artifacts, or things, but also processes and systems, which are sometimes mechanical, sometimes digital, and often human and creative. Finally, although today we may think, talk, use, read, and write about this term *technology* on a daily basis, this broad awareness and interest in technology is very recent. As several writers in this chapter note, even though technology is as old as human history, the term *technology* itself did not come into common usage until the mid-twentieth century.

In his book *Keywords*, the cultural critic Raymond Williams proposes that "some important social and historical processes occur within language." This phenomenon may be nowhere more evident in the present day than in this word *technology*. As a word that most of us refer to with great frequency, and as one that we now read about just about everywhere, technology is one of those words that, as Eric Schatzberg comments in his essay in this chapter, quickly begins to "mean everything and nothing." And yet the importance of this word and how it is used cannot be overlooked. As Leo Marx comments in his essay in this chapter, "such keywords often serve as markers, or chronological sign-posts, of subtle, virtually unremarked, yet ultimately far-reaching changes in culture and society." That the meanings of words may be unstable and important is both reassuring and disturbing news for writers. Such a state reflects the potential power of writing as much as it reflects many of the problems associated with it. The fact that this word *technology* is one that can mean and refer to so many different things is certainly part and parcel of why there is so much to say, and to write, about it.

All the writers in this chapter are interested in considering the many different things that technology is and has been—both as a word and as a concept—and how these definitions relate to and help us to understand technology's relationships with culture and society. Professor of Science, Technology, and Society Thomas P. Hughes reminds us of the many complications involved in defining *technology* and how it did not emerge as a term for describing the mechanic arts until the middle of the twentieth century. Posing the question outright in his essay "What Is Technology?" academic Eric Schatzberg looks at definitions of the word in both popular and scholarly usage and the relationships between the two. Journalist Sarah

from: Technology: A Reader for Writers. Edited by Johannah Rodgers. Oxford University Press, 2015.

Murray explores how Millennials, or the generation born after 1980, currently assess the impact of communications technologies on culture and society. Historian of Science and Technology Leo Marx proposes that the concept of technology itself, even more than the lethal weapons and bombs made from various technologies, may be hazardous. Futurist Kevin Kelly compares technology to a living organism and defines it as an entity with its own desires in his article "What Technology Wants." Finally, media theorist and cultural critic Neil Postman reflects on the "Five Things We Need to Know About Technological Change" in an essay that considers the ways and means in which technology always simultaneously "giveth" and "taketh away."

Read

Thomas P. Hughes
"Defining Technology"

Thomas P. Hughes is Mellon Professor of the History and Sociology of Science, Emeritus at the University of Pennsylvania. He is also Visiting Professor at the Massachusetts Institute of Technology and Stanford University. He has been writing, thinking, and teaching courses about technology for several decades. With a background in history and engineering, his writings on technology combine both scholarly and practical perspectives. He is the author of dozens of books and articles, including *Rescuing Prometheus* (Pantheon, 1998); *American Genesis* (Penguin 1990), which was a Pulitzer Prize finalist; and *Lewis Mumford: Public Intellectual* (Oxford University Press 1990), which he edited with Agatha Hughes. The following essay is excerpted from his most recent book, *Human-Built World: How to Think About Technology and Culture* (Chicago 2004). In this essay, Hughes explores the complexity involved in defining *technology* and considers the relationships between the history of the word and its use in contemporary society.

What does the word *technology* mean to you? What are your sources for this definition?

Defining technology in its complexity is as difficult as grasping the essence of politics. Few experienced politicians and political scientists attempt to define politics. Few experienced practitioners, historians, and social scientists try to inclusively define technology. Usually, technology and politics are defined by countless examples taken from the present and past. In the case of technology, it is usually presented in a context of usage, such as communications, transportation, energy, or production.

The word "technology" came into common use during the twentieth century, especially after World War II. Before then, the "practical arts," "applied science," and "engineering" were commonly used to designate what today is usually called technology. The *Oxford English Dictionary* finds the word "technology" being used as early as the seventeenth century, but then mostly to designate a discourse or treatise on the industrial or practical arts. In the nineteenth century, it designated the practical arts collectively.

"Defining technology in its complexity is as difficult as grasping the essence of politics."

In 1831 Jacob Bigelow, a Harvard professor, used the word in the title of his book *Elements of Technology . . . on the Application of the Sciences to the Useful Arts.* He remarked that the word could be found in some older dictionaries and was beginning to be used by practical men. He used "technology" and the "practical arts" almost interchangeably, but distinguished them by associating technology with the application of science to the practical, or useful, arts. For him, technology involved not only artifacts, but also the processes that bring them into being. These processes involve invention and human ingenuity. In contrast, for Bigelow, the sciences consisted of discovered principles, ones that exist independently of humans. The sciences are discovered, not invented.

I also see technology as a creative process involving human ingenuity. Emphasis upon making, creativity, and ingenuity can be traced back to *teks,* an Indo-European root of the word "technology." *Teks* meant to fabricate or to weave. In the Greek, *tektön* referred to a carpenter or builder and *tekhnë* to an art, craft, or skill. All of these early meanings suggest a process of making, even of creation. In the Middle Ages, the mechanical arts of weaving, weapon making, navigation, agriculture, and hunting involved building, fabrication, and other productive activities, not simply artifacts.

5 Landscape architect Anne Whiston Spirn's definition of landscape in *The Granite Garden: Urban Nature and Human Design* (1984) suggests a

way of thinking about technology. For her, landscape connects people and a place, and it involves the shaping of the land by people and people by the land. The land is not simply scenery; it is both the natural, or the given, and the human-built. It includes buildings as well as trees, rocks, mountains, lakes, and seas. I see technology as a means to shape the landscape.

As noted, "technology" was infrequently used until the late twentieth century. When a group of about twenty American historians and social scientists formed the Society for the History of Technology in 1958, they debated whether the society should be known by the familiar word "engineering" or the unfamiliar one "technology." They decided upon the latter, believing "technology," though the less used and less well-defined term, to be a more inclusive term than "engineering," an activity that it subsumes.

So historians of technology today are applying the word to activities and things in the past not then known as technology, but that are similar to activities and things in the present that are called technology. For example, machines in the nineteenth century and mills in the medieval period are called technology today, but they were not so designated by contemporaries, who called them simply machines and mills.

In 1959 the Society for the History of Technology began publication of a quarterly journal entitled *Technology and Culture.* The bewildering variety of things and systems referred to as technology in the journal's first two decades reveals technology's complex character. Rockets, steam and internal combustion engines, machine tools, textiles, computers, telegraphs, telephones, paper, telemetry, photography, radio, metals, weapons, chemicals, land transport, production systems, agricultural machines, water transport, tools, and instruments all appear as technology in the journal's pages. Yet the various kinds of technology noted in *Technology and Culture* have a common denominator—most can be associated with the creative activities, individual and collective, of craftsmen, mechanics, inventors, engineers, designers, and scientists. By limiting technology to their creative activities, I can avoid an unbounded definition that would include, say, the technology of cooking and coaching, as widespread as they may be.

Having taught the history of technology for decades and having faced the difficulties of defining it in detail, I have resorted to an overarching definition, one that covers how I use the term generally. I see technology as craftsmen, mechanics, inventors, engineers, designers, and scientists using tools, machines, and knowledge to create and control a human-built world consisting of artifacts and systems associated mostly with the traditional

fields of civil, mechanical, electrical, mining, materials, and chemical engineering. In the twentieth and twenty-first centuries, however, the artifacts and systems also become associated with newer fields of engineering, such as aeronautical, industrial, computer, and environmental engineering, as well as bioengineering.

10 Besides seeing technology associated with engineering, I also consider it being used as a tool and as a source of symbols by many architects and artists. This view of technology allows me to stress the aesthetic dimensions of technology, which unfortunately have been neglected in the training of engineers, scientists, and others engaged with technology.

My background helps explain why I have chosen a definition emphasizing creativity and control. Before earning a Ph.D. in modern European history, I received a degree in mechanical and electrical engineering. In the 1950s, I found engineering and related technology at their best to be creative endeavors. Not uncritical of their social effects, I still considered them potentially a positive force and expressed a tempered enthusiasm for them and their practitioners.

Since then, I have learned about the Janus face of technology from counterculture critics, environmentalists, and environmental historians. Yet the traces of my enthusiasm still come through in my publications, especially this one. Hence my defining technology as a creative activity, hence my willingness to sympathetically portray those who have seen technology as evidence of a divine spark, and hence my interest in those who consider the machine a means to make a better world. Yet this sympathetic view is qualified by what I have learned from critics of technology.

Analyze

1. Hughes begins his essay by writing, "defining technology in its complexity is as difficult as grasping the essence of politics." Explain the difficulties involved in defining politics. How might these relate to the complications involved in defining technology? How apt is this comparison? What may such a comparison suggest about the various ways in which technology is defined and discussed?
2. According to Hughes, why was the word *technology* infrequently used until the late twentieth century?
3. Who is Anne Whiston Spirn? What are some of the reasons why Hughes mentions her definition of landscape in his essay?

Explore

1. How much have you thought about this word *technology*? What was your definition of it prior to reading Hughes's essay? Has your definition changed after reading this essay? Why or why not? Write one paragraph in response to each question.
2. In your own words, and based on what you have learned from this essay, write your own working definition of *technology* using the one Hughes presents near the end of his essay as a model.
3. At the end of his essay, Hughes refers to the "Janus face of technology." If you are not familiar with what this reference to the Roman god Janus means, look it up. In one or two paragraphs reflect on how Janus relates to the issues Hughes raises in relation to defining technology and his discussion of technology.

Read

Eric Schatzberg
"What Is Technology?"

Eric Schatzberg is Professor of History of Science at the University of Wisconsin–Madison and Director of the Robert F. & Jean E. Holtz Center for Science and Technology Studies. He is working on a book on the history of the word *technology* and is using his blog, "Rethinking Technology" (http://rethinktechnology.wordpress.com/), as a place to explore and write about ideas related to this book. Offering readers some context for why he is writing a book about just one word, Schatzberg explains that while "Everyone knows that technology is an ubiquitous concept of our late-modern age . . . the term is also vague and poorly understood." In this essay, originally published as a blog post, Schatzberg discusses the diverse and sometimes contradictory meanings of the word to draw attention to the importance of its history and current status, as well as "to challenge the way the term gets used to obscure the role of conscious human choice in shaping our material culture."

What are some of the ways you use the word *technology* in your everyday life? Does this word always mean the same thing when you use it?

I'm writing a history of the concept of *technology*. (I use the convention of italicizing *technology* when talking about the term itself rather than what the term refers to in the world.) Why am I writing a book about one word? Well, most people would agree it's a pretty important word, central to the discourse of late modernity. As this Google Ngram shows, in frequency *technology* has become as important as science.

But frequency doesn't tell the whole story. *Technology* is a word that mystifies as much as it explains. In the memorable words of the online comic strip character Strong Bad, "the word technology means magic. It's basically anything that's really cool that you don't know how it works. And if it breaks, you have to buy a new one."

This is parody, of course. It works because Strong Bad captures how most people indeed relate to what we think of as *technology*. But this relationship expresses a deep irony. In one of its core meanings, *technology* is the epitome of rational human activity, what philosophers call "instrumental action," use of the most effective means to achieve a given end. (I'll be critiquing this definition of *technology* in my book, but that's a subject for a future post.) Yet to most users, the products of this rational action are as mysterious as transubstantiation of the Eucharist into the body of Christ.

That's just one example of how messed up the concept of *technology* is. But it's not an isolated example. In both popular and scholarly usage, the meanings of *technology* are deeply contradictory, almost perversely so. The concept embraces ideas and things, the recent and the ancient, everything and therefore nothing. One leading reference work in the 1950s defined *technology* unhelpfully as "how things are commonly done or made,"

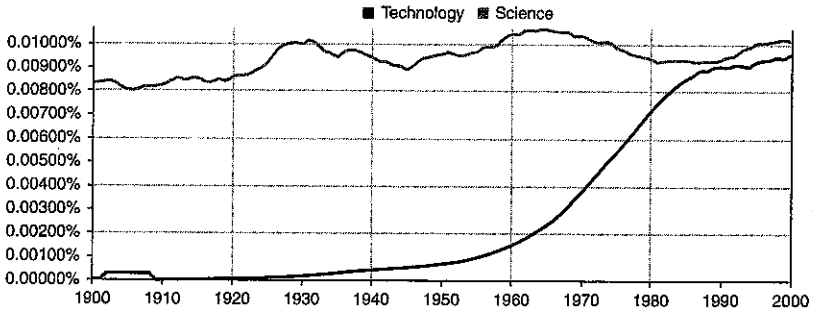

Figure 1.1 A Google Ngram showing the frequency of the words "technology" and "science" used in publicly searchable documents.

a definition that could apply to every form of human activity, from prayer to defecation. In contrast, popular usage limits *technology* primarily to digital electronics. This usage is common in elite discourse too, for example "instructional technology," which refers almost exclusively to educational use of digital tools. Similarly, the "technology" web page of the *New York Times* describes itself as covering "the Internet, telecommunications, wireless applications, electronics, science, computers, e-mail and the Web" (this is in metadata). But if we limit *technology* to digital devices, the term would be useless for explaining the role of machines, tools, skills, practical knowledge, and related theories in shaping human history.

Is this a problem? It is if we take *technology* seriously as a concept for understanding our modern world. 5

Analyze

1. Why does Schatzberg include the Google Ngram in his article? How does it relate to and support the argument he presents?
2. What examples does Schatzberg give to illustrate the ways in which various meanings of the word *technology* are "deeply contradictory"?
3. Explain why Schatzberg asserts that limiting technology to digital devices is a problem if we are to fully understand the meanings of this term *technology*.
4. Schatzberg employs a religious metaphor in this essay. Is this effective in supporting the points he is making regarding technology and magic and how difficult the word *technology* is to define? Why or why not? What are some other images he could have used to make this point? Explain why these images would have been more or less effective.

Explore

1. Look up the word *technology* in two different dictionaries, for instance *Merriam-Webster's* and *Dictionary.com*. Transcribe the definitions, making sure to cite your sources. Then, look up and carefully read the "Definition and usage" section for the entry on "Technology" on *Wikipedia*. What similarities exist across these entries? What differences? In a short essay, explain how and in what ways each entry and the differences amongst them relate to several key points made by Schatzberg in his essay.

2. Review the headlines on the current NYTimes.com "Technology" section (http://www.nytimes.com/pages/technology/index.html). Make two lists: one of five to ten technologies listed and a second of the sociocultural and economic issues being written about in relation to these technologies. Based on these lists, write your own definition of technology. Working with two or three of your classmates, compare and contrast the definitions each of you have developed. Then, discuss how these definitions relate to several issues discussed in Schatzberg's essay.
3. In the course of one day, make a note of every time you either use or hear the word *technology*, keeping track of when, where, and in what context the word comes up. Analyze the data you've collected. In what ways are the uses of this word similar or different? Is it possible to place the different uses of the word into categories? What might these be? Spend ten minutes free writing about your findings. Then, write a one-page analysis of the different uses and categories associated with this word.

Read

Sarah Murray
"Transition: Technology Puts Power in the Hands of Many"

Sarah Murray is a writer and journalist whose work focuses on sustainable development and the relationships among business, society, and the environment. Her articles cover a range of topics, including environmental sustainability, technology, and international development. You can access and read more of her articles on her website, http://sarahmurray.info/journalism/. In this essay, Murray reviews the findings of several recent surveys of "Millennials," or the generation born since 1980, to discuss the ways in which technology relates to this generation's current perspectives on social relations and economics.

In what ways have the use of online tools and smart devices affected your own social, professional, and economic outlook?

Few "millennials"—or the generation aged between 18 and 33—can remember a time when technology has not been a fundamental part of their lives. Not only does it answer their questions, but, through social media, it also gives them the ability to alter the way in which they are perceived by their peers and the greater world around them. Online tools and smart devices have empowered the generation born since 1980 in a way few previous technologies have done.

"Technology has played a huge role in how they're different from the generation that came before them," says Jean Case, chief executive of the Case Foundation, which she and her husband Steve Case, AOL's co-founder, created in 1997.

This generation sees technology as leveling the playing field. In the FT-Telefónica Global Millennials Survey of 18- to 30-year olds almost 70 per cent of respondents said "technology creates more opportunities for all" as opposed to "a select few."

This belief has brought tremendous confidence to the world's first generation of digital natives, despite facing the worst economic outlook since the great depression.

"We have all these incredible gadgets that connect us to the world," says 5
Paul Taylor, executive vice-president of the Pew Research Centre and director of its Social & Demographic Trends project. "But for them, it's the wallpaper of their lives and it allows them to place themselves at the centre of the universe."

With a Facebook page or a Twitter presence, millennials can broadcast their views, ideas and creative output globally—and potentially find an audience of millions. "That is enormously empowering," says Mr. Taylor. "That, as much as anything, contributes to their confidence."

While technology might help them feel at the centre of the universe, its ability to connect millennials to other communities across the world has also created in many a desire to help solve big global problems. "They're idealists and their level of engagement with the things they care about is extraordinary," says Ms. Case. She cites research the foundation conducted revealing that millennials want to do more than simply give to causes they care about. Some 44 per cent wanted to know how their donations were used and 41 per cent, when giving, also wanted to know about volunteer opportunities.

"This is a different level of engagement from young people than we've traditionally seen," she says.

Again, technology is playing a role. Supporting this philanthropic impulse are non-profit websites that match charities with volunteers or allow donors to track small donations and receive feedback from recipients. Meanwhile, the sense of how millennials can contribute as individuals is increasing as traditional ways of working are eroded and technology replaces not just manual labour but also intellectual capital.

"Artificial intelligence, algorithms and the web mean that all the repetitive jobs are going away," says Bill Drayton, founder of Ashoka, the social entrepreneurship organization. "The new value is in contributing to change." Millennials' belief in their ability to effect change varies across the world. The Telefónica survey found Latin Americans had the strongest sense that they could make a difference globally, at 62 per cent, compared with 40 per cent of all respondents.

This belief increases when considering their own environment, with 62 per cent of all surveyed saying they could make a difference locally.

What this highlights is a shift in the way leadership is viewed. Millennials' trust in traditional institutions and leaders is declining. More than half the respondents did not think governments reflected their beliefs and values. Instead, they put more faith in the wisdom of the crowd, accessed via social media. Millennials trust each other and turn to their peers when they have questions to answer. "There's a two-way connection and anyone can talk to anyone in the world," says Mr. Taylor.

Yet the confidence and connectivity that technology has brought this generation can also be accompanied by stresses and doubts.

"The old model of organisation, where a few people choreograph what everyone else does is failing and instead you have fluid, open architecture with synapses running in every direction," says Mr. Drayton. This means that, to survive and thrive, millennials believe they must rely less on institutions and more on themselves and their peers.

One thing that may help millennials navigate this new fluid, open environment is that, as a 2010 Pew Research Centre study revealed, they are more receptive to change than older generations.

The study, which polled millennials in the US, found them more tolerant of immigrants than their elders, with almost 6-in-10 saying that immigrants strengthened the country.

While religious extremism is on the rise among young people in certain communities, many are more religiously tolerant than their elders, with

76 per cent of those polled by Telefónica saying they were open to religions and beliefs outside their own.

Mr. Taylor sees this particularly at work among US millennials, among whom attitudes to interracial marriage and sexual identity are changing rapidly. "In the US, one thing that's notable is their acceptance of diversity," he says. "There's a lot of social change that's connected to this generation."

Of course, for the millions of young people without jobs, any tolerance, openness and confidence in their ability to effect change is tempered by the grim prospect of being unable to make the transition from school to the workplace or to afford to buy a home or eventually retire.

Given the growing gaps in employment prospects and wealth levels among young people worldwide, differences in attitude between the haves and have-nots are likely to increase, too.

However, given the millennials' desire to help solve problems, they may well play a prominent role in building a more stable economy and an equitable society.

Ms Case is optimistic. "These people will change the world, and they have opportunities to do that," she says. "We have a segment being left behind. But I'm hoping that the generation with the opportunities will pay attention to their peers without."

What the youth have to say:

Nicholas Davies, 23, Student Official, United Kingdom

> "While recession has had a huge effect on the number and range of jobs available to graduates, that is no reason to be pessimistic about the future. I will always strive for my ideal future, and persistence will get me there one day."

Pablo Rodríguez Sánchez, 27, Communications Co-ordinator, Mexico

> "Our generation today faces a void: our governments have failed us; companies have failed us too. We have a crisis of credibility towards institutions. We have come to realise we are the protagonists of the 21st century. Our generation is starting to wake up and create the solutions of our own problems."

Oghenefego Isikwenu, 29, Consultant, Kenya

"My future will be much better than that of my parents' generation thanks to better education. An innovative group of young Africans are actively involved in making a positive impact in their fields. But security is a big concern. With unemployment increasing more young people have no option but to go into crime."

30 Dana Sobh, 19, Student, Lebanon

"The future seems a little intimidating. You can't tell whether the actions of today are leading to success or destruction. I'm constantly haunted by thoughts such as 'Did I choose the right career path?' However, the economic climate might get better by the time I graduate."

Analyze

1. Write a one-paragraph summary of Murray's article.
2. What is Murray's argument? What claims does she use to support her thesis?
3. One key finding that Murray reports is that "This generation sees technology as leveling the playing field." What does she include as being part of this "leveling"? From your perspective, is leveling one of the effects technology has had in society? Why or why not?
4. Take another look at the end of the article, where Murray includes quotes from youth around the world. What do you notice about these? What are some common threads that run through them? If you were to add your own quotation to this list, what would you say?

Explore

1. Murray proposes that "Online tools and smart devices have empowered the generation born since 1980 in a way few previous technologies have done." Write one page reflecting on whether and how this has been your experience. Then, write one page considering whether, based on this reflection, you agree with Murray.

2. One of the reports referenced in the article is the FT-Telefónica Global Millennials Survey (http://survey.telefonica.com/survey-findings/). You can read this and other surveys related to the article, including "The Social Side of the Internet" (http://casefoundation.org/topic/social-media/publications?page=1) on the Internet. Locate one of these surveys or reports. Summarize what you've read and then compare that to Murray's claims based on the same study. Is your reading of this survey or study the same as Murray's or different? Write a short essay reflecting those similarities and differences.
3. Research one of the following devices—telegraph, telephone, or radio—and the effects it had on young people when it came into common use. Write a letter to Murray explaining your findings and how she might incorporate this historical perspective into a future article.

Leo Marx
"Technology: The Emergence of a Hazardous Concept"

Leo Marx is Senior Lecturer and Kenan Professor of American Cultural History Emeritus in the Massachusetts Institute of Technology's Program in Science, Technology, and Society (STS). His work, which has been foundational to the field of STS worldwide, examines the relationship between technology and culture in nineteenth- and twentieth-century America. He is the author of *The Machine in the Garden: Technology and the Pastoral Ideal in America* (1964); *The Pilot and the Passenger: Essays on Literature, Technology, and Culture in America* (1988); editor (with Merritt Roe Smith) of *Does Technology Drive History? The Dilemma of Technological Determinism* (1994); and editor (with Bruce Mazlish) of *Progress: Fact or Illusion?* (1996). In this excerpt from a longer essay, Marx reviews the history of the term *technology* and its meanings in contemporary culture and society.

Have you ever thought of technology as hazardous? Why or why not?