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We Have Heard It Said: Reflections on Christian Engineering Scholarship



by Murat Tanyel

Abstract

In the Sermon on the Mount, Jesus opens the subject on a number of propositions with “You have heard that it was said...” and continues with “But I tell you...” This pattern is repeated six times on the subjects of murder, adultery, divorce, oaths, “an eye for an eye,” and love for enemies, as the New International Version of the Bible identifies them. Each time that a topic is introduced, a stricter standard than the one widely accepted is proposed. The overall theme that can be drawn from the Sermon on the Mount is that Jesus has higher standards of conduct for his followers. This paper will look at a

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number of issues in engineering scholarship and will search for appropriate strategies that engineering programs and professors at Christian institutions of higher learning may follow.

I. Introduction

One sermon that the late Dr. James Montgomery Boice delivered while I was a member of Tenth Presbyterian Church in Philadelphia made a lasting impression on me. The sermon was based on Mat. 5:21-48. This passage is the part of the Sermon on the Mount that begins with “You have heard that it was said ... but I tell you ...” and ends with “Be perfect, therefore, as your heavenly Father is perfect.” The construction “You have heard that it was said ... but I tell you ...” is repeated, with one minor variation, six times. Each time, Jesus reminds his audience of a widely accepted norm and then demands a higher standard of conduct from his followers. The first iteration (Mat. 5:21, 22) can be rephrased as, “you may agree that murder is not acceptable, but you should not even get angry!” The second appeal (Mat. 5:27-30) may be summarized as “you may agree that adultery is wrong, but do not even subject yourself to a situation that might remind you of it!” In his third appeal (Mat. 5:31, 32), he corrects the notion that the consequence of divorce could be softened with some paperwork by clarifying the uncompromising consequence of such an act. The fourth demand (33-37) is on credibility. Rather than resorting to the name of a higher authority to make one’s word credible at that crucial time when one needs to be convincing, one’s

every utterance should be truthful, establishing a pattern resulting in absolute confidence. The fifth demand (36-42) deals with what was then agreed to be fair restitution (an eye for an eye, or a tooth for a tooth). In fact, rather than seeking compensation, one is to donate to the requester in excess of what is requested. The last demand (43-47) is definitely not the least. First, the audience is reminded of the standard to love one's neighbor while allowing for hate toward enemies. In contrast to that standard, the request is that one love even one's enemies. Boice's sermon pointed out that contrary to the popular belief that Jesus made life easier for his followers by eliminating a complex system of laws, he actually made life more difficult by raising the standards to which his followers are accountable. Boice concluded that the standards to which Christians are called are higher in every aspect of life than those of the society at large. Giving several examples, Boice exhorted the congregation to think critically about our professions and seek God's wisdom in ascertaining what those higher standards might be.

Boice's exhortation struck me in two ways. First, I realized that contrary to the emphasis in popular evangelical culture, life in Christ calls us to higher standards than those of the Old Testament times. At the time, I had come to the Lord relatively recently and was still in the mind frame of celebrating my freedom in Christ, without giving much thought to the responsibilities which that same freedom brings. Second, I realized that my profession is more than just an add-on to my "spiritual" life: it *is* part of my "spiritual" life. His exhortation introduced me to the truth that "all of life is religion," as Boice quoted Abraham Kuyper in a later sermon. At the time, I was getting ready to make the transition from a graduate student to an instructor of engineering. With the expectation that I would stay in academia, I wondered what being a Christian scholar in engineering would mean. To what higher standards (in the world of engineering) would I be called because of my commitment to Christ? More rigor, better mastery of the theory and practice: these were the first items that I thought of as I sat in the pew.

Since then, I have had many occasions to think about my field in the light of Christ's claim on every cubic micrometer of the universe. What

I have concluded is that while the first thoughts that came to mind as I listened to Dr. Boice's challenge were not incorrect, they were too simplistic and far from the complete picture. Whether I will get the complete picture in my lifetime is questionable, but of this I am sure: I should make a continuous effort to reflect on our profession and to reform my view of our profession as the Lord gives me wisdom. To start my reflection, I will review my understanding of engineering, of scholarship, and of engineering scholarship in section II and adopt a list of criteria as a response to the challenge. Section III will entail reflections on

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these criteria. Section IV will conclude my discussion.

II. Definitions: Engineering, Scholarship & Engineering Scholarship

When asked what I do, I answer, in various contexts, "I am an electrical engineer" or "I am an engineering professor" or "I teach engineering." While all of these are true, the most accurate description would be, "I am an engineering scholar." So, what is engineering? What is scholarship? And how is engineering scholarship different from plain engineering?

The Macmillan Contemporary Dictionary [1] defines scholar as a "person having much knowledge and a serious interest in learning and study; learned or erudite person"; it defines scholarship as "knowledge acquired by study; learning; erudition." While these definitions sound very broad, they suggest that scholarship involves an academic setting, usually at a post-secondary institution. For example, Walsh and Middleton's answer to the rhetorical question as to why Christians should engage in scholarship identifies the university as

the location for scholarship “because the university is at the heart of our culture” [2] and is therefore a tactical location from where Christian witness may charge. I should make a parenthetical note here about the term *university*. According to Macmillan [1], a university is “an *institution of higher education*, usually *including* one or more undergraduate colleges and graduate and professional schools with *facilities for teaching and research*, authorized to grant bachelor’s, master’s and doctoral degrees” (emphasis added). A college, on the other hand, is either an institution of higher education that confers degrees or a division in a university that offers a four-year course of study leading to a degree [1]. In other words, a college is a unit, and a university is a collection of colleges (and other schools). With this understanding, the distinction between a college and a university is irrelevant, and whatever can be said for the university is applicable to the college, with appropriate scaling. Therefore, those of us that “teach” at colleges are just as much a part of the body of scholars as university faculty, and Walsh and Middleton’s observation on the university is just as applicable to the college.

Adams defines engineering as “a human activity that involves an interplay between theory, experiment and imagination, in which human beings form and transform nature for practical ends and purposes, with the aid of tools and procedures” [3]. This is a carefully worded definition, which recognizes the dependence of engineering on science—in theory and experimentation—while also transcending it by involving other aspects. It is important to distinguish engineering from science and even applied science. Science is limited to the search for knowledge about reality; it is characterized by analysis or abstraction. Applied science is the pursuit of knowledge with a practical goal in mind [3]. Engineering, on the other hand, adds a whole new dimension: the application of scientific knowledge to produce a new artifact. In other words, engineering may not be practiced in abstraction and must be holistic, “forming and transforming nature.” Having clarified the distinction between science and engineering, I should also acknowledge similarities, such as the cultural aspect of engineering, stemming from the influence of societal institutions, historical traditions, and cultural beliefs and attitudes on the practice of

engineering. As Monsma, *et al*, have indicated, technology (hence, engineering) is not a neutral entity but is associated with a set of beliefs, assumptions, and values—in other words a faith [4].

Engineering scholarship, then, would be the continuous learning of this human activity, or the body of knowledge associated with this activity. Hence, it entails more than the practice of engineering. It also includes the transmission of the body of knowledge and skills necessary for the practice.

As I have noted previously, the engineering scholarship is also subject to scrutiny under Christ’s claim. Fowler observes that scholarship in general requires a “radical” transformation by the renewing of our mind to a worshipful service of the Lord [5]. While Walsh & Middleton point out the strategic importance of scholarship for Christian witness [2], Fowler argues a more fundamental reason for our engagement in scholarship [5]: Romans 12, verses 1 & 2 read “Therefore, I urge you, brothers, in view of God’s mercy, to offer your bodies as living sacrifices, holy and pleasing to God—this is your spiritual act of worship. *Do not conform any longer to the pattern of this world, but be transformed by the renewing of your mind*” [6] (italics reflect my own emphasis). Therefore, those of us that have been called to scholarship can either participate in it by conforming to the patterns in academia that have been established by the “world” or serve God with a mind-renewing transformation in scholarship. It is this transformation that will present opportunities to meet Boice’s challenge. The starting point for this transformation is an examination of the purposes and priorities that currently underlie the practice of scholarship. We must engage in academic activity as long as we are sure that it serves the priorities set by Jesus: love for God and neighbor. As long as those priorities are set (and in that order), we can go about “transformational scholarship.”

Fowler’s seven criteria, which he calls “contours” [5], are helpful guidelines for that scholarship. He suggests that transformational scholarship be critical, constructively relevant, communal, rigorous, intellectually open, culturally open, and modest. The rest of this discussion will be devoted to the application of those guidelines in the field of engineering.

III. We Have Heard It Said, But ...

Scrutiny of our profession under these seven criteria will reveal misconceptions, add to our busy schedules, or simply go against the way we have been conditioned. Each criterion reminds us that there is a better way of going about our business in engineering scholarship. Below is my attempt as an engineering scholar to internalize these criteria.

Critical Observation

One misperception about technology is its “neutrality.” As Adams points out, the adage “Guns don’t kill people, people kill people” is a typical statement about the alleged neutrality of technology or technological artifacts [7]. However, *because* technology “proceeds out of the human experience and is therefore affected by the predispositions and commitments of the human beings who shape it” [8], it will reflect those predispositions and commitments. Furthermore, technology influences human behavior [7], which implies that predispositions and commitments that current technology possesses will help define those of future technology. In short, technology is value laden [4, 8]. Now, Fowler suggests that Christian scholars should be critical in the sense that they subject the foundations of all scholarly endeavor to rigorous review. We should not take for granted the widely accepted normative frame of reference but instead should uncover the core and test it for faithfulness to “normative revelation of the Word of God” [5]. Therefore, we need to be critical of what kind of value is laden on the technology that we intend to use, develop, or profess. Since the misconception that technology is neutral prevails, the danger to be less critical when we study technical subjects is real.

One authoritative text in Control Systems offers, among other reasons for why automatic machines are desirable, the following argument: “Automatic machines are used to increase the production of a plant per worker in order to offset rising wages and inflationary costs. Thus industries are concerned with the productivity per worker of their plants” [9]. Although keeping costs down is an admirable goal, the wording suggests a regard for workers on the level of other

economic factors. It suggests that human beings are indistinct from other resources, an equal candidate, among many “things,” for resource reallocation. Whether the author intended this implication or not, it is nevertheless appropriate to ponder why we study control systems, to reject notions that are incompatible with our worldview, and to check whether the same study is warranted with the proper priorities. One could add, for example, that automatic machines leave people (who would otherwise have to carry out repetitive and mundane tasks) free to serve their God to their full potential. It is the job of the Christian scholar to

One misconception about technology is its “neutrality.”

point out such positions to her colleagues and students wherever appropriate. (One could follow a tangential argument as to whether there exists a mundane job. To state my position succinctly and loosely, I propose that any job at which a person can be easily replaced by a creature less capable than humans is mundane. For example, pulling a cart when there are plenty of available oxen would be a mundane job. On the other hand, pulling a cart when there is no other practical option for that cart to be moved could be a legitimate calling.)

Constructively Relevant Contribution

One often hears critical comments about the “publish or perish” culture that prevails at many research universities. One also hears the disparaging phrase “paper mills” in reference to research laboratories at such institutions. Whereas the criticism for the “publish or perish” culture is appropriate, a response that verges on resistance to publish is not appropriate. The reason often cited for resistance to publishing—that the teaching load at small, teaching-oriented colleges is higher than at larger universities—should be acknowledged but should not stop us from finding appropriate ways of contributing to our field. Publications are a venue by which we can make constructive, relevant contributions in our field. Working toward publishing scholarship ought not to be done at the expense of our Christian calling as classroom

teachers. However, scholars ought to see constructively relevant contributions as a part of routine work, just like giving finals. In the same way that giving finals, while not a part of every class, is an integral part of a course, contribution to scholarly journals, while not a part of the routine work of scholars, has to be an integral part of their work.

Another perceived block to publications in engineering programs at small institutions is the lack of funds for equipment. Indeed, research-caliber equipment in engineering is expensive; however, one does not necessarily need frontier research in order to gain insight to share with the greater engineering world. Conferences like the ASEE (American Society for Engineering Education) Annual Conference and Exposition or the FIE (Frontiers in Education), cosponsored by IEEE (Institute of Electrical & Electronics Engineers) and ASEE, are dedicated to educational innovations with peer reviewed proceedings. In fact, those proceedings include a number of papers that describe *inventions* of inexpensive alternatives to expensive equipment for laboratory instruction.

Communal Participation

Fowler asserts that the contribution needs to be communal, even going beyond traditional disciplinary boundaries. This assertion goes against the grain of academia, as we are trained to be individualistic. The more research we engage in, the more unique we are expected to become, having studied more and more an ever diminishing corner in God's creation. This individualistic training, coupled with a competitive environment, predisposes the academic endeavor to a very non-communal activity even though, ironically, we profess that engineering involves teamwork. Contrary to the usual expectations of academia, therefore, my colleagues and I in the engineering department encourage teamwork for projects. Yet this effort can be improved as our project teams rarely go beyond the engineering department.

Rigor

My first reaction to Boice's challenge described in the introduction is my demand for technical rigor. Indeed, I try to instill a yen for rigor in the young

scholars with whom I work. As a matter of fact, Fowler's position that our faith does not allow for sloppy work would resound with all my colleagues. Here, then, is the challenge for all educators: Van Dyk reminds us that the primary task of a Christian educator is to encourage the students to develop their potential fully to do the task that God has prepared for them [10]. While we must not tolerate sloppiness, this intolerance must exhibit itself in a gentle and encouraging demeanor.

Since engineering is an interdisciplinary subject, holistic engineering practice will entail the combination of many fields of study. We should therefore expect an appropriate level of rigor from the engineering students' overall curriculum. Adams warns us that a two-cultures approach (technical vs. humanities and social sciences) is problematic in undergraduate engineering education [3]. While mere additions of courses might be helpful, a positive attitude among us professors toward humanities and social sciences, together with an effort to emphasize the holistic nature of engineering, will be more effective in strengthening the engineering curriculum. Nevertheless, we should not shortchange the engineering curriculum to comply with the prevailing winds of decreasing requirements.

Intellectual Openness

We should be ready for scrutiny from all our colleagues, whether they share our Christian convictions or not. We may regard intellectual openness a scholarly form of "always be[ing] prepared to give an answer to everyone who asks [us] to give the reason for the hope that [we] have" (1 Peter 3:15) [6]. Submission of our programs to accrediting bodies, submission of our publications to peer reviewed journals or conferences, and submission of our products to independent testing are ways in which we can be open to intellectual scrutiny.

Cultural Openness

We must be ready to learn from other cultures. Our scholarship will not be genuinely transformational if it aims at only informing others. We must recognize that those from other cultural traditions have valuable insight that will inform and challenge us. In one of my electronics classes, I use a

book on environmentally conscious electronic design [11]. As the title *Green Electronics / Green Bottom Line* suggests, the book is written from a humanistic point of view. The author's intention is to preserve the earth for future generations and, while doing so, show to those who are only concerned about the finances that it is prudent to be environmentally conscious. This particular viewpoint leads to a valuable discussion about why we do what we do. I also take this opportunity to indicate that the main distinction between Christian and non-Christian endeavor, however noble the endeavor may look, is the motivation.

Modesty

Fowler suggests that our scholarship must be modest. We, the engineering educators, must be doubly cautious that neither we nor our students buy into the notion that technology will solve all the problems of the world. Mottos like "the difficult we do at once; the impossible takes a little longer" may help boost morale, but we must be extra careful not to instill an arrogant attitude in our students.

IV. Conclusions

That sermon I heard years ago is still with me. I have taken this opportunity to wonder what it is that makes Christian engineering scholarship more challenging and to wander through my field to look for ways to improve. During that wandering, I have found Fowler's criteria for transformational scholarship to offer valuable guidelines for a reformational path. One question still haunts me: What is so difficult about checking off a few criteria—do not the pagans have any criteria? And the lesson I want my students to see from the study of Goldberg [11] keeps rising in my head: it is not necessarily what we do but why we do it that makes the difference between a rebellious and an obedient response. If given a suitable incentive, the world will do right. As is demonstrated [11], the world will figure out ways to clean up the environment and keep it clean while thumbing its nose at the very Creator who told us to tend His garden. It is the state of the heart that distinguishes between two people performing the exact same

procedure, one who is storing up earthly treasures and one who is storing up heavenly treasures. Furthermore, our sovereign God will accomplish His purposes in spite of, or even through, those that thumb their noses at Him. Therefore, while we ought to strive for perfection in our scholarship, we must never lose sight of the reason for our activity. We must never let these guidelines become an end in themselves. Since we limited creatures so easily and conveniently get so preoccupied with whatever we are happily engaged in that we fall in danger of idolizing it, this is the ultimate challenge: that while we strive for excellence in our scholarship, we never lose the sight of the fact that our scholarship is to give glory to God.

ENDNOTES

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