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Science, Aesthetics, and the Liberal Arts Tradition

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Twenty-five years ago I was asked to deliver a Last Lecture as part of a Student Entertainment and Lecture Fund program at Ouachita. As a thirty-five year old, I was a bit perplexed at the prospect of preparing a last lecture. Egad, why would a thirty-five year old professor be delivering a last lecture? Several thoughts went through my mind. One might be disenchanted with educational institutions; one's health might be in decline; one might have developed personal or philosophical differences with the administration that require relocation; the list goes on. Now, I am sixty, a last lecture has more meaning, although even now, my retirement is *not imminent*. In part, I offer this qualifying comment because of the ribbing my colleagues have been giving me since Susan's email last Monday announcing the *last* lecture.

The main value in delivering such a lecture twenty-five years ago and delivering one again now is the soul-searching that one does as one distills the variety of experiences to determine the few major themes that define who one is, what one values most, and what legacy one would like to leave. Numerous topics came to mind, ones that would be fun to prepare and deliver – the molecular basis of good and evil, the importance of diversity, the balance between tolerance and intolerance, where would we be without Darwin, would God be pleased with the box we've put Him in, society as organism, the importance of passion, let's get on with stem cell research … the list goes on. Reflection is fun! Over the months of reflecting, I kept coming back to the theme that has defined my journey here at Ouachita – the importance of the liberal arts education. It's personal, it's professional, and it's the essence of what I am and what I value.

Science is important to me; much more so now than when I was a student. I was too busy learning the amino acids, pointing to the patella before the count of ten, counting balance swings to get that fourth decimal place, and, in 1963, trying to answer a true-false question like "There *may* be life on the moon." I did learn discipline, critical thinking skills, and a world of factual information, but I was too deeply enmeshed in the forest to see the beauty of the trees.

During those same years, I was, of course, required to take several general education courses, as we called them then – history, art, literature, music, religion – some of them courses I would not have elected to take on my own. I did tend to take the more demanding professors. Nothing seemed more boring to me that being required to take an uninteresting course under a professor whose interest in the course paralleled my own. The more demanding professors were usually the more interesting professors. They put a lot of effort into their courses, so they expected us to put a lot of effort into them too. Those courses were to prove very valuable to me. They were valuable to me because they introduced me to new areas of study. They were valuable to me because they gave me different tools for analysis and criticism than the ones I used in science. But most importantly, they were valuable to me because they provided me encounters with good teachers who were willing to be personal with the subject matter, to go out on a limb to challenge me, to reveal their great personal love for learning that vented itself in the French revolution, Beethoven, Van Gogh and *Candid*.

Sometimes the subject did not seem to matter as much as the person using the subject did. A fellow by the name of Ron Hayworth taught the European History course I ***had*** to take. I was not

too excited about such a dry topic as the course began, but Mr. Hayworth made it come alive. He was excited about it. He instilled in us the value of its study, but most of all he demonstrated how passion and scholarship can combine to make any experience valuable. Taking Ron Hayworth was more important in this instance than the topic he taught. As great as he was, I, fortunately, came to my senses before declaring a history major.

Other times the subject and the person combine to produce the magical combination. Such was the case with Miss Faye Holiman. She took this small town Arkansas kid whose interest in the visual arts was less than one on a scale of one to ten and introduced him to the great painters of the western world. Furthermore, she did it with a most scientific approach as we analyzed those paintings for form and substance and style. Little did I realize how many hours I would later spend in museums as a direct result of a course I would never have elected to take on my own.

Admittedly, while I enjoyed these classes, I did not realize their true value at once. I think the analogy of the slime mold would be appropriate here. As is typical of molds, development occurs from spores. The resultant amoeba-like cells go their merry ways, engulfing bacteria and generally behaving as individuals. They do so until the food supply runs short. Then they begin to aggregate in numbers ranging from 1000 to 200,000 cells. The cells of the aggregate begin to differentiate, forming a *single* organism. This organism produces spores, which in turn result in amoeba-like cells and the process repeats itself.

Shortly after my graduation from college, many of these bits and pieces that had been labeled general education began to aggregate along with the science and I began to see things I had never seen before. I suppose I had been so busy consuming courses that each area was sustaining itself. Now I had run out of courses so the aggregation began. The world was so beautiful! How had I missed the explosion of those hickory buds in the spring, the personality of that field mouse, the elegant form that rock had been forced to assume due to the power of water. I slowly began to realize what those people had done for me. They had planted seeds that would turn me on to learning and lead me to develop a sense of the aesthetic.

Webster defines aesthetic as "of or pertaining to the beautiful as distinguished from the useful, appreciation of or responsive to the beautiful in art or nature." What do I find beautiful? A partial list would include
crocus, sticking through the snow
the jousting of humming birds
the replication of DNA
any sculpture by Michangelo
Mozart's Eine Keine Nacht Musik
one of my children asleep in my arms
the visual elegance of a Japanese dinner
the reactions of a carbocation
the gaffs of a Tom Auffenberg
hostas
a performance by Anthony Hopkins
the pattern of evolution
friendship

sitting on a rock in the middle of a mountain stream
the mimicry of a walking stick
the wit of Gary Larson
an essay by Stephen Jay Gould
being in love with my wife
the face of a student who has just understood a difficult concept
an afternoon in the Barnes Foundation Museum
the humanity of Jesus Christ
the mastery of a second language
the beaming visage of a 13-year-old daughter sitting in a Paris restaurant at midnight on a Saturday night
a wintertime hike through the woods
making love on a special occasion
the workings of the immune system
the corporate mourning at the loss of a close colleague
the dedication of a Randall Wight
the crisp feeling of fall's first chill.
the confidence of a 14-year old computer whiz who *knows* he knows more about something than his father

It is no oversight that faculty meeting and Arby's are *not* on the list.

I opened this section by saying that science is important to me. It frames my window on the world. It provides me with a point of reference, a basis for the development of a personal philosophy. It daily offers me some new insight into the marvelous workings of natural systems and the sense of awe that accompanies that insight. There are so many interrelated events that must take place at just the proper time. Each of us begins as a single cell, made from the fusion of one of more than eight million possible sperm types that our fathers can make and more than eight million possible egg types that our mothers can make. There we are in the beginning, a cell brimming with the potential of the ages, of our forbearers encountering the forces of nature. That cell begins to divide into two, then four, then eight, then sixteen, again and again doubling in number and even as it does so those cells begin to differentiate into nerve cells, blood cells, muscle cells, each type developing when and where it is supposed to develop until some nine months later we are born, a free living being composed of trillions of cells of hundreds of types, each working in concert to insure our proper functioning. Even then our development goes on, an especially neotonous one that leads us slowly through puberty to the biologically mature state of adulthood. *What a piece of work is man*!

This entire process is controlled by large molecules seemingly monotonous in their structures. Those DNA molecules are like long chains composed of links of only four types. Yet in using these simple signals in a sort of elaborate Morse code, the magnificent development process occurs. From DNA, RNA is made; from RNA, proteins are assembled. Many of the proteins control the building of all of the other structures as this cathedral takes its form.

All of this building happens with a tremendous degree of accuracy, a marvel of natural engineering. Mistakes do happen. A single small mistake like one typographical error in an

encyclopedia can lead to disastrous consequences for an individual, with disorders like sickle cell anemia, cystic fibrosis or Tay-Sachs disease.

Yet even the mechanism for allowing these mistakes is a masterpiece from God. Without mistakes, there would be no mutations, our genetic variation would be limited, and the process of natural selection and evolution as we know it could not occur.

What a piece of work is man!
How noble in reason!
How infinite in faculty
In form, in moving
How express and admirable
In action like an angel
In apprehension how like a god
The beauty of the world
The paragon of Animals!

Shakespeare wrote these words more than 400 years ago. Still we marvel. The more we learn about man and other living creatures, the more in awe we are of God's work through natural processes. Increased understanding does not detract by removing the mystery, rather it enhances our appreciation.

With this combination of science and aesthetics, I am trying to make a case for the importance of the liberal arts education and the sense of the aesthetics that should be an outgrowth of it. Relative to science, I have two messages – one for the science specialist and one of the non-science specialist.

Kenneth Woodward in an article entitled "The Humanities Crises" stated, "To know the best of what has been thought and written, to be able to think critically, to be morally discerning and aesthetically discriminating are the marks of an educated person ..." Alfred North Whitehead in his essay entitled "The Aims of Education" wrote that "Education is the acquisition of the art of the utilization of knowledge." Neither of these men defined education as the accumulation of facts or course credits. Our purpose in the liberal arts tradition is to train students to be self educating. Whitehead went on to say, "What education has to impart is an ultimate sense for the power of ideas, for the beauty of ideas, and for the structure of ideas, together with a particular body of knowledge which has peculiar reference to the life of the being possessing it." In essence, he is saying that education must be composed of both the general culture that evolves from the liberal arts education and the special knowledge that comes from knowing a certain area in depth. He further states, "The general culture is designed to foster an activity of mind; the specialists course utilizes this activity."

To my science students I would say, it is true that graduate and professional schools demand a strong background in the sciences, either directly as courses required for entrance or indirectly as preparation for the rigors of the discipline there. It is natural for you to want to take every available science course and to complain of requirements that you take courses in other areas, CORE or otherwise. (As you can tell from the tone of my remarks thus far, I urge my students to

make the most of their study opportunities outside of science.) I do not ask you to lessen your pursuit of science, but to broaden your base for that pursuit. Yes, I urge you to take courses that are not required. At times in the future you will be called upon to make critical choices that affect you and others. You owe it to yourself and to the public to arm yourself with the moral discipline and the skills for value clarification that arise from the liberal arts tradition. For learning about values, few strategies can rival the time-honored practice of identifying with characters in literature and history, who, caught in ethical dilemmas, have had to make a choice.

So I tell them to take that course in literature or history, or one in philosophy or religion. Find out what those disciplines have to offer in the way of expanding critical thinking skills. For that matter, there is nothing wrong in taking a course just for the fun of it!

I also encourage them to take people. Take Byron Eubanks or George Keck. When my daughter, Teri, came to campus, she had a list, not one I had given her, but one she had developed on her own, gleaned from conversations with me and with other friends and colleagues. She had to have a course with Tom Greer, Johnny Wink, Randall Wight, Lavell Cole, and Tom Auffenberg. The course didn't matter; the people did. To students, I say find out how the minds of these people work and how that knowledge can improve the working of your own. By all means choose people who demand something of you. If a course is worth spending time in, it's worth working hard at.

I offer them one additional caution. Do not assume you must be in agreement with the tenets of the professor teaching a course in order for that course to be valuable to you. Learn what you can, argue for your viewpoint, be prepared to defend it, to rethink it, even to abandon it in favor of a new model, if necessary. If you do find yourself in agreement with every professor you take, then your education has been severely short-changed. Diversity of opinion is an excellent whetstone for the sharpening of thinking skills and for defining personal positions. You do not have to agree with a Trey Berry to find value in his argument.

A major weakness in the science curriculum in general is that there is so much emphasis put on hard science content – theory, mechanisms, techniques, instrumentation – that too little time is spent on how science relates to society or to you as a person. Oddly enough, these issues are a strength of the CORE science courses that science students are exempt from taking. Our intentions are honorable, but time constraints often rob us of issues we wish to address. Personal contact can and does bridge some of that content, but much of it must be made up by the student's own initiative. We offer suggested readings by Jacob Bronowski, Lewis Thomas, Loren Eisley, Richard Feynman, Stephen Gould, Edward Wilson, and many others.

To non-science majors, I would say that turning you on to literature, music, history, political science or philosophy may be easy because one of them may represent your area of interest. Learn all you can because everyone needs an area of special expertise. Whatever the area, it will provide a framework for your education. The question I often hear from the non-science major is, "Why should I take science? I do not like it, I do not understand it, it is too hard, it will ruin my grade point, and who cares about stem cells anyway?

It is true that if one fails to understand something, one tends to label it as hard and one does not like it. Under the circumstances one complains a lot, studies little, and indeed watches ones grades fall off the scale. Why does this occur?

Let's address the subject of hardness. Why is it hard? Is it hard because the science teacher is an ogre, who is out to fail any student who doesn't feel as affectionately towards science as he does? I think not. Is it hard because conceptually it is beyond the capability of the average student? Again, I think not. I would say to students, look at your childhood. Before you started to school you had mastered already the complex task of language, putting meaning with sounds. You all succeeded. Just after you started to school, you learned to read and to write, that is to correlate sounds with shapes. Now you had to analyze symbols. Again you succeeded. Nothing we can confront you with now will be of greater difficulty that those two tasks that all of you mastered as children. There is no way science can be too hard.

If it is not too hard, why can't you understand it? It can't be the methodology of science because you as children were expert in scientific methodology. Indeed as a group, small children are our best scientists as they systematically go about exploring their world. Children bombard the people around them with questions. Maybe this point is where the problem begins. Adults either do not know the answers or are unwilling to seek out the answers or simply do not want to be bothered. Gradually children stop asking why is the sky blue, why do leaves change colors in the fall, where does snow come from. They get the idea that the answers are not generally known, therefore, they must be hard to know. This problem may be compounded by a grade school teacher, who not comfortable fielding science questions, states flatly that science is too hard for this grade level. Wait until seventh grade, wait until tenth grade; wait until college, and if you are lucky, you won't have to take science at all. Yes, we have some barriers to overcome, but they are cultural ones, not ones of capability.

So, one may agree that it is more of a case of motivation than a case of ability. And try as we may, we in science need to work harder at providing proper motivation. That still leaves the question of value. A student will ask? What good will science do me? My answer: At its best, science will expand your repertoire of critical thinking skills as you are introduced to the methodology of science. It will provide models of natural systems that help frame your personal philosophy. It will introduce you to a basic body of knowledge about man and his interaction with his world, knowledge that will assist you in educating yourself for the myriad of social issues that are and will be confronting you through the remainder of your life – abortion, genetic engineering, reproductive technologies, cloning, energy alternatives, environmental hazards, and many, many more, knowledge that will allow you to understand yourself better – human reproduction, sexuality, genetics, and heredity. It should introduce you to the sheer beauty of nature, of nature's processes, of the intricate complexities and basic simplicities that characterize all matter on earth, living and non-living. In short, it should take its part in making you a well educated person.

Finally, for you my colleagues, I offer a comment from a recent newspaper and two lessons from nature.

Rick Weiss, a science writer for The Washington Post, wrote an article entitled "The Final Frontier" published in last Sunday's Arkansas Democrat-Gazette. Focusing on the Voyager program, he was lamenting the fact that Americans have lost sight of the value of non-applied, curiosity-driven research, that today, to receive funding, everything has to be applied research. Yet many of the technological advances of the past century have been outgrowths of basic research. For example, most of the diagnostic tests that we routinely use in medicine now derived from basic research that had no immediately practical end in mind at the time it was originally conducted. Weiss argues for the support of basic research, "Because our understanding of the world and our support of the quest for knowledge for knowledge's sake is a core measure of our success as a civilization."

Nobel laureate Arthur Kornberg stated, "The age-old aphorism—'Necessity is the mother of invention'--is usually wrong. Generally, the reverse has proved to be true: Invention is the mother of necessity. Inventions only later become necessities! It is crucial for a society, a culture, a company to understand the nature of the creative process and to provide for its support. No matter how counterintuitive it may seem, basic research is the lifeline of practical advances." Curiosity lives. Let's embrace it.

First lesson from nature: the importance of diversity. Nature teaches us this lesson constantly. The greater the diversity of genes in a population, the higher the probability of reacting to changes in the environment to allow survival. A good variation is one that allows individuals to survive to reproduce and pass on those traits to future generations. For example, consider a population of rabbits where individuals vary in fir thickness. Suppose a climate change occurs. If the climate becomes warmer, those with thinner fir have an advantage. For the population, some rabbits adapt, survive and reproduce, in this case the ones with average to thinner fir. Had the climate become colder, the advantage would have been with the rabbits of thicker fir. The important point is that variety must be present in the population to allow adaptation to changing circumstances.

Closer to home, we humans do not mate with our cousins, except in Texas, of course, because the probability of sharing common defective genes make the possibility of birth abnormalities too high. No less a person than Charles Darwin learned that lesson the hard way, having married his first cousin.

As another example, consider a monoculture – square mile after square mile of one particular kind of crop, be it wheat, corn, or pine trees. A particularly virulent pest can wipe out the entire crop in a short period of time. The best defense is a mixture of crops. If one crop fails, others are there to take its place. The variety of crops allows a variety of animal forms to be present. A pest in one crop may well be controlled by an organism originally residing in an adjacent crop. It is a lesson from which we as societies can profit. It flows to us in the form of pluralism. Our subculture gains from other subcultures in our midst. Not only do we learn tolerance and understanding, but we learn new methodologies, new ways of thinking, and, in that milieu, we create better forms within society.

That lesson can even find its way to campus. We are limited at a Baptist institution in the backgrounds of faculty we recruit and in students we attract. Within those limits, we must strive

to maximize the diversity we can tolerate. We do not all need to think alike; and we do not all need to have the same exact beliefs. We *need* creative tension. When we are too much alike, when we are too comfortable with our little world, the winds of change can blow in pests that can devastate our crop overnight. Where will tomorrow's students come from if the monoculture we nurture disappears from under us? And how can we possibly help students stretch and grow if we cannot provide them alternate world views?

Second lesson from nature: it doesn't have to be perfect to work. Consider the bumble bee. Aeronautical engineers will tell us that bumble bees should not be able to fly. The lift ratio of their wings to their body weight is too low. Indeed, graceful fliers they are not. They aren't called bumble bees for nothing. Their landings at the nest are more like controlled crash landings. But they work. If they had to be perfect, we wouldn't have them. What's the lesson for us? Often we have good ideas, but we do not act on them. We want to wait until things are perfect – when we have more time, when we know *all* of the facts, when we don't risk failure. Inertia is a very powerful force. A Joe Nix story comes to mind. A particularly meticulous student was working in Nix's water research lab years ago. She was loading samples into ampoules for digestion before measuring CO_2 levels. She was *very* slow. In an effort to help her see the need to work faster, Nix asked her why she was taking so long. Her reply, "Dr. Nix, I'm afraid I might break something." At that point, Nix picked up a beaker, threw it into the far wall, smashing it to bits. He said, "Well, Rachel, break something!"

So, I say to you, my friends, *break something*.

Thank you.