



# Science/Technology Education in Church-Related Colleges and Universities

*Publication Year: 1989*

*ID: BK022*

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## Session 4: General Discussion

*ID: BK022-018*



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## Session 4: General Discussion

**BERTRAM:** As you know, Dr. Chase from Wheaton College could not be with us for the weekend. His colleague, Dr. William Wharton, will speak to us in his place.

**WHARTON:** I'm the science division coordinator at Wheaton. I encouraged our president to write a paper for this conference. When he had a conflict, he asked me to represent him.

We've been talking about research universities. I'd like to contrast them with our school, a small four year liberal arts Christian college. For nine years I was a faculty member at Carnegie Mellon University in Pittsburgh doing research. I probably knew more than half the nuclear physicists in the United States, Europe, and Israel who had been in the field for five years, but at my own school I probably knew only 25 % of the faculty. At Wheaton I know all the faculty and interact with them all the time.

In the science/math/computer science division, we have a Tuesday lunch for the science faculty. One person will speak on something he or she is doing. On occasion we have someone from another department -- psychology, history or theology. We also have full faculty meetings for the whole college almost every Tuesday afternoon. Some are business meetings; others are faculty development meetings. All the faculty were asked to read Steve Hawking's book, *A Moment in Time*. I don't know how many read it -- maybe only a quarter -- but it was good having faculty in the English department and history department who didn't know much science, discussing their perspective of this book.

We're a very strong evangelical Christian school where everyone attends a chapel three times a week. The faculty are encouraged to have the devotions during class to help integrate the course material with their Christian faith. That's very important, too.

As President Chase mentioned, we have a new course called "Majestic Nature," a freshman course for non-science majors. We encourage students who have a fear of science to take it. The degree requires eight hours in science, and we feel strongly that everyone should take a pure science lab course. We argue that STS courses should not replace a pure science course and that students shouldn't even take an STS course until they've had the pure science course.

We emphasize that anyone who studies nature and tries to understand it should consider himself or herself a scientist. We take science off its pedestal. The first few weeks we go through Del Ratzsch's *Philosophy of Science* and let them see that science is subjective as well as objective. The course is twice the length of a normal four hour course. There's a lot of hands-on lab work. Last year, its first, we taught it for 11 students. When I took my section in the course, the students were open to trying new things. They weren't intimidated by science so much.

The course description says that "Majestic Nature" is an "interdisciplinary natural science course that includes perspectives from biology, chemistry, geology, mathematics and physics. This course is dedicated to helping you develop conceptual and analytical skills necessary for critical thinking in science, exploration of the nature of science, and origins and changes that occur in matter and energy. The faculty who have designed this course want you to capture the thrill, sensation, and exhilaration that emerge when science is practiced. We hope that you will learn the limits and methods of science and that you will discover what scientists are and how they solve scientific problems. Take an exciting intellectual journey into nature with faculty who have studied it for years and discovered the majesty of the universe."

Let me read a few of its six goals. "Science through its concepts and its products has been important throughout history. Aspects of science and technology pervade every area of American culture as well as that of most of the world. Since you as a Wheaton College graduate will influence our society and the world, it is important that you be trained in scientific thinking. This course is designed, therefore, to help you develop skills in scientific thinking so that you can understand and evaluate the scientific issues which you will encounter as a liberally educated citizen, people who have questioned and continue to question their place in the universe. Scientific discovery embraces

the natural world and brings content and experience to what could be an abstract philosophical discussion. This course provides you with the tools to discern and understand new scientific inquiry as a method for explaining natural truths.”

Another goal: “curiosity, exploration and learning are natural attributes of young people. Discovery in nature can be inspirational to your imagination and increase the sense of wonder for the universe. You will experience the pleasure and excitement which comes through studying scientifically the phenomena of nature.”

Why have we done that? This course is very labor intensive. It’s not always practical to offer it to a large number of people. From 11 students last year we’ve expanded to 25 each semester. It’s harder with 25. But the students who finished the course last year were very enthusiastic. One was interested in environmental issues and is now thinking of becoming a geology major, even though he hated science before he took the course.

We have a Pew science cluster. The Pew Foundation is funding interactive activities of Wheaton College with four other colleges and Northwestern University. Most of the activities are in the area of student and faculty research. Two faculty members from each school are meeting and developing a new course similar to Majestic Nature which all schools are committed to teaching. Let me point out that most of the issues discussed don’t pertain solely to a church-related school. They pertain to all schools. When we interact with a school like Northwestern, which is not church-related, we find we have practically the same goals they have.

I teach astronomy at our science station near Rapid City, South Dakota (near Mount Rushmore). We have two courses there each summer. One is a field type course for biology and geology majors; the other is for non-science majors. We advertise this as an excellent way to meet the eight hour science requirement. They meet their science requirement with a four hour course in introductory geology, and a course in environmental geology or environmental chemistry. Then they take my astronomy course. The students learn more there than back on the main campus.

Every student has to learn how to use a telescope. They have to pass a proficiency test in which they mount the telescope in an equatorial mount and tell me in advance what deep sky object (any object they can’t see with their naked eye) they’re going to find. They have to find it with the telescope. They’re up long hours every night looking. My lectures are only about half as long as those on the main campus, although we cover the same textbook material. I de-emphasize the textbook material. I sometimes give them the same exam I usually give at the college. Every time I’ve done that, the lowest score out there has been higher than the normal median score. I wonder how can that happen. Maybe I get them after they’ve already had six hours of science. Maybe they’ve learned how to take science by then. The main reason may be they’re concentrating on science. Also, it’s the only course they’re taking out there. At the college they have a major about which they’re more concerned. If they get behind in their work, their science course is sacrificed. There’s a lesson to be learned. Some colleges have short courses between semesters. It might help non-science majors to take their science course when it’s the only course.

At a later conference, we might discuss how church-related schools can meet the needs of the church. At Wheaton we’ve treated the creation-science issue. Our pastors and teachers in our elementary and secondary Christian schools are bombarded from both sides -- the creation-science movement and the non-theistic evolution movement. They’ve never been exposed to a position in between those two. We offered a series of lectures one night a week for eight weeks on this issue for the area pastors and science teachers from Christian secondary schools and other full-time Christian workers for whom this is important. We had faculty members from the Bible theology department and from the anthropology, geology, chemistry and physics departments. We discussed this whole issue and gave a balanced view which helped them. It is good to do things like this for the church. That’s one of the things I’d like to see discussed in a later meeting.

**BERTRAM:** I live in St. Louis but I teach in Chicago. The reference to the Mt. Rushmore station reminded me of an old story about Chicago weather. There was this Chicago father who said one day, “Oh, how I wish the sun would shine in Chicago, not so much for my own sake -- I’ve seen it once.”

The tack that Dr. Wharton’s presentation took may suggest a line of direction for our own discussions. In the attempted summary at the end of our morning session, I tried to fix upon two themes more or less, which had to do with a possible later conference. I had caught remarks from you dealing with at least three sub-points concerning that conference. One had to do with how inclusive the participation should be. Should it include people from kindergarten through university, or only people from colleges and universities? Should it include people from the sciences or ought it to include people from the humanities, and so on? A sub-issue had to do with the theme of such a possible conference. Bill Wharton picked up on that toward the end of his remarks. Maybe you’d like to consider this afternoon what a likely theme would be. Whether you choose to do that or not is up to you. So far we’ve done a pretty thorough job of establishing that there is need. It might be a good time to take this suggestion of content seriously. You may differ as to what you think the diagnostic problems are.

What if we switched the mood of the conference and assumed that we are pretty well agreed that there are problems? What would the solutions be? A kind of gnostic approach to solutions thinks that establishing what the problem is is the solution; knowing what is wrong will automatically lead to a rectifying of the wrong. No doubt that is part of the solution. But what if we would concentrate on what we at least imagined the solutions might be? It need not be some grand cosmic proposal. It may take the form of reciting, as Dr. Wharton just did and others have done, some of the attempts made at your institutions to meet those needs.

**BARNES:** We might write up the successful things done at our own institutions. It would take too much time to do it here.

I’m interested in paradigms. As I listen to scientists here talking about how comfortable they are with a meeting between science and religion, I think I hear one particular paradigm. I can see four different ways that science and religion can meet.

I’ll simply list them: 1) have scientists determine the outcome, to some extent at least, of specific religious doctrine. Karl Rahner recently said transubstantiation must be rethought in terms of current physics. 2) have scientists discuss fundamental anthropology, the understanding of what a human being is, what a soul is. Our current evolutionary understanding no longer defines a soul simply as an immaterial, immortal, platonic, substantial form. 3) consider the cosmological issue. I heard Dan Perrine talking on this level when he found the love of God in the lattices. When any of you find the glory of God or the grandeur of God in nature, I sense that most of you find religious meaning in your science on that kind of raw cosmic level, God was working through those things. That seems to be the basic paradigm many of you are operating from when you think about the relation between science and religion. This is a question. 4) take the skeptics, the agnostics and the atheists, who look at the range of scientific theories and say, “There’s nothing intrinsically religious to that.” They would say that if you find God in the lattice work or the molecules and so forth, it’s not because that’s intrinsic to science. That’s an addition you’re importing from your religious faith. It has nothing to do with science. That’s on the level of the fundamental nature of what science is and whether there are religious implications to that. Those are four different paradigms, and I don’t know what level any conference would be operating on if it were to talk about the relation of science and religion. It would be good to clarify which one of those four levels (or all of them) was being treated.

**BERTRAM:** You remembered Gerry Magill’s third point about paradigms. He made conscious, explicit reference to a previous speaker, Sr. Mary Ellen Murphy, who also had suggested a paradigm that science and theology might have in common, namely, a creative imagination or discovery. Would you like to elaborate that, to find ways of being critical about it.

**CROSS:** I see the practical problem of how to teach science. There's always the difference between scholarship and its communication. The problem is most acute in the physical sciences. The skills, talents and activity in the humanities and in the social sciences necessary for scholarship are closer to the skills needed to communicate its results than they are in the physical sciences. Perhaps we need to recognize a possible division of function between those who do science and those who teach it. Any national conference addressing this question for the churches and church-related schools could be very helpful to educators and scientists alike by exploring how best to communicate science to students. How best can we divide the task between the scientist, doing research at the cutting edge in perhaps some very narrow area, and those who investigate and communicate the fuller and larger meaning of those scientific findings in the academy?

**SHEAHEN:** For students, particularly brilliant high school students who are candidates to become science majors, the opportunity for undergraduate research is extremely attractive. They know that what is in the textbooks is knowledge that somebody else already has discovered. They feel the need to do more than simply grind through it for four years. To be part of a research team and to do something more than making coffee -- maybe doing the computer programming or something having to do with the data -- is an experience that helps them feel good about science and about their role in it. Being part of a research team helps immensely to learn what science is all about and helps them find value in the science. I cast one humble vote in favor of getting undergraduate students involved in a research program.

**BERTRAM:** With this new direction, an earlier concern with upgrading science research and education in church-related colleges to the point where it's competitive with the top 100 is noticeably absent. That's not been a part of the concern here.

**FREDRICKS:** Tom (Sheahen), did you have in mind science majors participating in research projects or the general liberal arts student?

**SHEAHEN:** I think the predominant example would have to be the science majors because, if you're a non-science major, it's unlikely that you could be a significant participant in a science research program.

**FREDRICKS:** Can I ask that of Bill Wharton?

**WHARTON:** Yes, it should be for the science majors. I could give one quick example with a new science cluster initiative. We had a math and French major work for some geology professors at Northwestern this past summer. She ended up working on a lot of math codes on the computer predicting from seismic data where the epicenters of earthquakes were. She was surprised how much math there was in geology. She decided to drop her French major, and go on for a higher degree in math. That's one example of a positive experience that occurred.

**BERTRAM:** In church work, that's called sheep stealing and it's frowned upon.

**PERRINE:** I don't think more than two or three church-related colleges are ever going to hit the top hundred. It's unreasonable for the rest of us. We can fill a slot not being filled by the big research universities. Wheaton College seems to be doing well in giving kids a hands-on experience at the undergraduate level. Usually the big PhD granting schools use their undergraduates as cannon fodder. Wheaton has a large percentage of people going on for their PhDs. After listening to you, I think I'm going to become an evangelical Christian.

I was delighted to find in Dr. Chase's paper and in your remarks that you see a responsibility to help the churches. In the Catholic church or Christian churches, the church authorities are so ignorant of this huge and wonderful cosmos that they are producing a terribly wasted, atrophied notion of God. Karl Rahner said somewhere that people who think they're atheists are often profoundly in contact with God. Conversely, people who mouth notions like the Trinity are often really polytheists. Some Christians in practice have so little understanding of the true Nicene Creed that they really have three gods. There are outstanding church authorities who are anonymous atheists in the sense that their ignorance of the true God who made this universe is so vast that they're at least schismatic if not heretics. Also, could you explain what "devotions" mean in the evangelical tradition?

**WHARTON:** Different faculty do different things. Some faculty just spend a few minutes at the beginning of each class period. I don't do it every class period, but sometimes I take one whole class period and really go into something quite deep.

**PERRINE:** Do you turn a classroom into a prayer service?

**WHARTON:** No, no. It's a study trying to integrate our Christian beliefs with the science we're teaching.

**PERRINE:** Do you actually pray sometime in there?

**WHARTON:** Some faculty do have prepared prayers. I don't.

**PERRINE:** But you do discuss the integration of science and faith. In Catholic schools like mine, we've long lost the courage to do things like that. There ought to be some theology across the curriculum. There ought to be some devotion. I'd like to see a great poet who is in science write a wonderful liturgy incorporating the knowledge of science into the idea of the image of God. Let's sing about how wonderful God is.

**JABLONSKI:** In a church-related institution we can help our students develop a sense of their ministry as scientists. We can help develop a spirituality for scientists, so they can integrate their science experience with their image of God. We should start talking to each other about our commonality. Is there such a thing as a specific spirituality for scientists. As we've explored the issues of social justice, we've seen that the prayers, songs and poetry have spoken of spirituality concerned with social justice themes. We scientists also have images that are more kindred to our spiritual growth. Are there scripture passages that speak to us more? Are there forms of worship best suited to the work of scientists?

I was privileged to be an observer at the impressive conference at the National Center for the Laity in Chicago on preparing the next generation for leadership in the U.S. church. It was particularly geared for the post World War II folks. They've helped people in different fields -- business people, secretaries, teachers. The science document will not be done unless there's planning and support from people who say it's important. That's something we can do. The University of Dayton has one of the largest campus ministry programs in the country -- 24 people involved. But we are not successful in getting people in the same discipline to work together. It seems as if students from different fields go on the retreats sponsored by campus ministry. They talk with other students on the campus. One student in premed last year asked me how one can go on a retreat with friends and acquaintances. They've had these experiences of sharing with people they don't know, but not with people they know. A group of premed biology majors put on a retreat for science majors. Some of those experiences seemed to give them something and helped them see what they were taking from their Christian environment in education for later. Without that retreat they may not have had that support.

**RECK:** As valuable as campus ministry is, I think that courses on an academic level are essential if we're going to achieve this integration. Could one of the agenda items for this proposed conference be the working out of concrete possible courses that might help achieve this? Take, for instance, an introduction to theology. I've seen courses done by others and I was able to develop something along that line. Take, for example, things we've heard here, like this "majestic nature" course at Wheaton. One person could outline a bibliography and others could develop it according to their local situations. A second suggested proposal was helping undergrads get into research programs. That's a possible idea. A third mentioned something along the idea of images of God, or where one finds God in one's experience, in one's work, in one's life -- something we could call introduction to religious experience. I'm sure there would be other possibilities as well. I'm not saying the whole conference would be focused on that but maybe some sections could be, so that people could come away with five or six possible courses which would allow an integration of science and theology.

**BYERS:** It would be helpful to focus on how one integrates science and religion. That is a question we usually do with the Bishops' committee, namely, how one is a person of faith in an age dominated by science. That may be a particular contribution a church-related school can make. There is ignorance in the Catholic hierarchy on

science. It's not a repressive ignorance or particularly negative; it's simply there. The bishops went through the education system I grew up in. They don't have much science training and their time is taken up with a thousand other things. A conference of that nature could be a positive contribution to filling in a gap which inevitably exists at the episcopal level. I think the bishops would welcome any results from a conference like that. It could help make Catholic schools find their Catholic identity and incorporate the scientific component into that.

**FORD (NY):** I'm going to keep finding work for Fr. Brungs. Thanks to E. L. Smith's money at New York Medical College, we began to organize the medical ethics/health ethics curriculum for both medical and graduate students. I searched out all of the sources of information and landed with the Kennedy Institute at Georgetown, among others. Ed Pellegrino and staff collect syllabi or course outlines, keep them on file, and sell them for two bucks a shot. Fr. Brungs should get a Peterson's list of church-related colleges and write every appropriate person asking them to send a copy of their syllabus. You'll get one or two pages, depending on the school. Then make a library and publish the roster by title. I've gotten valuable one or two page syllabi appropriate to the field; it's a diverse and useful service to American medical and health education to be able to get that information and not reinvent courses. I'd like to see the already mentioned paradigms written up as well as the Wheaton program. That would be helpful to all of us and to those who are not here.

**BRUNGS:** I'll do that during the lunch break.

**FORD (NY):** That's the beginning of a conference. You need a data base in what's happened. That's one way to do it.

**SMULDERS:** If we introduce young people to research at the undergraduate level, we're too late. I judge state science fairs in California and the Los Angeles County Fair. These are for junior high school and high school students. There are 12 and 13 year olds doing real research, able to tell you what they're doing. They're excited about it. These are people who will most likely go on in science; that's where we have to focus. Otherwise, they're turned off by science because they're not participating or they're not being allowed to participate.

I also have a program called the minority biomedical research support program. It's specifically designed to get under-represented minorities involved in research. My biggest problem is that the researchers get the funding and use it to do their research. They're supposed to help educate the young people whom they end up using as dishwashers. They don't involve them in science which is the purpose of the program. I have a difficult time picking the proper researchers who can motivate and excite them.

I arbitrarily take one lecture from a general biology course and talk about life as a religious. First, they don't know what a brother is. That class gets the most comments, because they're struggling with incorporating themselves into a scientific society. Why can't a religious be a scientist? Many struggle with that. How can a believer be a scientist? I talk about that for a whole class period.

**CONNELL:** I want to respond to Charles Ford. It's a great idea but it's narrow because it becomes biomedical ethics, not biological ethics. That ignores all the environmental issues which interest people now. It's fine to read about some of the very esoteric kinds of biomedical things. But what are we trying to do in terms of pollution and waste? It must be broadened beyond biomedical ethics.

**BRENNAN:** From discussions during the break, it appears that the bang and the buck go together to some extent. Complaints that we don't have enough scientists are tied to the potential salaries of scientists when they graduate. Is there a way to find an interdisciplinary education in both theology and sciences? Is there a way that ITEST and other groups can do some of what ROTC does for the United States military? Could we somehow involve some type of student affiliates on given campuses with ITEST, creating and developing resources to fund an interdisciplinary education at our church-related schools? People here are already versed in their own fields and think the dialogue is important. But many of the undergraduates are in *either* the "liberal arts" or in the "hard sciences," and dialogue doesn't always occur.

**FREDRICKS:** I want to comment on Tony Smulder's comments. I think you said it might be too late for the research experience in the undergraduate population. That is not our experience at Marquette. Students come from high schools with a variety of training, but little or no experience with research. The students we take into research laboratories with the faculty are enthusiastic about that experience. I would not want people to be discouraged.

**SMULDERS:** I meant that there's a whole group of people who are never going to be exposed to science because they end up in college as liberal arts majors without a chance even to be exposed to the excitement of science. I'm all for continuing research at the undergraduate level. There are fewer people interested in science. We must begin at an earlier stage. Assistance must be given in high school and junior high school.

**SHERMAN:** I particularly want to reply to Br. Tony's remarks. For about 20 years we have been doing a lot of research at the high school level. Many times we have consulted with various people -- Fontbonne, University of Missouri-St. Louis, Washington University, St. Louis University, anybody we can find. We've had a lot of success interesting students in research. We've visited cement plants and water works. I have never found a scientist who has refused to let us visit him or her or has refused to send us reprints of papers. The students love it. Tony's absolutely right, there's a whole group of people who never get interested in science because nobody takes the trouble to help them. It's terribly labor intensive, time consuming, but it's a hobby of mine. Now that I'm not teaching full time, I have more time to do that type of thing. People in the church-related colleges can help by making themselves available. I know that time is the big problem, but perhaps your administrators could see it as good PR for the school to do this kind of thing, to let a student come over and share the equipment. Let them use an infrared spectrometer or something that they wouldn't possibly get in high school. We go anywhere anybody will let us use their instruments when we need it. It's been tremendously successful.

Many church-related high schools these days -- most of you are aware of this -- require many hours of student service to the community before they can graduate. Our school requires 120 hours from freshman through senior year. Some schools like St. Louis University High School require about 60 hours in the senior year. Other schools spread it out over the whole four years. It varies from school to school, but it's pretty much ingrained in the students. A lot of those students go on to church-related colleges. I'm asking you to encourage students to continue that. This makes students aware of the community and of social problems. They go out to old folks homes, work at charitable institutions, so they see some of the problems of society. They see old people hooked up to feeding tubes in nursing homes. They see the problems of handicapped children. I'm asking for my own information, if you can build on this type of thing.

**BERTRAM:** You leave us with a soul searching question. Elena, do you want to respond to that immediately?

**COLICELLI:** Two things! Our campus has a center for volunteerism which picks up on all those kinds of things. Second, every year on campus we have a seminar on a social problem. Much of the seminar involves students making reports. They research the issue -- we're doing global warming this year -- and give a series of talks on its different aspects. Yes, we're trying to follow that.

**BERTRAM:** Mrs. Sherman, did you have in mind to relate your experience to this proposed conference in some way?

**SHERMAN:** Not necessarily, except to urge people to reach out into the high schools and make your people and your facilities available to them and, if possible, encourage student research. I have worked with science fairs. It is thrilling to see these young people doing some type of science research. It takes a lot of people working together to do it. That's what I'm really urging there.

**BRUNGS:** About five years ago ITEST put in a proposal to a major foundation for video production equipment. After serious consideration it was turned down. The reason given was that church people don't share their resources with each other. It may sound like a strange reason not to fund a project. In terms of Marie's remark, we don't have a good track record on sharing resources and skills. When I was teaching we did not encourage high school students to use the equipment, even though it was sitting idle. Maybe we just never thought of it. It's one thing

we can begin to think of. That would be a positive step forward. How about sharing lab equipment, faculty time, secretarial time? All these things are important to the success of any operation, and I don't think we've done that very well. The foundation's reaction was legitimate. We tend to hug our empires to ourselves and protect their boundaries lest somebody else get an advantage. I am amazed that we can say we are Christians while building these self-enclosed empires rather than helping each other.

**BERTRAM:** It follows a point Jim Skehan's has made a few times It's called love.

**BRADFORD:** I want to continue with Br. Tony's point. Undergraduate research is successful at Benedictine College and has been for at least 25 years. We've gotten many National Science Foundation grants to support undergraduate research. All science majors at Benedictine College are expected to enroll for a certain number of hours of undergraduate research credit. Many have the opportunity to present their work, usually at the Kansas Academy of Science. They enjoy that. Much of it has been published over the years and it has had a very positive effect on the college as a whole. The science departments at Benedictine College have produced by far the most undergraduate students going on for advanced degrees. I would be willing to guess that there probably haven't been more than five people, say, out of the philosophy department who have gone for an advanced degree in philosophy. We've had dozens and dozens of biology, chemistry and physics majors get PhDs. One of the reasons is that our science departments give the students an opportunity to do real science whereas the philosophy department does not give students the opportunity to do real philosophy.

**WHARTON:** Is the research done during the summer or during the year?

**BRADFORD:** It's all during the year. Although I haven't been on the faculty long enough to establish or start my own research yet, I am expected to do so once I get settled in.

**NICHOLS:** As a possible additional paradigm for the conference we might discuss what we would like our graduates -- either science or non-science graduates -- to be. What would we like our alumni to be? We might develop some way of assessing whether any of our alumni have actually changed from the time they entered our doors to the time they leave. Jesuit high schools and others are ahead of us in assessing what they would like their graduates to be and whether in fact their graduates are changed in ways that can be polled. I'm talking not only about academics, but also about social involvement, awareness of their relationship with God, with Christ, with their neighbors.

We like to have our students develop certain scientific ways of thinking and reasoning, objectivity and subjectivity, but also assessing the way scientists find their attitudes changing during these growth years -- their relationship with God, their ability to pray, their ability to find hope in the kind of world that they are learning more about. Whether one could discuss outcomes and ways of assessing outcomes that we would like to see for this category of students might be an approach for the conference.

**EAGAN:** It occurs to me that selection of a theme is critical. A theme that allows discourse between the scientist and religiously oriented is important. The suggestion has been made several times that we talk about a comparison of paradigms. I have difficulty with the term paradigm. Most philosophers and scientists have difficulty with it. What might be a catalyst for this vitally important discourse? I recommend the one suggested by Fr. Skehan in his account of the ceremony recognizing his mentor. The term integrity strikes me as an intensely personal, religious and scientific word. It's a term that speaks across boundaries. Although not a practicing Christian myself, I know enough of my Christian friends who understand that integrity has very deep religious connotations. Something might be done with that. It's obviously important for scientists. It's the word that allows us to understand that the scientist's activity is itself intensely personal.

Those who do graduate work in science often do not pick an institution for their development but scientists to work with. There's something that goes on among scientists that is very important and intensely personal. I don't know whether it would work, but I feel that something could be done with the idea of integrity in the sciences, in religion and in personality.

**SHEAHEN:** One of the interesting things about 5:00 pm on a Saturday afternoon is that the good Catholic mind naturally turns to confession. However, I think that I see something that is fundamental to the goals of any conference that we might think about here. It has to do with forgiveness. If I understand confession correctly, we not only ask God's forgiveness but we accept it within ourselves. Four hundred years ago the church made a bad blunder with Galileo. It took 100 years or so for it to become clear that Galileo was correct. In the years that have gone by, we have quietly deleted the condemnation of Galileo. But I don't think the church has ever forgiven itself or accepted God's forgiveness in the Galileo incident. There are many people, probably including a big fraction of the hierarchy, who still feel guilty and, as a result, stay aloof from science.

In Rustom Roy's contribution there's a section called "The Origin of STS and the Return of the Prodigal Son." He talks about science starting out as a part of the church but then going off as the prodigal son. It went off and did its own thing and teamed up with the secular humanist, the atheist. It wouldn't have anything to do with the church. Now, if it comes back home as the prodigal son returned, is the church, the forgiving father, ready to take it back? A prerequisite for the father must be that he forgives himself and accepts God's forgiveness. The church must accept God's forgiveness in the Galileo fiasco and put this blunder behind it. Let's accept science, a prodigal son, and celebrate what we have together and can do together and achieve a certain integrity between science and the church this way.

**BERTRAM:** I thought you were going to compare the church to the older brother in the parable.

**PANUSKA:** I have two comments. One, a lot of the suggestions have been made about themes. I think that in the selection of the theme we should stay very close to the primary purpose of ITEST, the issue base between science and theology.

I find that volunteerism is thriving on the campuses of certainly many private schools and of the state supported system. It's a major effort. At the University of Scranton we've been able to work out a cooperative effort with our sister institution -- about the only thing we've done together very seriously -- through a funded program on volunteer services. The Commonwealth of Pennsylvania through its consortium of colleges has recently begun a campus contact system which offers assistance to various colleges to encourage volunteerism. It hit me through this conference that almost all of the services considered volunteerism are socially oriented, people oriented, sometimes for the elderly, sometimes tutoring. If we could stimulate some groups to recognize research and science in a way that relates to the alleviation of human suffering, what a leavening that might be. It would be something that would influence images attitudes. It might even help solve some of the human problems. That research could be medical or physical. It could be sociological, demographic, what have you. But to have young students on the campus counting research as their volunteerism -- something they've become proud of and display on all resumes or job applications -- is something that could spread through the country with significant effect.

**COLICELLI:** I don't want a future conference to end up addressing undergraduate research, because that's taken care of in other places. All of our professional societies recognize how important undergraduate research is. We can read about curriculum variety in a lot of journals. We do everything we can for high school students. That's probably true of everyone in the room. We're on all these science fair committees and we love it. The science departments in small colleges are doing outreach. We must get students who are running programs, who are doing everything, and people are exhausted. We've had people do other than direct service by working on environmental commissions in local towns. Let's not reinvent the wheel.

Bill Nichols' suggestion is something we could do, an assessment that would bring in Christian values versus science. Every state sooner or later -- New Jersey seems to be sooner -- is going to be smacking us over the head on outcomes assessment. They're not going to ask the question about Christian values or church related values. Of all the themes I've heard, that's the only one we couldn't do at an American Chemical Society meeting.

On the larger issue of science and the public, there are a couple of initiatives from the National Science Foundation (NSF) on values and science and making science education available to the public. Again, I'm not sure if you want to be writing grants. It doesn't seem to me that science education is the major thrust of ITEST.

**TRUCHAN:** I concur with Al Panuska that we should keep, as the focus of a potential conference, the interface of religion and science and/or the integrity of science. If we focus on the first one, technically I think the second one might be assumed. One thing that is very important to me from my experience since 1972 is that, unless one talks about taking ideas and translating them into the actual teaching and assessing goals, it ends up being only a nice experience.

One of the outcomes at our institution was valuing. In all our disciplines we have to translate how we're teaching for valuing. We have created an external valuing instrument for our majors at the upper levels to make sure that, before they leave us, they come out with some kind of a value assumption and point of view. That takes an awful lot of work and reflection even to get there. It seems to be a way of getting at religion and science.

Though I agree with Elena that there are a lot of curriculum discussions, we may lure some people into a general meeting by talking about them. Then we can have some broad presentations that will focus the specialized groups who wouldn't come if they didn't see the specialization.

We have managed to do a lot of research at our institution by using industry. I say that for all of us who are in small schools. There are more than a hundred industries in the greater Milwaukee area where our students, since 1970, have spent a semester, taking the equivalent of a course, staying eight hours doing research at an industrial lab. It's a structured program. There are a lot of advantages. They have the latest equipment and do honest industrial research. It gives the students a chance to decide whether they want to stay in that work or not. It's been effective. Anyone in a city could find many tech places without much difficulty. We have a seminar on campus to make sure they're learning out in industry. It's not as if we cast them to the wolves and forget them. On returning they reflect to validate that experience. That can extend the small college opportunity for research without extending personnel. I recommend a model like that.

**COLICELLI:** Industry is eager to get people, and they consider them as feeders for their own plants.

**TRUCHAN:** Yes. They have repeatedly said that. The science students are pretty well trained by the time we send them out. Industry says that the students are wonderful because they're a stimulus in the department. It keeps the departments on their toes. It's been a plus situation back and forth. We also call in the mentors from industry to the campus for a seminar. We train them to be effective mentors. We've both learned how to clean up our acts. It's a way of effectively extending resources into industrial work or into medical colleges.

**CASPERS:** At the University of Detroit we have a co-op program which is a great benefit. Such a program helps the students to make career choices. We've had students change their perception of what they want to do with their degree. Often discussion can lead to ethical questions -- should they go to a company that may or may not be completely ethical. The students are not dumb. They come back and share their experiences.

We have a requirement in our core curriculum that the students have to discuss what the ethics are or the major challenges facing their area of study. They do that. The chemistry club decided that they wanted to share this experience with high school students. They put together a little traveling show. At first they had a hard time finding a high school that wanted them. When many of them talked -- with the exception of the church-related high schools -- they could not hold the students' attention. I think our problems begin even before the high school level.

**SKEHAN:** Following on Bill Nichols point and several other points from Leanne Jablonski, Dan Perrine and Pat Eagan, many of us are groping for a spirituality related to scientific research and the area of science. I found something of an outlet for this in offering a 24 week retreat, called a 19th Annotation Retreat. Bill Nichols has been doing likewise in a different format at his institution. At the private level there is a need, as Bill ultimately

said, to try to see what results of this spiritual development have taken place during the time in our institution. A program that relates to articulating the spirituality of scientific research is something that may be in order.

**BERTRAM:** Let me just lift into quick prominence something that's been talked about more than a few times. Some of you have addressed yourself to the question of what Pat Eagan called a comparative metaphor or a comparative image, one that's inclusive enough to jolt the energies both of the faith sciences and the natural sciences. Not far from that is Dan Perrine's suggestion of having the good poet who knows scientific cosmologies construct a liturgy. I even found myself wondering whether Br. Lawrence, being a Benedictine, would think of doing that. He turns out to be a molecular biologist. A few have commented on how many people in the physical sciences are also musicians and so on. Brother Lawrence happens to be an organist.

Perhaps the theme of a potential conference could take the form of exploring what inclusive images might heighten the encounter between theology and science/technology. Another requirement that some of you see is that it should be one that not only engages the imagination of, let's say, theologians on the one hand and scientists and technologists on the other, but it should also be a kind of theme that would be highly teachable to students. I say that only by way of reminding you of what you've been discussing.

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