our work responds to that call as well. I believe that we have found our response in the conviction that where ignorance of whatever kind reigns, there is trouble for the world. Pursuing knowledge jointly with our fellow scientists and sharing it with all who dwell with us on this small planet does contribute to eradicating ignorance and, therefore, to diffusing the trouble that is brewing globally.

We were a small group of Jesuits at Calascio's monastery; we came from five different countries; we shared a common dedication to our mission. We have, with the younger Jesuits preparing to join us, a well-founded hope for the future of our work.

Research Highlights

The Vatican Meteorite Collection The Observatory's research on meteorites, under the direction of Guy Consolmagno, is the theme of this year's Annual Report. The core of the meteorite collection was originally assembled by Adrien-Charles, Marquis de Mauroy (1848-1927), a distinguished agronomist and a "gentleman-scientist" of the old French nobility. A great friend of the Church, he donated a selection of meteorites—more than 1,000 samples—from his personal collection in 1905, and they were housed at the Vatican Observatory (Specola Vaticana), first in Rome and then in Castel Gandolfo. In 1935, Adrien-Charles' widow donated the remainder of his collection.

Since then, the collection has grown through donations and trades to more than 1200 pieces representing 484 different meteorite falls, producing a collection that allows us to see deeper into the mysteries of creation. Current research on these meteorites is centered on understanding their physical structure, including the nature and extent of the pore spaces, cracks, and voids present in these rocks. The hope is that these studies will give us insights into how these samples were formed more than 4.5 billion years ago, when the planets themselves were being formed. These studies are being done in collaboration with scientists in Great Britain, France, Italy, and the United States. In addition to our own studies, small meteorite samples are loaned to researchers around the world. These scientists are working on a variety of projects, ranging from the measurement of the visible and infrared colors of the rocks (to compare against asteroids) to the precise measurement of trace elements (for clues to their chemical history). A more in-depth report on our meteorite studies is found in *Section I. Astronomical Research*, in the subsection on *Planetary Sciences*.

VATT News Below is a round-up of our most recent results obtained with the Vatican Advanced Technology Telescope:

- The rate at which stars are formed has changed as the Universe evolved. Stars were formed more rapidly in galaxies that were formed early in the expansion of the Universe. José Funes is investigating this phenomenon.
- It is now almost certain that every galaxy hosts a supermassive black hole at its center. Funes is also investigating this.
- Quasars are some of the most enigmatic objects in the universe. Some of them are millions of times more energetic than our entire Milky Way galaxy. There appears to be a preferred epoch when they were formed in the Universe. Alessandro Omizzolo, with Chris Corbally, is investigating this.
- Globular clusters are the oldest objects in our galaxy. They were formed when the galaxy itself was first forming. Chris Corbally and Richard Boyle are studying the stars in globular clusters to determine the early stages in the formation of the Milky Way.

Personnel News

After three years as President of the Institute on Religion in an Age of Science, Christopher Corbally, S.J. has become the Institute's Immediate Past President. Corbally was also invited to join the editorial board of the journal, *Baltic Astronomy*.

Gustav Teres, S.J., adjunct scholar of the Observatory, has received the Presidential Gold Medal of Hungary for his contributions to the dialogue between faith and science.

On 22 November, Giuseppe Koch, S.J. was inaugurated Superior of the Jesuit Community at Castel Gandolfo. Since 1 September 2001, he has served as Assistant to the Director of the Observatory. We owe profound gratitude to Sabino Maffeo, S.J. who served more than twelve years as Superior, all but one of them as Superior of both the Castel Gandolfo and Tucson communities. He remains as Vice Director for Administration of the Observatory.

In August, Marcelo B. Ribeiro, with the Universidade Federal do Rio de Janeiro, completed a year of collaborative research in cosmology with William Stoeger, S.J. at the Vatican Observatory Research Group (VORG) in Tucson. In June, Aileen O'Donoghue completed her sabbatical leave as a visiting scholar with the VORG and is back at St. Lawrence University in Canton, NY.

Ivelina Momcheva, a citizen of Bulgaria who participated in the Vatican Observatory Summer School 2001, has been awarded the Martin F. McCarthy Jesuit Community Scholarship in Astrophysics. She began her graduate program at the University of Arizona in August. Nadya Gorlova of Ukraine, who received that scholarship in 2000, successfully completed her preliminary graduate exams in November.

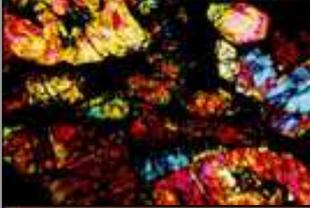
Vatican Observatory Foundation Annual Meeting

The annual meeting of the members and directors of the Vatican Observatory Foundation was held on 1 March 2002 in Tucson, Arizona. The following were elected to serve as members and directors for a three-year period: MANUEL J. ESPINOZA, RICHARD J. FRIEDRICH, JOHN B. HENKELS, JOHN B. HOLLYWOOD, S.J., JAMES C. MCGEE, PETER P. MULLEN, JUNE SCOBEE RODGERS, and FAITH VILAS. On the day preceding the annual meeting, members of the Observatory staff presented their research in a popular forum to friends of the Observatory and members of the Board. The next day members of the group were accompanied on an excursion to the National Optical Astronomy Observatories and other facilities on Kitt Peak, Arizona.

Through the efforts of NANCY KNOCHE, Development Director, and JAMES MCGEE, Chair of the Development Committee, the Foundation continues the two giving plans announced in previous Annual Reports: the *Circles of Giving* and "*Reaching for the Heavens*" *Guild Memberships*. At each Board meeting a festive dinner is held to welcome major donors into the various Circles of Giving, which have been named in honor of the following eminent persons in the history of the Church and science: John Paul II, Leo XIII, Gregory XIII, Pius XI, Angelo Secchi, S.J., Eusebio Kino, S.J., Christoph Clavius, S.J., and Georges Lemaître. Events of particular note that were organized by the Development Committee during the past year were: dinner at the Phoenix Country Club; reception, tours, and dinner at the Challenger Center in Peoria, Arizona; tour and reception at the Adler Planetarium in Chicago; lecture and reception at Georgetown University in Washington, DC; tour of the Rose Center of the American Museum and Hayden Planetarium in New York City, which was followed by a reception hosted by Board Member PETER P. MULLEN at a nearby restaurant; and lastly a brunch at the Arizona Inn in Tucson, Arizona, hosted by Board Member MANUEL J. ESPINOZA. On each occasion, talks were given on the history and research of the Observatory.

Once again, through the efforts of Board Member BRENDAN D. THOMSON, an official Vatican Observatory calendar for 2003 was produced with the theme, "A Bridge Over Time and Space."

George V. Coyne, S.J., Director



Astronomical Research

Theoretical Studies, Astrophysics, and Cosmology

STOEGER and ARAÚJO (Universidade Federal do Rio de Janeiro) with their collaborators are completing their work on specifying the procedure for solving the Einstein field equations in observational coordinates with cosmological data functions in the case of general perturbations (including non-spherically symmetric perturbations to Friedmann-Lemaître-Robertson-Walker [FLRW]). They also continue to work on generalizing such solution schemes to cases involving a mixture of dust and vacuum energy (non-zero cosmological constant). Once that is done, they intend to use these to constrain the deviations from FLRW with both astronomical and cosmic microwave background radiation data.

STOEGER AND RIBEIRO (Physics Institute, Universidade Federal do Rio de Janeiro) completed the first phase of their work relating the galaxy luminosity function to the relativistic energy density and to number counts for different redshifts, and using this to test the CNOC2 redshift survey luminosity functions for consistency with the assumed Einstein de Sitter cosmology. This is a preliminary step to using number-count and observer-area distance data to constrain the large-scale structure of the universe without assuming that it is FLRW, and including a significant cosmological-constant contribution to the mass-energy, which may be driving the acceleration of the expansion of the universe we now detect. As mentioned last year, one strong motivation for this is to determine on what length scales the universe can be adequately described by an almost- (or perturbed) FLRW cosmological model. It is fairly clear from cosmic microwave background considerations that this is true on the largest scales. But what is the smallest scale on which it is true? We still do not know. In pursuing an answer to this question through application of these procedures to solve the field equations with astronomical data, we shall also have to assume a reasonable model of galaxy number and luminosity evolution.

ELLIS AND DUNSBY (Department of Mathematics, University of Cape Town) together with MAARTENS (School of Mathematical Sciences, University of Portsmouth) and STOEGER are continuing their work on investigating the constraints on epochs in both closed and open FLRW cosmologies, as well as their relation to the earlier Planck era, during which quantum gravity dominates. ELLIS, STOEGER, McEWAN (Cape Town), and DUNSBY have already published two preliminary papers on this subject focusing on closed FLRW models. The work also involves investigating the effect on the epoch of an earlier mixed radiation-vacuum energy (cosmological constant) epoch just after the Planck era, and whether or not there are situations in which the Planck era can be avoided. In connection with this, Stoeger continues to do research on the Planck-era processes that would determine the size and homogeneity necessary for the inflation of a patch of the very early universe.

JUST (Department of Physics, University of Arizona) and STOEGER have been progressing with their research on a number of areas in quantum theory of measurement and quantum field theory.

LISZKA (Swedish Institute of Space Science, Sförs), PACHOLCZYK (Steward Observatory, University of Arizona), and STOEGER completed a study of the effect of ROSAT spacecraft wobble on the X-ray variability data from Seyfert galaxies (using NGC 5548 as an example). They demonstrated that the low-level deterministic and quasi-periodic signals from such a source can be separated successfully from the wobble harmonics. This confirms the detection of such intrinsic signals in earlier analyses. They are continuing to pursue a variety of other observational and theoretical topics related to active galactic nuclei (AGN) X-ray emission, which is almost certainly connected with the presence of supermassive black holes, or clusters of black holes, in these objects.

WHITMAN has written about 100 pages on his project of exposing the real irreducible representations of real forms of the simple complex Lie algebras. Since he wished to give a readable background in which to locate the material, he sought to review some old material in an interesting manner. Starting with a knowledge of linear algebra, the project leads the reader to an understanding of the fundamental decomposition theorem of Lie algebras. Every Lie algebra over a field of characteristic zero can be decomposed into a linear space direct sum of a semi-simple Lie subalgebra and a solvable Lie subalgebra. The lack of uniqueness of the decomposition constitutes one of the most important tools for understanding this material. A platform for presenting this exposition is the Clavius Group of Mathematicians (see Section III).

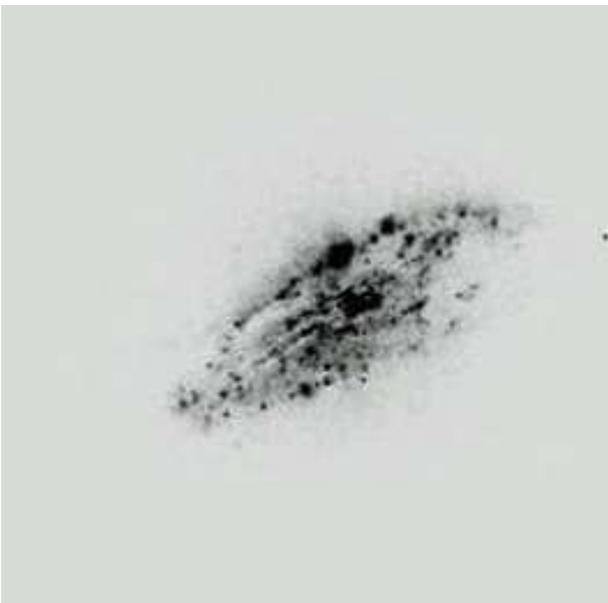
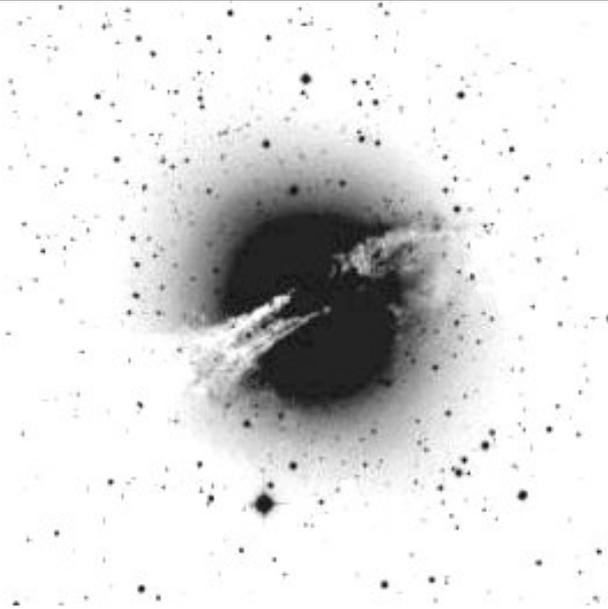
In collaboration with a group of physicists and mathematicians from Krakow Astronomical Observatory and Warsaw Technical University, HELLER is pursuing a program to elaborate generalized methods of geometry and their applications to general relativity and cosmology. Substantial progress has been made in investigating the structure of malicious singularities in cosmology, such as the Big Bang singularity, and an extensive review paper has been published.

Extragalactic Research

The modeling of galaxy evolution requires a better understanding of the relationships between the large-scale star formation rate (SFR) and the physical properties of the parent galaxies. Star-forming galaxies in the local universe provide important clues for understanding the evolutionary properties of galaxies and the physical processes that drive that evolution. To explore these relationships, KENNICUTT (Steward Observatory), FUNES, SAKAI (University of California, Los Angeles), and AKIYAMA (Steward Observatory) obtained H-alpha images to complete a volume-limited survey of integrated SFRs for a complete sample of nearby galaxies within the local 11 megaparsec volume. They observed about 300 galaxies in the northern hemisphere and about 70 galaxies in the southern hemisphere. The observations were carried out with the Vatican Advanced Technology Telescope (VATT), the Steward Observatory 90-inch Bok Telescope at Kitt Peak, and the Cerro Tololo Interamerican Observatory 0.9-m telescope at Cerro Tololo, Chile. This program has the following aims: (1) to construct the local SFR distribution function as a reference for cosmological look-back studies; (2) to develop new diagnostic measures of the rate and distribution of star formation in galaxy populations; (3) to quantify the role of starbursts in the evolution of low-mass galaxies; (4) to quantify the incompleteness biases in star-formation surveys; (5) to study the environmental dependence of the SFR distribution function; and (6) to provide a reference catalog and image database for use by workers in the field.

NGC 5128 (Centaurus A) is the nearest giant elliptical galaxy and the nearest AGN (active galactic nuclei), with a supermassive black hole and a powerful radio source. It is also and the nearest galaxy with shells and contains a central dust lane and a populous globular cluster system. MINNITI (Pontifical Catholic University of Chile), REJKUBA (European Southern Observatory), FUNES, and AKIYAMA (Steward Observatory) used the Very Large Telescope in Chile to obtain images of NGC 5128 to identify the optical counterparts to bright CHANDRA X-ray point sources. Based on size, optical magnitude, and color, they identified 23 new globular clusters, bringing the total globular cluster X-ray sources in this galaxy to 33, and establishing that 30% of the X-ray point sources in NGC 5128 are associated with globular clusters.

This upper photo is an R-band image of NGC 5128 (Centaurus A).



This H-alpha image (bottom) shows the complex distribution of ionized gas in the disk component of this giant elliptical galaxy. Vatican Observatory astronomer José Funes, S.J. obtained the images with the 0.9-m telescope at Cerro Tololo Inter-American Observatory in May 2001. They were reduced by Sanae Akiyama of Steward Observatory.

FUNES, REJKUBA, MINNITI, AKIYAMA, and KENNICUTT have also used the Very Large Telescope optical images of the innermost regions of NGC 5128 to obtain color-magnitude and color-color diagrams. These diagrams reveal a mixture of populations. They identify young stars and blue clusters, plus old globular clusters, embedded in the dusty regions of the disk of NGC 5128. In addition, H-alpha images taken with the 0.9-m telescope at Cerro Tololo Inter-American Observatory show the complex distribution of ionized gas in the disk component. The researchers have identified ring-like and arc-like structures, diffuse and discrete HII regions, etc. Based on this data set, they are studying the star formation history of the disk of this galaxy.

The Milky Way and M31 are examples of bright spiral galaxies surrounded by several satellites. The study of satellite galaxies can provide information on the merging and aggregation processes which, according to the hierarchical clustering models, form the larger spiral galaxies we observe. With the aim of testing hierarchical models of galaxy formation, GUTIERREZ (Instituto de Astrofísica de Canarias), FUNES, PRADA (Centro Astronómico Hispano-Alemán), and AZZARO (Isaac Newton Group of Telescopes) are conducting an ongoing observational program with the VATT on Mt. Graham. The program comprises broadband photometry in the optical and in the H-alpha narrowband for both the parent and the satellite galaxies, taken from the compilation by Zaritsky et al. (1997). The aim of this study is to determine star formation properties of the sample galaxies.

FUNES continued to collaborate with BERTOLA, CORSINI, and PIZZELLA (University of Padua). They are conducting an observing program using the Very Large Telescope in Chile and the 6.5-m MMT in

Arizona. The project is aimed at obtaining spectroscopic data that will allow an accurate investigation of the dark matter distribution within the optical regions of low-surface-brightness galaxies. The published data indicate the presence of a constant-density core dark halo. However, for different reasons, the ionized gas kinematical measurements may be affected by systematic errors. The use of stellar dynamics will allow the researchers to overcome such difficulties and will further constrain the central density radial profile of dark matter halos. Photometric data will also be taken with the VATT. The photometric radial profile will allow constraints to be placed on the mass distribution using dynamical models.

O'DONOGHUE (VORG visiting scholar, St. Lawrence University, Canton, NY) began collaboration with FISHER (Hampden-Sydney College, Virginia) on VLA radio observations of Straight-Angle Tailed Radio Galaxies. This research is funded by a grant from the State of Louisiana and took place at the Louisiana State University at Monroe.

OMIZZOLO and CRISTIANI (European Southern Observatory, Munich) are determining the luminosity function for a sample of about 800 X-ray emitting, bright quasar candidates. CORBALLY and O'DONOGHUE (VORG visiting scholar, St. Lawrence University, Canton, NY) collaborated with OMIZZOLO to obtain with the Steward Observatory 2.3-m telescope the last in a set of low resolution, red region spectra of that sample. Data reduction was completed at the Department of Astronomy of the University of Padua. Also related to this work, OMIZZOLO and RAFANELLI (Department of Astronomy, University of Padua) are studying the spectral data for NGC 526, an active galaxy, to determine the kinematics of this interesting object. The spectra were taken at the observatories of ESO and at the Telescopio Nazionale Galileo, Canary Islands.

The Galaxy and Galactic Objects

This HR-diagram for the NStars project, derived from spectral types and Hipparcos parallaxes, shows that the stars scattering below the main sequence are really at larger distances than those reported in the Hipparcos parallax survey. The spectral types confirm they lie beyond 40pc.

The Nearby Stars (NStars) project to obtain spectra, spectral types, and basic parameters of the 3600 stars within 40 parsec of the sun and earlier than M0 spectral type reported great progress: some 90% of the spectra are now observed; over a third are classified; SIMPLEX fitting is being applied to the spectra to obtain the parameters of T_{eff} , $\log g$, $[M/H]$, and microturbulence while chromospheric activity indices are calibrated and being calculated. The NStars project and its goals were described in the previous two Annual Reports. This year, the initial collaborators GRAY and McFADDEN (Appalachian State University, Boone, North Carolina), GARRISON (David Dunlap Observatory, University of Toronto), and CORBALLY were greatly helped by O'DONOGHUE (VORG visiting scholar and St. Lawrence University, Canton, NY). She assisted with observing at Steward Observatory, at Cerro Tololo Interamerican Observatory (CTIO), and at David Dunlap Observatory (DDO), with analyzing the spectra, and with steady classification work. MORTARA (Raytheon and University of Arizona) and KNOX (St. Lawrence University, Canton, NY) also became involved with the project. The former ported GRAY's XMK program for doing visual spectra classification to the Windows environment, "Winmk", and worked on getting the correct chromospheric activity calibrations for the Steward data. The latter helped with the observing at DDO and at CTIO.

The collaborative investigation of heavily reddened stars in clusters and of peculiar stars continues. STRAIZYS, KAZLAUSKAS, and CERNIS (Vilnius, Lithuania), with spectral classifications from CORBALLY and observing support from BOYLE, have compared photometric and spectral classifications of 18 stars in Perseus. Three are likely pre-main-sequence objects, and five are suspected binaries. The nature of the interstellar reddening law in the cluster IC 348 seems normal, though perhaps not so in the reflection nebula NGC 1333. For the crowded dust clouds along the Galactic equator near the Camelopardalis, Perseus, and Cassiopeia border, ZDANAVICIUS, STRAIZYS (Vilnius, Lithuania), and CORBALLY find that the extinction is close to the normal law for

infrared and optical wavelengths. However, the ultraviolet shows a slightly larger extinction than average. In a new investigation, CORBALLY started using the Steward Observatory 2.3-m telescope to obtain spectra of photometrically interesting stars in an Aries molecular cloud.

RUEGER (Diocese of Brooklyn), with the help of CORBALLY, continued to process the *UBVRI* observations of two fields in the North Galactic Pole (NGP), obtained with the VATT. STAGG (Fairfield, Connecticut) produced preliminary photometric reductions, which now need more precision and more objects included before the G-dwarf stars can be identified.

BOYLE, with collaborators PHILIP (Union College, Schenectady, New York), SMRIGLIO (University of Rome), DASGUPTA (Cardiff, Wales), JANUSZ (Krakow, Poland), and STRAIZYS, KAZLAUSKAS, LAUGALYS (Vilnius, Lithuania), continues to use the filters of the Strömvil photometric system to make CCD exposures on various star fields. One can determine from the very precise colors of the stars, derived from the observations, the temperatures and surface gravities of the stars. Observations for this program are made at the VATT, the USNO-Flagstaff 1-m telescope, the 1.5-m telescope of the Astronomical Observatory of Bologna at Loiano, Italy, and the 1.5-m telescope of the University of Arizona on Mt. Lemmon.

IGEA is studying Monte Carlo methods for the transfer of radiation, in collaboration with HUGGINS (Physics Department, New York University). He also participates in a research program on the chemistry of protoplanetary disks together with GLASSGOLD (Astronomy Department, University of California Berkeley) and NAJITA (National Optical Astronomy Observatories).

Planetary Sciences

Meteorites

· *Meteorite Parent Body Structure:* Meteorite porosity and asteroid structure continued to be a major focus of the work of CONSOLMAGNO. Two major review papers were submitted on this ongoing work in 2002. A compilation of all published meteorite porosity data, collected and analyzed by BRITT (University of Tennessee) and CONSOLMAGNO was revised and accepted at the journal *Meteoritics and Planetary Sciences*. Meanwhile, a major review chapter by BRITT, YEOMANS (Jet Propulsion Laboratory), HOUSEN (Boeing Aerospace), and CONSOLMAGNO on asteroid density and structure was revised and accepted for the *Asteroids III* book to be published at the end of 2002 by the University of Arizona Press.

In addition to this work, CONSOLMAGNO made density measurements of several SNC-class meteorites^{3/4}believed to have originated from the surface of Mars^{3/4}in the Vatican collection, and STRAIT (Alma College, Michigan) computed the pore space visible in thin sections of these meteorites using scanning electron microscope (SEM) backscatter images. This work puts new constraints on the structure of Mars, as the density values they found are significantly higher than those previously used in geophysical models of Mars. If these new measurements accurately reflect the density of the Martian crust, the size and composition of the core and mantle of Mars are much more strongly constrained (in order to match the known values of the mass and moment of inertia of Mars) than previously believed. On the other hand, to relax this constraint would mean that the SNC meteorites, though from Mars, would not be typical of Mars crustal rocks in general. Either possibility represents a significant shift in our understanding of that planet.

The low porosities found for the SNC meteorites also indicate that the process of breaking these meteorites from Mars and landing them on Earth did not significantly add microcracks to their structure. This implies that the higher porosities seen in ordinary chondrites may well be characteristic of their *in situ* (asteroidal) state.

· *Microcrack Porosity:* The thin-section work on SNC meteorites described above is part of a larger ongoing project to determine the nature of meteorite porosity by close examination of SEM backscatter images. Over the past year, STRAIT and CONSOLMAGNO examined the repeatability of the technique by looking at several hundred images of a thin section from one meteorite, Knyahinya, taken from the Vatican collection. The measured microcrack porosity tended to be higher at the edges of the

section, where large cracks were evident. Several interior areas also had significantly higher porosity. These areas tend to have major cracks through the fabric of the section, large holes, or gaps at the edges of large inclusions. Some areas with low porosity were where large metal inclusions filled most or all of the image area. Nonetheless, the final data set averaged over the areas measured compute an average porosity of $4.8\% \pm 2\%$, with about 8% of the total porosity being filled with weathering material, while the hand specimen of Knyahinya measured for porosity at the Vatican Observatory had a porosity of $4.7\% \pm 1.8\%$.

The range of porosities determined in this extensive study of the surface of one meteorite thin section show a similar range to that determined from a limited number of random images used to represent the sample. This confirms the assumption made in previous work that one can draw conclusions about the porosity of a sample based on a limited number of images.

· *Origin of Meteorites:* One goal of studying meteorite porosity and structure is to understand how gas and dust in the early solar system could have been compressed into hard, well-formed rocks. From work at the Vatican Observatory and elsewhere, it is now understood that ordinary chondrites are well-compacted stones with porosities generally less than 10%, and this porosity exists mostly as microcracks emplaced into the rock long after it was formed and solidified. What processes could have formed and solidified these rocks? Pressure, temperature, and water lithify terrestrial rocks. But although all meteorites have experienced some metamorphism, most have not seen sufficient pressure, temperature, or aqueous alteration to account for their lithification. How did nebular dust become well-lithified meteorites?

Pressures of 1 to 10 gigapascal (GPa), ten thousand to a hundred thousand times the pressure of air at the surface of the Earth, are needed to compress terrestrial sandstones. These pressures are higher than found inside any but the largest asteroids. However, asteroids that collide with a relative impact velocity of 1 km/s, equivalent to orbits with eccentricity of circa 0.05 in the asteroid region, create an energy density at the point of impact equivalent to a gigapascal.

However, a 1 km/s impact velocity is a most difficult velocity to attain. At present, relative impact speeds in the asteroid belt are much higher than 1 km/s, resulting in collisions that shatter rocks rather than compacting them. On the other hand, in the early solar nebula, when particle velocities were controlled by nebular gas drag, millimeter-size particles coupled to the gas could have impacted meter-size or larger bodies at roughly 0.05 km/s. Such an impact would perhaps be enough to compress under-dense dust balls, but it would hardly have been enough to turn them into solid rocks. The impacted bodies, however, might have been coherent enough to participate in further accretion.

CONSOLMAGNO, WEIDENSCHILLING (Planetary Science Institute, Tucson), and BRITT have suggested a scenario where just the right collision speeds could be obtained. When Jupiter formed in the early solar nebula (perhaps also inducing the shock waves that melted bits of dust to form the "chondrules" ubiquitous in ordinary chondrites), it could perturb a 100-km planetesimal into an orbit whose eccentricity fluctuated from 0 to 0.1; 10-km bodies should attain eccentricities of 0.05, while smaller ones would be damped to low eccentricity until the gas dissipated. Though collisions of such perturbed bodies at such speeds would disrupt similar-size bodies, collisions of smaller impactors into larger targets would allow the target to survive. A series of such impacts could produce lithified regions in a more porous, unconsolidated matrix. Subsequent collisional disruptions would dissipate this matrix, but allow the lithified regions to survive as meteorites to the present day.

· *Meteorite Magnetic Susceptibility Studies:* Magnetic susceptibility $\frac{3}{4}$ the degree to which a material responds to an external magnetic field—may provide a versatile, rapid, and nondestructive way to quantify the amount of magnetic minerals (such as iron–nickel metal, magnetic oxides, and sulfides) on a large volume of material. These phases are quite distinctive from class to class among meteorites, and so measuring the susceptibility provides a reliable and nondestructive way to classify a large number of samples in a short period of time.

ROCHETTE (European Center for Research and Teaching in Geoscience and the Environment, Aix en Provence, France), SAGNOTTI and CHEVRIER (National Institute of Geophysics and Technology, Rome), CONSOLMAGNO, DENISE (National Museum of Natural History, Paris), FOLCO (Antarctic Museum of Siena), OSETE (Universidad Complutense Madrid), and PESONEN (University of Helsinki, Finland) continued work begun in 2001 and have assembled a database of magnetic susceptibility

measurements on 975 stony meteorites from various European collections: Helsinki, Madrid, Paris, Prague, Rome, Siena, Vatican, and other smaller collections. Measurements on bulk samples (up to 400 g) with a large coil Kappabridge instrument take about one second. The meteorites can be left within their protective plastic bags, without any contact or specific preparation, and are subjected to a magnetic field weaker than the Earth's ambient field. This simple procedure thus allows the team to scan a whole collection in a couple of days without danger of contaminating the samples.

The average magnetic susceptibility for a given class of meteorite appears to characterize H, L, and LL classes well with little overlap. EL and EH classes are very homogeneous and show exactly the same average metal amount. R chondrites are the weakest magnetically. C chondrites have a large dispersion for a given type, with 1.3 orders of magnitude progression in metal or magnetite amount from CM to CH. In achondrites, large spreads are often encountered within a class, with a maximum for aubrite (2 orders of magnitude from Khor Temiki to Mount Egerton), indicating heterogeneous parent bodies. The distinct increase of metal content in howardite with respect to eucrite and diogenite mimics the lunar samples (regolith breccia versus rocks) behavior.

Some "outlying" meteorites, i.e., those with magnetic susceptibility values more than two standard deviations from the mean of their class, may well represent samples that have been misclassified or misidentified. In fact, the magnetic susceptibility measurements revealed several suspicious meteorite pieces in the Vatican collection (the most extensively studied collection to date), and their proper classification was subsequently made by examination of polished thin sections. In particular, the Vatican sample thought to be the carbonaceous chondrite Murray was found to be a terrestrial rock and not a meteorite; the sample labeled Luponnas is an LL, not a H, chondrite. Most intriguingly, the meteorite labeled Daniel's Kuil (an enstatite chondrite) has since been identified in thin section by MIDDLEFELDT (Johnson Space Center, Houston) to be either a howardite or the silicate portion of a mesosiderite, in either case making it a much more rare and precious sample than previously thought.

Magnetic susceptibility analysis has several potential future uses. Magnetic susceptibility scans of very large collections (such as the Antarctic meteorites) could classify many samples quickly, and historical collections like the Vatican's could be scanned to detect nonrepresentative or misclassified specimens. A magnetic susceptibility probe could be included on future missions to land spacecraft on asteroids or other solar system objects. Such a probe, weighing less than 50 g, would be the only petrological tool with a penetration depth (about 3 cm) sufficient to look past superficial "space weathering" effects. On Earth, a magnetic susceptibility probe could also provide an efficient way to distinguish meteorites from terrestrial rocks for Nomad, the Antarctic meteorite-hunter robot currently undergoing field testing.

· *Lunar meteorites:* RUSSELL and JEFFRIES (Natural History Museum, London) along with CONSOLMAGNO have begun a detailed combined petrologic and rare earth element (REE) study of lunar meteorites. The goal is to better understand how impact processing has affected the compositions of lunar components, and to attempt to disentangle the composition of the melts from which the earliest lunar rocks initially formed. The first samples studied were from the Dar Al Gani 400 meteorite, a lunar highland melt breccia in the Vatican collection, and from Northwest Africa 482, an anorthosite from the Natural History Museum collection.

Thick sections of these meteorites were prepared, petrologically characterized using SEM, and major elements determined by electron probe. The thin sections were then subjected to REE analyses with a 50 mm spatial resolution using the 213 nm inductively coupled plasma mass spectrograph probe at the Natural History Museum. Calculations were then made to determine the REE composition of the associated equilibrium melt for each lithic clast.

All phases exhibited unfractionated REE patterns and a positive Eu anomaly, with a greater range of values than seen previously. Apparently the impact process severely affected the local distribution of REEs in lunar shock melt breccias. However, some signatures of the initial REE pattern remain preserved within the lithic clasts and can be used to place constraints on the conditions experienced during the anorthite-forming period on the Moon.

· *New Meteorite Acquisitions:* A series of donations and trades has brought a number of new meteorites into the Vatican collection. Most notable was the donation of the meteorite Dhofar 081, found in the Sahara desert in 1999; it is the third lunar sample in our collection (which includes another Sahara meteorite, Dar al Gani 400, and the Apollo 17 sample donated to the Vatican in 1972). Also

included in these new acquisitions are Bilanga (a diogenite that fell in Burkina Faso, formerly Upper Volta, in 1999); Dhofar 018 (a howardite found in Oman in 2000); Gao–Guenie (an H5 that fell in Burkina Faso in 1960); Northwest Africa 091 (an L6 found in the Sahara in 2000); Selma (an H5 found in Alabama in 1906); and a 1.3–kg polished slice of the anomalous iron meteorite Tishomingo, found in Oklahoma in 1965. In addition, we were given thin sections of the meteorites Dar al Gani 190 (type CO 5); Dar al Gani 412 (a rare CK 5); Dar al Gani 430 (C3); Ghubara (L5); Gold Basin (L4); Holbrook (L6); Huckitta (pallasite); and Northwest Africa 010 (H4).

In 2002, pieces of the meteorites Allegan, Bjurbole, and Dar al Gani 476 were loaned from the Vatican collection to the Cranbrook Museum of Science (near Detroit, Michigan) for a three–year display. In addition, loans for scientific research were made of samples of Epinal to STRAZULLA (Catania, Italy) for destructive irradiation to simulate space weathering; samples of Finmarken, Holbrook, and Mocs to COSMOVICI (CNR, Rome) for astrobiology studies; and a piece of Vigarano to BRUCATO (INAF, Naples) for spectra measurements. Some meteorites of the Vatican collection were placed on exposition at the meeting, "Impacts: Asteroids, Meteorites and Comets Meet the Earth," held in both Turin and Milan, Italy.

Kuiper Belt Objects

Kuiper Belt Objects (KBOs) are the subject of a continuing long–term observational program at the Vatican Advanced Technology Telescope. KBOs are large proto–cometary bodies found beyond the orbit of Neptune. Their cousins, the Centaur objects, spend most of their time in the Kuiper Belt, but their paths have already been perturbed into orbits that will eventually bring them close to the Sun, like comets. First discovered only ten years ago, KBOs represent a new population of objects in our own solar system that in many ways resemble the disks of matter now being discovered around other stars.

The primary KBO observers are TEGLER (Northern Arizona University), ROMANISHIN (University of Oklahoma), in collaboration with CONSOLMAGNO, and RETTIG (University of Notre Dame). Though bad weather dogged much of their spring 2002 observing run, the October run yielded three excellent nights with photometric clarity and sub–arcsecond seeing. From these observations, good colors and light curves for four new KBOs were obtained.

These latest measurements will help to test the controversial claim that objects with perihelion distance less than 40 AU divide into two separate color populations (instead of a more continuous distribution of colors among the objects). To date, the ongoing survey of Centaur and KBO colors includes accurate B–V and V–R colors for about 50 objects. There is now evidence for a pattern in the colors observed; though KBOs in excited orbits can range in color from gray to red, all 20 of the observed KBOs on low eccentricity and low inclination orbits with perihelion distances greater than 40 AU exhibit extremely red surface colors.

It is thought that the surfaces of these objects are primarily icy and thus originally colorless, but that long–term exposure to cosmic rays and UV light converts carbon–bearing species into more complex organic molecules with a distinctly red color. Very red KBOs are presumably those with older surfaces, while more "gray" objects have had their surfaces recently gardened either by impacts or by the outgassing and refreezing of volatile materials jetting from the interior of these comet–like bodies. Thus, understanding the distribution of colors can provide direct evidence on the nature and frequency of the resurfacing episodes, and give clues to the evolutionary history of the outer solar system.

Moons of Jupiter

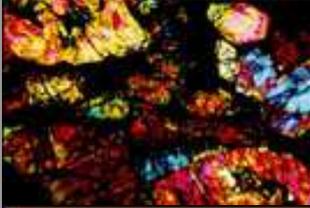
On November 12, ARLLOT and THUILLOT (Institute for Celestial Mechanics, Paris), and KIKWAYA with assistance from COSTA began a series of observations of Jupiter satellite mutual events at the Vatican Observatory's 60–cm Double Astrograph reflector in Castel Gandolfo. By precisely timing the moment when one satellite eclipses another, the dynamics of their gravity fields can be determined, which in turn provides details on the interiors of the satellites and of Jupiter itself. These mutual events are observable over a period of nine months every six years, and to best provide the data needed they require a network of observers recording events at a variety of times and places. The current set of mutual event observations are being coordinated worldwide by ARLLOT.

History and Philosophy of Science; Interdisciplinary Studies

STOEGER continues to pursue a variety of projects on the relationship among the natural sciences, philosophy, and theology, including developing a more adequate theology of creation, examining the philosophy of relations and causes in a scientific context, and preparing for two conferences next year: The Capstone Conference on Scientific Perspectives on Divine Action, sponsored by the Center for Theology and the Natural Sciences (CTNS) and the Vatican Observatory (VO), is scheduled to be held in Castel Gandolfo in early September 2003. The University of San Francisco–CTNS–VO Conference on "Reductionism and Emergence," is scheduled for early October 2003 at the university.

CARUANA continues to pursue studies in logic and science, in particular, on the nature of contradiction in Wittgenstein.

CORBALLY has been reflecting on the ethical issues that have arisen over having telescopes in the sensitive ecological site of Mount Graham, Arizona. His analysis and proposals toward resolving the conflict were helped by participants in the European Conference on Science and Religion and by O'DONOGHUE (VORG visiting scholar and St. Lawrence University, Canton, NY).



Instrumentation and Technical Services

Cover

Observatory Operations and Activities

■ *VATT Maintenance, Upgrades, and Servicing* SWIFT (Steward Observatory/VATT technician) is completing his training for facility maintenance and preparation. He is now handling most of the routine operations at the VATT. He is occasionally trading duties with NELSON (Steward Observatory/VATT principal scientist), but he is in overall charge of monitoring the observing schedule and preparing the facility for observers.

Much of the fall was taken up with mechanical study and improvement of the telescope before FRANZ (Steward Observatory) was transferred to the Large Binocular Telescope project. The primary effort went into understanding the encoder mounts at the VATT. This involved testing and evaluation of the current system to finalize the design of the new encoder mounts. The result was the resetting of the encoder drive disc on the azimuth (it was warped and tipped) and a careful alignment of the encoders. A new pointing map was produced along with improvements to the pointing model itself. Open loop pointing was substantially improved, and many observers report a significant reduction in "initializations" of telescope pointing.

Another improvement to the mechanical system was the installation of a full suite of primary mirror metrology sensors. Their installation makes possible a full rigid body measurement of the displacement of the primary mirror. Data analysis of the results from monitoring in the fall has not yet commenced. Installation and calibration of the dome encoder is now complete. Final release is waiting on the concurrent release of other new user interfaces to the telescope control system (TCS).

Prototyping of a new catalog interface for the TCS and new user interfaces has been accomplished and accepted by CORBALLY and BOYLE. Permanent installation is scheduled for 2003. Related to this was the acquisition of two new guide cameras for the VATT. The new Lesser-Schmidt guide camera was delivered in August, and an SBIG ST-V was acquired as a backup. It is expected that the ST-V will go into service first as the engineering crew deals with the substantial heat generated by the Lesser-Schmidt camera and its related power supplies and controllers. Software interfaces for both new cameras are well in hand and are being integrated with the new effort toward the catalog-TCS interface.

A large Uninterrupted Power Supply (UPS) from the Steward Observatory Mirror Lab was recently installed at the telescope to handle increasing power loads from electronics critical to the telescope. An effort is being made to see if the original UPS can be installed as well so that each UPS will both split the load and, in the case of failure of one, take up as much of the full load as it can handle. A detailed study of available capacity is being made by SWIFT.

The primary mirror was re-aluminized during the summer. The effort to disassemble the telescope and get it working again for the fall went smoothly. The secondary mirror was not recoated at this time. The mirror vibration fix installed last fall on the secondary seems to have adhered to both the mirror and the secondary mount. Mirror cleaning with CO₂ snow has now become a routine part of telescope maintenance.

The project to provide VATT with a medium-resolution optical spectrograph, known as the "VattSpec," has made steady, slow progress. HARMER (National Optical Astronomy Observatories) has tested the camera lens assembly and determined that, while the lens spacing is not perfect, the camera will certainly suffice for the job. He now joins CORBALLY, CROMWELL, and NELSON in getting the mechanical and control aspects of VattSpec specified and manufactured.

HARMER has almost completed the optical design for a wide-field corrector to match the field of the coming 4K×4K CCD camera for the VATT. He has had the input and help of BOYLE, CORBALLY, CROMWELL, FRANZ (Steward Observatory), and NELSON. This corrector is expected to have greatly reduced ghost images compared to an earlier corrector, and so to produce more precise photometry.



Visiting astronomers from Wheeling Jesuit University and Pittsburgh University gather for an informal consultation in the VATT telescope control room. Monitoring the short-term brightness of QSOs were, left to right: Michelle Belfort, Pittsburgh undergraduate; Joseph Busche, WJU faculty; Chris Tartamella, WJU undergraduate; and Dan Nester, Pittsburgh faculty. (Photo by Chris Corbally, S.J.)

■ **VATT Scheduling** BOYLE, chair of the VATT Telescope Allocation Committee with COYNE and CORBALLY, schedules the observing runs on the VATT. This is done three times a year in synchronization with the trimester scheduling done by the University of Arizona Telescope Allocation Committee. In addition to Vatican Observatory astronomers, regular users of the VATT include astronomers from the University of Notre Dame, Wheeling Jesuit University, New Mexico Highlands University, the University of Arizona, Arizona State University, and Northern Arizona University.

■ **Castel Gandolfo Telescope Upgrade** Last year we reported on the renovation, under the guidance of MAFFEO, of the dome of the Zeiss visual telescope at Castel Gandolfo. A project is now under way to replace the electrical system and, under contract with the firm Astromeccanica di Luciano dal Sasso (Aprilia, Italy), to install the following: a computer-commanded, micro-stepping system on the right ascension motor; a computer command on the declination motor; and a CCD autoguide system with a flip-mirror on the guide telescope to permit alternating between visual and CCD usage. This work is being supported by generous donations from the *Fondazione Cassa di Risparmio della Banca di Roma*, the *Compagnia di S. Paolo di Torino*, the *Banca d'Italia*, and *SARAS, Raffinerie Sarde*.

VO Meteorite Laboratory

In the past year the Meteorite Laboratory at Castel Gandolfo has acquired a Meiji ML 9300 model petrographic microscope with a digital camera and appropriate accessories. Petrographic microscopes are as important to geologists and meteoriticists as telescopes are to astronomers; this new instrument allows analysis of the Observatory's ever-growing collection of meteorite thin sections. Observing with cross-polarized light, both the identification and characterization of samples can be performed. This instrument also provides a way of giving digital images of sample sections to others wishing to borrow them for scientific research.

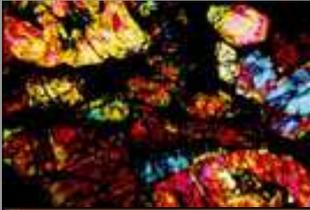
Cyber Activities

OMIZZOLO and BARBIERI (Department of Astronomy, University of Padua) are working on an international project to digitize astronomical archival plates. The aim of the project is to produce high quality images of astronomical plates to offer to the international astronomical community through the World Wide Web. The method being used was tested through photometric studies in selected areas, and the results are satisfactory. Thus far about two hundred plates from the Astrophysical Observatory of the University of Padua at Asiago and about the same number of plates from the Vatican

Observatory at Castel Gandolfo have been digitized. The first results of this project are scheduled to be presented at the meetings of the International Astronomical Union in Sydney, Australia in 2003.

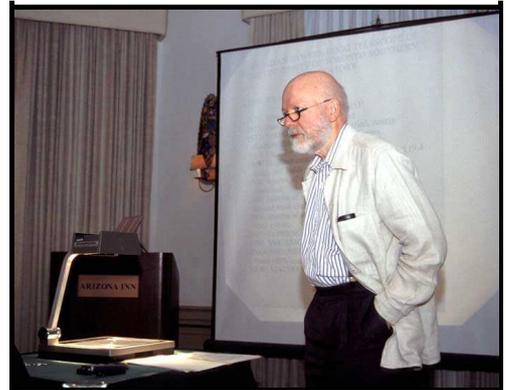
The functioning of the Observatory depends strongly on rapid and reliable internet connections with major centers on two continents and with collaborators spread widely around the world. To this end, IGEA, BOYLE, and ROSSI have planned a major upgrade to the local area computer network (LAN) at Castel Gandolfo. A fast ethernet network with backbones in fiber optics to protect it from the effects of lightning has been installed. This increases the number of network points for use at the Vatican Observatory Summer Schools and for other visitor use and allows faster communications among the computers and workstations in the Observatory. Meanwhile, the need to be able to communicate during European business hours, which are early morning hours in Arizona, means that efficient internet connections at the Lee Street Jesuit Residence are also essential. To this end, CONSOLMAGNO has installed a "WiFi" wireless network with dual base stations at the Lee Street residence, with connections to a local broadband internet service provider.

CORBALLY continued to maintain the website of the Vatican Observatory and its Foundation. A talk by COYNE in streaming video, edited by MARUSIAK (EyePopMedia), gets regular requests, and more such postings to the website are planned. NYLUND (Steward Observatory) worked with CORBALLY and KNOCHE to produce a suitable web-based form for those interested in information about the Vatican Observatory. The website is at the URL <http://clavius.as.arizona.edu/vo/>



Observatory and Staff Activities

Conferences



Robert F. Garrison, University of Toronto, presents his paper on "The MK Process: A Vision for the Future" at the Festschrift held in his honor by the Vatican Observatory in Tucson, June 10/11, 2002. (Photo by Chris Corbally, S.J.)

Two dozen astronomers gathered in Tucson 10–11 June to celebrate a Festschrift for Robert F. GARRISON on his retirement from the University of Toronto the previous year. Garrison, a VOSS 1990 faculty member, built a strong professional relationship with the Observatory that goes back more than 25 years. The meeting was hosted by the Vatican Observatory and held at the Arizona Inn. CORBALLY, MURPHY, and Joseph HENRY, S.J. (Pittsburgh), with indispensable help from Michelle COURNOYER (Steward Observatory), handled the local organization. The scientific program was arranged by GRAY (Appalachian State University, Boone, North Carolina) and CORBALLY. These two are co–editors with PHILIP (Union College, Schenectady, New York) for the actual Festschrift publication.

With the theme of "probing the personalities of stars and galaxies," the conference papers covered the various aspects of Garrison's research interests: stellar spectroscopy, morphological classification of galaxies, and galactic structure. Central was the technique he championed and maintained of MK spectral classification, and his vision of its future in, for instance, the realm of very low temperature L– and T–dwarf objects. The service aspects of public lectures and running small telescopes were also discussed, all very much a part of the honoree's scientific life.

A "Boboque" for participants and guests at the Jesuit Community in Tucson on nearby Lee Street was favored with a partial eclipse of the sun to start the evening cookout. A number of Garrison's former students and collaborators were present, exchanging stories and strengthening friendships. This was characteristic of the brief conference itself, in which interesting science was communicated and collaborations were strengthened.

* * *

The Observatory sponsored the European Science Foundation Network on Science and Human Values meeting 3–6 July at Castel Gandolfo. The conference brought together sixteen scholars from eight European countries to discuss the challenges of science to religious values in Europe during the eighteenth and nineteenth centuries. Several scholars discussed the influence of Darwinian evolution on religious thought and practice. COYNE discussed the promotion of science by the Papacy during the nineteenth century, especially as it related to the refounding of the Vatican Observatory.

* * *

Forty former students and faculty of the Vatican Observatory Summer Schools (VOSS), representing 24 different countries, gathered 7–13 July at Rocca di Papa (Rome) for the Symposium on Astrophysics Research and on the Dialogue between Science and Religion. The symposium was nicknamed "SuperVOSS II," since it was the second reunion of VOSS graduates since 1986, when the Observatory began offering the month-long summer schools to an international group of young scholars selected on the basis of their promise to develop research careers in astrophysics. SuperVOSS II was the initiative of IMPEY (University of Arizona). The morning sessions were dedicated to astrophysics, and the afternoon to discussions on science and religion. Keynote speakers, all renowned international scholars, introduced specific topics in the science–religion dialogue. The speakers and their topics were:

- William Carroll, Tutorial Fellow in Theology, University of Oxford, UK • "Thomas Aquinas, Creation and Big–Bang Cosmology;"
- Vatican Observatory Director George Coyne • "The Sacred Cows of Science and Religion Meet;"
- Chris Impey, Department of Astronomy, University of Arizona, Tucson • "Truth and Beauty in Cosmology: Does the Universe Have an Aesthetic?";
- Ernan T. McMullin, Program in the History and Philosophy of Science, University of Notre Dame, Indiana • "The Anthropic Principle in Cosmology;"
- Lynn J. Rothschild, Ecosystem Science and Technology Branch, NASA Ames Research Center, Moffett Field, California • "A Roadmap for Astrobiology;"
- Trinh Xuan Thuan, Department of Astronomy, University of Virginia, Charlottesville • "Science and Buddhism: Gentle Bridges between the Science of the World and the Science of the Mind."

* * *

The governing board of the Association of European Jesuits in Science met in Castel Gandolfo with CONSOLMAGNO and KOCH on 21–22 September. The board consists of LEACH (Universidad Complutense de Madrid), SEIDEL (Institut für Naturwissenschaftliche Grenzfragen zur Philosophie und Theologie, Munich) and DEVOS (Université Notre–Dame de la Paix, Namur, Belgium). Plans were made for the next meeting of European Jesuit Scientists. This meeting, to be sponsored by the Specola, will be held next year in Rome.

* * *

The Clavius Group of Mathematicians—a community of Jesuits, other religious, and lay persons founded by WHITMAN and another Jesuit in 1963—held its 40th summer meeting at Fairfield University in Fairfield, Connecticut. This important project, sponsored by the Jesuit Order, brings together lay mathematicians and their families with research and professional Jesuit mathematicians within a context of a Faith Community in the professional world of mathematics.

Presentations and Academic Activities

CARREIRA • Gave a series of lectures in Central and South America and Mexico from September to November. Lectures were offered at various educational and cultural centers, including two universities and the major seminary in Guadalajara, two universities in Bogota, one in Medellin, six universities in Peru, and one in Chile.

CARUANA • Presented the annual course "Philosophy of Science and Nature" for about 80 undergraduates, and directed a seminar entitled "Genetics and Justice" for 12 doctoral students at the Philosophy Faculty, Pontifical Gregorian University, Rome. • In October gave a talk entitled "Nature and Divinity: The Impact of Science on the Concept of God" at Arrupe College, Jesuit School of Philosophy and Humanities, Harare, Zimbabwe. • Gave a paper at the University of Bologna on logic and science entitled "Wittgenstein and the Status of Contradictions" during an International Meeting on "Wittgenstein Today" organized by the *Società Italiana di Filosofia Analitica*. • From August to November presented a course on "Philosophy of Science and Cosmology" at Arrupe College, Jesuit School of Philosophy and Humanities, Harare, Zimbabwe.

CONSOLMAGNO • Completed his third and final year as a member of the Division for Planetary Sciences (DPS) Committee of the American Astronomical Society (AAS). • Participated in meetings of the DPS Committee at the Washington, DC, headquarters of the AAS on June 17, and the following day at NASA headquarters, and on Capitol Hill, meeting with staffers from several congressmen and congressional committees. • Participated in meetings of the DPS Committee on October 6 and October 10, during the annual DPS meeting in Birmingham, Alabama. • Was elected to the governing Board of the Meteoritical Society, commencing at the beginning of 2003 and running for two years. • Continued to serve as secretary of Commission 16 (Planets and Satellites) of the International Astronomical Union (IAU), maintained the Commission web page, and edited the Triennial Report of the Commission prepared in anticipation of the 2003 IAU General Assembly. • Presented a seminar, "Meteorite Porosity and Asteroid Structure," at the University of Western Ontario on January 22; at the Adler (Chicago) Planetarium Department of Astronomy on February 13; at the NASA Jet Propulsion Laboratory on April 18; and at NASA Ames Research Center on August 29. A variant of this talk, examining the role of high-speed computing in discussing asteroid structure, was presented at the Hewlett Packard laboratories in Palo Alto (California) on April 24. • Visited the University of Texas (Austin) on January 24 to consult with SCHAEFER. • Consulted at NASA JPL April 17–18 with BURATTI, HARRIS, WEISSMAN, and YEOMANS. • Visited MIT on May 3, consulting with RIVKIN and GRIER (Harvard/Smithsonian Center for Astrophysics). • Paid working visits to the Natural History Museum (London) for processing meteorite thin sections and to consult with BLAND, GRADY, and RUSSELL on May 15, September 25, and November 13. • At the Smithsonian Institution Natural History Museum in Washington, DC, on June 14 planned the sampling of the Vatican's Pirapora meteorite (also known as Angra Dos Reis Iron) with MCCOY and MACPHERSON. • Delivered four meteorite samples on July 30 as a loan for a special display at the Cranbrook Institute of Science outside of Detroit, Michigan. • Visited NASA Ames Research Center on August 29, meeting with ROTHSCHILD, CRUIKSHANK, and BISHOP. • Discussed at SUNY Stony Brook on October 4 possible future collaborations in bioastronomy with DAVIS. • Visited the Geosciences Department of Yale University on October 1, and its meteorite collection on October 2. • Met at the Southwest Research Institute in Boulder, Colorado, on October 28 with BOTTKE, CHAPMAN, DURDA, MERLINE, and YOUNG.

CORBALLY • After three years as President, was appointed Immediate Past President of the Institute on Religion in an Age of Science. Earlier as President, chaired council meetings in February at Campion Center, Weston, Massachusetts, and in July at Portsmouth, New Hampshire, and chaired the annual meeting on Star Island, New Hampshire. • Participated in the Star & Planet Formation Discussion Group at Steward Observatory and presented an outline of 8 Boötis star theories. • Hosted Wheeling Jesuit University's first observing run at VATT. • Collaborated with Steward Observatory and MGIO personnel to improve outdoor lighting code in the Gila Valley. Represented the Vatican Observatory at International Dark-Sky Association "Excellence in Lighting" awards in the Pima County area. • Continued on the Board of the St. Albert the Great Forum at the Catholic Newman Center, University of Arizona.

COYNE • Gave a paper on "Idolatry, the Temptation of Both Science and Religion" at the Introductory Workshop on Science, Technology and Values: Worldviews in Dialogue at Pune, India. • At the Physics Department of Seattle University spoke on "The Detection of Extra-Solar Planets." • Spoke on "Cosmology and the Origins of Life" to the *Istituto Studi Mediterranei* at the *Università della Svizzera Italiana* at Lugano, Switzerland. • Presented a talk on the "Galileo Myth" to the Philosophy Department of the Catholic University of Lublin and to the Polish Academy of Sciences at Krakow. • Gave a paper on "Theological Implications of Modern Cosmologies" to the International Institute "Jacques Maritain," Preganziol, Italy. • Participated in the meeting "Galileo and the Church," organized at the University of Notre Dame, Indiana, by McMULLIN and delivered a paper on "The Church's Most Recent Attempt to Dispel the Galileo Myth." • Participated in the meeting "Why is there Something Rather than Nothing" at Varenna, Italy and gave a paper on "Origins and Creation." • Participated in the meeting "The Jesuits II: Cultures, Sciences, and the Arts, 1540–1773" held at Boston College, Chestnut Hill, Massachusetts, and gave a paper on "The Jesuits and Galileo: Fidelity to Tradition and the Adventure of Discovery." • Serves on the Advisory Board of a new journal, *Omega Indian Journal of Science and Religion*. • Continues as a member of the Governing Board of the Pontifical Academy of Sciences, on the Executive Council of the International Center for Relativistic Astrophysics headquartered in Rome, and on the Advisory Council for the Cosmology Prize of the Peter Gruber Foundation. • Participated in the prize award to Vera Rubin at the Carnegie Observatories, Pasadena, California.

FUNES • Observed at the 0.9–m telescope at the Cerro Tololo Inter–American Observatory, Chile, in April and September. Ten nights in total were awarded to the project on "Star Formation in the Local Universe." For the same project, observed at VATT during seven nights in March. • At the 6.5–m telescope at the MMT Observatory (Mt. Hopkins, Arizona) observed two nights on the project "Dark Matter in Low Surface Brightness Galaxies." • Observed fourteen nights in May and December at VATT as part of the project on "Star Formation in Satellite Galaxies." • Worked in June for a week with BERTOLA, CORSINI, and PIZZELLA at the Department of Astronomy of the University of Padua and gave a seminar on "Star Formation in the Local Universe." • In August, worked with MINNITI at the Department of Astronomy of the Pontifical Catholic University of Chile in Santiago. As invited professor, taught a brief course on "Star Formation in Galaxies." Gave a seminar on his extragalactic research and a public lecture on "Astronomy and Faith." • Lectured on "Astronomy and Faith" at the Schools of Medicine and Nursing of the Universidad San Sebastian, Puerto Montt, Chile. • In Bolivia, in September lectured on "Astronomy and Faith" at the Schools of Philosophy and Theology at the Catholic University of Bolivia, in Cochabamba. At the same university lectured to students of the School of Engineering. Gave a 2–day workshop to religious in formation on "The Contemporary Image of the Universe." • In Potosi, he participated in a public discussion on "Scientific, Sociological and Theological Reasons" at the "Universidad Autónoma Tomas Frias." • Lectured about the present knowledge of galaxies at the Department of Physics of the same university and at the "Instituto Normal Superior Eduardo Avaroa."

HELLER • Gave a talk on "The Structure of the Big Bang" at the Department of Astronomy, University of Padua. • At a conference in Lublin, Poland, on "Space in Contemporary Science" gave a paper on "Evolution of the Concept of Space."

IGEA • Continues as Professor of Philosophy of Nature at the Theological Institute of St. Ildefonso (Seminary of Toledo, Spain).

MAFFEO • Gave a talk on "The Vatican Observatory: Between Science and Faith" at Crescentino (Vercelli, Italy). • To the *Ateneo Romano Regina Apostolorum* spoke on "Father Angelo Secchi: Priest and Astronomer."

O'DONOGHUE (Visiting Scholar 2001–2002) • Nominated for the American Association of Community Colleges Outstanding Alumni Award for 2003 by Colorado Mountain College. • Attended the fall meeting of the Astronomical Society of New York and annual business meeting of the New York Astronomical Corporation, of which she is treasurer. • Completed the Linux System courses in Denver, Colorado. • Assisted Michael McFadden with spectral observations for the NStars project with the 1.5–m telescope at Cerro Tololo Interamerican Observatory, La Serena, Chile. • Observed spectra of NStars with GARRISON (University of Toronto) and KNOX (St. Lawrence University) with 1.88–m telescope at David Dunlap Observatory, Toronto. • Taught the intensive interdisciplinary seminar for advanced undergraduates on "The Evolution of the Universe" for the Oklahoma Scholar–Leadership Enhancement Program of the Oklahoma State Regents. The course took place on the campus of Northwestern Oklahoma State University in Alva, Oklahoma.

OMIZZOLO • As representative of the bishop of Padua, is working to create a group to investigate the relationship between faith and science. The group will include the Diocese of Padua and various departments of the University of Padua. The coordinator of this group is RAFANELLI, Director of the Department of Astronomy of the University of Padua.

STOEGER • Continues to teach the "Science and Theology" course in the Molecular and Cellular Biology Department, University of Arizona, with LINDELL and HEWLETT (University of Arizona). • Participated in a Templeton Foundation Science and Religion Course Program workshop at the Ateneo de Manila, Philippines, where he gave the keynote presentation, "Divine Action in a Broken World." • Attended the Catholic Theological Society of America meeting in New Orleans. Convened and chaired the Theology and Natural Sciences Continuing Group Session on the topic "Adam and Eve, Modern Genetics and Original Sin." • Presented a series of three lectures at the Pontifical Catholic University in Rio de Janeiro (PUC–RJ): "Science, the Laws of Nature and Divine Action," "Our Knowledge in Science, in Theology and in Spirituality," and "Cosmology and a Theology of Creation." He also gave a colloquium on "Cosmology: How Did the Universe Become What It Is Today?" to the university's Physics Department and to the Institute of Physics at the Federal University of Rio Janeiro. While there, worked with ARAÚJO and his collaborators, and with RIBEIRO. Gave a lecture, "The Laws of

Nature in the Natural Sciences and Beyond," at the Fundação do Oswaldo Cruz in Rio de Janeiro. • Lectured on "Our Experience of Knowing in Science and in Spirituality" at the Pontifical Catholic University of São Paulo; on "The Dialogue Between Faith and Science" at Instituto Teológico de São Paulo; and on "The Laws of Nature" at the University Extension Center in São Paulo. • Gave a colloquium, "Cosmology and the Anthropic Principle: How Has the Universe Been Fine-Tuned for Life," at the Institute of Physics at the National University of the State of São Paulo. • On October 31, spent the day working at the Institute of Physics, the University of São Paulo, and gave a colloquium there on "Cosmology: How Did the Universe Become What It Is Today?"

Public and Educational Outreach

CONSOLMAGNO • Continues to participate on the *Outreach To Space* Scientific Advisory Board. *Outreach to Space* is a collaborative proposal to the U.S. National Science Foundation from eight regional science museums in Illinois, Indiana, and Alaska for preparing exhibits and programs related to space, to be displayed in non-museum settings (such as churches and county fairs) in order to bring science education to the general public. As part of this participation, met with MIR (SciTech Museum, Aurora, Illinois). • Was filmed at the MIT Chapel for a traveling National Science Foundation exhibit "Cosmic Questions," which opened at the Boston Museum of Science in September. Was also filmed for an exhibit on meteorites and planetary sciences at the Museum of Planetary Sciences of the Province of Prato (Italy). • On October 1 received the Thomas E. Golden Fellowship at the St. Thomas More Catholic Center of Yale University, where he presented the Golden lecture titled "Reflections on Free Will and the Anthropic Principle." Also directed a prayer service at the St. Thomas More chapel on "The Book of Job, Chapter 38: Finding God in the Natural World." • Was the Science Guest of Honor at "ConFusion," the annual science fiction convention of the University of Michigan Science Fiction Society held in Detroit 17–19 January, where he participated in three panels on science fiction as well as gave three formal lectures. • Was a panelist at the World Science Fiction Convention in San Jose, California, and at regional science fiction conventions in Chicago 7–10 February and 8–10 November. • Spoke on his experiences as "Brother Astronomer" to students from St. Rita's Grade School, Aurora, Illinois, and at the Sci Tech Science Museum of Aurora on 11 February; to the children's religion class of the Bethany of Fox Valley (Illinois) United Methodist Church on 13 February; to classes at the Strake Jesuit High School (Houston) on 5 April; to the Caltech Management Association on 16 April; at the Yale St. Thomas More Catholic Center and the Yale Divinity School, on 2 October; at the University of Detroit Jesuit High School, 14 October; and to an astronomy class at the University of Detroit Mercy, on 16 October. • Spoke on "God, Astronomy, and the Search for Elegance" to chapters of the Catholic Businessman's organization *Legatus* in Ann Arbor, Michigan, on 23 January; in San Diego, 21 March; in Ventura (California), 22 March; in San Francisco, 23 April; and in Fresno (California), 25 April. • Gave a presentation on the religious life of scientists and engineers, title "The Mechanics of God," to the Santa Cruz Lutheran Church (Tucson) on 3 February; as a special two-day seminar at Loyola University of Chicago, on 8 and 9 April; to a Science/Religion Faculty Forum at Marquette University, Milwaukee, on 9 April; to the St. Francis Assisi Parish of San Jose, California, on 28 August; as an evening seminar at the University of Detroit Mercy, 15 October; at the Lay Theological Academy of Grosse Pointe, Michigan, on 16 October; and to the St. Albert the Great Forum of the University of Arizona Newman Center, on 23 October. • Described the writing of his book *Turn Left at Orion* to a chapter meeting of the Royal Astronomical Society of Canada in London, Ontario, on 22 January. • Discussed "Are Asteroids Fluffy?" at the ConFusion convention on 20 January; to the Sun City (Phoenix) Astronomy Club, on 26 February; and to the San Jose Astronomical Association, on 19 October. • Taught a four-hour class at the Adler Planetarium in Chicago over two nights (7 and 14 February) entitled "New Moon: Radically New Ideas for the Origins of a Very Old Planet" and gave a second (two hour) class there, "The Vatican and the Sun," on 6 February. • Discussed "Space Exploration of the Solar System" at the Vatican Observatory Foundation Seminar on 28 February, and again at the Raytheon Laboratory (Tucson) on 1 April. • Described the connections between meteors, meteorites, comets, and the Leonid shower in the talk "When the Sky Falls to Earth" at ConFusion on 18 January; at Yale University's Peabody Museum of Natural History on 2 October; at the Cranbrook Institute of Science (Detroit) on 13 October; and to an adult education group in Arricia, Italy, on 3 December. • Explained "Why The Pope Has An Astronomer" at ConFusion on 19 January; to the Houston Astronomical Society, on 5 April; for a University of Dallas summer high school program on 15 July; and to a tour group to Castel Gandolfo led by MITTON (Cambridge University) on 11 September.

CORBALLY • Spoke to the Lions Club in Safford, Arizona, on "Good Lighting and Dark Skies." • Gave

a public lecture in the York University, Canada, Seminar Series in Science and Society 2001/2 on "Discovering ET, Discovering God?" Gave lectures with a similar theme to the Senior Essay Society, Stonyhurst College, England, and at the St. Thomas the Apostle Parish, Tucson, sponsored by the Knights of Columbus. • Spoke at the Thomas Merton Center, Palo Alto, California, on "Enhancing Faith and Mindfulness through an Astronomer's Filter." • Led a Friday chapel meditation at St. Michael's Day School, Tucson, with the theme "God and the Universe." • With O'DONOGHUE and CONSOLMAGNO, participated in several successful Crescent Moon Sightings organized by Dr. Polachek in Tucson. • Continued as an advisor to the *Earth & Sky* radio series broadcast nationally and internationally • Was interviewed for several astronomy projects at the University of Arizona. • Hosted various visits to the VATT on Mt. Graham, including ones for the Board of the St. Albert's Forum, Tucson, and the Sacred Heart Parish of Willcox, Arizona. • Hosted visits to the Steward Observatory Mirror Laboratory, including that of Steve Goldstein of The Philadelphia Inquirer.

COYNE • Participated in the cultural project of the Archdiocese of L'Aquila, Italy, "Two Ways, One Truth: Science and Faith," and gave a paper on "The Galileo Affair and the New Cosmologies." • Gave the inaugural address at the dedication of the Clavius Science Center at St. Ignatius High School, Cleveland, Ohio. • Participated in the program, "Infinities," at the Piccolo Teatro, Milan, and gave a paper on "Life in the Universe." • Gave a paper, "The Universe: Seeking God Beyond the Big Bang," in the series, "*I Martedì Sera*," sponsored by the *Unione Industriale Torino*. • Participated at a round table discussion, "The Remote Future: A Journey from Science to Science Fiction," at the Science City of Naples, Italy. • Gave a paper on "The Evolution of the Universe" to the students participating in the school of astronomy organized by the Inter-University Consortium for Space Research, Turin, Italy as part of the initiatives of the European Association for Astronomy Education. • At the cultural center, "*Lo Studiolo*," of Bagnoregio, Italy, gave a paper on "Life in the Universe." • Gave a series of three talks on the most recent results from the Hubble Space Telescope to the *Università della Terza Età* at Ariccia, Italy. • Talked of the origins and development of the Vatican Observatory to the Board of the Gregorian University Foundation at their meeting in New York City. • Spoke on the history of the Church and science to the gathering of the "Colleagues" at Seattle University. • Helped with the organization of the meeting on "The Special Character of Human Life" sponsored by the Association of Consecrated Virgins, Servidoras at their center, *La Armonia*, Mar del Plata, Argentina. Gave a paper on the physical conditions for the origins of life. • Gave presentations at cultural events for friends and benefactors of the Vatican Observatory Foundation at: the Phoenix Country Club; the Challenger Center in Peoria, Arizona; the Adler Planetarium in Chicago; Georgetown University in Washington, DC; the Rose Center of the American Museum and Hayden Planetarium in New York City; the Arizona Inn in Tucson, Arizona.

FUNES • Gave two lectures to the general public at Saint Cyril's Parish, Tucson. • Conducted a 2-day workshop for teachers of *Fe y Alegria* in Potosi, Bolivia, on "The Contemporary Image of the Universe." • Gave two lectures on astronomy to students of the middle school of the *Colegio San Francisco Javier*, Puerto Montt, Chile, and two lectures to students of the middle school of the *Colegio San Mateo*, Osorno, Chile. Gave a public lecture on "Astronomy and Faith," Osorno. • Gave four talks on Astronomy to the students of high school of the *Colegio Sagrado Corazón*, Sucre, Bolivia.

HELLER • Gave a paper on "How to Teach about the Creation of the Universe?" at a conference in Krakow, Poland, on the teaching of science and religion in schools • Presented lectures to the general public on recent developments in cosmology, philosophical aspects of science, and science and religion.

IGEA • Presented a paper in a discussion panel at the Summer School of the *Universidad Complutense de Madrid*. • Gave a talk on the compatibility between science and religion in the Diocese of Lugo, Galicia, Spain.

MAFFEO • Participated in three television programs of SAT 2000 of *Radio Televisione Italiana Tre* on the topic of extraterrestrial life.

O'DONOGHUE • Gave a public talk at Northwestern Oklahoma State University entitled "The Songs of Ancient Electrons." • Conducted a retreat on "Loving the Universe" at the Manna House of Prayer in Concordia, Kansas. In six talks, explored the expansion of the universe; the nature of light and matter at the quantum level; and the origin of the chemical elements in light of the writings of Teilhard de Chardin, and the contemporary theologians Sally McFague and Beatrice Bruteau.

STOEGER • Is now Chair for the St. Albert the Great Forum Board at the University of Arizona Catholic Newman Center. The Forum sponsors lectures and discussions on science–theology issues. • Gave a presentation, "The Anthropic Principle Revisited," at the St. Albert the Great Forum. • Gave a presentation on "How Will the Universe End?" at the Vatican Observatory Foundation Seminar on February 28. • Gave a series of three public lectures on Science and Theology at Sacred Heart Cathedral Parish in Kota Kinabalu, Sabah, Malaysia. Afterwards gave a public lecture on "Cosmology: What We Know about the Universe" in Kuching, Sarawak, Malaysia, sponsored by the Amateur Astronomical Society of Sarawak. • Gave a week–long series of lectures on cosmology, science, and theology at the Seabeck Summer Camp, Seabeck, Washington, to the members of the University Congregational United Church of Christ (Seattle, Washington). During this time also led a study group on the creation literature of the Old Testament. • Gave the Rimes' Lecture at Spring Hill College, Mobile, Alabama, on "Cosmology and Creation: The Origin, Development and Destiny of the Universe."

TERES • Gave a series of fourteen lectures in Hungary and in Norway on the "Origin of the Universe and the Anthropic Principle" and on "The Possibility of Extraterrestrial Civilization."

News Media Contacts

"The Pope's Telescope," a special story in the September 8 issue of the Philadelphia *Inquirer Magazine*, featured interviews with CONSOLMAGNO, CORBALLY, COYNE, and HENKELS.

CONSOLMAGNO • Was interviewed for the magazine *US Catholic*. • Participated in an hour–long radio and internet interview for the evangelical science and religion publication *Reasons to Believe* on April 12. • Was recorded with COYNE by the BBC for a program on *Church and Science* broadcast in May. • Was interviewed for the Birmingham News and the ABC network affiliate WBMA television's religious affairs program *Matters of Faith*. • Appeared on the *Nova* television program "Galileo's Battle for the Heavens." • Over several months in the fall, CONSOLMAGNO and BYRNE (BBC) conducted a series of interviews for a BBC radio program *The End of the Universe*. Among those interviewed included the cosmologist REES (Astronomer Royal of the United Kingdom, Cambridge University), philosopher of science CARTWRIGHT (London School of Economics), and historians of science CHANG and GREGORY (University of London). The program will air in the UK in early 2003.

CORBALLY • Provided interviews to the following media and journalists: Caroline Graham, *London Mail on Sunday*, on the Christmas Star; Mark Akwith, of Spacecast.com, Canada; Jay Ingram, TV Ontario; Michael McAteer, *Toronto Star*; Matthew Muhm, *Daily Wildcat*, and Scott Thompson, of Associated Press (Phoenix), on astronomy–friendly outdoor lighting; Joan Gislow, *Palo Alto Daily News*; Alison Rose, PTV Productions, Toronto, Canada; Michael Tissoni, Xaura Films; Stewart Becker, *Tucson Weekly*. • Participated in the panel discussion, "Test of Faith," hosted by Valerie Pringle for VisionTV, Canada. • Answered questions from: Paul Thaker, *New York Times*; Joseph Young, *St. Cloud Visitor*; William Broadway, *Washington Post*.

COYNE • Provided interviews to the following media and journalists: Maria Grazia Gismondi and Guido Nigro, Australian National Radio; Alexey Pivovarov, NTV Channel, Russian National Television; David Lemarchand of Maximal Productions; Alison Rose for PTV Productions, Toronto, Canada; English Program of the Vatican Radio; talk show of the Diocese of Pittsburgh; Paul Arnold of BBC Science; Roberta Rose of Cicada Films for the Discovery Channel; Larry Witham of *The Washington Times*; Margaret Wertheim in preparation for the article that appeared in *Wired* magazine, December 2002; David Levy, astronomy talk show, Tucson; Klaus Bachmann for an article in *Geowissen*, Hamburg, Germany; William Broadway for an article in the *Washington Post* and in the *Japan Times*; Luigi Dell'Aglio for the article in *L'Avvenire*, 29 September 2002; Michele Giordano for an article in *CHI* magazine, February 2002; Giovanni Caprara for an article in *Corriere della Sera*, 7 January 2002; Chiara Capuani for the program, RAI TG3; Annalisa Gaudenzi, RAI *Divisione Radiofonia*; Giovanni Pellegrini for an article in *Giornale del Popolo*, Lugano, 13 June 2002; Michele Crudele for the presentation of the *Dizionario Interdisciplinare di Scienza e Fede*, edited by Giuseppe Tanzella–Nitti and Alberto Strumia; • Participated at the Polish Academy of Science in Krakow in the presentation of the Polish edition of the book *Galileo for Copernicanism and for the Church* by Annibale Fantoli.

FUNES • Provided interviews to the *San Diego Union Tribune*; to the weekly magazine *Noticias* of Buenos Aires, Argentina; and to *Canal 13*, Corrientes, Argentina.

HELLER • Gave several interviews to various Polish newspapers, journals, radio, and television on the interaction among science, philosophy, and theology.

IGEA • Continued biweekly popular astronomy talks on Radio María, Madrid.

MAFFEO • Provided assistance to Alison Rose for PTV Productions, Toronto, Canada, during her filming at Castel Gandolfo in June and July. • Was interviewed on three Italian television stations • RAI 2, Channel 5, and SAT 2000 • about his book on the history of the Vatican Observatory, on extra-terrestrial life, and on the science-faith dialogue.

O'DONOGHUE • Continued providing short chats about astronomical and sky phenomena to listeners of North Country Public Radio (NCPR) of Canton, New York. • Participated as a guest host for the NCPR *Readers and Writers on the Air* series of call-in discussions with authors of current books. Discussed *Galileo's Daughter* with author Dava Sobel and the NCPR station manager and series director, Ellen Rocco. Annibale Fantoli, author of the Vatican Observatory Publication *Galileo: For Copernicanism and for the Church* contributed to the discussion by phone from Victoria, Canada.

STOEGER • Gave a radio interview in Adelaide, Australia, on the interaction between science and theology.

TERES • Provided interviews in Hungary to: *Dunat TV* and *Zenit TV*, Budapest; *Local TV*, Kecskemet; *Remeny Radio*, Pecs; *Miskolc Radio*.

International Meetings

29 December–2 January: Pune, India. Introductory Workshop on Science, Technology and Values: Worldviews in Dialogue. GEORGE V. COYNE, S.J. gave a paper.

6–10 January: Washington, DC. 199th Meeting of the American Astronomical Society. RICHARD BOYLE, S.J., CHRISTOPHER CORBALLY, S.J., and JOSÉ FUNES, S.J. gave papers.

11 January: Washington, DC. "Galaxies: Mind Over Matter," a Celebratory Symposium for Vera Rubin. CHRISTOPHER CORBALLY, S.J. and JOSÉ FUNES, S.J. attended.

29 January–1 February: Puebla, Mexico. "Science and Religion Towards a New Culture of Collaboration. JAVIER IGEA gave a paper.

10–15 March: Houston, Texas. Annual Lunar and Planetary Science Conference. GUY J. CONSOLMAGNO, S.J. co-authored three papers.

19–24 March: Nijmegen, The Netherlands. Ninth European Conference on Science and Theology. CHRISTOPHER CORBALLY, S.J. gave a paper, moderated a working group, and chaired a plenary session.

10–11 June: Tucson, Arizona. A Festschrift for R. F. Garrison, "Probing the Personalities of Stars and Galaxies." RICHARD BOYLE, S.J. participated. CHRISTOPHER CORBALLY, S.J. gave a paper, chaired the Local Organizing Committee, and co-chaired the Scientific Organizing Committee.

21–26 July: Los Angeles, California. Annual Meteoritical Society Meeting. GUY J. CONSOLMAGNO, S.J. coauthored three papers.

27 July–3 August: Star Island, New Hampshire. Annual Conference of the Institute on Religion in an Age of Science (IRAS). CHRISTOPHER CORBALLY, S.J. participated and chaired the IRAS Council and Annual meetings.

19–23 August: Granada, Spain. Founding Meeting of the International Society for Science and Religion. CHRISTOPHER CORBALLY, S.J. and MICHAEL HELLER participated.

23–25, August: Granada, Spain. Science and the Spiritual Quest Symposium. CHRISTOPHER CORBALLY, S.J. participated.

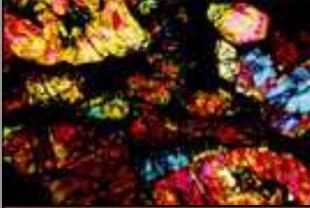
5–11 October: Birmingham, Alabama. Annual Meeting of the Division for Planetary Science of the American Astronomical Society. GUY J. CONSOLMAGNO, S.J. presented a paper; JEAN-BAPTISTE KIKWAYA, S.J. submitted a poster.

17–18 October: Tucson, Arizona. Steward Observatory Internal Symposium. CHRISTOPHER CORBALLY, S.J. gave a paper.

26–30 October: Denver, Colorado. Annual Geological Society of America Meeting. GUY J. CONSOLMAGNO, S.J. presented a paper.

8–11 November: Vatican City. Plenary Meeting of the Pontifical Academy of Sciences. GEORGE V. COYNE, S.J. gave a paper; MICHAEL HELLER participated.

14–16 November: Rome. *La Sapienza Come Fonte dell'Unità Europea*. SABINO MAFFEO, S.J. participated.



Publications

Cover

Publications

BOYLE, R. P., JANUSZ, R., KAZLAUSKAS, A., and PHILIP, A. G. DAVIS. "CCD Strömvil Photometry of M 37," 2001, BAAS, 33, 1388

BOYLE, R. P., LAUGALYS, V., and PHILIP, A. G. D. "Flatfield Correction by Differential CCD Photometry in M 67," 2002, BAAS, 34, No. 4

BRITT D. T., YEOMANS D. K., HOUSEN K. R., and **CONSOLMAGNO**, G. J. "Asteroid Porosity and Structure," 2002, in *Asteroids III*, ed. W. Bottke and R. Binzel (Tucson: University of Arizona Press), in press.

BRITT, D. T. and **CONSOLMAGNO**, G. J. "Stony Meteorite Porosities and Densities: A Review of the Data Through 2001," 2002, Meteorit. Planet. Sci., in press.

BUDZIK, S. and **HELLER**, M., eds., *The Future in Unity (Questiones ad disputandum – 1)*, 2002 (Tarnów: Biblos), in Polish.

CARREIRA, E. M. "Il Principio Antropico," 2002, *Civiltà Cattolica*, I, 435–446

CASANOVAS, J. "Copernico," 2002, entry in *Dizionario Interdisciplinare di Scienza e Fede*, ed. Giuseppe Tanzella–Nitti and Alberto Strumia (Vatican City: Urbaniana University Press, Città Nuova) II, 1641–1653

_____. "Kepler," 2002, entry in *Dizionario Interdisciplinare di Scienza e Fede*, ed.: Giuseppe Tanzella–Nitti and Alberto Strumia (Vatican City: Urbaniana University Press, Città Nuova) II, 1882–1893

CONSOLMAGNO, G. J., ed., "Commission 16: Physical Study of Planets and Satellites," 2002, in *Reports on Astronomy, Vol. XXVA*, ed. H. Rickman, in press.

CONSOLMAGNO, G. J. and BRITT, D. T. "Low Density Materials and Asteroidal Macroporosity," 2002, Lunar Planet. Sci. XXXIII, 1701

_____. "Three Points on Meteorite Porosities," 2002, Meteorit. Planet. Sci. 37, A38

CONSOLMAGNO G. J. and STRAIT, M. M. "The Density and Porosity of Martian Meteorites," 2002, in *Program and Abstracts, Geological Society of America Annual Meeting*

CONSOLMAGNO, G. J., WEIDENSCHILLING, S. J., and BRITT D. T. "Forming Well Compacted Meteorites in the Solar Nebula," 2002, BAAS, 34, 890

CORBALLY, C. J. "When Astronomers and Environmentalists Clash over a Sky Island," 2002, *Studies in Science & Theology*, Vol. 9, accepted

COYNE, G. V. "Specola Vaticana," 2002, entry in *Dizionario Interdisciplinare di Scienza e Fede*, ed. Giuseppe Tanzella–Nitti and Alberto Strumia (Vatican City: Urbaniana University Press, Città Nuova) II, 1323–1329

_____. "Seeking the Future: A Theological Perspective," 2002, in *The Far Future Universe*:

Eschatology from a Cosmic Perspective, ed. G. F. R. Ellis (Philadelphia and London: Templeton Foundation Press) 12–19

_____. "Direzione della Specola Vaticana," 2002, *Attività della Santa Sede 2001*, 1338–1351

_____. "Modern Cosmology, A Resource for Elementary School Education," 2002, in *The Challenges for Science: Education for the 21st Century* (Vatican City: Pontifical Academy of Sciences Scripta Varia 100)

_____. "Condizioni Fische Macroscopiche per la Vita," 2002, in *Epistemología de las Ciencias*, ed. L. B. Archideo (Buenos Aires: CIAFIC Ediciones) 119–138

CRISTIANI, S., GRAZIAN, A., **OMIZZOLO**, A., and **CORBALLY**, C. "Mining the Local Universe: The QSO Space Density," 2001, in *Mining the Sky*, Proceedings of the MPA/ESO/MPE Workshop, Garching, Germany, 31 July–4 August, 2000, ed. A. J. Banday, S. Zaroubi, and M. Bartelmann (Heidelberg: Springer-Verlag), 154

ELLIS, G. F. R., **STOEGER**, W. R., McEWAN, P., and DUNSBY, P., "Dynamics of Inflationary Universes with Positive Spatial Curvature," 2002, *Gen. Rel. & Grav.*, 34, 1445–1459

ELLIS, G. F. R., McEWAN, P., **STOEGER**, W., and DUNSBY, P., "Causality in Inflationary Universes with Positive Spatial Curvature," 2002, *Gen. Rel. & Grav.*, 34, 1461–1481

FUNES, J. G., CORSINI, E. M., CAPPELLARI, M., PIZZELLA, A., VEGA BELTRAN, J. C., SCARLATA, C., and BERTOLA, F. "Position–Velocity Diagrams of Ionized Gas in the Inner Regions of Disk Galaxies," 2002, *A&A*, 388, 50

_____. "An Atlas of Position–Velocity Diagrams in the Inner Regions of Disk Galaxies," 2001, *BAAS*, 33, 1379

GRAY, R.O., and **CORBALLY**, C.J. "A Spectroscopic Search for 8 Boötis and Other Peculiar A–type Stars in Intermediate–Age Open Clusters," 2002, *AJ*, 124, 989

GRAY, R. O., **CORBALLY**, C. J., GARRISON, R. F., McFADDEN, M. T., ROBINSON, P. E., and **O'DONOGHUE**, A. A. "The Nearby Stars (NStars) Program at Appalachian State University, Vatican Observatory, and David Dunlap Observatory," 2001, *BAAS*, 33, 1437

GRAZIAN, A., **OMIZZOLO**, A., **CORBALLY**, C., CRISTIANI, S., HAEHNELT, M. G., and VANZELLA, E. "The Asiago–ESO/RASS QSO Survey II. The Southern Sample," 2002 *AJ*, 124, 2955

HELLER, M. *The Meaning of Life and the Meaning of the Universe*, 2002 (Tarnów: Biblos), in Polish

_____. *Time and Causality*, 2002 (Lublin, Poland: Scientific Society of the Catholic University of Lublin), in Polish

_____. *The Beginning is Everywhere*, 2002 (Warsaw: Prószyński i Ska), in Polish

_____. "Genesis of Time," 2001, in *Time and Causality*, ed. M. Heller and J. Młynarczyk (Kraków: OBI; Tarnów: Biblos) 70–83, in Polish

_____. "Between Theology and Science," 2001, *Tarnowskie Studia Teologiczne*, XX/2, 3–11, in Polish

_____. "Generalizations: From Quantum Mechanics to God," 2001, in *Quantum Mechanics: Scientific Perspective on Divine Action*, ed. R. J. Russell, P. Clayton, K. Wegter–McNelly, and J. Polkinghorne (Vatican City: Vatican Observatory Publications) 191–210

_____. "Where the Universe Came From?" 2002, *Ċwiat Nauki* (Polish edition of *Scientific American*) 130, 38–47, June 2002, in Polish

_____. "Evolution of Concepts in Physics," 2002, in *Nauka–Religia–Dzieje*, XI, ed. J. A. Janik (Kraków:

Jagiellonian University Press) 49–62, in Polish

_____. "Science and Faith in Interaction," 2002, in *The Human Search for Truth: Philosophy, Science, Theology* (Philadelphia: Saint Joseph's University Press) 98–107

_____. "The Ultimate Theory and the Laws of Physics," 2002, *Tarnowskie Studia Teologiczne*, 21/1–2, 113–117, in Polish

_____. "Physics and Philosophy in the 20th Century," 2001, *Organon* 28/30, 95–110

_____. "Looking for the Meaning," 2002, *Znak* 569, 72–89, in Polish

_____. "Time of the Universe," 2002, in *The Far-Future of the Universe: Eschatology from a Cosmic Perspective*, ed. G. F. R. Ellis (Philadelphia–London: Templeton Foundation Press) 53–64

HELLER, M. and **MYCZKA, J.**, eds. *Time and Causality*, 2001 (Kraków: OBI; Tarnów: Biblos), in Polish.

HELLER, M. and **SASIN, W.** "Differential Groupoids and Their Application to the Theory of Spacetime Singularities," 2002, *Intern. J. Theor. Phys.* 41, 919–937

HELLER, M., **SASIN, W.**, and **ODRZYGÓŃ, Z.** "Noncommutative Quantum Dynamics," 2001, *Gravitation and Cosmology* 7, 135–139

_____. "The Classical Singularity Problem: History and Current Research with Historical Development of Modern Cosmology," 2001, in *ASP Conference Series*, Vol. 252, ed. V. J. Martinez, V. Trimble, and M. J. Pons–Borderia (San Francisco: Astronomical Society of the Pacific), 121–144

_____. "Time and Physics: A Noncommutative Revolution," 2002, in *A Collection of Polish Works on Philosophical Problems of Time and Spacetime, Synthese Library*, vol. 309, ed. H. Eilstein (Dordrecht–Boston–London: Kluwer Academic Publishers), 47–56

_____. "Generalized Symmetries and Time," 2002, in *Quantum Theory and Symmetries*, ed. E. Kapuñcik and A. Horzela (New Jersey–London–Singapore–Hong Kong: World Scientific), 66–73.

_____. "Geometric Structure of The Big Bang," 2002, in *Extensions of Quantum Physics*, eds. A. Horzela and E. Kapuñcik (Montreal: Apeiron), 103–113

MAFFEO, S. "Giuseppe Lais," 2002, in *Dizionario Biografico degli Italiani* (Roma: Istituto dell'Enciclopedia Italiana), in press

MINNITI, D., **REJKUBA, M.**, **FUNES, J. G.**, and **AKIYAMA, S.** "Optical Counterparts of X-Ray Point Sources Observed by CHANDRA in NGC5128: 23 New Globular Clusters", 2002, *ApJ*, submitted

O'DONOGHUE, A. A. "Mountain Skies," 2002, *Adirondack Magazine* (published by the Adirondack Mountain Club, Lake George, NY), March–April, July–August, and November–December

OMIZZOLO, A. "Astronomia," 2002, entry in *Dizionario Interdisciplinare di Scienza e Fede*, ed. Giuseppe Tanzella–Nitti and Alberto Strumia, (Vatican City: Urbaniana University Press, Città Nuova), I, 121–131

_____. ed., *Origini: Atti dei Seminari, Università di Padova*, 2002 (Padua: SARGON Editrice)

ROCHETTE, P., **SAGNOTTI, L.**, **CHEVRIER, V.**, **CONSOLMAGNO, G.**, **DENISE, M.**, **FOLCO, L.**, **OSETE, M.**, and **PESONEN, L.** "Magnetic Classification of Meteorites and Asteroid Probing," 2002, *Lunar Planet. Sci.* XXXIII, 1117

ROCHETTE, P., **SAGNOTTI, L.**, **BOUROT–DENISE, M.**, **CONSOLMAGNO, G.**, **FOLCO, L.**, **GATTACCECA, J.**, **OSETE, M.**, and **PESONEN, L.** "Magnetic Classification of Stony Meteorites: 1. Ordinary Chondrites," 2003, *Meteorit. Planet. Sci.*, in press

RUSSELL, S. S., **CONSOLMAGNO**, G. J., and JEFFRIES, T. E. "Rare Earth Element Distributions in Lunar Meteorites: Clues to Their History," 2002, *Meteorit. Planet. Sci.* 37, A124

SMRIGLIO, F., DASGUPTA, A. K., and **BOYLE**, R. P. "CCD Photometry in the Vilnius System in the Vicinity of the Globular Cluster M 56," 2002, *A&A*, 388, 149

STOEGER, W. R. "Report on the Theology and Natural Sciences Group Session: God After Darwin, Doing Theology in Light of Evolution," 2001, Proceedings of the 56th Annual Convention of the Catholic Theological Society of America, ed. R. C. Sparks, 162–163

_____. "Developments in Contemporary Cosmology: The Challenges and Opportunities to Religion," 2002, in *Contemporary Science and Religion in Dialogue: Challenges and Opportunities*, ed. J. Kozhamthadam, (Jnana–Deepa Vidyapeeth, Pune, India: ASSR Publications), 46–97

_____. "Science, the Laws of Nature and Divine Action," 2002, in *Interdisciplinary Perspectives on Cosmology and Biological Evolution*, ed. H. D. Regan and M. W. Worthing (Adelaide, Australia: Australian Theological Forum), 117–127

_____. "Cosmology and Theology of Creation," in 2002, in *Interdisciplinary Perspectives on Cosmology and Biological Evolution*, ed. H. D. Regan and M. W. Worthing (Adelaide, Australia: Australian Theological Forum), 128–145

_____. "Cosmologia," 2002, entry in *Dizionario Interdisciplinare di Scienza e Fede*, ed. Giuseppe Tanzella–Nitti and Alberto Strumia (Vatican City: Urbaniana University Press, Città Nuova), I, 285–299

_____. *As Leis da Natureza: Conhecimento humano e ação divina*, 2002, translation into Portuguese of *The Laws of Nature, the Range of Human Knowledge and Divine Action* [Tarnów, Poland: Biblos, 1996], (São Paulo, Brazil: Paulinas) 153 pp

_____. "Reflections on the Interaction of My Knowledge of Cosmology and My Christian Belief," 2002, *CTNS Bulletin*, 22.1, 9–18

_____. "Cosmology: VI Modern History of Science," entry in the new edition of *Religion im Geschichte und Gegenwart*, ed. H. D. Betz, et al. (J. C. B. Mohr [Paul Siebeck] Publishing House), to be published

_____. "Age of the Universe," "Eschatology," "Field Theory," "Grand Unified Theory," "New Physics," "String Theory," "Superstrings," and "Thermodynamics, Second Law of," entries in *Encyclopedia of Science and Religion*, Editor in Chief: J. Wenzel Vrede van Huyssteen (Macmillan Reference USA), in press

_____. "What is 'the Universe' Which Cosmology Studies," in *Ian Barbour Festschrift Volume*, in press

_____. Book review of *At Home in the Universe* by David Toolan, 2002, *Spiritus*, 2, 1 (Spring), 119–123

_____. Book Review of *Seeing Double: Shared Identities in Physics, Philosophy and Literature* by Peter Pesic (Cambridge, MA, The MIT Press, 2002), *The Journal of Religion*, to be published

STRAIT, M. M. and **CONSOLMAGNO**, G. J. "Microcrack Porosity in the L/LL Meteorite Knyahinya: How Homogeneous?" 2002, *Lunar Planet. Sci.* XXXIII, 1711

_____. "The Nature and Origin of Meteorite Porosity: Evidence From Thin Section Analysis," *Meteorit. Planet. Sci.* 37, A137

STRAIZYS, V., **CORBALLY**, C. J., KAZLAUSKAS, A., and CERNIS, K. "A Comparison of Photometric and Spectral Classification of Some Stars in Perseus," 2002, *Baltic Astronomy*, 11, 261

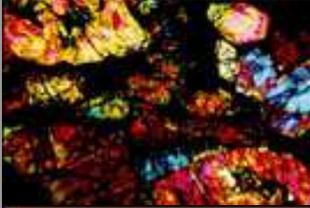
TERES, G., *The Bible and Astronomy*, 2002, Third Revised and Enlarged Edition (Oslo: Solum Forlag)

UGLESICH, R., CROTTS, A. P. S., BALTZ, E., DEJONG, J., TOMANEY, A., **BOYLE**, R., **CORBALLY**, C., and GOULD, A. "Evidence for Halo Microlensing in M 31," 2002, *BAAS*, 34, No. 4

UPGREN, A. R., SPERAUSKAS, J., and **BOYLE**, R. P. "Space Motions of Low-Mass Stars. III.," 2002, *Baltic Astron.*, 11, 91

YOUNG, A., RUDNICK, L., KATZ-STONE, D. M., and **O'DONOGHUE**, A. A. "Electron Population Aging Models for Wide-Angle Tails," 2002, *New Astronomy Reviews*, 46, 105-107

ZDANAVICIUS, J., STRAIZYS, V., and **CORBALLY**, C. J. "Interstellar Extinction Law Near the Galactic Equator Along the Camelopardalis, Perseus and Cassiopeia Border," 2002, *A&A* 392, 295



Observatory Visitors

Cover

Observatory Visitors

The Observatory at Castel Gandolfo was happy to receive the visit on 3 October of His Eminence Joseph Cardinal Ratzinger and the members of the International Theological Commission.

The Vatican Observatory at Castel Gandolfo and the Vatican Observatory Research Group in Tucson, Arizona, hosted a number of visitors during the year. Noteworthy were the number of school groups and cultural groups received by MAFFEO, assisted by KOCH and BUONVINO, at Castel Gandolfo.

The following individuals paid working visits to the Observatory:

JEAN-EUDES ARLOT, Institute for Celestial Mechanics, Paris, France

MIGUEL CHAVEZ, Instituto Nacional de Astrofisica, Optica y Electronica, Puebla, Mexico

AJOY K. DASGUPTA, South Glamorgan Education Department, Cardiff, UK

ELIZABETH GRIFFIN, Oxford University, England

ROBERT GARRISON, University of Toronto, Canada

RICHARD GRAY, Appalachian State University, USA

ROBERT JANUSZ, S.J., Krakow, Poland

ALGIS KAZLAUSKAS, Institute of Theoretical Physics and Astronomy, Vilnius, Lithuania

VYGANDAS LAUGALYS, Institute of Theoretical Physics and Astronomy, Vilnius, Lithuania

A. G. DAVIS PHILIP, Union College and Institute for Space Observations, Schenectady, NY, USA

WILLIAM THUILLOT, Institute for Celestial Mechanics, Paris, France

FRANK YOUNGER, Dominion Astrophysical Observatory, Victoria, Canada

Among other professional guests at either Castel Gandolfo or Tucson during the year were:

CRISTIANO BATALLI-COSMOVICI, Istituto di Fisica dello Spazio Interplanetario, CNR, Rome;
FRANCESCO BERTOLA, Department of Astronomy, University of Padua; FRED CHAFEE, W. M. Keck Observatories, Kamuela, Hawaii; ENRICO CORSINI, Department of Astronomy, University of Padua; DALE CRUIKSHANK, NASA Ames Research Center, California; SIMON MITTON, Cambridge University, UK; PIERRE ROCHETTE, European Center for Research and Teaching in Geoscience and the Environment, Aix en Provence, France; FILIPPO SMRIGLIO, Department of Physics, University of Rome; MELISSA STRAIT, Alma College, Michigan; FRED VRBA, U.S. Naval Observatory, Flagstaff, Arizona.

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