Glorious Are the Works of the Lord: Studying the Heavens

Warren Rubel Lecture in Christianity and Higher Learning, by Bruce J. Hrivnak 15 February 2001
(Delivered to the faculty and students of Christ College, Valparaiso University)

Introduction

It is an honor and a pleasure to be here with you this evening. It was with mixed emotions that I agreed to speak on the topic of “Christianity and Higher Learning.” In addition to the honor of the invitation, I felt daunted by the task, for I have never given such a lecture. I also felt humbled by the selection (do they really want me!) and excited by the opportunity that it would enforce upon me to reflect further on this topic which I consider to be central to my work here at Valparaiso University. I am glad to be here.

The Psalmist writes, “The heavens declare the glory of God, the skies proclaim the work of his hands. Day after day they pour forth speech, night after night they display knowledge. There is no speech or language where their voice is not heard. Their voice goes out to the ends of the world” (Ps 19:1-4a).1

However, one might think it to be just the opposite, that those who spend the most time studying the heavens and nature appear least inclined to be religious. There is a perception that a person who is a scientist lives according to logic, data, and a detached objectivity, and that in contrast a person who is religious lives by faith, feelings, and a personal subjectivity. Facts versus faith. This idea of science and religion as two divergent approaches to life in this world is pretty pervasive. I find that people are often surprised to find out that I am both a scientist and a Christian.

Science has answered so many questions about our world and with more time, it may seem that it will answer almost all. In the past, things that mankind attributed to God we now attribute to gravity, germs, plate tectonics, etc. Science, due to its technological prowess and benefits, has risen in prestige. As science has increased our knowledge, it appears that God has been pushed to the edges or completely out of the picture.

How has the Christian church responded? It has responded in a variety of ways but often defensively. In an effort to uphold the supernatural teachings of the Bible, including miracles, the incarnation of God in Jesus, his virgin birth, and the bodily resurrection of Jesus, the church has often responded by emphasizing the importance of faith and by being suspicious of science. Scientists are often cast as atheists with a hidden agenda to disrupt belief in God and turn young people from the faith of their fathers and mothers. While this contrast may not be the experience of all, it is still a common strain. Controversy over the teaching of biological evolution and “creation science,” and evidence regarding the “big bang” beginning for the cosmos appear from time to time in the popular news. At least in the area of origins there seems to be a “warfare” between science and religion. Before examining this more, let me tell you some things about my own particular background, and then go on to interweave my reflections on science and the Christian faith with my own life story.

My Beginnings as a Christian and Scientist

My development as a Christian and as a scientist initially followed two separate paths. I grew up attending church regularly, learning Bible stories and God’s commandments. I thought of God as distant. I remember a vivid sense of God as a judge with a balance scale. I was basically a good kid, and would feel on some days that my good actions and thoughts outweighed the bad; however, that was not always the case, and who knew what tomorrow might bring. What if on the judgement day the scales were tipped against me? I had a clear sense of God’s righteous law.
My coming to understand and embrace the gospel, God’s good news, was strongly influenced by my mother. I remember as a boy in elementary school that she began reading the Bible regularly, attended Christian meetings, and took my brother and me with her to a small chapel on Sunday evenings. I could see some changes occurring in my mother’s life. It appeared that she was able to show love beyond the call of duty in the midst of some challenging situations. This I attributed to God’s work in her life.

What I heard at this time also made sense. I learned several things that the Bible teaches. First that no one is good enough to please God. We all fall short. The Bible says that “all have sinned and fall short of the glory of God,” and that “the wages of sin is death” (Rom. 3:23, 6:23). Then, that God provided the solution. He sent His son who was righteous. Furthermore, that through faith in Jesus we are saved, on the basis of his righteous life and his substitutionary death. “God made him who had no sin to be sin for us, that we might become the righteousness of God” (II Cor. 5:21). Finally that we can have assurance of this salvation. “I write these things to you who believe in the name of the Son of God so that you may know that you have eternal life” (I Jn 5:13). What would earlier have seemed like arrogant presumption I now saw as a gracious gift.

This was good news to me! It meant that there was a way for me to be right with God, in spite of the fact that I personally could not live up to his standards or even my own. It was as I was beginning junior high school that I made a faith commitment to God, trusting in what Jesus did to atone for my sins before a holy and loving God. I came to see God as my heavenly Father who personally cared for me. Not only did this remove fear of judgement and lead to trust in God, but it gave me a growing sense of purpose for my life. I also saw God working in my life to help me begin to be less self-centered and more loving, although these are areas in which I continue to need growth.

In the meantime, I found that I was good in math and was interested in science. I was a serious student and loved to read. My parents, both immigrants from Czechoslovakia, worked hard and had a very strong desire that their children graduate from college. The manned space program was just getting started at this time. A career as an astronaut was appealing, but the need for glasses and motion sickness on carnival rides clearly disqualified me! Nevertheless, space had an appeal for me as it did for many others, and my high school yearbook lists my career goal as “physicist.”

Looking back, I see what a private Christian life I lived in high school and on into college. I had a discipline of Bible reading and praying, and desired to do what was right. However, I did not have Christian friendships and did not get involved in Christian activities outside of attending church on Sunday. My faith was a private compartment in my life.

During my junior high school and high school days, my family joined a growing Baptist church that I would classify as evangelical and somewhat fundamentalist. From this church background, I came to several impressions as I went away to college. One was that young people who were committed Christians went to Bible college in order to go on the mission field or to become a pastor, a “full-time” Christian worker. (I did not feel that committed and probably wasn’t at that time.) Another was that in going to a major secular university one would be very open to attacks on one’s faith and to the ridicule of atheistic professors, and that not “losing the faith” would be a real challenge. (I think that there is some truth to that, and in fact I saw some evidence of that in my first-year philosophy class.) I also sensed that in the church there existed both a suspicion of science and a high regard for science. A deep suspicion of science because it ignored God and often came to conclusions seemingly contrary to the Bible, particularly epitomized by the theory of evolution of man from lower life forms. On the other hand, the prestige of science was valued. If some scientific discovery seemed to be harmonious with the Bible (or rather let me say with an interpretation of the Bible), it was noted in a bulletin insert or a sermon illustration as being consistent with or even "confirming" the Bible. The fact that science had not yet found the bottom of the ocean was highlighted when Micah 7:19 was read, “You will again have compassion on us; you will tread our sins underfoot and hurl all our iniquities into the depths of the sea.” I found such references to science distracting (I didn’t think that the forgiveness of my sins depended upon the bottom of the ocean remaining beyond discovery) and sometimes distressing. I wondered how I would be regarded as a scientist in the church.
I don’t want to imply that this was the background of every young person growing up in a conservative church in the 1960’s with an interest in science. On the other hand, I don’t think that this was simply my perception or only the way things were in my church. There clearly was a deep-rooted suspicion of science and the universities in many conservative churches, and in some cases this may have been well-founded. This can lead one to wonder if it had always been the case that the church and science were in opposition.

Christianity and Science: A Look at the Historic Background

How did we arrive at the situation of opposition or even warfare between science and religion? It may be surprising to some to learn that many of the founders of modern science were deeply religious men and committed Christians. Names of these include Johannes Kepler (who determined the shape of the orbits that the planets follow around the sun), Galileo (who first turned the newly invented telescope towards the heavens to study them), Isaac Newton (the brilliant physicist who among other things formulated the basic laws of motion and gravity), Michael Faraday (the great experimenter in electricity), and James Clerk Maxwell (who formulated the laws relating electricity and magnetism). Listen to the following words: “I give you thanks, Creator and God, that you have given me this joy in thy creation, and I rejoice in the works of your hands. See I have now completed the work to which I was called. In it I have used all the talents you have lent to my spirit.” This was written by Kepler in one of his notebooks.2

Modern science and the scientific method of systematic inquiry arose in Western Europe. Some historians say that it was Christianity that provided a foundation for modern science with its belief in one God with a definite character, which meant that the universe was an orderly and knowable place. 3 From the Bible one can derive a worldview that nature is both real (not an illusion) and has value since it was created by God and thus is worthy of study. The Creation is good, the material world is not evil. As an outcome of the Protestant Reformation and its doctrine of the “priesthood of all believers,” the teaching arose that not just religious but all lawful secular vocations can be callings from God. 3 A majority of the initial members of the Royal Society of London, one of the first scientific societies, were Puritans, 4 who saw the study of nature as a way of glorifying God. I list the names above not to imply that we should believe what they believed because they were important people or scientific heroes, but rather to show that scientific study and Christian faith were quite compatible and even mutually encouraging.

Even the situation with Galileo, which is often cast as a proto-typical case of the church opposing science, turns out to be more complicated than that upon further inquiry. Apparently Galileo had many enemies among those at the universities who staunchly supported the Aristotelian views he attacked. Also Galileo’s personality seemed to antagonize others and in controversy his attacks were biting. Envy of his rising status may also have been involved. The point to be made is that the trial and condemnation of Galileo made by the Catholic church was more complex than simply the case of the church seeking to maintain its authority and so restraining scientific inquiry. 5

With this background, why is the situation so different today? Several factors appear to have been at work during the 18th and 19th centuries. These include rationalism, anti-traditionalism, the “God of the gaps” view of God which invokes God to explain the gaps in our knowledge, the efforts in some circles to remove the supernatural from the Bible, Darwinian evolution and the ensuing controversies, and an increasingly naturalistic viewpoint. All of these appear to have been factors and have been written about. 6 Apparently some, among whom was Thomas Huxley at the end of the 19th century, consciously wanted to overthrow the cultural dominance of Christianity, to replace a “Christian worldview with scientific materialism.” 3 The warfare image was initially spread primarily by opponents of Christianity such as Andrew D. White, the president of Cornell, who wrote A History of the Warfare of Science with
Theology (1896) that helped to lead to the popular impression of a past and lasting opposition. However, as we have seen, such opposition was not the case.

In the second quarter of the 20th century, as conservative Christians saw themselves as a minority within or as separatists from many of the major church denominations, a fortress mentality seems to have set in. Modernism and liberalism in theology and naturalism in science seemed to be carrying the day. A tightly defined circle of orthodoxy was established, one which often included a commitment to a literal interpretation of the Bible. The public fallout of the Scopes trial (1925) concerning the teaching of evolution in public schools further put conservative Christians on the defensive. Committed to the belief that true science, which dealt with facts, was not in contradiction to the Bible, they concluded that scientific ideas which seemed to contradict the Bible must be false or biased science.\(^7\) This led to a retreat from the scientific laboratories and in many cases from engagement in the world and instead led to Bible colleges and the study of the Bible and practical skills. In some cases, anti-intellectualism arose, if not in principle, at least in practice. Of course, this exacerbated the problem, for this resulted in fewer Christians in science and fewer Christian role models for students.\(^6\)

I realize that this is not true of all traditions, but as I look back, this is my broad-stroke interpretation of the background out of which I went off to college.

My Time in College and Some Changing Views

I majored in Physics as an undergraduate at the University of Pennsylvania, and kept busy with studies and running on the track team. I continued in my life as a private Christian, reading the Bible and attending a local church for an hour on Sunday, but with very little Christian engagement beyond that. Each semester in college, I'd plan to get more involved with Penn’s InterVarsity Christian Fellowship (IVCF), believing group Bible study and Christian fellowship were good things to do. However, I actually participated little because it was not a high priority among the several things competing for my time.

During my last semester as an undergraduate, however, several things happened to cause some changes. I attended a large Christian conference over Christmas break at the University of Illinois, sponsored by IVCF. I was encouraged and challenged to see a basketball arena filled with 16,000 fellow college students who were serious about living a Christian life. Over spring break I went to a smaller Christian student conference featuring Francis Schaeffer, a Christian apologist who encouraged Christians to engage the world. I realized that I tended to confine my faith internally and did not have confidence that it fit with the real world. Reading the works of Schaeffer, such as the God who is there,\(^8\) gave me confidence to face the world as a Christian with the sense that all truth was God's truth: a Christian worldview would really fit with the real world that God made, and in fact was the only one that would. One can get the idea, with all of the various philosophies that have arisen in the world, that Christianity had been tried and found wanting and that these others fit better with the real world. But I came to see that these different worldviews developed from the presuppositions and choices that people made as to how they would respond to life in this fallen world. The idea that the teachings of the Bible and a Christian worldview actually made sense of the world was exciting and liberating for me. Related to this, that same spring, I felt particularly challenged to trust God more in all of my life. Inwardly I had a personal, private faith that God cared for me. Way out there, I believed that God had created the stars, but my life and faith was compartmentalized. In terms of my day-to-day life, how I spent my time and set priorities, I felt that I was struggling on my own. I sensed that I was leading a basically self-centered life, filtering things through the grid of what they would do for me. I didn’t feel good about this; this was not the way that I wanted to live the rest of my life. I wanted to live as an integrated, whole person. I remember sitting down on a street curb, reflecting on this and the illogical nature of believing that God was involved in the big picture of the universe out there, but feeling that I could not trust him for how I
find some of these transitional objects. We continued finding additional ones, a few dozen in total.

During the light from the star and then warm up and shine in the infrared. Such a quarter of the gas around it leaves, losing. The core of the star is then exposed, producing a huge shell of gas around the star and leaving in the center a hot core. This is called a planetary nebula, which, however, is a misnomer, since it is not related to planets. The gas shell eventually dissipates into space and the core cools to become a white dwarf. This is the cycle that we think stars like the sun go through.

The particular research I have been engaged in is studying the transition from the red giant, the large red star, to the planetary nebula, when one sees the glowing shell of gas around the hot core. What goes on in between? It turns out it’s a stage that’s been hard to study partly because it takes place rapidly, astronomically speaking, over a few thousand years, and partly because the star is often obscured by the gas and dust it is losing. The opportunity to study them arose in 1983 with the IRAS satellite. It orbited the earth with a telescope sensitive to infrared emission, and by surveying the entire sky, it found a quarter of a million sources. Infrared emission is given off by objects that are warm, not hot like stars such as the sun. This is what one would expect for stars surrounded by gas and dust, which would absorb the light from the star and then warm up and shine in the infrared.

When the IRAS data became available, I was at the University of Calgary in a postdoctoral position. It was fortunate timing that during the year before coming to Valparaiso, I had the opportunity to begin interacting with Dr. Sun Kwok, who had just joined the faculty at Calgary and who was already recognized as an expert in the study of planetary nebulae. We began collaborating on some research during that last year and have continued doing so for 17 years. The satellite data showed where in the sky these infrared sources were located. Using some of the largest telescopes in the world, located in Hawaii, we had the opportunity to look for these objects and to see whether the star in the center was visible. In many cases the star was completely obscured, but in some cases we could actually see the central star. We were quite excited when we found the first case of a bright star that corresponded to the infrared source. When we took the spectrum of it we saw indeed it was a red supergiant. Thus we had begun to find some of these transitional objects. We continued finding additional ones, a few dozen in total.

**My Research: Studying the Stars**

Along with my graduate studies I also did some teaching at Penn in their summer school and at nearby LaSalle College. I enjoyed teaching and seemed to do well at it. However, my thesis research was going slowly. At that time I could see myself enjoying a career as a college teacher. Success and enthusiasm in research came more slowly but have come to be an integral part of my professional life.

My early research as a graduate student and in the years immediately after that focussed on the basic properties of stars. These can be determined most accurately when they have a companion star. By studying the orbital and light variations of such binary stars, one can deduce the mass, size, and luminosity of each.

Stars, however, also change or evolve with time due to changes in their internal structures. Stars like the sun will expand and eventually become large red giant stars. Such stars can have the diameter of a hundred suns. After a period of stability, the star will again expand and begin to lose its outer layers. These then drift away, producing a huge shell of gas around the star and leaving in the center a hot core. This is called a planetary nebula, which, however, is a misnomer, since it is not related to planets. The gas shell eventually dissipates into space and the core cools to become a white dwarf. This is the cycle that we think stars like the sun go through.

Thus when I began my research as a graduate student I set out to study first the properties of the stars themselves and then to see how they are related to the properties of their companions. By studying these properties we can try to understand how stars are formed and what happens to them as they age.

As these things were coming together in my life, I graduated with a degree in Physics. I had applied to several graduate schools in Astronomy, and in God’s providence I stayed in Philadelphia and entered the Astronomy Department at the University of Pennsylvania. This turned out to be an exciting and challenging chapter in my life. I became an active part of a small church that had just been started by some recent seminary graduates who desired to minister to students and present a Christian witness to the campus community. Several of us were graduate students in the physical sciences and the pastor was a physics major as an undergraduate. I had found kindred souls. Lucy and I met and were married there. I consciously determined to set some priorities for my time and to not let my studies be the focus of my whole life as they had been as an undergraduate. It was a time of digging into the Bible and theology as a group and of seeking to consciously live in Christian community.

I was fortunate to start graduate school just as the field of planetary nebulae was becoming really active. The data was coming in from the Goddard Institute for Space Studies, and we had decided to collaborate with them in order to get a good set of data. We were able to do this and we were able to study the properties of the stars themselves and then to see how they are related to the properties of their companions. By studying these properties we can try to understand how stars are formed and what happens to them as they age.

I have been engaged in this research ever since. In fact, I have been working on this problem for over 20 years. During this time I have had the opportunity to travel to many different places around the world, meeting with other astronomers and physicists, to collaborate on our research. I have also had the opportunity to teach at several different universities, both here in the United States and abroad. I have enjoyed teaching and have found it to be a very rewarding experience. It has been my pleasure to share my knowledge and enthusiasm for the field of astronomy with others.

I have also had the opportunity to continue my research on the properties of stars and their companions. I have been able to make many useful contributions to the field, and I have been able to see my research being used by others in their own work. I have been fortunate to have had the opportunity to work with many excellent students and colleagues, and I have been grateful for the support and encouragement they have given me.

I have been fortunate to have had the opportunity to travel to many different places around the world, meeting with other astronomers and physicists, to collaborate on our research. I have also had the opportunity to teach at several different universities, both here in the United States and abroad. I have enjoyed teaching and have found it to be a very rewarding experience. It has been my pleasure to share my knowledge and enthusiasm for the field of astronomy with others.
At the same time, my colleagues at the University of Calgary began looking at some spectral data from the IRAS satellite. A large peak at 21 microns in the infrared spectrum indicated some new molecular feature that had not previously been studied or recognized here on the earth, arising from the gas and dust around the star. This was exciting and in a way got us going on a bit of a detective story. We initially found four such objects and later a dozen, and all the ones that showed the signature of this new chemistry in space were stars in the transitional phase between red giant and planetary nebula. Something in that stage or that environment caused this molecule to form. We found that a common trait in all the objects with the 21 micron emission feature was that they possess an unusually large abundance of carbon. After some more recent satellite data and a lot of work in laboratories, the source of this emission peak has likely been identified as titanium carbide around the star. However, that may not be the end of the story as there have more recently been some other suggested identifications. It has been exciting to participate in the discovery of some new molecules in space. This identification of titanium carbide could set limits on how titanium is formed in stars and so it gets us into the subject of nucleosynthesis and the formation of elements.

We are also interested in studying how the gas was ejected from the star. The red giant stars are spherical in shape, yet planetary nebula gas shells have a variety of shapes. Using the telescopes again in Hawaii we were able to take pictures of these objects, but they were just too small to see details of the shapes of the gas shells. However, that changed when we had the opportunity to use the Hubble Space Telescope. In Figure 1 are shown Hubble pictures taken of two objects from our study. From ground-based telescopes in Valparaiso we had been able to determine that each of them appeared not as a single point of light but as two blobs. With the Hubble much more detail is seen. They each appear to have bipolar lobes, with light scattered from the lobes toward us and with a dark lane across the middle. In addition we see some faint circular arcs. (Note that these are false color pictures, with the colors used to bring out enhancements in the bright regions.) In Figure 2 are displayed two more objects that we observed with the Hubble which again show a bipolar structure, but in this case one of them appears to be tilted toward us. We are finding that many of these transitional objects have a bipolar structure, so a theoretical model has been constructed assuming there must be a torus or donut-shaped region of dust around the central star which prohibits the light and gas from expanding in those directions. Thus the gas expands in opposite directions through the hole in the torus and scatters the light towards us producing such bipolar shapes. In one of our most recent Hubble images (Figure 3) we are able, for the first time, to directly see this obscuring torus. In two additional cases we have been able to discover surrounding circular arcs. These arcs are seen by light reflected from the gas. The presence of both circular arcs and bipolar lobes in the same objects suggests that the gas was initially ejected from the star in a spherical process, producing the circular arcs, and then later changed to produce gas moving off in opposite directions. We are presently investigating why this would occur.

I am also carrying out some research with students using the modest but modern facilities of the Valparaiso University Observatory to study how the brighter of these stars vary in light due to pulsation. This can tell us something about the internal structure of the stars.

This is only one small taste of what we have been learning about the cosmos. The stars that I have been studying are all found in our Milky Way Galaxy. As we move beyond our own galaxy, we find a universe consisting of galaxies each containing billions of stars. One of the special projects done with the Hubble Space Telescope was to focus the cameras for ten days on one region of the sky, taking hundreds of photographs that were then superimposed on one another to build up an image of the faint light. Each one of the objects in the resulting picture (Figure 4) is a galaxy, except for a few nearby foreground stars. There are 1,500 galaxies in the image. Now, just to put it in perspective, this picture has the angular size of a grain of sand held at arm’s length. This region was picked because it seemed to be an empty region in space. If we assume that it is typical of the whole universe, that implies that there are a total of 50 billion galaxies, each containing billion stars. Truly this is an awesome and beautiful universe!
My Life as a Christian and a Scientist

This glorious universe was created by God, and I consider it a privilege to be able to study it and teach others about it. One can ask what difference it makes to me as an astronomer that I have a Christian faith. Has it affected the kind of work I do or how I carry it out?

Has my faith affected my choice of research topics? No, not significantly. The Earth is the Lord’s and the heavens are his handiwork; thus they are all appropriate areas of study. (In principle, being a Christian could certainly affect the subject of one’s scholarly research – certain experiments on humans or animals would be inappropriate, and some areas have more immediate benefit or usefulness than others.) But I have basically carried out my research in areas of interest and opportunity. Perhaps I have been less enthusiastic than some in the search for extraterrestrial life. This is partly because I believe that life did not arise by random chance and partly because I don’t believe that the existence of extraterrestrial life is such an ultimate question. The question of whether we are alone in the universe has been answered by God.

Has my faith affected the way I carry out my scholarly work? Yes, I believe that it has. I have benefited recently from reading Mark Schwehn’s book *Exiles from Eden*¹¹ (and wish that I had read it earlier). I appreciated his illustration of several spiritual virtues that can influence the way one goes about his/her scholarly work. Here are some of these that elicited personal responses. *Humility*: being humble before other scholars and working to try to understand what they are saying. A more senior scholar can either take time for younger colleagues in his field and even learn from them, or he can simply dismiss their differing views out of laziness, busyness, or as a response to feeling threatened. *Self-denial*: not putting myself first. I have certain ideas, theories that I favor. It is not hard to promote these if I look primarily at supportive data and stress how it fits with my hypothesis, or if I look primarily at the weaknesses of competing theories, without acknowledging and dealing adequately with their strengths. It takes more effort to charitably and sincerely deal with the competing ideas of a colleague than to minimize or simply ignore them. Yet we can be tempted to do this, if not for self-promotion, at least as a response to the pressure of time and the desire to complete a project as soon as possible and have it published. In fact, after reading this section of Mark Schwehn’s book, I felt that I had to go back and do some more work on a paper I was preparing, to see that I was fair to another viewpoint. I want to “do unto others as [I] would have them do unto [me]” (Matt. 7:12). One can also consider *honesty and integrity*. Honesty is, of course, expected in reporting data and experimental results. It is an implicit assumption in scientific research. Being honest and presenting realistic expectations also comes into play in writing grant proposals.¹² Do I really expect to carry out all of the great research that I propose within the specified time period? I find that I struggle constantly with setting unrealistic expectations of what I will get done and then so often feeling the pressure of being behind schedule.

It is easy to get caught up in self-promotion and even to exaggerate the importance of a scholarly project. We hear it said “If you don’t promote your work, who will?” “If others don’t know about the good work that you’re doing, then you are less likely to get your research proposals approved and funded. And this affects not only you, but also support for your students and even the presentation of the university in a more favorable light.” So there is a balance here. I find that I need to be self-conscious about this so that I am fair and don’t get caught up in self-promotion. I also believe that it is important that I do *good work*. My summer research students each year hear me stress the importance of working diligently and carefully and doing the job right, and if we later find that we have not done this, then going back and carefully correcting our work. For me, this follows because it is the Lord whom I serve and his handiwork that I am describing. This means working whole-heartedly and carefully.

As a teacher, my faith motivates me to deal with students as whole people, who feel the ups and downs of life in a fallen world. I set high standards for them, because I want them to learn about the cosmos and also to learn to think carefully and critically. God made a very interesting world and he gave
us the ability to inquire into it. I particularly encourage students to work at integrating their learning with their religious beliefs. In the astronomy survey course, the question of origins comes up as we discuss the history of the earth and cosmology. Almost all Valparaiso University students have some religious beliefs and most come from a background of Christianity. As an assignment near the end of the semester in Astronomy 101, I present the students with three basic approaches on how the biblical language on origins can be understood. Please realize that this is oversimplified, but I think that it is representative. One is a literal approach, which considers the biblical discussion of origins and especially Genesis chapters 1 and 2 as being literal. This is the approach taken by “young-earth creationists,” who interpret the six creation days in Genesis as consecutive 24-hour days and conclude that the Earth is young, a few thousand years old. On the other side is the figurative interpretation, in which the different genres of writing found in the bible are noted and the creation account in Genesis is interpreted figuratively. A third approach is to see a harmony between the creation accounts in the Bible and the findings of science. All three views start with the basic idea that God is the creator. The figurative view avoids conflict with science by assuming that the Bible does not make scientific statements. The literal view believes that the Bible does make scientific statements and that the scientific evidence for billions of year ages for the Earth and stars and the evidence for evolution in the cosmos is simply wrong. The harmony view advocates a correspondence between the description and the order of creation in the Bible and the modern scientific picture. In this view, for example, God’s initial creation of light corresponds to the big bang. My goal is not to persuade students to one particular view, but to have them read and discuss the various views in order to see how others approach these questions. I desire for them to begin to integrate rather than to compartmentalize their faith and learning. Some of them are doing this. I am glad to be at a place like Valparaiso where encouraging such examination and integration is not seen as out of place but rather encouraged.

In two particular areas, I confess, I feel like I walk a bit of a tightrope regarding my work as a scientist and my Christian commitment.

I have encountered many devoted Christians who believe that the Bible teaches that God made the sun and stars just like they are within six 24-hour days not long ago. They have been taught to believe that is what the Bible teaches and that any other view is unbiblical and simply an accommodation to modern science. This view can even be made a test of Christian orthodoxy. I have usually avoided being controversial on this issue. I have been content to talk one-on-one with people to express my opinion that the evidence of nature does not support the view that the Earth and the cosmos are only thousands of years old; rather they appear to be billions of years old and shows evidence of change by processes in nature. Of course, that in itself does not settle the issue, for I do not wish to imply that the scientific viewpoint should simply decide it. But I think that we need to take seriously the evidence in nature as being part of God’s general revelation to mankind. Since it has the same author, the general revelation we see in nature should be consistent with the special revelation that we find in the Bible. How then do we deal with apparent differences between them? Perhaps the arguments about whether the sun moves around the earth or vice versa are instructive here. I have basically adopted the principle summarized by the Princeton theologian Charles Hodge, “if [the ordinary] sense brings the Mosaic account into conflict with facts, and another sense would avoid such conflict, then it is obligatory on us to adopt the other.” Thus I look for an alternate interpretation of the biblical text that would fit with the data of astronomy or archeology or history without doing violence to the context or the overall biblical thrust on the topic. Those of us with a strong view of God’s providence in human affairs should not have difficulty in accepting His providence in cosmic affairs. I think that one can understand the days of creation as being representative of God’s creative activity, with the order perhaps indicating not the order of creation (which would imply that plant life was created on day three and the sun on day four), but the order of how it would have appeared to an observer on earth (had one been present). I am pleased that my own denomination, the Presbyterian Church in America, has recently adopted a statement which, while affirming the historicity of the early chapters of Genesis, has also affirmed that ministers my have divergent views on the length of the creation days. I am reminded of a quote on this subject J. H Pratt
from the end of the 19th century which is as follows: “The Book of Nature and the Word of God emanate from the same infallible Author, and therefore cannot be at variance. But man is a fallible interpreter, and by mistaking one or both of these Divine Records he forces them too often into unnatural conflict.”

While I do not believe that this is a central issue of Christian doctrine which should divide believers, nevertheless, I feel that I should be more aggressive at times and not let uncritical thinking in this area go unchallenged. There is an issue of truth and the integrity of God’s creation involved. In fact, the “young-earth” view may set an unnecessary hurdle in the way of scientists and other educated people coming to faith in Christ and trust in the reliability of the scriptures. As an aside, I have been pleased to recently met several younger Christian astronomers who are just getting started in their careers. At their initiative, several of us have been getting together at the annual meeting of the American Astronomical Society and encouraging one another in our callings. A healthy exchange of e-mail circulates among us on various issues. I am delighted to see this.

The other area where I feel that I walk a tightrope is that of time and priorities. Wanting to do my work well as a teacher and scholar requires a lot of time. Here at Valparaiso University, we place a high commitment on teaching and mentoring our students well. Given the time that takes, it is then difficult to maintain an active scholarly research program on a national or international level. I struggle with issues of time and balance here. Not balance between teaching and scholarship, but between academic work and the rest of my life. Being an astronomer is my vocation, not my life. In the larger picture I am called to not only be a scholar-teacher, but also a husband, father, churchman, and neighbor. I am to do all of these things in the context of serving God, by his grace, and as one who is accountable to him. As my brother has reminded me on more than one occasion, on our deathbeds it is unlikely that we will regret that we had not spent more time at our work. I very much appreciate the patience of my wife and children and Lucy’s gentle nudges when things get too out of balance with my work.

I thank you for your patience in hearing me describe the path that I have taken to and in my vocation as an astronomer, and also how my Christian commitment has impacted this. As I mentioned earlier, I carry out this work with a sense that it is a privilege and a responsibility. It is a privilege to study the heavens as God’s handiwork and their development by processes that God has created. It is a privilege to tell others of the awesomeness of the creation: professional colleagues though papers and conferences, students in the classroom, and the community at the public nights at the observatory. I also consider it a responsibility to serve God with the abilities that he has given me and to love and serve him with my heart and soul and strength and mind. This calling has been exciting and fulfilling, and the reflection that the preparation for this lecture entailed has been helpful in self-consciously refreshing my vision. The Westminster Shorter Catechism, question 1, asks in 17th century English, “What is the chief end of man?” The answer is, “The chief end of man is to glorify God and enjoy him forever.” That answer continues to sound good to me today.

References

1. References from the scripture are taken from the Holy Bible: New International Version, copyright by the International Bible Society.


8. Schaeffer, Francis A., 1968, the God who is there (Chicago: Inter-Varsity Press).


10. Image from the Space Telescope Science Institute/NASA.


13. Examples of these views are as follows: literal - The Biblical Basis for Modern Science by Henry M. Morris, 1984, (Grand Rapids: Baker); concordant or harmony - The Fingerprint of God by Hugh Ross, 1991 (Orange, CA: Promise Publishing), Genesis One & the Origin of the Earth, by Robert C. Newman & Herman J. Eckelmann, Jr., 1977 (Downers Grove, IL: InterVarsity Press); figurative - The Fourth Day: What the Bible and the Heavens are telling us about the Creation by Howard J. Van Till, 1986 (Grand Rapids: Eerdmans).


15. Pratt, J. H. 1872, in Science and Scripture Not at Variance, quoted in Perspectives on Science and Christian Faith, published by the American Scientific Affiliation, a national organization of scientists who are Christians.

Some additional books on Christianity and science not referenced above that I have found to be helpful and interesting over the years include the following: The Christian View of Science and Scripture, Bernard Ramm, 1954 (Grand Rapids: Eerdmans); Christianity & the Age of the Earth, Davis A. Young, 1982, (Grand Rapids: Zondervan); The Scandal of the Evangelical Mind, Mark A. Noll, 1994 (Grand Rapids: Eerdmans).
Figure 1: Hubble Space Telescope (HST) images of two dying stars surrounded by gaseous nebulae recently ejected when the star was a red giant. One can see two bipolar lobes separated by a dark region which is presumed to be an obscuring torus hiding the star. (Note that these are false color pictures, with the colors used to bring out enhancements in the bright regions.)

Figure 2: Two additional cases in which the stars are surrounded by bipolar nebulae. On the left the nebula is seen edge on and the obscuring torus hides the star and in the right the nebula is viewed at an intermediate angle and the star is seen.
Figure 3. In this case one can directly see the torus around the star, viewed at an intermediate orientation.

Figure 4: Hubble image of view into deep space. One thousand five hundred galaxies are seen in this tiny region of space! (NASA image.)