



VATICAN OBSERVATORY
FOUNDATION

2016 ANNUAL REPORT OF GIVING



President's Report

If there is one major frustration I have felt as president of the Vatican Observatory Foundation, it comes from the number of times I hear people tell me, "I didn't know the Vatican had an observatory!" Our mission for the past 125 years, given to us from Pope Leo XIII, is to show the world how the Church supports science. Every time I hear that people don't even know we exist, I am reminded of just how much more work we have to do to "show the world."

Members of the Observatory give hundreds of talks, interviews, and other presentations to the general public every year. There aren't enough members of staff, or hours in the day, to do much more! But we can extend our reach in two important ways.

The first is to harness the power of the Internet. We are now giving more and more talks to schools and parishes remotely, using Skype. That allows us to talk from wherever we happen to be in the world. For example, I had a delightful hour with a parish in Illinois last November, even though I was still in Rome, just returned from the Jesuit General Congregation where we had elected our great friend Fr. Arturo Sosa to be the new Father General of the Jesuits.

We are producing a number of short faith-and-science videos in cooperation with Loyola Productions to be placed on line. Some of them are already available on our YouTube channel (search for "YouTube Vatican Observatory Foundation channel") with more to be posted as they are completed.

Our biggest internet presence is still under construction. Funded by a grant from the Templeton Foundation, we have spent much of 2016 preparing a massive online resource for Catholic educators and educated Catholics on Faith and Science, which will have links to hundreds of articles, videos, and books dealing with the wide range of topics that come up, from the history of the Church and science (especially Galileo) to modern theological speculations in light of current science about cosmology... and aliens! Stay tuned for more details as we go live in 2017.

Many of those articles are taken from our blog site, The Catholic Astronomer, which is now reaching upwards of



The Six Elected Brothers in Rome

10,000 visits a week. With new writers Deirdre Kelleghan and Chris Graney we are now covering topics from astronomy outreach to astronomy history, making our astronomy blog "catholic" in more ways than one!

These developments lead me to the other way that we can extend our reach. Notice that the blog, the web site, the videos are all products of folks who are not Vatican Observatory astronomers but friends. (Yes, we pay for their services... but they put their heart into this work because they are our friends.) We rely heavily on our friends to help us do our work.

I mentioned above the Jesuit General Congregation. That occurred in Rome in October and November, and as an elected delegate (one of six brothers) I spent nearly two months praying and working with 200 other Jesuits from around the world to elect a new Father General and outline the path where we hope he will lead us over the next decade or two. It was intense... at times as spiritual as a retreat, at times as enervating as a faculty meeting. But it also reminded me of the power of people working together to accomplish what no person alone can do.

We have an essential mission at the Vatican Observatory. We live in a time when some people want to dispute the very existence of Truth. Both science and religion are under attack for insisting that truth does exist. Only with your help, as members of a Foundation supporting both true religion and true science, can our mission succeed. That mission, ultimately, is to give glory to the One who is the Way, the Truth, and the Life.

Br. Guy Consolmagno
President

Chairman's Report

As I write this we have just celebrated the feast of Epiphany. As described in the Gospel of Matthew the Magi follow a star that leads them to the Christ child. A joyful moment of discovery "while the morning stars sang together and all the sons of God shouted for joy." (Job 38:7) A journey of mind and spirit. A juxtaposition of science and religion.

The astronomers of the Vatican Observatory continue this journey as they apply human reason to pierce the veil of God's infinite creation. In 2016 gravitational waves, predicted 100 years prior by the mind of Albert Einstein, were discovered. Closer to home Vatican Observatory scientists made important discoveries and earned international awards. Fr. David Brown, whose research focuses on stellar evolution, has completed computer simulations of subdwarf B type stars that sheds light on what our Sun may evolve to in 5 billion years. Fr. Richard D'Souza, who just received his PhD in April 2016, has shown that there is more stellar mass in galaxies than previously thought providing new insights into how galaxies in the universe grow through accretion and mergers with smaller galaxies. Fr. Richard Boyle, whose research focuses on stars and asteroids, was honored by his collaborators who named asteroid 302849 "Richardboyle".

The Vatican Observatory is one of the few institutions in the world where science and religion meet in constructive dialogue. I found myself in awe of the work of the Vatican Observatory when I first learned of the group fifteen years ago. The study of the universe by men of faith is fascinating on multiple levels, and I am honored to help guide the non-profit Vatican Observatory Foundation.

The Vatican Observatory Foundation was established in 1987 by Pope John Paul II to fund construction of the Vatican Advanced Technology Telescope to conduct leading edge research as well as to support education. Our mission remains the same today and is all the more relevant in a time when many misleadingly assert that religion and science are incompatible. In my view, the Vatican Observatory Foundation is a fascinating partnership between the Catholic Church, dedicated scientists, and benefactors like you who welcome the pursuit of knowledge and understand that the Heavens proclaim the Glory of the Creator.

In 2016 the Vatican Observatory achieved unique milestones in outreach to lovers of wisdom, young and old. Our Catholic Astronomer blog traffic grew 65% resulting in over 99,000 views for the year. The number of "Likes" on our Facebook page increased 30% to nearly 2700. Please share this page with your friends and see if we can get 5000 likes in 2017. On behalf of the Board of Directors, I offer my profound gratitude to all who support the Vatican Observatory Foundation. Your support is paramount to the long-term viability of this vital endeavor. In these pages I hope you find insight, inspiration, and a sense of awe.

Rich Friedrich
Chairman

Our Mission

The Vatican Observatory has a double-edged mission: scientific research into the knowledge of the universe, including our place in it, and the education of the public based upon the knowledge derived from that research. These two driving forces of our mission are very much intertwined. In 1987, the Vatican Observatory Foundation was established as a tax-exempt corporation to support this mission.

RESEARCH. In the early 1990s the marvels of technology and the commitment of a few visionary philanthropists made possible the creation of the Vatican Advanced Technology Telescope (VATT), which empowered scientists to look with more acute "eyes" into the universe. Today, the VATT continues to provide stunning access to the heavens for researchers from around the globe. Combined with other technologies and the continued commitment of Vatican Observatory scientists, our work is literally pushing the boundaries of what we know and how we know it. Joining in this research are many students of astronomy from around the world.

EDUCATION. Each year members of the Observatory staff share their expertise by making educational presentations on the average to over 5,000 persons from 90 educational, religious, and academic groups. In recent times Vatican Observatory scientists have played an increasingly important role in the dialogue between science and faith.

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The VOF has made every effort to ensure that all information is correct. If any errors or omissions are noted, we offer our apologies and ask that you notify us.

2016 Circles of Giving Awards

For decades, each year the Vatican Observatory Foundation has been honoring those individuals and organizations whose generosity has attained a certain level of life-time support. This public recognition is but a small token of our profound gratitude and appreciation. Our many thanks and prayers go to all those who support our mission but especially to these being honored this year.

Each Circle of Giving is named in honor of one of the exceptional individuals connected with Astronomy, the Society of Jesus and the Vatican Observatory.

The Eusebio Kino Circle

Fr. Eusebio Kino, SJ, was the first Jesuit astronomer in the Arizona desert and a splendid example of the Jesuits extending their apostolic endeavors from the old to the new world. Unable to go to the missions in China, in the seventeenth century he came to Sonora, the region which today comprises Northwestern Mexico and Southwestern United States.

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The Christoph Clavius Circle

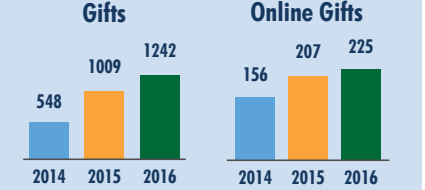
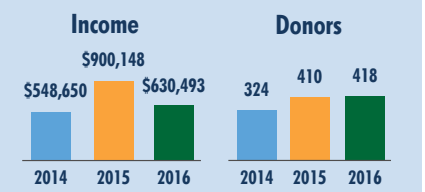
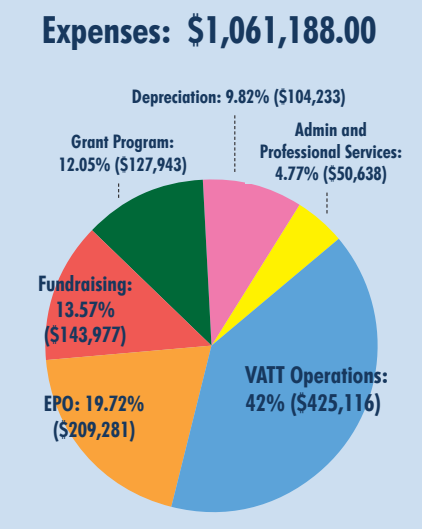
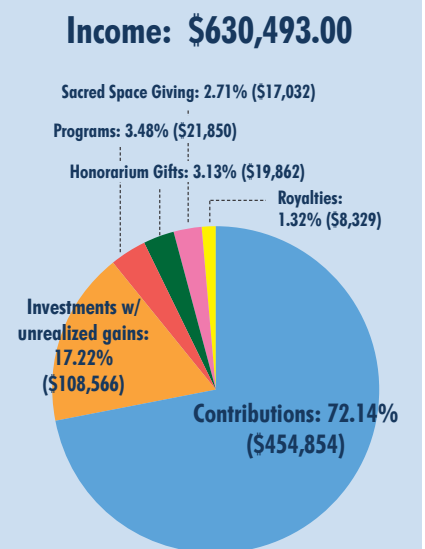
Fr. Christoph Clavius, SJ, was a mathematician, confident of Galileo, and a major figure in the reform of the calendar. He suffered the tensions of his day between old world views and the challenges of such as Galileo. Facing them as a scientist, he confirmed Galileo's telescopic observations and established a tradition of true scholarship which contributed to the spirit embodied in the founding of the Vatican Observatory.

Karen Gardner Mary Louise Jackowicz Ken and Karen Miller

The Georges Lemaitre Circle

Fr. Georges Lemaitre, a Belgian priest and cosmologist was one of the first to propose what has come to be known as the Big Bang. As president of the Pontifical Academy of Sciences, he had the very difficult task of trying to convince Pope Pius XII of the difference between scientific theories and religious creeds. With such figures as Hubble and Einstein, Lemaitre was a principal protagonist in the birth of modern cosmology.

Terry Seidler The Strake Foundation



The financial information above reflects pre-audit figures subject to adjustment



Development Report

In 2016 the VOF started the year in Phoenix with our Annual Seminar and the traditional Circles of Giving Dinner honoring several of our most loyal donors. The over 200 who attended the morning Seminar learned much from four brilliant experts about "Water in the Universe." This theme was a precursor to the discussions that would be held in June at the biennial Vatican Observatory Summer School in Castel Gandolfo. Later that day those at the dinner were fascinated by Dr. Jim Bell's presentation about his work with NASA's three Mars rovers.

The VOF outreach programs continued to thrive last year. The second Faith and Astronomy Workshop was held again in January at the inspiring Redemptorist Renewal Center outside Tucson. Here parish educators spent 4 days learning about astronomy and how it can enhance their faith.

Again, in 2016 several groups of high school students worked with Fr. Richard Boyle using VATT to create images of their favorite astronomical subjects. The students chose subjects with very specific criteria including size and the time frame and provided the precise coordinates. With the results from Fr. Boyle and VATT they composed some incredibly beautiful astrophotography.

Conversations on The Catholic Astronomer blog continue to increase with more weekly contributors and more interested readers joining in. If you haven't seen the site check it out at www.vofoundation.org/blog. There are fascinating articles about all kinds of things: falling into a black hole, art and astronomy, possible mud cracks on Mars, stars and the Bible, etc. Consider joining the conversation by subscribing to the monthly Sacred Space

What is an observatory? What's happening with our telescope?

The word "observatory" suggests a place where observations are carried out. The Vatican Observatory, like many other institutions, has this word in its name for historical reasons. The Observatory (the institution) operates an observatory (a facility). In addition, our staff astronomers have access to other observational infrastructure. The Vatican Advanced Technology Telescope (VATT) on Mt Graham in Southern Arizona has been our flagship facility since 1993. In order to return it to the forefront of astronomical technology, we have undertaken to robotize it in close collaboration with the University of Arizona, and create a new type of telescope network, the Arizona Robotic Telescope Network (ARTN), with the 61" Kuiper telescope on Mt Bigelow and the 90" Bok telescope on Kitt Peak.

University of Arizona's Mountain Operations team operates 18 telescopes, including VATT, and it is also building the ARTN. Looking back, 2016 was a challenging year. First, in June, VATT's Chief Engineer announced his departure, effective on September 30. He became the Chief Engineer of the 6.5-m Monolithic Mirror Telescope on Mt. Hopkins. And on October 20, Bob Peterson, the head of Mountain Operations, died at his desk in his office at Steward Observatory.

The situation, although thrust upon us unexpectedly and in tragic circumstances, became an opportunity to rethink the team structure, our needs and the available assets. Buell Jannuzi, Director of Steward Observatory, Jeff Kingsley, Associate Director, and I undertook this work, redrafting job descriptions to distinguish between operation and upgrades.

Several minor and one major corrective maintenance operations were performed this year. The latter concerned the secondary mirror's support and positioning system. Its failure illustrated the need for VATT's overhaul. We had planned replacing the secondary-mirror system but the incident came too early, before we were ready for the planned replacement, forcing us to use our team's limited resources towards repairing the old system.

A very promising development concerns the commissioning of the Potsdam Echelle Polarimetric and Spectrographic Instrument (PEPSI). In the Fall 2014 Newsletter we explained that the search for planets orbiting other stars than our Sun (exoplanets) requires sensitive and stable spectrographs, capable of measuring the Doppler shift corresponding to the back-and-forth "star wobble" in reaction to the exoplanet's motion. PEPSI is fed light from VATT through a 500-m optical fiber. Our collaborators from the Astrophysics Institute in Potsdam, Germany, who built PEPSI, have reached an exciting milestone in 2016, demonstrating that the spectrograph is capable of radial velocity measurements down to 1 m/s. This level of instrument stability is only available at a handful of facilities round the world, and may allow to measure such systems as the Proxima Centauri. We have started discussing a col-

laboration with NASA's Transiting Exoplanet Survey Satellite (TESS) mission.

Telescopes are a part of the research projects past, present and future. Today most telescopes are built for specific research projects. Other telescopes are legacy of past projects, and they can be adapted for new projects. An Observatory as a research institute is not defined by the observing facilities available to its astronomers. The key are people and their collaboration with colleagues near and far.

Paul Gabor, S.J., Ph.D.
Vice Director, Vatican Observatory

Vatican Observatory Colleagues Remember Dr. Vera Rubin

Dr. Vera Rubin died on Christmas Day in Princeton. She was a longtime staff astronomer at the Carnegie Institution, married to a mathematician and chemist and mother of four children all doctoral level scientists.

Fr. Chris Corbally writes, "*what a remarkable and delightful person Vera was, especially for us at the Vatican Observatory! I came to know her and her husband Bob during the first Vatican Observatory Summer School on 1986. The VOSS was the brainchild of Fr. Martin McCarthy, a staff member of the observatory from 1958 to 1999, and it was initiated with the help of the then director, Fr. George Coyne. Both Martin and George knew Vera well from Georgetown University days. They knew of her passion for science, her doggedness in pursuing the observations to verify the existence of dark matter and her determination to provide opportunities for women in science.*"

Dr. Rubin was an examiner on Fr. George Coyne's Ph.D. dissertation oral exam at the Georgetown College Observatory. Fr. Coyne agrees with Fr. Corbally when he refers to Vera's "passion for science." He says, "*True, indeed, but her passion showed itself primarily in her passion for people: students, colleagues, friends, and, above all, family. Some years after the first summer school, to which Chris has referred, we hosted Vera and her husband Bob for several weeks of quiet research at the Vatican Observatory at Castel Gandolfo. Since several of the Observatory telescopes are located in the adjoining papal gardens, I, as director, had access to the gardens and welcomed Vera and Bob to take walks there, advising them to always wear their identity badges. One day I received a report from the garden authorities that a young couple had been seen holding hands while strolling in the gardens and that they had been identified as guests of the Observatory. Holding hands in the papal gardens! I dutifully responded that I would check into the matter. Vera and Bob assured me that they were wearing their badges. I asked no more. I estimate that this "young couple" were about 35 years married at that time and had seen four children through graduate studies in the sciences, including their daughter, Judy, an astronomer. Amazing what passion and holding hands will do!*"

Read more about Dr. Rubin on The Catholic Astronomer blog.

Giving program, an easy way to support our mission and keep informed.

Several new videos were completed during the year and posted on our YouTube channel. Watch the one about Galileo with Fr. Mueller and Dr. Graney or listen to Fr. Kurzynski talk about Georges Lemaitre, the Father of the Big Bang. During the year, the groundwork was created for our Faith and Science website. This site will soon go live and provide a digital library of a variety of resources in various formats for educators and the general public.

The technological advances being implemented at the VATT will assure years of excellent scientific research. None of this would be possible without the generosity of our friends. With so many believing in our mission 2016 was a very good year and with the advances on the telescope and the outreach programs the Vatican Observatory Foundation will continue to have clear skies. Thank you!

Katie Bannan Steinke
Development Director

Remembering Bob Peterson



Bob Peterson, head of Mountain Operations, passed away this fall. Among many other responsibilities he had been actively involved with the VATT for

decades, from selecting the site on Mt. Graham to making sure the telescope was always safe and its mirrors in perfect condition.



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INSIDE ✦ **Annual Report 2016** ✦ *excelling in faith, education, and research*

View from the Roof of the Apostolic Palace, Castel Gandolfo



✦ **SAVE THE DATE** ✦
2017 Annual Seminar

Palmer Commons • University of Michigan
Saturday, October 14
9:00 a.m. - Noon

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