Finding a Prophetic Voice in the Biotech Century

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Introduction

By all accounts, we have entered a new age of biotechnological expansion. Futurists almost universally claim that the 21st century will be what Jeremy Rifkin has called "The Biotech Century."[1] More recently, Vanderbilt University professor of business management, Richard Oliver, has announced that "The Bioterials Age will complete the triumph of economics over politics, which was begun in the Information Age. It will unleash forces stronger than nationalism and more powerful than the combined armies of the world."[2] Nations around the world are concerned about the long-term impact of biotechnology on our food products. For instance, on 29 January 2000, delegates from more than 130 nations adopted the first global treaty regulating trade in genetically modified products.[3] Interestingly, the United States's biotechnology industry opposed many of the regulatory policies included in the Montreal Treaty.

The future portends great benefits from biotechnologies like genetic engineering, cloning, cybernetics, nanotechnologies, and a litany of neologisms yet to be invented; but the future may also portend human tragedy, a loss of human dignity, and an increasingly hostile world to concerns that transcend the purely materialist world of contemporary scientific research.

Are Christians even aware of these issues? Certainly some are. Does the church have anything to say about biotechnology? If not, why not? If so, what? Can we afford not to speak to these issues? Can we afford to misspeak on these issues? These are sober questions for Christians who are witnesses to the dawn of the biotech age.

In this article I will attempt both to show the evolution of biotechnology as a worldview (i.e., as a way of seeing the world) and to underscore the need for the church to exercise her prophetic voice. Finally, I will make several suggestions for churchly engagement in biotechnology.

The Biotechnological Explosion

While a little over a decade and a half ago it was unclear whether or not there was a biotechnology industry as such, few would question that today biotechnology is big business. In 1984, the Office of Technology Assessment (OTA) opined: "It is important to recognize that there is no 'biotechnology industry.' Biotechnology is a set of technologies that can potentially benefit or be applied to several industries."[4] Nevertheless, contemporary participants in biotechnology most certainly view their work as part of a recognizable industry or, even, "metaindustry."[5] Says Nobel-prize-winning geneticist Arthur Kornberg,

> Genetic engineering and associated technologies have brought about the most revolutionary advances in the history of biological and medical science. Applications of this genetic and chemical knowledge created a biotechnology industry with vast economic and social potential. The biologists and biochemists who

> invented these new technologies in their academic laboratories came to the forefront of entrepreneurial ventures to use this knowledge to develop drugs and devices for the diagnosis, prevention, and treatment of disease.[6]

Kornberg points out that by 1993 there were nearly 1,300 biotechnology firms in the United States, employing over 80,000 individuals, with sales of $6 billion annually.[7] The Biotechnology Industry Organization (BIO), whose purpose it is to lobby legislators on issues related to the industry, presently maintains an office in Washington, D.C. BIO represents over 600 biotechnology companies, academic institutions, state biotechnology centers, and other organizations in 47 states and more than 20 countries.[8]

In the United Kingdom alone there are over 500 public and private biotech organizations. Oliver also observes that "Others with a sizable per capita biotech industry include, Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, The Netherlands, Norway, Poland, Spain, Sweden, and Switzerland. Belgium has some of Europe's most entrepreneurial biotechs, while Denmark has been a leader in developing biotech regulations."[9]

In sum, there are over 2000 biotechnology organizations in the United States and more than 1000 in the European Union. Investment in U. S. biotechnology alone increased 12 percent in 1997, from $83 billion to $93 billion. Biotechnology is one of the fastest growing business segments around the globe.[10]

Biotechnology may be, as has been suggested, a set of techniques, but on the threshold of the third millennium, we must also acknowledge that biotechnology is a recognizable, market-driven, corpus of businesses whose primary purpose is to make profits.[11] As Colin Ratledge stated, "Biotechnology is not then a science: it is a means of applying science for the benefit of man and society. In practice, this means that biotechnology is used to make money—or in certain instances—to save money."[12] Biotechnology promises to remain quite lucrative. *Genetic Engineering News* noted in December 1995 that U. S. sales of biotechnology products are expected to grow at an average annual rate of approximately 12 percent, from $10 billion in 1996 to $32 billion in 2006.[13] This neo-entrepreneurial science did not arise *ex nihilo,* however. The roots of biotechnology reach deep under the substrata of the human, and especially the Western, drive for invention and innovation.

Sheldon Krimsky of Tufts University maintains that "biotechnology has been part of the human repertoire of techniques since the dawn of civilization."[14] Biotechnology, "any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants or animals, or to develop micro-organisms for specific uses,"[15] has been part of the human experience since the Sumerians (7000 BC to 5000 BC) used microbes in beer-making and the Egyptians (4000 BC) invented leavened bread. Nevertheless, the ascension of biotechnology is of relatively recent vintage.

"Biotechnology" has a rich and varied, though contemporary, history. Robert Bud, historian with The Science Museum of London, describes the origins of biotechnology in his thorough treatise, *The Uses of Life: A History of Biotechnology*.[16] "Today," says Bud, "the best-known definition [of 'biotechnology'] is perhaps that spelled out by the Organization for Economic Co-operation and Development (OECD): 'biotechnology is the application

of scientific and engineering principles to the processing of materials by biological agents to provide goods and services.'"[17] Biotechnology's recent incarnation had its beginnings in the period surrounding World War I with the development of zymotechnology in the brewing industry. Yet, it was not long until zymotechnology evolved into biotechnology in the quest to engineer nature "to provide goods and services." Bud locates the first reference to the cognates of "biotechnology" in the use of the German word *"Biotechnik"* by Gustav Tornier in 1901 at the *Internationalen Zoologen-Congresses zu Berlin* (World Zoological Congress in Berlin). Tornier described living organisms as *"Bioten"* and the manipulation of living organisms technologically as *"Biontotechnik."*[18] This terminology was adopted by biologist Wilhelm Roux and found its way into his 1910 dictionary, *Terminologie der Entwicklungsmechanik der Tiere und Pflazen*.[19] One of Roux's students who immigrated to the United States, Jacques Loeb, innovator of parthenogenesis, hoped to discover a *"Technik der lebenden Wesen"* (a technology of living matter).[20] Bud comments on Loeb: "Loeb himself was cautious, yet to him, as to Roux, the lines between the animate and inanimate were arbitrary."[21]

Not until the second decade of the twentieth century was the term *"Biotechnik"* coined officially. Both an Austrian social critic, Rudolph Goldscheid, and botanist-turned-philosopher, Raoul Francé, used the term in 1911 and 1918 respectively. While it is beyond the scope of this present work to distinguish the ways these two harbingers of biotechnology defined *"Biotechnik,"* it is important to note that its use was not entirely univocal.[22]

In 1921, influenced by the ideas of Francé, Patrick Geddes introduced the term "biotechnic" to the English-speaking world. Though he made use of the notion with increasing frequency, never giving attribution to Francé, Geddes never took credit for originating the term, according to Bud.[23] A botanist by training, Geddes began to be interested in the evolution of societies; in particular, the evolution of urbanization and industrialization. Even before the turn of the century, Geddes borrowed the archaeological taxonomy of epochal identification and described the industrial age as divided between the "paleotechnic" and "neotechnic" eras. The paleotechnic age was realized by the invention of the coal-burning steam engine. Contrariwise, the neotechnic age was realized by the cleaner and pervasive use of electricity. A future epoch in human civilization Geddes described as the "geotechnic" age; an age in which "technology would harmonize with the earth's needs."[24] Geotechnics had a decidedly ethical dimension for Geddes. As he put it, "Geography is descriptive science (*geo* earth, *graphy* describe); it tells what *is*. Geotechnics is applied science (*geo* earth, *technics* use); it shows what *ought to be*."[25]

Bud discovered that though Geddes had referred to the concept of biotechnics as early as 1917 with the publication of *The Coming Polity,*[26] it was not until 1923 that Geddes defined "biotechnics" as composed of "agriculture, medicine, hygiene, and eugenics."[27] The publication in 1926 of the *Encyclopaedie Britannica* Supplement was, however, the occasion for the popularization of the term "biotechnic." There, J. A. Thomson attributed the origin of the word to Patrick Geddes and "explained that it meant the use of biological organisms for the benefit of man."[28] Biotechnics as a concept

continued to evolve through the work of J. B. S. Haldane, Julian Huxley, Lancelot Hogben, and Lewis Mumford.

In his monumental study, *Technics and Civilization*,[29] Lewis Mumford, a devotee of Geddes, chronicled four stages in the history of human technological invention. Each stage represents phases in the effort to utilize special resources and raw materials in the development of the so-called "machine age." The first stage was what Mumford called the age of eotechnics—"the dawn of the age of modern technics."[30] Eotechnics embodied the era of water and wood, when human production consisted in the manipulation of the forces of nature. Windmills and waterwheels harnessed the energy that had been the objects of veneration and terror: wind and water. Wood was used for building in the eotechnic era, but more importantly, during this period all three (wind, water, and wood) were combined to manufacture boats and ships.

The next phase, the paleotechnic phase, resulted in the industrial revolution. Coal and iron were employed to produce the energy requisite for mass production. Mumford maintained that the paleotechnic age reached its apogee in "the great industrial exhibition in the new Crystal Palace at Hyde Park in 1851: the first World Exposition, an apparent victory for free trade, free enterprise, free invention, and free access to the world's markets by the country that boasted already that it was the workshop of the world."[31]

The third stage was the neotechnic era. During this phase in the evolution of the machine, electricity became a new form of energy. At the same time, the neotechnic stage saw the invention of a host of new synthetic compounds, including celluloid, bakelite, and synthetic resins. Furthermore, the high level of conductivity required by the use of electricity led to the exploitation of copper and aluminum. The neotechnic age also celebrated the invention of the internal combustion engine, a revolutionary innovation indeed.

Finally, Mumford pointed to what he called the "biotechnic period, already visible over the edge of the horizon."[32] This stage would be characterized, he argued, by a "completer integration of the machine with human needs and desires."[33]

Mumford further argued that the machine "devaluated" rarity (because machines could produce a million copies of the master model), age (because machines placed emphasis on adaptation and innovation), and archaic taste (because machines established new standards of value). The upshot of the evolution of the machine, for Mumford, meant that "we cannot intelligently accept the practical benefits of the machine without accepting its moral imperatives and aesthetic forms."[34] Whether Mumford was doing the work of social theorist or cultural prophet is beyond the scope of this present essay. In any case, he seems to have been prescient in his prediction that "technics, instead of benefiting by its abstraction from life, will benefit even more greatly by its integration with it."[35] The emergence of biotechnology is a case in point.

Bud maintains that the publication of *Technics and Civilization* was a major impetus in the development of biotechnics in the United States.[36] By 1936, a research and educational program in "biological engineering" had been initiated at the Massachusetts Institute of Technology. Less than a decade later, the University of California at Los Angeles and the Univer-

sity of California at Berkeley had engineering programs specializing in various "technologies."[37]

Simultaneously, following World War I, industrial microbiology saw significant expansion. Japan, one of the most biotechnologically advanced societies in the world, was producing ethanol as a substitute for oil by 1935 and after World War II, the United States began producing pharmaceuticals as the age of antibiotics evolved.[38] During this epoch, biotechnology was largely constrained by the boundary conditions of nature. Yet, clearly a novel and powerful industry was under cultivation. "The close links between medical care and chemical engineering were consolidated by wartime discoveries of the microbial antibiotics, above all penicillin."[39]

The union of medicine, engineering, and agriculture produced the modern biotechnology industry. By 1947, "biological engineer" and "biochemical engineering" were neologisms gaining increasing frequency in the literature. By the mid-1960s, graduate programs in biochemical engineering had been developed in at least five U.S. universities. These programs trained researchers for the emerging pharmaceutical and food industries. The era of bioengineering was in its ascendency. Soon, chemical engineering would be seen as the preeminent method of "inquiring into the nature of biological systems themselves."[40] Inquiry would lead rapidly to manipulation.

The marriage of engineering and medicine yielded fertile ground in which to cultivate this growth industry. The 1970s witnessed the development of the new genetics and provided a novel field for application of the techniques that could, by then, be called, "biotechnology." In its 1984 report to Congress, *Commercial Biotechnology: An International Analysis*, the Office of Technology Assessment opined,

> In the past 10 years, dramatic new developments in the ability to select and manipulate genetic material have sparked unprecedented interest in the industrial uses of living organisms. Following the first successful directed insertions of foreign DNA in a host micro-organism in 1973, scientific researchers in the United States and other countries began to recognize the potential for directing the cellular machinery to develop new and improved products and processes in a wide diversity of industrial sectors.[41]

By the 1980s, then, the commercialization of biotechnology was seen as critical to the fortunes of the United States. John H. Gibbons, former director of the Office of Technology Assessment, said in the same report to Congress,

> A well-developed life science base, the availability of financing for high-risk ventures, and an entrepreneurial spirit have led the United States to the forefront in the commercialization of new biotechnology, but continuation of the initial preeminence of American companies in this field is not assured. Japan is likely to be the leading competitor of the United States, followed by the Federal Republic of Germany, the United Kingdom, Switzerland, and France.[42]

The narrative of biotechnology is varied and complex. Nevertheless, after tracing the lineaments of this history, several preliminary observations seem warranted. First, the evolution of biotechnology is part of a larger historico-cultural revolution(s). Mumford accurately locates the biotechnic age as the culmination of a series of pre-industrial and industrial revolutions. Second, the "machine" meta-

phor became a powerful conceptual apparatus for the biotechnological revolution. Third, a shift in the mode of valuing living things occurred during this period. The engineering model applied to biology contained an implicit paradigm shift in the way organisms, tissues, cells, and genes were valued. In short, these and other intellectual developments of modernity set the stage for the pervasive materialism of our own era.

Finding a Prophetic Voice

The corporate and visible church plays an extraordinarily critical role in the world. As ambassadors of Christ, those who are called by his name are to represent him in all of his offices. Confessional churches have universally understood the offices of Christ to include the offices of prophet, priest, and king.[43] As prophet, Jesus reveals the word of truth, the word of God, to expose and inform our ignorance of God's will and way. As priest, the Lord Jesus was both the final sacrifice and sacrificer for sins, offering up his own sinless life as a propitiation for our transgressions. As king, Christ is Lord to rule over and protect his people. He alone is Sovereign—a benevolent dictator—and owns the right to rule over the universe, including every human being. The ambassadorial role of the church means that the church also functions in the three-fold offices of Christ. He is the head, the church is his body, mystically and vitally joined to him in living union.

Dutch theologian R. B. Kuiper has put it this way,

> Organizations have officers. The church, too, has its officers. However, at this point, as at so many others, appears the unique glory of the church. Whereas in other organizations a limited number of persons is wont to hold offices, in the church every single member is an officer. Nor is that the whole truth. There are in the church three offices. They represent Christ, the Head of the church, as prophet, priest, and as king. Now each church member holds not merely one or even two of these offices, but all three. Every single church member is at once a prophet, priest, and a king. That surely spells glory. [44]

Not only do individual members serve in these three-fold offices, at one and the same time the people of the covenant, namely, the church, functions as prophet, priest, and king. Under this biblical/theological schema the role of the church in the world, including its role in biotechnology, may be understood. For the purposes of this article, I will explore only the prophetic role of the church with respect to biotechnology.

The prophet is sent from God, to speak on behalf of God, as God's representative to his own people. In his magisterial volume on Old Testament theology, Paul House maintains that " . . . God's prophets are sound interpreters of the Law, faithful carriers of divinely revealed future events and accurate mediators of God's will."[45] Like the prophets of old, the church, in its prophetic ministry, functions as both forth-teller (proclaimer) and foreteller (predictor) of the Word of God. Just as it was the role of the biblical prophets and of the Lord Jesus Christ Himself to speak only what God had said (John 8:26, 28; 15:15), so the church is to communicate God's truth.

Through its prophetic ministry the church occupies a unique place in the social order. By submitting to and communicating the word of truth, Christians may provide a unified and ubiquitous voice in the world. The church proclaims the true and authoritative Word of the

living God, the Creator of the universe. While the church herself is not infallible, she does proclaim the infallible Word.

For instance, God's revelation accounts for human origins and the unique nature of human beings (cf. Genesis 1-3). Even more impressively, God's Word accounts for the experiences of life and death and the otherwise inexplicable nature of the human condition (e.g., the thirst for human relationships and the sinfulness of humanity). Thus, when Christians claim human life is the result of the special creative work of God who fashioned us in his own image and likeness (Genesis 1:27), they appeal to a transcendent authority, namely, biblical revelation. Rightly interpreted, the Bible alone provides a reason to treat human beings with genuine dignity and provides a rationale for the sanctity of human life. Every human being—unborn, born, disabled, healthy, unhealthy, or aged—possesses sacred value because he or she is made by God in his own image.[46] The value of human life is not measured functionally, as though humanness is merely the possession of a set of faculties such as reason, volition, or awareness. Similarly, the value of human life is not measured by social worth or utilitarian criteria, as though it were valuable because other humans value it. Rather, the value of human life is measured ontologically (i.e., by the kind of beings we are). Human life possesses sacred value by virtue of what it is, or, more appropriately, who humans are and whose they are.

In its prophetic role, therefore, the church declares to the world that every human being owes his or her existence and unique value to the God who has made them. The church, basing its anthropology on the authority of the word of the sovereign Lord, elevates human life—the crown and glory of God's handiwork (Psalm 8). Hence, one of the prophetic responsibilities of the church is to declare the sanctity of human life.

The church also has a unique role in its prophetic ministry as fore-tellers of truth. A commitment to scriptural authority yields an obvious predictive power to the church. The church may proclaim on the basis of God's authority that, for instance, sinful choices have deleterious consequences. "A man reaps what he sows" (Gal 6:7b). Believers can predict accurately that when any precept, principle, or virtue revealed in Scripture is violated, tragic results will occur. When one violates God's ideal for human sexuality—one man, one woman, one flesh, for life—the consequences are disastrous. The dissolution of the family, the AIDS epidemic, and the trauma of divorce are the results of ignoring the truths of Scripture. Members of Christ's church could (and did) predict, generally speaking, these awful tragedies and warned society that these consequences would surely follow disobedience.

Believers can predict or inform contemporary society that the answer to teen pregnancy and the solution to the spread of sexually transmitted diseases is not found in a foil condom wrapper. The Bible declares unequivocally that sexual intercourse outside the boundaries of monogamous heterosexual marriage will result in insuperable grief and sadness. The church is obligated, as part of her prophetic ministry, to continue to inform the world, including policy-makers, about what God has said and to provide creative means for abstinence-based sex education even if the government insists in promulgating its destructive policies.

Furthermore, through its prophetic

ministry the church can predict that blessing ultimately will follow adherence to God's revealed norms. When a society respects the sacred value of human life, for instance, all human experience is enriched and ennobled. The world contains more compassion and deeper concern for hurting persons when, for example, persons act in accord with the Samaritan imperative (Luke 10:30ff) than when individuals adopt an "everyone for himself or herself" mentality.

We must not appear to be too simplistic. Because we live in a fallen world, sometimes temporally bad consequences follow even the best intentions. Even this is foreseeable when the human condition is viewed in the light of biblical theology. Knowing that human nature is fallen gives the church a potent predictive power. In some cases, at least, the potential for evil uses of otherwise good technologies can be controlled if society takes seriously the doctrine of human depravity. Take the case of genetic research. The relief of some human suffering and the cure of a few diseases has already resulted from the Human Genome Project. Because of the church's understanding of the human propensity to sin, however, the church can predict that, unless restrictions are adopted now, the information gained from the project will be used to harm many individuals.[47] Genetic information already has been used to discriminate against persons (e.g., in the eugenics movement earlier in this century in America,[48] in the Jewish holocaust and the Nazi experiments,[49] and in sickle-cell screening in the 1970s[50]). Since human nature has not changed, the church can foresee abuse in the future, unless scriptural norms are followed.

Finally, since the role of the prophet was first and foremost to declare the word of the Lord to the covenant people (the church), she will mount a massive educational ministry to help Christians understand biotechnology from a Christian worldview perspective, if she would be obedient to her appointed role. That is to say, since all truth is God's truth, and since we live in a world that is facing the brave new world of biotechnology, Christians have an obligation to understand how God's revelation applies to those technologies. This will mean that seminaries will have to equip ministers to address the ethics of genetic engineering, gene therapy, transgenics, xenotransplantation, stem cell research, and a growing number of issues. Sadly, most seminaries provide only very limited opportunities to address these issues. Yet, these are, and will increasingly become, the context for thorny pastoral problems. Already pastors are being asked to counsel their members regarding artificial reproductive technologies. But few pastors are prepared to help because they find themselves uninformed not only about the technologies but also about how to think about them.

Additionally, through her prophetic ministry the church must develop a Christian mind on these issues through her regular educational ministry. Every church member has a stake in the biotechnology revolution. Bioengineered plants and animals are sold in grocery stores and markets, often without labeling. Gene therapy will increasingly become the standard of care for many illnesses. Soon, attempts will be made to create biochips for downloading information stored in the human brain. Nanotechnology will create machines the size of molecules to perform complex functions and microsurgery inside the human body. In sum, not only

is biotechnology remaking the world, but it may remake human beings. Unless there is a context for Christians to discuss these technologies within the framework of a biblical ethic, there is no hope that they will be able to make informed decisions about the use of these technologies.

Finally, through her prophetic role, the church must help shape public policy related to biotechnology. The list of technologies is daunting. Richard Oliver mentions just a few of the technologies scientists are working on:

• Creation of life in a lab.

• Predetermination of the sex of children and their genetic makeup.

• Pharmagenomics, which directs and tailors drugs to individual genotypes.

• The ability to "program" out of human genes the propensities to contract various diseases and illnesses.

• Genetically derived therapies for the prevention and cure of most cancers, heart disease, AIDS, and other diseases, including new strains of vaccine-resistant ones such as malaria.

• Repair of damaged brain cells and spinal cords.

• Production of proteins that fight infections or treat problems such as growth deficiency.

• Mass production in a lab of at least six U. S. Federal Drug Administration (FDA) approved monoclonal antibodies, which, when injected into a patient, hone in on the antigens that populate the surface of cancer cells.

• The ability to clone, or duplicate, mammals including humans.

• Control of aging and obesity.

• Animals that grow replacement organs for humans who die before getting a transplant organ from a human donor (about 50 percent of current patients are in this category).

• Inexpensive "transgenic" vegetables that will produce vaccines capable of inoculating the world's poor against diseases that have ravaged them for centuries.

• A tree that will grow in a few years instead of 50 or 100, fundamentally changing the economics of everything wooden.

• A natural plant that will produce a substitute for the raw materials in plastic, potentially impacting the entire oil and petro-chemical industries.

• The world's strongest fiber and the world's most powerful adhesive produced by insect and animal "factories."

• A biological, protein-based computer thousands of times faster than today's fastest.

• BioElectronic noses, tongues, ears, and heads to test industrial and consumer goods and provide new levels of real-time health care assessment.

• BioSynthetic skin, blood, and bone, as well as the "precursor" human master cell that can be directed to grow new bone and cartilage.

• New materials for products and packaging that repair themselves and adapt to the environment.

• New materials that swell and flex like muscles to replace human muscle and machine power in factories.

• New materials that repel any ink, paint, or stain.

• New materials that shape and reshape themselves for a huge variety of industrial, consumer, and health care applications.

• New energy sources that are efficient, pollution free, and almost free.

• New paints that capture and store the energy of the Sun in cold weather, and repel its heat in hot weather, reducing energy costs and pollution associated with

heating and cooling.

• A "smart mouse" that points the way to eliminating aging in humans.[51]

Each of these technologies will require laws or policies to regulate or, in some cases, outlaw their use (e.g., cloning a human being). Through coalitions and agencies like the Southern Baptist Ethics and Religious Liberty Commission, Christians have both an obligation and opportunity to help frame public policy and make laws related to biotechnology. Nevertheless, relatively few Christians and even fewer churches are informed about these issues. What is more alarming, they do not know how to impact the public policy process. This must change if the church is to be a faithful prophet to her culture and to her members.

The following are my recommendations for Prophetic Ministry in the Biotech Century:

• In order to more faithfully fulfill her prophetic role, churches will have to make it a priority to teach Christian ethics in general and bioethics in particular.

• Pastors should preach and teach biblical anthropology since all of these technologies impact human beings positively or negatively.

• Seminaries must carve out either curricular or extracurricular opportunities for students to learn about the developments in biotechnology and be provided skills to interpret those technologies from a Christian worldview perspective.

• Church educators must reprioritize the educational ministry of the church, giving increased attention to bioethical issues, including biotechnological issues.

• Southern Baptists should increase funding and personnel resources to agencies and commissions that have a direct impact on biotechnology policy, including international policy work.

• Christian students should be encouraged to pursue vocations in biotechnology and the sciences. Individuals can impact biotechnology at the local level by bringing their convictions to bear in their own vocations.

We must not retreat!

ENDNOTES

[1]Jeremy Rifkin, *The Biotech Century: Harnessing the Gene and Remaking the World* (New York: Jeremy P. Tarcher/Putnam Publishers, 1998).

[2]Richard W. Oliver, *The Coming Biotech Age: The Business of Bio-Materials* (New York: McGraw-Hill, 2000).

[3]Andrew Pollack, "Nations Agree On Safety Rules for Biotech Food," *New York Times,* 30 January 2000.

[4]*Commercial Biotechnology: An International Analysis* (Washington, DC: U. S. Congress, Office of Technology Assessment, OTA-B-218, January, 1984) 72.

[5]Robert Bud, *The Uses of Life: A History of Biotechnology* (Cambridge: Cambridge University Press, 1993) 190.

[6]Arthur Kornberg, *The Golden Helix: Inside Biotech Ventures* (Sausalito, CA: University Science Books, 1995) ix.

[7]Ibid., 1.

[8]The Biotechnology Industry Organization (BIO) is the world's largest trade organization to serve and represent the emerging global biotechnology industry. According to Carl Feldbaum, president of BIO, "biotechnology has become a significant economic force, with more than 1,300 companies, nearly $13 billion in annual revenues and more than 100,000 people on its direct payroll." *BIO Editors' and Reporters' Guide to Biotechnology 1996-1997* (Washington, DC: Biotechnology Industry Organization, 1996) 1.

[9]Oliver, *The Coming Biotech Age*, 208.

[10]Ibid., 36.

[11]It should be said that "making money" is not necessarily negative. In fact, the most charitable reading of the biotechnology industry's goals leads one to the conclusion that the industry has very altruistic goals. For instance, Amgen (Applied Molecular Genetics), the world's largest independent biotechnology company, identifies its mission "To be the world leader in developing and delivering important, cost-effective therapeutics based on advances in cellular and molecular biology." Similarly, Amgen declares, "Our primary purpose is to bring meaningful improvement to the lives of patients through our products." *Amgen's Mission, Goals & Values* (http://wwwext.Amgen.com/cgi-bin/genobject/amgenValues/tigo_8AIFId).

[12]Colin Ratledge, "Biotechnology: The Socio-economic Revolution? A Synoptic View of the World Status of Biotechnology," in E. J. Da Silva, C. Ratledge, and A. Sasson, *Biotechnology: Economic and Social Aspects* (Cambridge: Cambridge University Press, 1992) 1. Interestingly, Ratledge maintains that "Altruistic biotechnology does not exist or if it does it simply consumes money and does not generate it" (3).

[13]"Double-Digit Growth Predicted for Biotechnology Products in the Next Decade," *Genetic Engineering News*, December 1996, 6. The entrepreneurial aspects of biotechnology most assuredly affect the methodology used by those who function within its environs. For instance, Kornberg and others point out that the so-called "targeted research" agenda may have deleterious consequences on future discovery. Cf. "Pros and Cons of Biotech Ventures," Chapter 8 of Kornberg, *The Golden Helix*, 231-258.

[14]Sheldon Krimsky, *Biotechnics and Society: The Rise of Industrial Genetics* (New York: Praeger Publishers, 1991) 23.

[15]*Commercial Biotechnology*, Summary, 6.

[16]Robert Bud, *The Uses of Life: A History of Biotechnology* (Cambridge: Cambridge University Press, 1993).

[17]Ibid., 1. More importantly, perhaps, Bud comments: "'Bio' suggests natural; it connects all those living things whose lives, it often seems, would be better but for the human species. By contrast, 'technology' evokes human control over nature. The combination of the two has often seemed deeply disturbing, even monstrous, as amalgams of people and machines have been described" (2-3).

[18]Ibid., 53.

[19]Wilhelm Roux, et al., eds., *Terminologie der Entwicklungsmechanik der Tiere und Pflazen* (Leipzig: Wilhelm Engelmann, 1912) 66. Cited in Bud, *The Uses of Life*, 53.

[20]Bud, *The Uses of Life*, 53.

[21]Ibid., 53-54.

[22]Intriguingly, one of Francé's friends, Adolf Wagner, said in a 1925 *festschrift* that *Biotechnik* "is only an idea, a word, but one of those which unifies an entire world." Adolf Wagner, *"Biotechnik and Plasmatik,"* in *Der Begründer der Lebenslehre Raoul Francé: Eine Festschrift zu seinem 50 Geburstag* (Stuttgart: Walter Seifert, 1925) 7. Cited in Bud, *The Uses of Life,* 61.

[23]Bud, *The Uses of Life,* 66.

[24]Ibid., 68.

[25]Benton Mackaye, *From Geography to Geotechnics* (Urbana: University of Illinois Press, 1968) 22. Cited in Bud, *The Uses of Life*, 68.

[26]V. V. Branford and Patrick Geddes, *The Coming Polity,* 2nd ed. (London: Le Play House, 1919) 267-268.

[27]Bud, *The Uses of Life,* 69.

[28]J. A. Thomson, "Biology," *Encyclopaedia Britannica* Supplement to the 11th ed., 1 (1926) 383-85. Cited in Bud, *The Uses of Life*, 69.

[29]Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace and Company, 1934).

[30]Ibid., 109.

[31]Ibid., 155.

[32]Ibid., 353.

[33]Ibid.

[34]Ibid., 355.

[35]Ibid., 254.

[36]Bud, *The Uses of Life*, 83.

[37]Ibid., 87.

[38]Krimsky, *Biotechnics and Society,* 24.

[39]Bud, *The Uses of Life,* 101.

[40]Ibid., 101.

[41]*Commercial Biotechnology,* Summary, 6.

[42]*Commercial Biotechnology,* 3.

[43]The *Second London Confession* (1689), for instance, says, "This number and order of Offices is necessary; for in respect of our ignorance, we stand in need of his prophetical Office; and in respect of our alienation from God, and imperfection of the best of our services, we need his Priestly office, to reconcile us and present us

acceptable unto God: and in respect of our averseness, and utter inability to return to God, and for our rescue, and security from our spiritual adversaries, we need his Kingly office, to convince, subdue, draw, uphold, deliver, and preserve us to his Heavenly Kingdome" (Ch. VIII. Art. 10). See e.g., W. L. Lumpkin, *Baptist Confessions of Faith*, rev. ed. (Valley Forge, PA: Judson Press, 1969).

[44]R. B. Kuiper, *The Glorious Body of Christ* (Grand Rapids: Eerdmans, 1966) 126.

[45]Paul R. House, *Old Testament Theology* (Downers Grove: InterVarsity Press, 1999) 222.

[46]It is important to note that human life does not possess "intrinsic" value. The notion of the intrinsic value of human life is popular, but, technically, incorrect. Human life is not valuable in and of itself, but has value because God himself has invested it with value. Thus, human life derives its value from God.

[47]See my pamphlet, *Genetic Engineering: Bane or Blessing?* (Nashville: The Christian Life Commission, 1994).

[48]Daniel J. Kevles, *In the Name of Eugenics: Genetics and the Uses of Human Heredity* (Los Angeles: University of California Press, 1985).

[49]Robert Jay Lifton, *The Nazi Doctors: Medical Killing and the Psychology of Genocide* (New York: Basic Books, 1986). Arthur L. Caplan, ed., *When Medicine Went Mad: Bioethics and the Holocaust* (Totowa, NJ: Humana Press, 1992).

[50]Marque-Luisa Miringoff, *The Social Costs of Genetic Welfare* (New Brunswick, NJ: Rugers University Press, 1991). Dorothy Nelkin and Laurence Tancredi, *Dangerous Diagnostics: The Social Power of Biological Information* (New York: Basic Books, 1989).

[51]Oliver, *The Coming Biotech Age*, 36-37.