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The Catholic Church and Technological Progress: Past, Present, and Future

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Abstract: Over 2000 years the Catholic Church has slowly developed a posture towards technology which is predominantly techno-optimist and techno-progressive, and yet the Church does not have this reputation today. Concomitantly, Church institutions and individuals have made crucial contributions to the advance of science and technology, yet despite this practical effort to better human development, Christian theology has been remarkably uninterested in the subject of technology. This lack of interest is no longer tenable; scholars of religion and theologians should seriously engage technology because it is empowering humanity in ways that were previously reserved only for gods. This blind spot has not only hampered the Church's ability to understand itself and our world, but also impeded the ability of the Church to fulfill its mission. Pope Francis's 2015 encyclical *Laudato Si* has begun to address this neglect, but is best understood in the context of Christian history, not only as written, but more so as practiced.

Keywords: Catholic; Christian; history; technology; theology; ethics; *Laudato Si*; Pope Francis

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1. Introduction

Tertullian, criticizing the role of philosophy in religion, famously asked "What has Athens to do with Jerusalem (Tertullian 1914, chp. 7)?" While his attitude might find sympathy amongst some religious fundamentalists, for most of history it has been anathema to the majority Christian scholars and theologians. And yet, I assert, even among those scholars and theologians unsympathetic to Tertullian's saying, his sentiment remains in force in theology with respect to one field of human rationality even today.

Harking back to Aristotle's tripartite division of reason into theory, practice, and production; while many Christians have come to accept theoretical reasoning (philosophy, theology, and science) and practical reasoning (ethics) as deeply intertwined with their faith, in matters of *techne*—rational production, engineering, technology—sentiments ranging from uncertainty to ignorance to disdain are still widespread. Building upon Aristotle's notion of *techne*, I define technology as a means to an end, which consists of both applied conceptual techniques (e.g., mathematics, the scientific method, the concepts of engineering) and the purpose-laden material products (e.g., tools, artifacts, structures) of human reason and labor, including the skills, practices, and knowledge necessary to create and utilize those rational products.

To paraphrase Tertullian we might yet ask "What has technology to do with theology?" or, more anachronistically, "What has Silicon Valley to do with Jerusalem (or Rome)?" The standard, accepted, answer throughout most of Judeo-Christian history would have been "not very much." But contemporary advances in technology are demonstrating that this response is inadequate (Green 2014b, 2016b). As we create technologies capable of destroying the world and remaking ourselves, we tread into what was formerly the exclusive realm of God. Surely this *novum* is worthy of consideration (Jonas 1984, p. 1).

In ancient Greece and Rome, artisans and workers were looked down upon for their bondage to tools and manual labor (Plutarch 1932; Xenophon 1971, vol. 1, chp. IV.2, pp. 22–23; Aristotle 1984). But Western Christian theology evolved away from this ancient overt disdain for the manual arts and developed into a spectrum of perspectives on labor and technology. On one hand, labor and technology existed because of original sin, and therefore working was living a punishment, continuing the imperfection of this world (Boas 1948, p. 24; Ambrose 1961, chp. 10; Ovitt 1986, p. 488). On the other hand, through work we could improve this world, and while not achieving perfection, we could come closer to it, as St. Augustine argues: material progress shows God's beneficence and providence (Ovitt 1986, p. 492; Augustine 2009, chp. 24). Of note is that the first end of the spectrum was a theoretical tradition, which while disparaging work, or neglecting it, did not reject it. The second is a practical tradition, one of deep love and respect for manual labor, and even a love for innovation and technological progress. It is quietly embedded in the Bible, present in the religious tradition, and dramatically apparent in the history of technology in Western Europe. The first tradition has faded with time, yet the second has not come to clearly replace it, leaving something of a vacuum, which I hope to help fill; therefore the second tradition is the one which I will examine here.

In our contemporary world, one may legitimately wonder "What is the Catholic Church's stance towards technology?" It seems, for example, that in its resistance to reproductive technology and control the Church must be retrograde and wish to return to the technological past. And when combined with its continual critique of the modern world, whether in the *Syllabus of Errors*, *Rerum Novarum*, *Humanae Vitae*, *Dignitas Personae*, or *Laudato Si*, little defense is obvious against this assertion. The Church just plain seems to be opposed to modernity, especially technological modernity.

However, this is a much too simplistic evaluation of the Church's long history with technological advance. The question of the Church's stance on technology must first be disaggregated, because technology is not one thing, and the Catholic Church evaluates different technologies in different ways.

The connections between Christian theology and technology have not yet been thoroughly explored; indeed, in the last few decades there are just the beginnings of what could be called a *theology of technology*. Some older examples would include works by Nicholas Berdyaev (Berdyaev 1932), Jacques Ellul (Ellul 1964), Lynn White (White 1978), Paul Tillich (Tillich 1988), and Carl Mitcham and Jim Grotes (Mitcham and Grotes 1984). This field, however, in response to a clear need in society, has recently begun to grow at a rapid pace. More recent works include those of Albert Borgmann (Borgmann 2003), Noreen Herzfeld (Herzfeld 2009), Brad Kallenberg (Kallenberg 2011, 2012), David F. Noble (Noble 1998), and Brent Waters (Waters 2016). There remains, however, immense work to be done.

In this paper I will take a predominantly "high-altitude" perspective, occasionally dipping into the weeds, looking at the past, present, and future of the relationship of Christianity and technology. I will argue that technological development (and the science which underlies it) is integral to the successful fulfillment of the Christian vocation in the world. I will look particularly at Catholic Christianity, but I believe that the findings are broadly applicable to Christianity as a whole, though with some diversity of perspectives.

In response to the question "What is the Catholic Church's stance towards technology?" I will argue that "technology" should be divided into a spectrum ranging from "good" to "neutral" to "bad" technologies, and that (because technology is a means to an end) the hallmark of the morality of a technology relates to whether it facilitates good or bad moral actions. I will argue that the Church is in favor of technologies which facilitate good moral actions, and opposed to those which facilitate bad moral actions, as those actions are understood in its tradition. I will argue that the history of the Catholic tradition as actually practiced is important for interpreting contemporary more theoretical documents regarding technology. And in response to the anachronistic paraphrase of Tertullian, I will argue that Silicon Valley has a lot to do with Jerusalem (and Rome).

2. The Past Relationship of the Catholic Church and Technology

For much of human history, religions in general have been promoters of technology, ranging from megalithic circles to ornate religious structures, the printing press, and the invention of hypertext (involving Roberto Busa, S.J., and Thomas J. Watson of IBM) (America Magazine 2011). Historically, the Catholic Church and its members have done immense work towards advancing science and technology. Indeed, many aspects of the Christian worldview helped form the basis for science, and these presuppositions are likewise crucial for technological progress (Moritz 2009; Artigas 2000; Barbour 1990; Brooke 1991, pp. 18–33; Davis 1999; Hodgsen 2005; Rescher 1987).

The Bible engages with the idea of technological advancement in several places; though at the largest scale some have noted that the Bible begins in the Garden of Eden, and ends in the City of God, thus (since both are holy) apparently blessing, or at least not damning, technological progress (Thiel 2015). We already see the role of technology in the first chapters of Genesis. While the question of the existence of technology in the Garden of Eden has provoked contention in the past, with Jacques Ellul vehemently disagreeing with his contemporaries on the issue (Ellul arguing that there was no technique or work before the Fall) (Ellul 1984, chp. 8, p. 125), there is no question that technology does at least appear after eating from the forbidden tree, with Adam and Eve creating rough garments of leaves (Genesis 3:7). In Genesis 3:21, immediately prior to their expulsion from Eden, God gives Adam and Eve new clothing, gifting higher technology (animal skins) to replace their shabby improvised clothing made of leaves. This gift of animal skin clothing also implies a new technological dependency upon the instrumental exploitation of animals, and by extension all of nature, as a result of—or perhaps as a remediation for—sin. Continuing in Genesis we witness Noah's Ark as an example of a technological artifact saving humanity and animal creation from destruction, thus playing an integral role in God's plan (Gen. 6:14–8:19). Upon leaving the Ark, Noah immediately builds an altar for burnt offerings to God, illustrating the role of technology in divine worship and thanksgiving (Gen. 8:20). In contrast, in the Tower of Babel narrative we see humanity abusing technology for the sake of competing with God, rather than cooperating, and they are duly punished (Gen. 11:1–10). These contrasting stories show the ambivalence of technology and its dual-use capacity: it can be used for good or evil. The Hebrew Scriptures continue to fruitfully engage technological production, for example in the Exodus descriptions of the Ark of the Covenant, and 1 Kings and 1 Chronicles descriptions of Solomon's Temple.

In the New Testament it is worth noting several passages relevant to technology. In Luke 10:37, Jesus calls his disciples to "go and do likewise" and John 14:12 states "Very truly, I tell you, the one who believes in me will also do the works that I do and, in fact, will do greater works than these . . . " (all quotations NRSV (NRSV Committee 1989)). This exhortation to imitation and greater works is primarily a moral claim, but in our contemporary world it is also a technical claim because technology empowers us to perform moral works of great magnitude. For example, as a healer, Jesus went about "curing every disease and every sickness" (Matt. 9:35, also 10:1), and "the blind receive their sight, the lame walk, the lepers are cleansed, the deaf hear, the dead are raised" (Matt. 11:5). Indeed, Jesus goes so far as to command his disciples to "cure the sick, raise the dead, cleanse the lepers" (Matt. 10:8). One might think that modern medical technology fulfills some of this commandment, though perhaps not yet all of it. Likewise, the Green Revolution in agriculture, led by Lutheran agronomist Norman Borlaug, vastly multiplied humanity's food supply and might in some way "do likewise" following Jesus's multiplications of the loaves and fishes (Matt 14:13–21 and 15:32–16:10, Mark 6:31–44 and 8:1–9, Luke 9:10–17, and John 6:5–15). In Borlaug's 1970 Nobel Prize lecture he cited the Bible five times, and relied upon several other Biblical allusions and moral principles (Borlaug 1970). While these technological advances might seem far from Jesus's actions, in Matthew 7:16 Jesus says that we can determine true prophets "by their fruits." True prophets will produce good actions in the world; words matter less than results. In the realm of technology we might ask, then, how practically prophetic engineers are who contribute to sanitation, transportation, communication systems, and other vital

public goods. While they may not praise God with their lips, they do with their actions, and according to this verse, that is the more important way.

Some of the most clearly pro-technology passages in Scripture are those which call God an artificer (Greek, *technites*, Wis. 7:22, 8:5–6, Heb. 11:10) (Gaine 2016) and which also clearly point out that Jesus was a carpenter (or "builder," Greek *tektonos*, Matt. 13:55, and *tekton* Mark. 6:3). In updated terms, we might say that God is an engineer or a technologist. For Christians of all times and places this serves to bless the manual arts and lift them up, unlike how those professions were considered in ancient Greece and Rome (Kallenberg 2012, pp. 44–45). Simon Francis Gaine, O.P. (Gaine 2016, pp. 497–500), points out that this Biblical description of God as artificer is further expounded in both Augustine (Augustine 1968, vol. 50, p. 241) and particularly Thomas Aquinas, who found it to be a very fruitful analogy (Aquinas 1948, I 14.8, I 27.1 ad. 3, I 39.8, I 44.3, I 45.6, III 3.8; Kovach 1969; Aquinas 1955–1957, IV 13, IV 42).

There are, of course, other verses and interpretations which degrade manual labor as a curse (Gen. 3:17–19), but, interestingly, while these verses could be interpreted in ways which squelch innovation, they typically are not. Indeed, in the context of the expulsion in Genesis 3, God's condemnation of Adam and Eve to hard labor and the concomitant gifting of higher technology seems to point us exactly towards technology as remediation for sin. To seek higher technology would seem to follow God's example. And many Christians, including monks, have taken this example to heart over the last 2000 years.

St. Benedict, one of the patron saints of engineers, founded his monasteries not only on prayer, but also on work, following the guiding principle of "*ora et labora.*" And so, following their founder, monks took on such civil and mechanical engineering activities as metalworking, building flood control earthworks, draining swamps, and building reservoirs and mills. Monasteries were responsible for many of Europe's cultural and technological "firsts." Beginning in the 6th century, monastic communities created the first large-scale European system of schools, libraries, scriptoria, and infirmaries; the importance of which cannot be underestimated for the collection, preservation, production, and transmission of technical knowledge. The remains of the first known tidal-powered water wheel have been found in Ireland, at Nendrum Monastery Mill in Strangford Lough, dating to the early 7th to late 8th centuries (Manning et al. 2007). Modern musical notation originated with Guido d'Arezzo, O.S.B., in Italy, c. 992–1033 AD (Encyclopædia Britannica 2017). The first impact-drilled well, and first Artesian well in Europe, was drilled by Carthusian monks in Artois, France, in 1126 (Gies and Gies 1994, p. 112). Monastic beers date into the distant past, the first systematized approach to wine quality control was by Dom Pierre Perignon, O.S.B., in the 17th cent., and the liqueur Chartreuse was invented in 1737. These advances involving alcohol may seem insignificant but they are not, as they had direct connection to the development of food preservation, chemistry, and microbiology.

Contemporarily with the early monasteries, St. Isidore of Seville, a Doctor of the Church, wrote his encyclopedia, the *Etymologies*, in the early 600s which helped preserve crucial ancient knowledge, including many kinds of technology. While St. Isidore made an overtly disparaging connection concerning the origin of the Latin word for "*mechanicus,*" drawing its etymology from the Greek word *moichos* for "adulterer" (Kallenberg 2012, pp. 45–46), in his thoroughness and enthusiasm for all knowledge he practically encouraged the preservation of technology after the fall of the Western Roman Empire. This is a prime example of a theologian simultaneously speaking ill of technology, while also cultivating it. For his efforts in systematizing knowledge, in 1997 Pope John Paul II named St. Isidore as the patron saint of the internet and computers (Don Miller 2017; Kelly 2010).

By the early 9th century, holiness and technological progress were becoming overtly connected. For example, the Utrecht Psalter depicts the armies of God using a rotary sharpening wheel, while their enemies using a stationary sharpening stone, thus connecting higher technology to Godliness (White 1978, pp. 185–86). This depiction persists into the Eadwine Psalter in 1100s, thus showing the continuity of the association of holiness and technology.

As the High Middle Ages approached, construction advanced dramatically. Churches are full of technology: stone construction and carving, cement and metal, metallurgy to produce tools, wood carving, ceramics, quarrying and mining of minerals and precious stones, glass chemistry and technology, trade and transportation technology, and so on. As just one example, pipe organs—known in the ancient world, but considered profane outside of Western Europe—became prominent components of Western churches. By 950 AD Winchester Cathedral in England had an organ with 400 pipes the operation of which required 70 men to continuously pump 26 bellows (White 1978, pp. 65, 186–87). Following in the spirit of high-tech construction, in the 12th century a religious order of brothers devoted to engineering grew in France. The *Frères Pontifes*, or Brothers of the Bridge, built such spans as the Pont Saint-Bénézet (Pont d'Avignon) and Pont St. Esprit. These engineering brothers made dramatically innovative use of flattened arches and dual-sided cutwaters to reduce scour, two traits of bridges used even today (Gies and Gies 1994, pp. 150–51).

In the 1120s, Hugh of St. Victor, of the St. Victor Monastery in Paris, wrote his *Didascalicon* in an attempt to rehabilitate the manual arts in the eyes of theology. In it, following Aristotle, Hugh parses the wisdom of philosophy into three kinds: theoretical, ethical, and mechanical. However, far from neglecting or disparaging the mechanical arts, Hugh is so bold as to assert that the mechanical arts have a role in human salvation (Kallenberg 2012, pp. 48–51). This growing overt optimism about technology is noteworthy. While previously, practically speaking, the Church and individual Catholics were quite technologically progressive, theology had mostly ignored the subject. Now, ambivalence was undeniably becoming optimism.

As the Middle Ages progressed, it gradually became apparent that their technology had surpassed the technology of the ancients, and Roger Bacon went so far as to extrapolate yet further advance and thereby predicted a future with "ships, automobiles, airplanes, and submarines" (White 1978, p. 81). The growing medieval universities provided a venue for the further intense progress of science and technology. Prominent natural philosophers and scholars of this period include St. Albert the Great, who reputedly created a talking brass head (Chambers 1728). Brazen (brass or bronze) heads were also attributed to such luminaries as Roger Bacon (Butler 1948) and Bp. Robert Grosseteste (Gower [1390] 2013, vol. 2, ll. 234–43), and St. Thomas Aquinas reputedly once smashed one, fearing it was demonic (Knight and Lacey 1828). These tales are no doubt exaggerated, but they do indicate something of the esteem natural philosophers had at this time. However, ambivalence, ignorance, and uncertainty towards technology and labor remained. For example, in the *Summa Theologiae*, despite being quite forward about analogizing God to an artificer, St. Thomas Aquinas devoted just two articles (out of thousands) to the virtue of "art," exhibiting at best a benign neglect of the issue (Aquinas 1948, I–II 57.3, 4; Durbin 1981).

The development of all-mechanical clocks in Europe in the late 1200s and early 1300s provided a powerful impetus for the continued growth of a technological economy. Before the 13th century, clocks with escapement mechanisms were known in the world (e.g., Su Sung's Kaifeng Clock (Gies and Gies 1994, pp. 89–91)), but were very rare and therefore easily lost to time. When Catholic churches and monasteries across Europe adopted clocks for timekeeping, the clock making and repair industry grew rapidly, thus promoting, replicating, and refining the technology (Gies and Gies 1994, pp. 210–15). While in the Greek East time-keeping was thought to profane the eternity of holy spaces, in the West clocks came to symbolize temperance, orderliness, and virtue (White 1978, pp. 181–204).

The Catholic Church and Catholic scientists and technologists were vital in the development of the scientific method (which is itself a technique for acquiring knowledge), for promoting advances in architecture and structural engineering, for conducting geographic exploration, and many other endeavors. To summarize the period until the 20th century, I will just list a few prominent scholars: Evangelista Torricelli, 1608–1647, inventor of the barometer, Blaise Pascal, 1623–1662, mathematician and developer of the mechanical calculator, etc.; Bl. Bp. Nicolas Steno, 1638–1686, father of stratigraphy; Andre-Marie Ampere, 1775–1836, pioneer of electrodynamics; Ab. Gregor Mendel, 1822–1884, the father of genetics; Louis Pasteur, 1822–1895, the father of microbiology; and Fr. Georges Lemaitre,

1894–1966, father of Big Bang cosmology. So integral is technological practice to the Catholic faith that engineers have four patron saints: St. Benedict of Nursia, St. Ferdinand III of Castille, St. Joseph, and St. Patrick (CatholicSaints.Info 2008). Additionally, several engineers have been declared saints, blessed, or venerable, including: Blessed Alberto Marvelli, Blessed Jan Franciszek Czartoryski, Saint Rocco Gonzalez, and Venerable Jerzy Ciesielski (CatholicSaints.Info 2013). Indeed, the Pope's title as "Pontiff" means "bridge builder."

While the history presented so far lauds the positive relationship of the Catholic Church and technology, it should also be noted that the Church has historically opposed some technologies. In particular, the Church has condemned weapons technologies. The Second Lateran Council of 1139 banned the use of the crossbow against fellow Christians (White 1978, p. 82). The ban was ineffective, however, the idea of weapons which are intrinsically immoral and against the laws of war continues to this day and can be found in many international treaties, such as the 1675 Strasbourg Agreement (banning poison weapons), the 1899 and 1907 Hague Conventions, the 1925 Geneva Protocols (restricting chemical weapons), the 1972 Biological Weapons Convention, the 1983 Convention on Certain Conventional Weapons, and the 1993 Chemical Weapons Convention. Future conventions might attempt to limit or ban cyberwarfare, nuclear weapons, lethal autonomous weapon systems or artificially intelligent weapons systems, nanotechnological weapons, etc.

Nuclear weapons have attracted immediate and repeated denunciations from the Vatican. The day after Hiroshima, the Vatican condemned the existence of the atomic bomb and wished that its makers had followed the wisdom of inventors like Leonardo da Vinci (who reputedly refused to make an especially devilish weapon he had imagined) and destroyed the weapon before it was used (Chicago Tribune 1945). In 2015, "Marking the 70th anniversary of the use of nuclear bombs by the United States . . . Pope Francis reiterated the Vatican's long-standing call for a total ban on nuclear arms and other weapons of mass destruction" (Martín 2015). Weapons technologies facilitate death and destruction, and as such facilitate grave objective evils, even if under certain circumstances war might be justifiable (as in just war theory). In particular, weapons which are indiscriminate or disproportionate are morally unjustifiable.

The Church has not only condemned weapons technologies, however. More controversially, the Church has condemned technologies involving human reproduction, such as condoms, the contraceptive pill, intrauterine devices (IUD), implantable hormonal contraceptives, in vitro fertilization (IVF), pre-implantation genetic diagnosis (PGD), sterilization, abortion, gamete donation, gestational surrogacy, and so on. While some praise these technologies for freeing sexual activity from the burden of procreation, or as refining procreation in the laboratory and assisting those with fertility problems, the Church sees this "liberation" as instead an enslavement to the lower appetites, rejecting the higher good of human life for the lower good of carnal pleasure.

While the condemnations of weapons and technologies of reproductive control stand out to the modern mind, they also stand out in the history of the relationship between the Catholic Church and technology not because they are the rule, but because they are the exception. The overall history of the Church has been one of collecting (both spatially and temporally), preserving, promoting, producing, and consuming technologies. Very few technologies have been singled out for rejection; the vast majority of technologies, those deemed beneficial and life-affirming, have been enthusiastically accepted.

3. Present

In this section I will summarize the Church's present relationship with technologies by taking a deeper look at *Laudato Si*, and some of the traditional influences that operate within that encyclical (Pope Francis 2015). While this section specifically concerns the "present" the past will be crucial for interpreting current Catholic teaching.

As seen in the previous section, the Catholic Church has a *de facto* tradition of encouraging technologies which promote life and discouraging technologies which hinder life. I say *de facto*,

because as pointed out before, the Church is traditionally intellectually somewhat ambivalent on technology in theory, while being enthusiastic in practice.

Historically, what Catholic scholarly ethical work has been done on technology has tended to be at the extremely specific level, in the evaluation of particular technologies, such as reproductive technologies. That in itself is significant, though—most new technologies have a presumption of innocence upon them, and therefore only certain classes of technologies are deemed worthy of concern. Large-scale philosophizing and theologizing about technology has not been a major subject because morally bad technologies are the exception, and typically minor ones, to the rule.

At a general level, the Catholic Church's relationship with technology can be summarized as this: some technologies are good, some are neutral, and some are bad. This might seem too simple, but this concept is foundationally related to the first principle of practical reason, often paraphrased as "Good is to be done and pursued, and evil is to be avoided" (Aquinas 1948, I–II 94.2), and acts as a principle to systematize the Church's entire relationship with technology. This moral axiom is deeply embedded into the history of the Church, and parallels can be found both in the Hebrew Scriptures (Deut. 30:19) and in the early Christian *Didache* (1:1), both of which explicitly divide the human path into one of life and one of death. God clearly instructs that humanity should choose life.

At the most basic level, good technologies facilitate good actions and bad technologies facilitate bad actions. If good is to be done and pursued, then good technologies also ought to be pursued. And if evil is to be avoided, then technologies which facilitate evil ought to be avoided too. Dual-use technologies, which can facilitate either good or bad actions, require careful institutional governance.

Examining Pope Francis's recent encyclical *Laudato Si* can help to elucidate the meaning of this otherwise quite abstract principle. *Laudato Si* clearly praises and encourages some technologies:

> We are the beneficiaries of two centuries of enormous waves of change: steam engines, railways, the telegraph, electricity, automobiles, aeroplanes, chemical industries, modern medicine, information technology and, more recently, the digital revolution, robotics, biotechnologies and nanotechnologies...It is right to rejoice in these advances and to be excited by the immense possibilities which they continue to open up before us, for "science and technology are wonderful products of a God-given human creativity (Pope John Paul II 1981)" ... Technology has remedied countless evils which used to harm and limit human beings. How can we not feel gratitude and appreciation for this progress, especially in the fields of medicine, engineering and communications? (Pope Francis 2015, no. 102)

Pope Francis further describes some good technologies:

> Technoscience, when well directed, can produce important means of improving the quality of human life, from useful domestic appliances to great transportation systems, bridges, buildings and public spaces...Who can deny the beauty of an aircraft or a skyscraper? Valuable works of art and music now make use of new technologies (Pope Francis 2015, no. 103).

The Pope includes a very specific request for the development of better energy technologies and encourages technologists to pursue this line of inquiry, saying: "Worldwide there is minimal access to clean and renewable energy. There is still a need to develop adequate storage technologies" (Pope Francis, no. 26). These remarks are fascinating in the context of Christian history. The Pope is aligned with the tradition of such optimistic thinkers and practitioners as the Nendrum monks, Hugh of St. Victor, and the Brothers of the Bridge. In the world, there are problems to solve and technology can solve them. Technology should be put to good use helping people: that is what it is *for*.

However, the Pope does not think of technology as an unconditional blessing. While optimism and belief in progress are warranted, dangers still lurk. While the Pope encourages new technologies, *Laudato Si* also acknowledges that there are moral ambiguities in the potential actions facilitated by technology.

> We have the freedom needed to limit and direct technology; we can put it at the service of another type of progress, one which is healthier, more human, more social, more integral.

> Liberation from the dominant technocratic paradigm does in fact happen sometimes, for example . . . when technology is directed primarily to resolving people's concrete problems, truly helping them live with more dignity and less suffering (Pope Francis, no. 112).

Despite the ambiguities of technology we should not resign ourselves to pessimism: "There is also the fact that people no longer seem to believe in a happy future... Let us refuse to resign ourselves to this, and continue to wonder about the purpose and meaning of everything..." (Pope Francis 2015, no. 113). We ought to believe in a happy future *and work* to make it happen. Fascinatingly, this directly parallels technology entrepreneur Peter Thiel's notion of "definite optimism"—optimism in a better future because we will make it that way by our own work (Thiel 2015; Thiel and Masters 2014). The pope agrees, but does not limit optimism to the technological level: our optimism is in the purpose and meaning of it all, not just the technology.

Further, this has significant ethical implications:

> All of this shows the urgent need for us to move forward in a bold cultural revolution. Science and technology are not neutral; from the beginning to the end of a process, various intentions and possibilities are in play . . . Nobody is suggesting a return to the Stone Age, but we do need . . . to appropriate the positive and sustainable progress which has been made, but also to recover the values and the great goals swept away by our unrestrained delusions of grandeur (Pope Francis 2015, no. 114).

There are also technologies which are morally ambiguous, and others which are clearly morally bad because they facilitate evil actions. The Pope says:

> Yet it must also be recognized that nuclear energy, biotechnology, information technology, knowledge of our DNA, and many other abilities which we have acquired, have given us tremendous power. More precisely, they have given those with the knowledge, and especially the economic resources to use them, an impressive dominance over the whole of humanity and the entire world. Never has humanity had such power over itself, yet nothing ensures that it will be used wisely, particularly when we consider how it is currently being used. We need but think of the nuclear bombs dropped in the middle of the twentieth century, or the array of technology which Nazism, Communism and other totalitarian regimes have employed to kill millions of people, to say nothing of the increasingly deadly arsenal of weapons available for modern warfare (Pope Francis 2015, no. 104).

Powerful technologies can empower differentially, and in this case a few decision-making humans—whether technologists, business leaders, politicians, or military leaders—become extremely powerful, with the rest of humanity subject to their whim. If we had the ethics and institutional structures to properly control these powers, the differential might be less worrisome, but because we do not, our straits are dire indeed. CS Lewis noted this problem of differential empowerment due to technology in his 1943 book *The Abolition of Man*, where he states "what we call Man's power over Nature turns out to be a power exercised by some men over other men with Nature as its instrument" (Lewis 1944).

Technology—as described by the Pope as a total category of human endeavor—is ultimately morally ambiguous because it contains within itself too many sub-categories. Good and bad technologies must be separated, individually evaluated, and then treated distinctly, depending on their moral salience. And the more powerful that a technology is, the stronger that moral salience will be.

Emerging weapons technologies, then, are of particular concern and here the Pope could easily borrow a phrase from the technologist Bill Joy, who warned of emerging weapons technologies in 2000, calling them weapons of "knowledge-enabled mass destruction" (Joy 2000). Technologically advanced arsenals make war more deadly than ever before and therefore more important to avoid than ever before. Pope Francis states: "War always does grave harm . . . risks which are magnified when one considers nuclear arms and biological weapons . . . Politics must pay greater attention

to foreseeing new conflicts and addressing the causes which can lead to them" (Pope Francis 2015, no. 57). The danger of technological war has been a growing concern of the Popes since World War Two. Francis begins *Laudato Si* by recalling Pope John XXIII's 1963 encyclical *Pacem in Terris* which sought multilateral nuclear disarmament, one which would be "thoroughgoing and complete, and reach men's very souls (Pope John XXIII 1963, no. 113)". Pope Francis also cites Pope Paul VI's 1971 *Octogesima Adveniens* on the emerging ecological crisis, calling it a "'a tragic consequence' of unchecked human activity: 'Due to an ill-considered exploitation of nature, humanity runs the risk of destroying it and becoming in turn a victim of this degradation'(Pope Paul VI 1971, no. 4)."

One must also mind the Pope's continual rejection of the "technocratic paradigm" in the encyclical (106–14), but absolutely not confuse the technocratic paradigm with technological progress itself. As is clearly shown above, Pope Francis explicitly desires specific forms of technological progress; however it must be a directed progress, one towards good and away from evil. The technocratic paradigm is too complex to describe fully here (others such as Jacques Ellul, (Ellul 1964), Romano Guardini (Guardini 1998), Neil Postman (Postman 1992), Pope Benedict XVI (Pope Benedict XVI 2009), Michael Hanby (Hanby 2015), etc., have said much already), but in one aspect it can be understood as the belief that every problem is merely one of efficiency, and that therefore technology can solve every problem, without the intervention of ethics. The technocratic paradigm thus explicitly violates the entire Catholic tradition on the interaction of ethics and technology; hence it is not a suitable paradigm for a Catholic approach to technology.

As seen in the previous section, the Catholic Church has done an enormous amount of conceptual and physical work towards the advance of science and technology throughout history. It still does today, most notably through its educational and healthcare systems. For example, Catholic Universities with engineering schools specifically direct technological development in ways that promote human life and health. At just one university, Santa Clara University in California, the Frugal Innovation Hub helps develop technologies for the developing world and the Miller Center for Social Entrepreneurship helps social entrepreneurs in the developing world start and grow their businesses, thus benefitting their communities and nations (Frugal Innovation Hub n.d.; Miller Center for Social Entrepreneurship n.d.).

In conclusion, some might say that the Catholic Church's approach to nuclear weapons, other brutal weapons, environmentally unsustainable technologies, artificial birth control, some reproductive technologies, and embryonic stem cell research is "anti-technology," but these critics would be mistaking the exception for the rule. The Church's response to this criticism would be that it is not "anti-technology" but rather "anti-bad-technology" and that only good technologies ought to progress. Obviously, there is debate possible on what qualifies as "good technology" and "bad technology," but that is a separate debate. In any case, this is a significant point: for nearly its entire history the Church has stood for the preservation and advancement of knowledge and technology, with exceptions only for a few of those technologies which it evaluates as preventing or harming human life. *Laudato Si* is best interpreted in light of this tradition.

4. Future

Quoting Pope Benedict XVI, in *Laudato Si* Pope Francis clearly states that in regard to our precarious future: "The work of the Church seeks not only to remind everyone of the duty to care for nature, but at the same time 'she must above all protect mankind from self-destruction' (Pope Benedict XVI 2009, no. 51, 79)". This is not an aberrant comment in the encyclical; several times Pope Francis states that "An outsider looking at our world would be amazed at such behaviour, which at times appears self-destructive" (Pope Francis 2015, no. 55), and that we should "escape the spiral of self-destruction which currently engulfs us" (Pope Francis 2015, no. 163).

These statements are powerful: doom is approaching, we are causing it, and we must work to stop it. Thus Pope Francis challenges "all people of good will (Pope Francis 2015, no. 62)" to act to protect humanity from our impending fate. This includes not only technological solutions to the problems

created by our technology, but even more so moral solutions, and ultimately, a change of heart. God does not just want our righteous actions; God wants our souls.

This deep internal conversion requires that we—not just a few, but many people—make the necessary ethical decisions and strengthen the necessary institutions to create our better world. Echoing the philosopher Hans Jonas (Jonas 1984, p. 23), Pope Francis says:

> We stand naked and exposed in the face of our ever-increasing power, lacking the wherewithal to control it. We have certain superficial mechanisms, but we cannot claim to have a sound ethics, a culture and spirituality genuinely capable of setting limits and teaching clear-minded self-restraint (Pope Francis 2015, no. 105).

The Pope knows that " . . . a technology severed from ethics will not easily be able to limit its own power" (Pope Francis 2015, no. 136) and therefore, in the priorities of current action, ethical development must come first, before all else. We are technically strong, but morally and politically weak. We live in a fragile world that " . . . challenges us to devise intelligent ways of directing, developing and limiting our power" (Pope Francis 2015, no. 78). As I tell my students in every course I teach: formerly human action was constrained by our weakness; now we must learn to be constrained by our good judgment, our ethics (Green 2015b). Only when one has immense power must one learn to control it. For humankind, that time has arrived. If we cannot come to control our power we risk extinction.

Ancient philosophers and theologians could disparage or ignore the subject of technology because humans were weak (Green 2015c). Formerly we had to use our own muscles to physically hit people to kill them; now with nuclear weapons, with a phone call we can end civilization in 30 minutes. And while we hypertrophy our destructive capabilities, we still allow untold numbers of children to die every day from easily preventable conditions such as malnutrition and disease. We are strong in our capacity for evil, and weak in our capacity for good. This is precisely the situation that centuries of Catholic moral teaching has sought to avoid.

Pope Francis knows we are morally weak, and we lie to ourselves about our moral weakness:

> As often occurs in periods of deep crisis which require bold decisions, we are tempted to think that what is happening is not entirely clear... Such evasiveness serves as a license to carrying on with our present lifestyles... This is the way human beings contrive to feed their self-destructive vices: trying not to see them, trying not to acknowledge them, delaying the important decisions and pretending that nothing will happen (Pope Francis 2015, no. 59).

What is needed is not so much better technologies, but morally better human beings. In humanity's headlong rush to prioritize technical power, we have concomitantly failed to prioritize goodness and holiness. Morality without power is helpless, it is useless to others—we cannot protect our fellow human beings or aid the fulfillment of their humanity. But power without morality is even worse—in this case we can do much to our fellow human beings, but what we choose to do is evil. It can only lead to death, not only of our fellows, but of ourselves. What we need is a balance of morality and power, where we are powerful enough to help each other and good enough to actually do it.

The Pope knows we need better people, morally speaking, not just better technology. We must "love our neighbors" and help each other as we can. But better technology should be a tool for these "better people," who ought not use outdated technology to inefficiently pursue the noble ends assigned by their religion. A truly prudent "better person" would use the best means available, including the best technology—existing or awaiting invention—to maximize their beneficial impact on the world. And here the dialogue of theologians with scientists, engineers, and technologists becomes not just an interesting endeavor, but a mission. While the world contains much danger, it also contains much hope. Christians should resurrect their own tradition of technological optimism and development for the sake of helping others.

In addition to the constant Christian call to the Corporal and Spiritual Works of Mercy, to help the poor, and everyone, through moral guidance, education, healthcare, and other social welfare programs,

there are three areas of technological endeavor which at this point in history might best express the Church's mission to "above all protect mankind from self-destruction."

Mitigating and adapting to global catastrophic and existential risk—As noted by Popes Benedict and Francis, the Church must protect humankind. Climate change, nuclear weapons, synthetic biology, nanotechnology, artificial intelligence, and so on, all threaten the future of humanity with extinction. If the Church wants to promote the continued existence of humanity, then Catholics should engage intensely to protect humankind and alleviate and limit these existential dangers. Many people, both religious and secular are already engaged in this work, but Catholics should be especially zealous in it (Bostrom and Cirkovic 2008; Future of Humanity Institute n.d.; Global Catastrophic Risk Institute n.d.; Green 2014a, 2016a; Long Now Foundation n.d.).

Limiting the negative effects of transhumanism—Humanity could be destroyed by death, or by transformation into something no longer human. Transhumanism seeks to modify human nature into enhanced forms superior to all who now exist. At its core, enhancing humanity to be the best that it can naturally be is good. Health extension is good, growth in knowledge is good, growth in goodness is good—Pope Pius XI noted these good goals in regards to the eugenics movement in *Casti Conubii* in 1930 (Pope Pius XI 1930, pp. 66–71). But in its worst forms it becomes idolatry (replacing God with lower goods) and risks great evil; in particular it risks using evil means to achieve what might be otherwise subjectively good ends, such as instrumentalizing the lives of some humans to serve as ends to others. The movement should be studied, its excesses opposed, and many are already working on this subject (Cole-Turner 2011; Green 2015a; Meilaender 2013; Mercer and Trothen 2015; O'Donovan 1984).

Encouraging space exploration and settlement—The first two threats, extinction and transformation, are dangers which can be dealt with directly, as above, or indirectly, by progress away from them, i.e., escape. It should not be forgotten that in the depths of Christian history, remote settlements such as monasteries preserved civilization during dark times. In our time, for some risks (e.g., runaway greenhouse effect, artificial intelligence, nanotechnology, synthetic biology), nothing on Earth can serve as an adequately remote settlement (though the ocean surface, underwater (Turchin and Green 2017), underground, and Antarctica have all been proposed as refuges (Baum et al. 2015; Turchin 2016); refuges off-planet are the next step. The previous two areas of endeavor are limiting, but this one is freeing. Space exploration might seem far removed from the realities of Earthly life, where the Beatitudes and command to "go and do likewise" might typically predominate, but the Catholic Church has encouraged exploration, both physical and intellectual, from the beginning. Ever since Jesus gave the Great Commission in Matthew 28:18–20, missionaries have explored much of the Earth, and with only a few uncontacted tribes remaining, we might well ask what is next. Among the many options, Brother Sun and Sister Moon, and many sibling orbital objects await. Not only has the Church institutionally already encouraged space exploration with Pope Paul VI's message for the Apollo 11 Moon landing (NASA 1969) and Pope Benedict XVI's prayer for and conversation with the International Space Station (Patterson 2011), but also many individual Christians have been physically engaged with space exploration, the encouragement of it, and in writing articles, books, and novels (Consolmagno 2000; George 2005; Green 2015d; Levinson and Waltemathe 2016; Peters 2013; Russell 1996; Vakoch 2000).

These are just a few of the tasks of the future, as mentioned before, all the traditional tasks of the Beatitudes and Works of Mercy still remain in effect. But as we "grow up" as a species our household chores become harder. The question for future Christians might be thought of as this: who do we want to "grow up" to be? The Bible calls us to become like God, but primarily in what way? Through technology we can become more like God in terms of our power. Through goodness we can become more like God in holiness. But clearly, goodness and holiness must be our first priority. Ethics should judge technology, must judge it, or we will face disaster and even extinction. For God, who is Existence Itself, no amount of power could destroy Him. But for humankind our existence is not guaranteed. We are intrinsically contingent and we are capable of great evil. In our evil we have grown powerful enough to threaten our own existence. Only through goodness can we grow wise enough not only to maintain our lives, but even to flourish.

5. Conclusions

Within contemporary Christianity there is a spectrum of responses towards technology, ranging from the radically optimistic progressivism of the Mormon transhumanists to the technological skepticism of the Amish. Where is the Catholic Church on this spectrum, and furthermore, where *should* it be?

Historically speaking, in practice, the Church has been extremely technologically optimistic and progressive, perhaps more so than any other organization in the history of planet. From installing formerly "profane" pipe-organs and clocks in churches to confidently searching for scientific truth wherever it is to be found (knowing that "truth cannot contradict truth"—that all discoveries will be reconcilable with the Catholic faith), the Church has exuded scientific and technological optimism.

However, this is not the current perception—why? The first problem, the question of this paper, is the lack of an adequate philosophy and theology of technology. In the past we did not need a detailed theology of technology as long as the practices of technology advanced on their own, in ethical ways. However, now that these practices have become questionable we now need to understand the theoretical basis for our actions, to properly guide our new works. Rome and Silicon Valley have not yet figured out just how much they need to talk. Lacking systematic theoretical underpinnings, the Church cannot help but respond in an *ad hoc* and sometimes confused fashion to each new wave of technological development, waves that have become a tsunami. Recent Popes have begun to remedy this lack, but vast work remains.

The second problem, I believe, is that as humanity has grown in power there is more and more to say "no" to. When one is weak, there is little to reject, for little can be done at all, but when one is powerful much must be rejected because there are so many wrong choices that can be made. One does not need to counsel babies against murder and war, precisely because they cannot do such things, but one does need to counsel heads of state against them, precisely because they can.

This growth in power has made the Church come to seem negative about technology, but it is only an apparent negativity. The primary response of the Church to technology has historically been and remains an enthusiastic "yes!" Pope Paul VI's 1967 encyclical *Populorum Progressio* strongly presents this view, its very name in English being *On the Development of Peoples*, and it considers not only the moral and economic development of the world, but also the role of technology in that development (e.g., (Pope Paul VI 1967, no. 25, 65)), while still rejecting technocracy (e.g., (Pope Paul VI 1967, no. 34)

I believe that Christians should be a particular kind of techno-progressive, specifically one which seeks to use technology for the sake of human development. Specifically, as with all issues of moral salience, we need to direct technological developments towards good and away from evil (Green 2016a). In some cases this will mean resisting certain technologies, particularly ones which harm people such as weapons, or technologies with dire side-effects such as ones which contribute to climate change. In other cases this will mean vigorously pursuing technologies that help people, such as technologies that improve health, education, public safety, and which contribute to all aspects of human welfare. This idea of differential technological development has made something of a splash in secular philosophy in the last few years (Bostrom 2014, p. 281), while it has been embedded in Catholic teaching for centuries.

Jesus, as a carpenter, knew a bit about engineering. But he didn't save humanity through his own carpentry, he saved us through his death on and resurrection from on a grisly piece of carpentry that humans made, called the Cross. From this we should be made aware of the ambiguous nature of much technology—many technologies are dual-use. Carpentry can be used to promote life or death, and as we explore emerging technologies we would do well to remember that dual use technologies may require governance, and ultimately it is the human heart that most requires governance. It is we who should be morally good, not just our technology that should be technically good.

As we grow in power it becomes more and more apparent that technology, the rational production of material goods, has a vital role in human action in this world. It also has theological relevance, as we seem to become more godlike in our power, while remaining human in our ethics. When we

harken back to Tertullian, who asks the relational question of religion and rationality, I hope that we can now see that rational production—engineering and technology—has been ignored by theology for too long. The archetypes represented by Athens (or Silicon Valley) and Jerusalem (or Rome) are not separate cities now, and they never were. There is only one city, and we are all living in it—everyone, religious or not and technologist or not—together.

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