The Technological Imperative in Canada

R. Douglas Francis

The Technological Imperative in Canada
An Intellectual History

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I dedicate this book to Murray Fraser (1937-97)
for his encouragement and support
while president of the University of Calgary

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The Technological Imperative

Introduction

'Technology is the metaphysics of our age; it is the way being appears to us.'[1] The distinguished Canadian philosopher George Grant, author of the quotation and one of the intellectuals whose ideas on technology are examined in this book, came to this conclusion after a sustained period of thinking about the nature and meaning of technology. His observation also capped over a century of thought on technology by Anglo Canadian thinkers who analyzed the nature of technology and contributed to an understanding of how technology came to be, as Grant notes, 'the way being appears to us.' This book examines that thought.

In the process of tracing the evolution of Anglo Canadian thought on technology, I realized that these thinkers saw technology as the most pervasive and dominant force in the modern world; it became for them an imperative – what I call the 'technological imperative.' This technological imperative, they believed, created a mindset that was itself technological, shaped by the very technology the mind was attempting to comprehend. In analyzing their perspective on this mindset, and in noting the importance they gave to the dominating influence of technology, I realized – and this is a central argument of my book – that these Canadian intellectuals were the *makers* of the technological imperative. This book examines the unfolding of the Canadian perspective on that technological imperative.

Ironically, this was not what these Canadian thinkers intended; it was quite the opposite. Having so closely read the ideas of Canadian thinkers on technology over a long period of time, I realized that they were moralists who were attempting to retain or salvage a moral order – a moral imperative – that they believed the technological imperative either enhanced or else threatened. Their solution was to attempt to reconcile the two imperatives or at least to make Canadians aware of the benefits or dangers that the technological imperative posed to the moral imperative. Those Canadian thinkers who favoured technology maintained that the technological imperative would complement the moral imperative by instilling moral values

essential for the advancement of society and Western civilization. Those who saw technology as a threat feared that the technological imperative would undermine the moral imperative by breaking down communal ties that were important for the well-being of society and by undermining moral and spiritual values that had been the underpinning of Western civilization. Yet these latter intellectuals realized they could not simply dismiss the technological imperative. They had to confront it and seek a balanced perspective. In their attempts at reconciliation, or at least coming to terms with these two imperatives, these Canadian thinkers created and magnified a tension between the two imperatives that remained a constant in Canadian thought from the mid-nineteenth century to the beginning of the twenty-first century. The end result was that neither imperative became dominant or absolute. It is possibly another example of the Canadian tendency to compromise – a compromise, however, that failed to satisfy any of the Canadian thinkers examined in this book.

Analysts of the moral imperative in Canada have attributed its decline to the emergence of critical thought, Darwinian science, and higher criticism. In *A Disciplined Intelligence: Critical Inquiry and Canadian Thought in the Victorian Era,* historian Brian McKillop focuses on the role critical inquiry played in challenging and, by the 1890s, shattering the moral imperative that was founded on constraint and dominated by a myth of concern that was largely closed.[2] He sees a new attempt at reconciling the moral imperative with critical thought in the emergence of the philosophy of idealism that underlay the social gospel movement at the turn of the twentieth century. In *The Regenerators: Social Criticism in Late Victorian English Canada,* distinguished Canadian historian Ramsay Cook picks up where McKillop left off to argue that, in their attempt to reconcile the sacred and the secular, social gospellers in Canada actually contributed to the secularization of society.[3] They abandoned their traditional role as religious leaders of society to focus on secular concerns in the hopes of creating 'the Kingdom of God on Earth.' Cook blames Darwinian science, along with its offshoot Social Darwinism, and higher criticism, the challenge to the infallibility of the Bible as a sacred text, as the major causes of the undermining of the moral imperative.

I contend that it was the emergence of the technological imperative in the late nineteenth and twentieth centuries that challenged the moral imperative and weakened it as an absolute in Canadian thought. Equally, however, the continuous presence of the moral imperative during the same period of time prevented the technological imperative from becoming dominant. One important purpose of this book is to show the playing out of this rivalry in Canadian thought and the resulting tension it generated.

Another way that the perspective on technology among these Canadian thinkers had a 'Canadian twist' to it (besides the Canadian attempt at compromising the technological and moral imperatives) was in their association

of technology with civilization within the context of the Canadian identity. 'Civilization' is identified in two ways: as Western civilization with Britain as its centre in the nineteenth century, and as American civilization, a 'bastardized' form of Western civilization, according to some Canadian theorists, that by the twentieth century had become pervasive. In the nineteenth century Canadian theorists of technology saw technology as the means by which Canadians could partake of the virtues of Western civilization by physically *and intellectually* linking their country to Britain. In so doing, technology enabled Canadians to be world citizens, able to rise above their parochial existence on the North American continent. Technology also became associated with freedom for these nineteenth-century Canadian thinkers, a means by which, through their technological association with Britain and Western civilization, Canadians could be independent of the United States.

In the twentieth century, technology had a negative identity when associated with the United States and American imperialism. Technology was seen as instilling American values into Canadian society that were antithetical to traditional British Canadian morality. Technology was also seen as a source of power that had enabled the United States to dominate Canada and, through American imperialism, to control the entire world. Thus, the theme of technology as freedom versus power, which has its roots in Greek thought as a theme in Aeschylus's play *Prometheus Bound* and in early Christian thought in Saint Augustine's *The City of God,* appears in Canadian thought as part of the ongoing debate over Canadian identity.

I had originally intended to include both Anglo Canadian and French Canadian thinkers on technology in this book. Certainly, the theme of technological imperative versus moral imperative runs through French Canadian thought, although the moral imperative in French Canadian Roman Catholicism is nuanced differently than in Anglo Canadian Protestantism. In addition, French Canadian intellectuals looked at technology from the perspective of national identity and in the context of survival, or, in the case of French Canadian thinkers, *la survivance,* as their English Canadian counterparts did, although the 'nation' for French Canadian thinkers usually centred on Quebec. However, as I further pursued French Canadian thought on technology, I realized the plethora of intellectuals and the richness of perspectives to be analyzed. I came to the conclusion that to provide the same depth of analysis for French Canadian thinkers on technology that I have tried to provide for Anglo Canadian thinkers in one study was simply impossible. To attempt to do so would make French Canadian thought on technology appear to be an 'appendage,' or in addition, to that of Anglo Canadian thought rather than as a study in its own right.

The issue of gender arises in dealing with the subject of technology. A number of recent feminist studies of technology have noted the many ways

that technology is gendered in their disfavour. As well, it has been noted that until recently the vast majority of individuals writing about technology have been males. Certainly, this study bears that out. All of the Canadian thinkers whose ideas I analyze in this book are Anglo Canadian males, with one exception: Adelaide Hoodless. I had hoped to find more Canadian women in the past who reflected at length on the meaning of technology, especially from a female perspective, but Hoodless was the only one. In her case, she looked at domestic science as a form of technical education, a topic I address in Chapter 3. In the current period, Ursula Franklin, a professor of engineering at the University of Toronto, and Heather Menzies, an adjunct professor at Carleton University in Ottawa, have addressed the problem of a lack of female analysts of technology and offered their own perspectives as to why this is the case and what impact this deficiency has had on our understanding of technology. I discuss their views in my Conclusion. I had considered examining in what ways Canadian theorists of technology have gendered the technological imperative, providing in essence a postmodernist approach to the subject. However, I concluded that, since no one has looked at technological thought in Canada, the first step is to examine what these thinkers had to say about technology and leave it to others to analyze the views of Canadian theorists of technology from the perspective of gender and even from the perspectives of race and class as well. I am aware that all of the individuals whose ideas I discuss in this book are of Anglo-Celtic upbringing and of a privileged class, most of them with an academic background. Again, why this is so and what impact race and class might have on their perspective could be another important and related topic of study in and of itself.

One popular theme in postmodernist studies is power, particularly relating to the questions of who holds power, who is powerless, and how those in positions of power utilize it to keep the powerless under their control. This theme arises in my study because technology has always been a source of power, a theme that I note, if only in passing, when important to an understanding of the ideas of the individuals discussed. The exception is my chapter on Harold Innis and Eric Havelock: the theme of power was front and centre in their understanding of technology.

The challenge in writing a history of this kind is to find a theoretical model or form of classification that is appropriate to a subject as vast as technology. What we usually think of when we hear the word 'technology' is objects and machines. But one does not have to venture very far into the literature on technology or into the ideas of Canadian theorists to realize that technology is much more than objects and machines. Carl Mitcham argues in his article 'Philosophy of Technology' that technology can be classified into four broad categories: technology as object, technology as knowledge, technology as process, and technology as volition. Under technology as object,

Mitcham notes that the common-sense view is to associate technology with 'tools, machines, electronic devices, consumer products and the like,' and then to classify 'technological objects into various types and ultimately the articulation of an ontology of artifacts.'[4] Technology as knowledge, Mitcham's second category, is chiefly concerned with laws and how they relate to human nature. As Mitcham notes, 'To view technology as a kind of knowledge not only invites epistemological analysis, it transforms technology from an extension of man into an inherent constituent of human nature.'[5] Mitcham's third classification, technology as process, assumes that what is important about technology is the process of 'making and using' rather than how things are made and used.[6] The former – 'making' – became the domain of the engineer, while the latter – 'using' – has become the concern of the social scientist. Mitcham's last category, technology as volition, is concerned with the 'aims, intentions, desires, and choices' of those utilizing technology.[7] Increasingly, the debate focuses on whether the aims, intentions, desires, and choices are human ones or whether technology has a will of its own that dictates the choices humans make. I have found Mitcham's classification useful as an organizing principle for the Canadian thinkers in this book, as I will show in a moment. But I realized there is another category, at least with regard to Canadian analysts of technology: technology as imperative. Canadian thinkers may have differed as to whether they identified technology as object, knowledge, process, or volition, but they were united in their belief that technology was an imperative.

I begin my work with a chapter on the ideas of major international thinkers on technology. It is the evolution of their thinking that provides the historical and intellectual contexts in which to place the Canadian thinkers in this book. Historically, technology went from being seen first as objects or machines, then as a form of knowledge, as a process, and finally as volition. This was the case among the Canadian intellectuals that I discuss as well. Thus, by examining the ideas of the major international analysts of technology, I provide an intellectual context and backdrop for my discussion of the ideas of Anglo Canadians. As well, the issues raised by these international analysts of technology are ones that I too address in my analysis of Anglo Canadian theorists of technology.

My historical examination of Anglo Canadian thought on technology begins in the mid-nineteenth century with the writings of Thomas Coltrin Keefer and Thomas Chandler Haliburton on railways. They both saw railways, or more precisely railway locomotives, as objects or machines, the first level of identification of technology. These mighty juggernauts were so powerful, and the influence of railways so pervasive, Keefer and Haliburton argued, as to inaugurate a new modern era in Canada. To begin with Keefer and Haliburton on railways is not to suggest that no significant technological inventions preceded locomotives or that no Canadian thinkers before Keefer noted

the importance of earlier technological inventions. However, I do contend that no technological invention prior to the locomotive had as significant an impact to cause sustained reflections on its significance, and no Anglo Canadian thinkers prior to Keefer and Haliburton reflected at length on the impact of technology on Canadian thought. Only with the advent of railways did Canadian thinkers begin to think systematically and deeply about the nature, meaning, and significance of technology as opposed to just using it. There was a sense of wonder, excitement, and awe about railways as a form of technology that marks the railway era and Keefer's and Haliburton's writings as new and distinct. They claimed that railways were inaugurating a new world in which technology would be the dominant force, an imperative.

In the late nineteenth and early twentieth centuries, as Canada underwent its industrial revolution, a number of Canadian educational theorists saw technology as knowledge, the second phase of identification. Borrowing Francis Bacon's dictum that 'knowledge is power,' these educational theorists argued for the importance of technical education not only for the material advancement of Canada but also, and more importantly, for the moral and spiritual advancement of the country. I analyze their ideas in Chapter 3.

During the First World War and in the interwar years when large-scale industrialism and mechanization took hold, Canadian analysts of technology saw technology as process, the third way of classifying technology. During the war years, technology was defined as a process of war. In Chapter 4, I have used the ideas of the distinguished philosopher-psychologist George Sidney Brett as my focal point for analyzing the ideas of technology as a process of war. In the immediate postwar era, William Lyon Mackenzie King wrote of technology as a process of industrialism in *Industry and Humanity* (1918), as did the noted novelist Frederick Philip Grove in his novel *Master of the Mill* (1944). Their ideas are analyzed in Chapter 5. In *The Unsolved Riddle of Social Justice* (1920), Stephen Leacock examined technology as a process of mechanization. The same theme is evident in a number of poems by Archibald Lampman, one of the 'Confederation poets.' I discuss their ideas in Chapter 6.

In the post–Second World War era, theorists of technology realized that technology was much more than tools, machines, mechanization, or mode of production: it represented a pervasive value system. Canadian analysts of technology confronted the larger issue of the power of technology to control human thought. For these intellectuals, the issue of technology as volition loomed large, the final form of classification of technology. In Chapter 7, I trace the theme of technology as power in the context of volition in the writings of noted Canadian economist, historian, and communication theorist Harold Innis, as well as in the writings of Eric Havelock, Innis's colleague in the classics department at the University of Toronto in the 1930s

and early 1940s. The ideas on technology, especially electronic technology, of Canadian guru of communication technology Marshall McLuhan are analyzed in Chapter 8. In Chapter 9, I explore the association of technology with mythology in the writings of Northrop Frye, world-renowned scholar of mythology, and discuss the poetry of E.J. Pratt, Frye's teacher and later colleague, in which so many of the Canadian myths on technology have taken form. In Chapter 10, I trace the evolution of the ideas on technology of George Grant, one of the most extensive analysts of technology, and that of the poet Dennis Lee. I focus particularly on Grant's perspective of technology as 'being' and on the implications of this perspective on the concept of technology as volition. Grant came to see technology as so pervasive that the only meaningful response was one of silence. Dennis Lee, moved by Grant's emotional appeal to Canadians to fight American technological dominance, also used the theme of silence in his reflections on technology in his epic poem *Civil Elegies*.

In tracing Anglo Canadian thought on technology through the four perspectives of technology – as object, knowledge, process, and volition – I also show how technology goes from being seen as machines, external to human beings but having an impact on them, even on their perspective on the world, to being seen as a pervasive force that shapes our very essence as human beings, including the values and ideals by which we live. Equally, technology goes from being 'out there,' external objects or processes that humans can react to and possibly control, to being 'in here,' a force within the human mind that controls our ways of thinking. In all cases, Canadian theorists of technology have come to see it as a mindset that is itself shaped by the very technology that humans are attempting to comprehend and control – hence, an imperative.

One final issue needs to be addressed. How does this study fit into the existing English Canadian historiography on technology and Canadian thought? What is surprising is how little has been written on this topic despite its pervasiveness. To date, no one has looked at the evolution of Anglo Canadian thought on technology as this book does. While most of the individuals whose perspectives on technology form the basis of this book are well known to Canadian intellectual historians, most have not been looked at from the perspective of their views on technology. The exceptions are Harold Innis, Marshall McLuhan, and George Grant. Arthur Kroker, an analyst of technology, did a study of the ideas of these three theorists in *Technology and the Canadian Mind: Innis/McLuhan/Grant*. While insightful in terms of the views of these intellectuals and how they interrelate, the discussion occurs in a vacuum since Kroker does not trace the roots of their thinking on technology, nor does he put their ideas into a historical context. The other important study that includes Innis, McLuhan, and Grant, as well as Northrop Frye, and that deals with the subject of technology is Robert E.

Babe's *Canadian Communication Thought: Ten Foundational Writers*. Babe does provide brief biographical sketches of these individuals, as does this book, to reveal the roots of their thinking. However, the focus of his study is not on their views of technology per se but rather, as his title indicates, on their communication thought. While technology is certainly an important component of these intellectuals' views on communication, it does not get adequate treatment. Also, Babe, like Kroker, fails to place the ideas of these communication theorists in a broader historical context. These criticisms of Kroker and Babe apply as well to other analysts of Innis, McLuhan, Frye, and Grant. The tendency is to focus on a theme other than technology. For the few analysts who do dwell on the subject of technology in the thought of these Canadian intellectuals, the approach is to look at the topic of technology in selective writings only, such as in Innis's communication studies, rather than as a theme throughout all their major writings. Finally, no one has identified technology as an important topic in English Canadian intellectual life, that is, as an imperative – the technological imperative – and then shown how it has interacted with the other dominant imperative in English Canadian thought since the mid-nineteenth century, namely, the moral imperative, as I have done in this book.

The evolution of the idea of technology as metaphysics within Anglo Canadian thought has been long and multifaceted. I highlight the peaks of that intellectual journey by focusing on the ideas of the major Anglo Canadian theorists of technology from the mid-nineteenth century to the present. In so doing, I show precisely how these Canadian theorists came to shape a technological imperative that continually came up against a moral imperative in a way that accentuated the tension between these two dominant modes of thought. It was this tension, and the feeling among some Canadian intellectuals, like George Grant, that the technological imperative invariably dominated over the moral imperative, that caused him to reluctantly conclude that 'technology is the metaphysics of our age; it is the way being appears to us.'

1
Perspectives on Technology

International analysts of technology have grappled with the nature, meaning, and significance of technology since its emergence as a dominant force in Western civilization. Their ideas enrich our understanding of the multifaceted ways of seeing technology. They also offer a theoretical lens through which to frame Canadian thought. More importantly, however, the ideas of the international thinkers on technology provide an intellectual backdrop for the ideas of Canadian thinkers on technology. In discussing the issues these international theorists raised and the perspectives they offered, one becomes aware to what extent Canadian theorists of technology were in tune with the thinking of their times; they were not writing in an intellectual vacuum. While Canadian thinkers may not have been cognizant of the ideas on technology being put forward by intellectuals elsewhere, they did nevertheless share a Zeitgeist of the times in which they wrote. They also raised questions and grappled with issues from their own Canadian perspectives that were age-old ones relating to technology. Identifying these issues and noting the changing currents of thought on technology among international theorists of technology thus provide the intellectual framework needed to enrich our understanding and enhance our appreciation of the depth of insights on technology offered by Canadian thinkers.

Lewis Mumford, distinguished and insightful writer on the history of technological thought, has traced the historical and intellectual evolution of technology, first perceived as objects and then, by the advent of the Industrial Revolution, as machines, from prehistoric times to the twentieth century. He shows how technology began as an idea in the minds of primitive human beings that grew to keep pace with the numerous technological inventions over the centuries. He argues that over time machines came to shape a mindset that was itself 'mechanical,' that in essence the idea of technology consumed itself. As early as the sixteenth century, technology had come to be seen as a form of knowledge. The provocative Renaissance thinker Francis Bacon, identified as the first philosopher of technology, or

what he called the mechanical arts, saw technology as a way of thinking that was superior to scholastic philosophy and that could create a utopian world if it were to become the dominant paradigm of thought. To him, knowledge was power, and technical knowledge was the greatest source of intellectual power. William Leiss, a Canadian analyst of theories of technical education, explores the ideas underlying the perspective of technology as knowledge from Francis Bacon's time to the present in *Under Technology's Thumb*. I also note the importance of John Kenneth Galbraith's work on technical education as 'technostructure.' Karl Marx, writing in the mid-nineteenth century, became the first analyst of technology to identify the multiplicity of ways in which the process of industrialism and its offshoot, mechanization, affected all aspects of society, especially the lifestyle of the working class. What Marx did for the nineteenth century, the noted analyst Siegfried Giedion did for the twentieth century in *Mechanization Takes Command,* showing that the process of mechanization had even 'invaded' the private spaces of the home and of the mind. Martin Heidegger, distinguished German philosopher of technology, provided the first significant analysis of technology as volition, noting in his seminal essay 'The Question Concerning Technology' the ways in which it shapes the values and beliefs of the modern age. French theorist Jacques Ellul explored the subject further, especially the idea of technology as a *mentalité* that was itself technologically induced, in his important study entitled *The Technological Society*. System designers, particularly advocates of cybernetics, have explored ways of using communication data to create patterns of thought that can be applied to solving problems. Norbert Weiner presents this perspective on technology in *Cybernetics: Control and Communication in the Animal and the Machine*.

What follows is an overview of the key ideas of these major international thinkers on technology as representative of the perspective of technology from one of the four broad categories of machines, knowledge, process, and volition. These major international thinkers on technology also provide an intellectual and historical context for analyzing the ideas of Canadian theorists of technology that form the essence of this work.

Analyst Lewis Mumford went the furthest in studying technology as objects or machines.[1] In his monumental works, beginning with *Technics and Civilization* (1934) and including *Art and Technics* (1952), *The Transformations of Man* (1956), and his two-volume study *The Myth of the Machine: Technics and Human Development* (1966) and *The Myth of the Machine: The Pentagon of Power* (1970), Mumford explored all aspects of the world of technology as 'the machine.' He differentiated between machines as specific objects, such as the printing press or the power loom, and 'the machine' as a 'shorthand reference to the entire technological complex.' Concerning the latter, he noted, 'This will embrace the knowledge and skills and arts

derived from industry or implicated in the new technics, and will include various forms of tool, instrument, apparatus and utility as well as machines proper.'[2]

He traced the historical evolution of technology from prehistoric tools to machines run by the power of wind, water, animals, and humans in the 'ecotechnic' phase (from roughly 1000 to 1750 AD), by coal and steam in the 'paleotechnic' phase (1750 to 1900 AD), and by electricity in the 'neotechnic' phase (1900 on). What is significant about his study, besides the extensive period covered in his analysis of 'the machine,' is threefold. First of all, he includes as 'machines,' and therefore within his definition of technology, artifacts not usually identified as machines, such as utensils (baskets, tables, and chairs), apparatus (dye vats and brick kilns), utilities (reservoirs, aqueducts, and roads), works of art, and even human beings themselves. Indeed, he argued that the greatest machine – the 'megamachine' – has been collective human power, initially used to build the Egyptian pyramids, for example, and later used as large-scale armies. Second, he maintained that machines have both shaped the culture of the society from which they developed (far more than has been recognized by the people within that society and analysts since) and, more importantly, were themselves shaped by humans through a cultural context of the time. During the paleotechnic phase, for example, the technology of the Industrial Revolution, particularly related to the production of coal and the introduction of the steam engine, created new institutions such as capitalism and modern armies, which in turn resulted in the creation of 'a new civilization.'[3]

Mumford argued that machines came to dominate human life to a greater extent than ever before or since, making humans quantifiable entities valued only for their productivity. He believed that in the recent neotechnic phase and the advent of electricity, the imbalance was corrected, and machines served human needs and were patterned on organic life. A redeeming feature of this age was the shift from quantitative to qualitative standards through automation, which, he claimed in *Technics and Civilization* (1934), would liberate man from inhuman work. However, Mumford came to doubt this claim by the time he wrote *The Myth of the Machine* in the 1960s.

Closely related to his second point on the interaction of technology and culture is his third point on seeing all technology as machines. Even his term 'the machine' to refer to items not usually seen as machines, or to sources of power in the ecotechnic phase, and even to a way of perceiving the world – a mindset – indicates the pervasiveness of his image and definition of technology as machines. This image not only weakens his analysis of technology in the twentieth century, when the image distorts more than it explains, but also limits his analysis of technology by seeing the technological mindset as only 'mechanical' in nature, thus eliminating aspects of this technological mindset that for some theorists of technology go well beyond

what might be imagined by the term 'the machine.' While Mumford certainly suggests some of these wider implications,[4] his insistence on using the term 'the machine' for this wider mindset clearly links technology with machines only in his perspective on the subject of technology. It also makes humans out to be 'mechanical beings,' lacking in moral and spiritual values. Note for example Mumford's discussion of the 'new scientific method' as an aspect of the mindset of Western civilization that underlay our modern technological age and the extent to which he sees that scientific method as associated with machinery:

> Machines – and machines alone – completely met the requirements of the new scientific method and point of view: they fulfilled the definition of 'reality' far more perfectly than living organisms. And once the mechanical world-picture was established, machines could thrive and multiply and dominate existence: their competitors had been exterminated or had been consigned to a penumbral universe in which only artists and lovers and breeders of animals dared to believe ... By renouncing a large part of his humanity, a man could achieve godhood: he dawned on this second chaos and created the machine in his own image: the image of power, but power ripped loose from his flesh and isolated from his humanity.[5]

The cultural aspect of technology clearly interested Mumford. He believed that the greatest impact of new machines and new energy sources was qualitative rather than quantitative and thus more accessible to the cultural sensitized than the statistician or the scientist. Yet even the 'cultural sensitized' would miss the qualitative impact of new technology, Mumford maintained, if they saw it only as a one-way interaction – the machine on society. Mumford refused to see machines as having ultimate sway and autonomous power over humans. From the beginning, he noted, human spirituality and creativity, through dreams and the imagination, created the ideas and human energy needed to create the machines. He wrote, 'His [man's] first task was not to shape tools for controlling the environment, but to shape instruments even more powerful and compelling in order to control himself, above all, his unconscious. The invention and perfection of these instruments – rituals, symbols, words, images, standard modes of behavior (mores) – was, I hope to establish, the principal occupation of early man, more necessary to survival than tool-making, and far more essential to his later development.'[6] Thus, man was a thinker and a creator of ideas before he was a tool-making animal or later a worker or technician. That is why, Mumford explained, the earliest great machines in the West that were precursors of the Industrial Revolution – the clock, watermill, horse-powered treadmill, and windmill – were creations of the monastery. Christianity provided the essential intellectual milieu for such inventions by providing

a spiritual motivating force for work – that is, the belief that in doing good works one was serving God – and incentive – that is, faith in the creative ability of humans as 'children of God.' Mumford contended reluctantly that once in place, however, the mechanical prevailed over the spiritual component of technology, providing both the rationale and the means for humans to advance.

Because of Mumford's persistence in seeing technology and culture as an interactive dynamic, he remained essentially optimistic about the ability of humans to control technology. While there were periods when it appeared as though humans were the slaves of the machine, such as during the Industrial Revolution of the paleotechnic phase, ultimately the imbalance corrected itself, and humans emerged dominant over the machine. Only as Mumford reached the twentieth century and the current age did he become pessimistic. He feared that, in the pursuit of perfection, humans had come to trust in the machine to change them for the better. As a result, society in general was allowing technology to come under the control of an elite intent on creating a utopia that would be authoritarian and uniform rather than liberating. Mumford noted with concern that we are moving toward the age of 'megatechnics' when 'the dominant minority will create a uniform, all-enveloping, super-planetary structure, designed for automatic operation. Instead of functioning actively as an autonomous personality, man will become a passive, purposeless, machine-conditioned animal, whose proper functions ... will either be fed into the machine or strictly limited and controlled for the benefit of depersonalized, collective organizations.'[7] Mumford believed that what contributed to this 'misdirection' was the myth of prehistoric man as predominantly a tool-making animal and modern man as essentially a worker and a technician. Ultimately, technology had to be seen not as an autonomous entity but as a human creation, existing at man's will for human ends.

The perspective of technology as objects or machines was followed by the perspective of technology as knowledge. This view dates back to the seventeenth century, when Francis Bacon declared in *The New Organon; Or, True Directions Concerning the Interpretations of Nature* (1620) that 'Knowledge is Power.' Bacon, who has been called the first philosopher of industrial science,[8] believed that technical knowledge, what was then called the 'mechanical arts,' was the most powerful and useful form of knowledge, superior in every way to scholastic discourse. Technical knowledge held the possibility of conquering nature by eliminating its vagaries and unpredictability and overcoming the devastation of human life through flood, famine, disease, and pestilence. Bacon maintained that scholastic knowledge, by comparison, saw physical nature as shaping human nature, thus becoming bogged down on issues of morality that he believed had no place in dealing

with technology. Technical knowledge held the potential to create a utopian state, a state he sketched out in his novel *The New Atlantis* (1624).

Bacon's faith in technology as knowledge and power continues into the present. It can be found in the teachings of schools of the practical arts and schools of engineering and in our belief that with each new invention and the accumulation and integration of new technical knowledge the world comes closer to a state of perfection. Technical knowledge is seen as the key to the future, and 'from this standpoint,' William Leiss, the Canadian analyst of technology, notes, 'technologies are essentially a crystallized form of human knowledge.'[9]

Unlike the Canadian thinkers who follow in this study, who are theoreticians of technology, Leiss analyzes in his major work *Under Technology's Thumb* the ideas of those thinkers over time who have perceived technology as knowledge. He argues that the popularity of technical knowledge arose out of the political theory of classical liberalism in the early modern period of the West. It assumed that social progress would occur on the basis of rational or educated self-interest, as opposed to emotional appeal to the social conscience of society as a whole. As John Locke reasoned, the rational person was the 'industrious' being who accumulated property. In the self-regulating and highly competitive marketplace of the laissez-faire economy, knowledge, especially technical knowledge, became a commodity, a form of 'capital,' and a factor in success. Locke pointed out that a knowledgeable worker was more productive than an untrained one. It was Karl Marx, however, who pointed out the direct link between technical knowledge and the productivity of labour; what he condemned was the application of this knowledge and resulting productivity for private ends (as private property) and one class only (the bourgeoisie) rather than for the good of society as a whole and in particular for the working class that contributed substantially to that productivity. By the nineteenth century, Leiss notes, 'many writers regarded scientific and technical knowledge as the cornerstone of the truly revolutionary changes in production made through the industrial system.'[10] As Alfred Whitehead observed, a process of invention was the greatest invention of the nineteenth century, and that process was the by-product of scientific and technological knowledge. From that starting point, technology as knowledge evolved to the point at which it has now become one of the sacred and unquestioned truths of our modern value system, so much so, in fact, that it has created its own idols – what Leiss calls 'the idols of technology' – comparable to the idols that Francis Bacon fought against to get the 'mechanical arts' or technology accepted in his day.

In *The New Industrial State* (1967), John Kenneth Galbraith, an economist by training but a social activist by conviction,[11] argued that technology in the late twentieth century was so sophisticated as to require megacorporations with an array of highly educated specialists – researchers, designers,

lawyers, accountants, economists, engineers, personnel specialists, public relations agents, among others – to ensure maximum technological efficiency.[12] He called this technical knowledge 'technostructure' and noted that it had replaced capital as the crucial factor of production. This technostructure, created and sustained by technology, has its own imperative that may appear less threatening than power structures in the past, since power resides in many experts in a corporation rather than in one individual. However, these techno-corporations with their collective technical expertise, Galbraith pointed out, wield infinitely more power than any individual could have hoped to wield in the past. Worse still, these corporations operate purely on the profit motive: to produce more consumer goods at huge profits for the financial benefit of the shareholders in the corporation; they lack a social conscience. Hence Galbraith's concern that these techno-corporations, rather than politicians or the public at large, are driving the economies of the world, and especially the largest of those economies, that of the United States. He also noted the difficulty in the modern world of controlling the technical will to power because it is invisible, complex, and diverse. Nevertheless, he warned, it is no less dangerous to the good of society: it is all the more so because it provides the goods that consumers want and thus appears to be a 'friend' or at least 'benign,' until we are awakened to the motives behind its drive to power and the negative implications that result from it. Galbraith argued that 'we are becoming the servants in thought, as in action, of the machine we have created to serve us.' Society is allowing economic goals to drive social policy rather than vice versa. This needs to be corrected, he emphasized, so that what counts 'is not the quantity of our goods but the quality of life.'[13]

Daniel Bell, an American cultural analyst, has also noted the importance of technical knowledge in the modern age. In *The Coming of Post-Industrial Society,* he argued that 'broadly speaking, if industrial society is based on machine technology, post-industrial society is shaped by an intellectual technology. And if capital and labor are the major structural features of industrial society, information and knowledge are those of the post-industrial society.'[14] Technical knowledge, Bell noted, has replaced machinery and land as the key resource in society, and the possession of technical know-how has become the route to power, thus fulfilling Bacon's prediction that knowledge is power.

Such hyperbole, Leiss points out, creates the danger of elevating technical knowledge, and therefore technology itself, to the status of 'new god' of the modern world. It also poses the danger of seeing technology as a mammoth and autonomous entity – a somewhat friendly Frankenstein – over which humans have little control and technical knowledge as the only worthy kind of knowledge to acquire. The danger becomes what Leiss calls 'a despotic marriage of knowledge and power.'[15] The answer is to realize that technical

knowledge is only one form of knowledge and not necessarily the best at coming to terms with complex social problems arising out of the very technology that needs to be studied and addressed. Ultimately, Leiss points out, we must come to realize that the motivating factor for change in society today is not technology but the social values that lie behind the technology. These are the cultural and intellectual assumptions on which we operate, the moral values for which we strive. In that search, the 'technological imperative' can be a positive factor but should not be the ultimate goal. In the end, then, Leiss remains optimistic that technical knowledge can be a positive factor for social change so long as it is seen as only one – and not the primal – factor in coping with problems and moving toward an enlightened future. As he notes in his tempered conclusion on the subject, 'We shall need every ounce of technological ingenuity and scientific understanding we can muster to pull us back from the abyss of irremediable environmental disaster. But there is no hope of healing so long as the illusion persists that those instruments themselves can bring about the harmonization of human interests.'[16]

Implicit in Leiss's analysis of technology as knowledge is a corollary of this perspective on technology, namely, that technology – technical education – can be a powerful agent for social reform. Francis Bacon himself envisioned technical knowledge being used in this way in his promise that the benefits of applying technical knowledge – the mechanical arts – to nature and society far outweighed its dangers and limitations. From Bacon onward, a host of social reformers and utopianists alike have seen in technology the panacea to the multiplicity of ills besetting society, many of which are, ironically, the direct results of the very technology that has become the object of faith.

Machines seldom operate as self-contained entities. They form part of a larger complex that we call industrialism and a process that is described as mechanization. This became the third way of perceiving technology: as process. Karl Marx has often been seen as the first to analyze the dynamics and implications of the process of mechanization in the factory system that became the core of industrialization. In his section called 'Machinery and Large-Scale Industry' in *Capital: A Critique of Political Economy,* Marx began by distinguishing between tools and machines: the former being the instruments of humans, whereas the latter were implements of their own mechanization. Once set in motion, Marx pointed out, these mechanical instruments 'perform with [their] tools the same operations as the worker formerly did with similar tools.'[17] Hence machines began to replace workers, as opposed to tools that were used by workers. When these machines began to operate as a system, as in a factory, then they constituted a 'vast automaton.' Marx described such mechanized systems as 'a mechanical monster

whose body fills whole factories, and whose demonic power, at first hidden by the slow and measured motions of its gigantic members, finally bursts forth in the fast and feverish whirl of its countless working organs.' Here then, Marx noted, was full-scale mechanization.

What followed were 'the abolition of the old handcraft and manufacturing systems in the spheres of production,'[18] and the division of labour, along with the exploitation of workers, including the women and children of the male workers, as mere 'commodities' for the benefit of capitalists. Marx noted the chain reaction set in place by the mechanization of the mode of production in terms of its impact on the working class:

> Partly by placing at the capitalists' disposal new strata of the working class previously inaccessible to him, partly by setting free the workers it supplants, machinery produces a surplus working population, which is compelled to submit to the dictates of capital. Hence that remarkable phenomenon in the history of modern industry, that machinery sweeps away every moral and natural restriction on the length of the working day. Hence too the economic paradox that the most powerful instrument for reducing labour-time suffers a dialectical inversion and becomes the most unfailing means for turning the whole lifetime of the worker and his family into labour-time at capital's disposal for its own valorization.[19]

Mechanization took command, Marx noted, and workers were forced to keep pace with the relentless motion of the machines to the point of nervous exhaustion. As well, workers became slaves to the machines. They reacted by fighting the machines, by railing against the system that created the machines, through riots and strikes, and by denouncing the capitalists who controlled and benefited from the system. What is impressive about Marx's analysis is his ability to show the multifaceted ways that machine technology in the form of a mechanized industrial system had an impact on all aspects of society, especially on the working class. However, he failed to address the moral and spiritual impacts of technology on the working class. In the end, Marx believed there were potential economic benefits associated with technology for the working class but that such benefits could not accrue until control was taken out of the hands of the bourgeoisie and placed in the hands of the proletariat. In Marx's mind, industrialism and the accompanying process of mechanization were value-neutral; as to the outcome, it depended in whose hands the power of technology resided.

A more recent major study of technology as mechanization is Siegfried Giedion's *Mechanization Takes Command: A Contribution to Anonymous History* (1948).[20] Surprisingly, Giedion did not define mechanization but rather showed its multifaceted nature in the material, natural, organic, and human

realms. Its roots lay in the rationalistic view of the world of the eighteenth century, with its faith in progress and human perfectibility. In the nineteenth century, mechanization was seen as the means to achieve these ideals. Mechanizing production became the ultimate goal, but this could only come about when the guilds were abolished, Giedion argued. This in turn required a change in perspective from what Giedion called 'the miraculous to the utilitarian.'[21] Thus, Giedion also maintained, like Mumford, that technology in the form of mechanization is the by-product of a particular mindset that emerged in the modern world – a mindset that saw the world in mechanistic terms, that measured everything in quantitative as opposed to qualitative terms, that put a premium on utilitarian over spiritual values, and that had as its ultimate goal the rational, systematic, and calculated mechanization of the organic and inorganic, natural and human worlds. This ultimately required the severing of thoughts from feeling, and the dehumanizing of human beings through an alteration of human nature. Although noting this disjuncture between the practical and moral aspects of the new technological mindset, Giedion did not explore its implications. Instead he simply noted by way of introduction to his study: 'At the origin of the inquiry stood the desire to understand the effects of mechanization upon the human being; to discern how far mechanization corresponds with and to what extent it contradicts the unalterable laws of human nature.'[22]

Giedion argued that the ultimate form of mechanization was the assembly line: 'It aims at an uninterrupted production process. This is achieved by organizing and integrating the various operations. Its ultimate goal is to mould the manufactory into a single tool wherein all the phases of production, all the machines, become one great unit. The time factor plays an important part; for the machines must be regulated to one another.'[23] The assembly line was 'an American institution,' just as mechanization was most notably 'an American phenomenon.' Underlying the assembly line and giving it its rationality or purpose was scientific management, another American phenomenon and the brainchild of Frederick W. Taylor. Both reflected the initial optimism and euphoria with which mechanization was greeted. Giedion maintained that mechanization reached its extreme form in the interwar years, when it penetrated the private sphere: the household through the kitchen and the bathroom; nutrition through food processing; and leisure through the automobile. On the latter, he noted, 'The automobile is a personal appurtenance which comes to be understood as a movable part of the household ... The automobile is a harbinger of full mechanization ... Walking, relaxation for its own sake, because the body demands it, or because the brain requires a pause in which to recuperate, is increasingly eliminated by the motor-car.'[24] Even the senses come under the sway of mechanization: the eye by the silent cinema, the ear by the radio, and both senses by the television. Heralding Marshall McLuhan's later theories on communication

technology, Giedion argued that new mediums create new values and new modes of imagination.

For Giedion, change is the one 'constant' in the modern world of technology. He began his study with the concept of movement, which, he claimed, 'underlies all mechanization.'[25] Our modern concept of motion has its roots, he argued, in the Judeo-Christian tradition, the belief that the world was created at a point in time – *ex nihilo* – 'and set in motion by an act of will.'[26] Out of the search for the principles and first causes that underlay God's action came the question of change and thus an interest in the nature of movement, especially although not exclusively in the realm of astronomy. By the eighteenth century, movement in all its forms was of interest, Giedion pointed out, best embodied in Étienne Jules Marcy's popular book *Le Mouvement* (1894). By the nineteenth century, movement forward became associated with progress. And progress was measured in terms of technology, which became translated into a faith in production as an end in itself. According to Giedion, this was the basis of a change in orientation of thought from 'the miraculous to the utilitarian,'[27] and it expressed itself in every sphere of life. Synchronous movement – constant change – became synonymous with mechanization and thus associated with technology, in contrast to the erratic and spontaneous movements of organized life. The former was predictable and therefore considered the ideal; humans had to fit the ideal, and thus they become like the machine: mechanized, regular, and predictable. As William Kuhns notes in his analysis of Giedion's ideas, 'Man increasingly moves less by the measure of his own body and mind than by that of the machine.'[28]

What was Giedion's evaluation of technology as mechanization? He claimed in his evaluative summation of his study that he refrained 'from taking a positive stand for or against mechanization. We cannot simply approve or disapprove. One must discriminate between those spheres that are fit for mechanization and those that are not.'[29] For Giedion, these were moral questions that had no place in evaluating the impact of technology as mechanization. However, Giedion still had a desire to believe, like Mumford, that technology is an external entity that may inform and shape the human mind to certain desired ends but can ultimately be controlled and used by humans 'to protect [themselves] against its inherent perils.'[30] Yet the whole thrust of his argument and study is that mechanization is so pervasive, insidious, anonymous (see his 'Anonymous History') as to be beyond human control, a 'Frankenstein' that humans have created and are unable to contain. Indeed, Giedion's description of mechanization reminds one of Mary Shelley's *Frankenstein:* 'Because mechanization sprang entirely from the mind of man, it is more dangerous to him. Being less easily controlled than natural forces, mechanization reacts on the senses and on the mind of its creator.'[31] As for the future judgment of history on the age of mechanization, Giedion

was not optimistic from his perspective in 1948, having experienced the Second World War: 'Never has mankind possessed so many instruments for abolishing slavery. But the promises of a better life have not been kept ... Future generations will perhaps designate this period as one of mechanized barbarism, the most repulsive barbarism of all.'[32]

Technology as volition is the fourth and final perspective. Volition refers to 'the aims, intentions, desires, and choices'[33] that humans see in and bring to technology. The term assumes that technology in itself is neutral; its value depends on its uses. However, there is also a counter-belief, one that we have already seen: that technology is beyond human control and indeed controls humankind, shaping and dictating the very values that society sees as of utmost importance. Indeed, implicit in the concept of technology, as opposed to science, is the belief that the ends or intentions of these two disciplines are different: science aims at knowing the world, while technology aims at controlling or manipulating it. The question then becomes: Who or what is controlling or manipulating the world? Do humans control technology, or does technology itself control by shaping and dictating the values, ideals, and aims humans bring to it? From the perspective of technology as volition, it appears that technology takes command, dictating our views of it, including the belief that technology is controlling us by dictating how we think.

Martin Heidegger provided the most extensive philosophical study of technology as volition or 'willing' in his *Being and Time* (1927) and especially in his later essay 'The Question Concerning Technology' (1954).[34] In *Being and Time,* he explored the implications of the concept of *Dasein* (literally 'to be here'), a being-in-the-world. Part of this 'being' has been of a practical concern for 'manipulating things and putting them to use.' These things were identified initially and fundamentally by their use – a hammer, for example, 'for hammering.' Thus, Heidegger believed that practical knowledge was the fundamental form of knowledge from which other forms, like abstract knowledge, derived. With regard to human beings, then, they were tool makers before they were abstract thinkers, the exact opposite perspective from that of Lewis Mumford.

In 'The Question Concerning Technology,' Heidegger went further, arguing that technology is 'by no means anything technological'[35] – that is, to do with tools, machines, industrialism, or mechanization – 'or, in Latin, an *instrumentum*.'[36] Rather it is 'a kind of truth, a kind of revealing or disclosing of what is.' However, the truth that is 'revealed' or 'disclosed' is different in the modern world of technology from anything that preceded it. Heidegger pointed out that ancient technology revealed by means of 'bringing-forth' from nature through art and poetry; modern technology (beginning with the Industrial Revolution) reveals by 'challenging,' a 'setting upon,' nature.

The implication here is that ancient technology created artifacts in co-operation with nature, whereas modern technology imposes on nature, 'forcing it to yield up materials and energies that are not otherwise to be found.'[37] Furthermore, the objects of nature that were used in ancient technology continued to have an inherent value of their own independent of their use by humans, whereas objects in modern technology have no inherent value apart from human use.

Heidegger also argued that nature too became an object of manipulation (his 'setting upon' in the modern technological age). He called this perspective *Gestell* ('enframing'), which is the technological attitude toward the world and thus the essence of the modern mindset. This perspective or modern mindset, Heidegger noted, had its origins in Descartes, *ego cognito* [ergo] *sum,* in which humans found their self-certainty *within themselves* rather than within the world over against themselves. The world – nature – became a *representation* of reality formed within the human mind, set as object against humans as subjects, to be understood within the human mind and thus humanly manipulated and controlled. Heidegger believed that his altered philosophical perspective lay at the root of modern science. As William Lovitt points out in his Introduction to *The Question Concerning Technology and Other Essays,* for Heidegger 'the modern scientist does not let things presence [sic] as they are in themselves. He arrests them, objectifies them, sets them over against himself, precisely by representing them to himself in a particular way.'[38] Such a mindset was an essential – indeed the *central* – component of the modern technological world, because everything is seen over against humans to be controlled by them.

However, *Gestell,* or 'setting upon' and 'challenging,' occurs not only toward nature but also toward humans themselves. 'The essence of modern technology,' Heidegger wrote, 'starts man upon the way of that revealing through which the real everywhere, more or less distinctly, becomes *Bestand* ["stock," "standing-reserve," things "in supply"].' It is a way of thinking or perceiving the world that humans as technological beings, or 'tool makers,' are destined or fated to uphold. This way of thinking or perceiving is 'the modern volitional stance towards the world.' Because it is itself 'technologically based,' this mindset is extremely difficult, if not impossible, to get outside of to view objectively. Hence, Heidegger referred to it as 'the supreme danger.' He explained why:

> This danger attests itself to us in two ways. As soon as what is unconcealed no longer concerns man even as object, but does so, rather, exclusively as standing-reserve, and man in the midst of objectlessness is nothing but the orderer of the standing-reserve, then he comes to the very brink of a precipitous fall; that is, he comes to the point where he himself will have to be taken as standing-reserve. Meanwhile man, precisely as the one so threatened,

> exalts himself to the posture of lord of the earth. In this way the impression comes to prevail that everything man encounters exists only insofar as it is his construct. This illusion gives rise in turn to one final delusion: It seems as though man everywhere and always encounters only himself ... *In truth, however, precisely nowhere does man today any longer encounter himself, i.e., his essence.* Man stands so decisively in attendance on the challenging-forth of Enframing that he does not apprehend Enframing as a claim, that he fails to see himself as the one spoken to, and hence also fails in every way to hear in what respect he ek-sists [sic], from out of his essence, in the realm of an exhortation or address, and thus can never encounter only himself.
>
> But Enframing does not simply endanger man in his relationship to himself and to everything that is. As a destining [willing], it banishes man into that kind of revealing which is an ordering. Where this ordering holds sway, it drives out every other possibility of revealing.[39]

As Gregory Bruce Smith notes, for Heidegger, 'modern technology is no mere instrumentality that man can consciously and rationally control by imposing "values" upon it. We stand within its mode of revealing and cannot stand outside it.'[40] While Heidegger presented this all-encompassing technological mindset within which human beings view the world and to which they look for understanding, guidance, and meaning, he refused to pass moral judgment on its value. He also resisted passing judgment on whether this technological mindset had been beneficial or destructive to modern society.

As well, Heidegger refused to see the modern technological perspective as 'fated' to exist. He believed that in the very awareness of danger comes what he calls the 'saving power' of technology, and reasoned, 'Enframing, as a destining of revealing, is indeed the essence of technology, but never in the sense of genus and *essentia*. If we pay heed to this, something astounding strikes us: It is technology itself that makes the demand on us to think in another way what is usually understood by "essence."'[41] That other way is to think of technology as an 'Idea' whose truth can be known to man and, in the very act of 'human reflection,' free man. Heidegger argued that this view of technology as an 'Idea' is evident in the other Greek meaning for *techne:* 'the bringing-forth of the true into the beautiful,'[42] an idea captured in the Greek word *poiesis,* which refers to both *techne* and art. Art, he noted, was both 'akin to the essence of technology' and yet 'fundamentally different from it.'[43] Thus, in coming to terms with the meaning of art, we come closer to understanding the essence of technology and, paradoxically, better able to rise above it to see it for what it is – its essence.

For Heidegger, then, technology is a way of perceiving – a mindset – that is itself 'technologically induced' in that it orders a way of perceiving the world that is in essence 'technological.' Only by coming to terms with this

technological perspective are humans able to see the very essence of technology that is the basis from which humankind can 'liberate' itself from the mindset. This is no facile act of will or a shallow way of thinking, Heidegger cautioned, but a coming to terms with technology as a supreme act of faith, a volition in the highest sense of the term.

Jacques Ellul questioned the implications of seeing technology as volition in his ground-breaking book *The Technological Society* (1964).[44] Ellul argued that, due to the power of technology, the modern world is radically different from anything that went before it. Ellul is not clear as to when this modern 'technological civilization' began, although his study concentrated mainly on the post–Industrial Revolution (Ellul called it the 'technical revolution') period. Indeed, one of Ellul's arguments is that the modern world of technology has developed slowly and unconsciously, making it a cumulative rather than sudden phenomenon.

According to Ellul, to use the term 'technology' in speaking of the modern world is to misunderstand its pervasive nature, because the term has come to be associated with machines, whereas the world of technology is much more than machines. This is the exact opposite perspective from that of Mumford, who saw technology in all guises only as machines. It is a mindset, a way of perceiving the world, that incorporates the machine and all it symbolizes in its perspective but is evident in every sphere of life: economics, politics, law, education, religion, eating habits, work, and recreation. To distinguish this mindset from machines, Ellul chose to use the term 'technique' rather than 'technology.' He provided a definition of technique in a 'Note to the Reader,' a section in the revised edition of his text, published in 1967: 'The term *technique,* as I use it, does not mean machines, technology, or this or that procedure for attaining an end. In our technological society, *technique* is the *totality of methods rationally arrived at and having absolute efficiency* (for a given stage of development) in *every* field of human activity. Its characteristics are new; the technique of the present has no common measure with that of the past.'[45]

Such a definition incorporates three concepts that Ellul argued are integral to the modern world of technology: totality, rationality, efficiency. Technology, or technique, is total in that it 'integrates everything,' including humans themselves. He showed the totality of technique by contrasting it with the machine: 'As long as technique was represented exclusively by the machine, it was possible to speak of "man *and* the machine." The machine remained an external object, and man ... remained none the less independent. He was in a position to assert himself apart from the machine; he was able to adopt a position with respect to it. But when technique enters into every area of life, including the human, it ceases to be external to man and becomes his very substance. It is no longer face to face with man but is integrated with him, and it progressively absorbs him.'[46]

Ellul described rationality, the second concept, as a process by which 'mechanics is brought to bear on all that is spontaneous or irrational.' Examples of rationality, he noted, are 'systematization, division of labor, creation of standards, [and] production norms.' All are characterized by 'the reduction of method to its logical dimension alone. Every intervention of technique is, in effect, a reduction of facts, forces, phenomena, means, and instruments to the schema of logic.'[47]

The final common characteristic of the modern world of technology, according to Ellul, is efficiency. '"The one best way": so runs the formula to which our technique corresponds,' he pointed out. 'When everything has been measured and calculated mathematically so that the method which has been decided upon is satisfactory from the rational point of view, and when, from the practical point of view, the method is manifestly the most efficient of all those hitherto employed or those in competition with it, then the technical movement becomes self-directing. I call this process *automatism*.'[48]

Automatism, in turn, is one of five characteristics that made the modern world of technology totally different from any previous world orders. He identified the other four characteristics as self-augmentation, monism, technical universalism, and autonomy. Self-augmentation is the ability of technique to pursue its own course without the decisive intervention by human beings, because of an unquestioning faith in technical progress as inherently good. Monism is the fact that the 'technical phenomenon, embracing all the separate techniques, forms a whole.'[49] Technical universalism is the ability of technique to pervade the whole world and equally to master *all* the qualitative elements of civilization, including art, literature, and religion. '*Technical civilization,*' Ellul argued, 'means that our civilization is constructed *by* technique (makes a part of civilization only what belongs to technique), *for* technique (in that everything in this civilization must serve a technical end), and *is* exclusively technique (in that it excludes whatever is not technique or reduces it to technical form).'[50] The fourth characteristic is autonomy, by which technique becomes an end in itself to be achieved by its own means. In such a technological world, humans only begin the operation without participating in it, a perspective analogous to the concept of *deus ex machina,* by which God started the world that then ran on its own accord. Furthermore, autonomy of technique is premised on the elimination of all human activity, because the latter is inferior due to variability and elasticity.

Ellul argued that technique has not only created a modern age that is totally different from any previous age but has also created 'a new man,' who must fit into a world that is not of his own making and that runs counter to his 'human nature.' Ellul noted, for example, 'He was made to go six kilometers an hour, and he goes a thousand. He was made to eat when he was hungry and to sleep when he was sleepy; instead, he obeys a clock. He

was made to have contact with living things, and he lives in a world of stone. He was created with a certain essential unity, and he is fragmented by all the forces of the modern world.'[51]

This technological world, Ellul argued, is beyond human control. It operates according to its own laws that are beyond our comprehension. While technology has liberated humankind from nature's oppression, it has in the process ironically subjected humans to a greater oppression, 'the forces of the artificial necessity of the technical society which has come to dominate our lives.'[52] In such a world, it is meaningless to talk in terms of human volition and freedom of choice. According to Ellul, 'technique can never engender freedom.' For him, then (in keeping with the metaphor of technology as Frankensteinian), technology is, as William Kuhns perceptively notes, 'best symbolized by Dr. Frankenstein's monster, which, once alive, cannot be killed, coped with, related to, or compromised ... The monster also has the supreme advantage of invisibility. And not seeing him, people refuse to believe that he roams their world.'[53]

While Ellul and Heidegger were pessimistic about the ability of humans to control and use technology for beneficial ends – to see technology as being within the purview of human will – there have been others who believe that it is within human power not only to change a present system through technology but also to create a totally new system that can be applied to specific problems. They are systems designers, and the most sophisticated of these with regard to the rise of technology is Norbert Wiener in his science of cybernetics.[54] Wiener noted that cybernetics is derived from the Greek word *kubernetes,* or 'steersman,' implying the ability of humans to control their actions through technology. Indeed, the subtitle of Wiener's book *Cybernetics* (1948) makes the perspective implicit: *Control and Communication in the Animal and the Machine*.

The assumption underlying cybernetics is that 'society can only be understood through a study of the messages and the communication facilities which belong to it; and that in the future development of these messages and communication facilities, messages between man and machines, between machines and man, and between machine and machine, are destined to play an ever-increasing part.'[55] The importance of messages lies in the process of communication rather than in the message itself, a reflection of Marshall McLuhan's famous dictum 'the medium is the message.' Once that process is understood, it can be classified and controlled. Weiner called the process of understanding 'information.' Such information, based on past decisions and patterns of action, becomes 'feedback' to predict future action. These decisions and patterns are characteristic of modern machines, like computers, as much as of human beings, Wiener argued – hence his belief that the same laws apply to humans as to machines. One such law, coming out of the study of thermodynamics, is that action within machines tends

toward entropy – that is, to dissipate energy and run down, or to go from a state that is highly organized, differentiated, and less probable to one that is more probable, undifferentiated, and chaotic. Wiener believed this tendency to entropy is true of the universe in general, eventually resulting in the self-destruction of the world. However, within the increasingly entropic world are pockets of decreasing entropy, of which humans are one such pocket. As a result of their faith in progress, they are able to continue, through faith in the future, to generate new energy and new sources of information. Modern information technology has the same ability to resist entropy. Such realizations can be used to create a better world so long as the information is used for positive ends. Wiener was both optimistic and pessimistic about human potential. He believed that cybernetics offered a way of channelling human knowledge and energy for positive ends. Equally, like all forms of technology, it had the possibility to destroy the world if humans were not clear as to what end technology should serve. Wiener distinguished between technological 'know-how' and human 'know-what.' Technology can provide the 'know-how' to accomplish certain ends or purposes, but humans needed to provide the 'know-what' – that is, the values and ends to which technology should be directed. Without the 'know-what,' the 'know-how' of technology would take command and control humankind. Wiener's warning goes to the heart of the concept of technology as volition:

> Any machine constructed for the purpose of making decisions, if it does not possess the power of learning, will be completely literal-minded. Woe to us if we let it decide our conduct, unless we have previously examined the laws of its action, and know fully that its conduct will be carried out on principles acceptable to us! On the other hand, the machine like the djinnee, which can learn and can make decisions on the basis of its learning, will in no way be obliged to make such decisions as we should have made, or will be acceptable to us. For the man who is not aware of this, to throw the problem of his responsibility on the machine, whether it can learn or not, is to cast his responsibility to the winds, and to find it coming back seated on the whirlwind.[56]

Wiener pointed out that the 'machine' he was referring to may be made of 'brass and iron' or 'flesh and blood.' 'When human atoms are knit into an organization in which they are used, not in their full right as responsible human beings, but as cogs and levers and rods,'[57] they are machines, equally as dangerous as man-made machines. Only free human agency – human volition – can control the power of machines, be they mechanical, electrical, or human 'machines.' Wiener cautioned that, in all cases, the technology to fear is the closed mindset that tends to be endemic to all forms of technology. Thus, for Wiener, the analogy of technology was not, as it was for

Ellul, to Mary Shelley's *Frankenstein* but rather to Samuel Butler's *Erewhon,* where machines were better able to cope with the changing environment than humans and therefore outdistance and control humankind. Wiener feared that this possibility could become a reality unless human beings resisted the danger of technology encroaching on their freedom and assumed their own responsibility.

The historical and intellectual evolution of international theorists' perspectives on technology from objects, tools, and machines to knowledge, process, and volition parallels the evolution of Canadian thought on technology from the mid-nineteenth century to the present. Thus, Lewis Mumford's historical overview of the evolution of the idea of technology as machines illuminates our understanding of the ideas of T.C. Keefer, T.C. Haliburton, and Sandford Fleming, who saw railways, especially the locomotive, as mighty machines that were transforming the physical and intellectual landscape in the mid-to-late nineteenth century. Alexander Graham Bell saw communication technology, especially the telephone, as shaping a new world in which technology would be supreme. William Leiss's exploration of the idea of technology as knowledge offers insight into the ideas of the Canadian advocates of technical education who put forward similar ideas to their European counterparts to get technical education accepted at the elementary, secondary, and university levels of education. Canadian thinkers in the interwar years, most notably George Sidney Brett, William Lyon Mackenzie King, and Stephen Leacock, put forward perspectives on technology as process of war, industrialism, and mechanization respectively that were very much in keeping with the views of Karl Marx and Siegfried Giedion. The ideas of Martin Heidegger, Jacques Ellul, and Norbert Wiener provide an intellectual context for illuminating the ideas of Harold Innis, Marshall McLuhan, Northrop Frye, and George Grant writing in the same period and equally concerned about the implications of the idea of technology as volition.