Should Bioengineering Graduates Seek Employment in the Defense Industry?

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They say that the difference between a mechanical engineer and a civil engineer is that the mechanical engineer develops weapons whereas a civil engineer designs targets. The implication is that some engineers are involved with building peaceful infrastructure whereas others contribute to destruction. This brings to mind the question: what is the proper role for engineers in the creation of weapons and defenses against them? In particular, should engineers specializing in biology or medicine be involved in the defense industry? After all, bioengineers are supposed to be builders or healers rather than warriors or destroyers.

I was reminded of this question after reading the article entitled "Universal Conscription as Technology Policy" by Brad Allenby and Mark Hagerott in the Winter 2014 issue of the National Academy of Sciences *Issues in Science and Technology* (vol. 30(2): pp 41-46). The thrust of their article was to argue for the reinstatement of universal mandatory conscription (the draft) among the U.S. young men and women. Some of their main points were that weapons of war have lately become very highly technological, and we need an influx of savvy young people to run them, that the all-volunteer military is becoming increasingly isolated from civilian life, and that the drastic nature of war cannot be appreciated as well without a more widespread populace experiencing it. Whereas I agree with all of these points, and have long thought that universal service to the country would have the beneficial effects of adding discipline to young lives, improving appreciation for military service, infusing the military with new ideas and attitudes, providing useful occupational training for some in need of practical education, and would dampen civilian support for adventuresome military interventions, I don' t believe that universal military service can find enough political support to be enacted any time in the foreseeable future.

As a veteran of the Vietnam war, I was originally a reluctant supporter of the war, but developed a decidedly anti-war outlook after I witnessed what war really means to those who participated and those who, through no fault of their own except that they happened to live there, were caught up in its repercussions. War, I am sure, may be justified only in extreme circumstances, and maybe even not then. So, it is, then, that I had taken a negative stance against recommending to my students that they find employment with the many defense-related agencies located in my home state of Maryland.

We have in Maryland and nearby states numerous military facilities with research and development activities, the headquarters of the National Security Agency, and other Department of Defense governmental offices. All have engineering openings with comfortable salaries and locations close to many of the families of our students. So, the attraction of these employment opportunities is not inconsequential.

Nevertheless, many of our students are what one would call idealistic and interested in improving lives. They do not talk about destruction and hegemony. Examples and projects included in our classes reinforce this idealism directed toward using their engineering skills for beneficial improvements rather than toward the opposite. They learn about ethics and ethical

considerations as guides to make decisions that are both moral and supportive of the common good.

It is for this reason that I have changed my mind on this issue. I have decided that it would be good if more conscientious engineering graduates find employment in the defense industry. If we can't have civilians spending a few short years of their lives in the military, as would be the case with universal conscription, then we can at least bring ethical and constructive attitudes to the tools of war. We need engineers with deep ethical beliefs to question whether it is good and right for an operator sitting comfortably behind a console in an environmentally-controlled location to control a drone intended to kill people thousands of miles away. We need engineers to realize the broader implications of the weapons they help to design in order to place limits on their use, if need be. We need people of conscience to be aware of the possible terrible repercussions of military actions, and to be able to give the military the tools they need to perform humanitarian activities. We need knowledgeable engineers to temper radical tendencies that could be developed by an isolated military.

Engineers specializing in biology and medicine are particularly needed because the rapid advances of knowledge in these fields are opening up new opportunities both for good and bad applications. Engineers are needed who can develop new weapons and countermeasures within an ethical context, and resist pressures to use their knowledge base to develop unethical or illegal bioengineering systems. Biological or psychological warfare can have far-reaching consequences. Our engineers should be involved in their development.

In October 1994, the famous astronomer Carl Sagan addressed an audience at Cornell University. Behind him on a giant screen was projected a small point of light that he identified as a photograph of our planet Earth taken from the spacecraft Voyager looking back as it was leaving our solar system. Sagan directed the audience to concentrate on that small, lonely dot in the midst of a vast darkness, and spoke:

"Look again at that dot …On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives …

The Earth is a very small stage in a vast cosmic arena. Think of the rivers of blood spilled by all those generals and emperors so that, in glory and triumph, they could become the momentary masters of a fraction of a dot. Think of the endless cruelties visited by the inhabitants of one corner of this pixel on the scarcely distinguishable inhabitants of some other corner; how frequent their misunderstandings, how eager they are to kill one another; how fervent their hatreds.

Our posturings, our imagined self-importance, the delusion that we have some privileged position in the universe, are challenged by this point of pale light. Our planet is a lonely speck in vastness, there is no hint that help will come from elsewhere to save us from ourselves …

There is perhaps no better demonstration of the folly of human conceits than this distant image of our world. To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known."

This is the message of peace that I would hope that my graduates could bring to the military and to society in general: that we must be strong in defense but peaceful in intention, that as bioengineers we must act ethically and in harmony with each other and with the most beautiful world that we call home.