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WHAT IS TECHNOLOGY?

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Many years ago, a Canadian philosopher surmised that one of the reasons why technophilosophy had received so little attention was uncertainty about its very object, as shown by the vagaries of the term "technology". "To some" he wrote " it means all techniques; to others, all applied sciences (including medicine and city planning); and to still others again, something else."²

Well, that's still true. There is no simple or single answer to the question "What is technology?". The Oxford English Dictionary (OED) provides three meanings (indicated on Table I) but these do not exhaust the account of contemporary usage. Many meanings can be justified, although some are regarded by purists as more valid than others on etymological grounds; what is important is to establish the *context* in which the meaning is to be used. What is inexcusable is for an author to produce the bare statement "technology is....." with no qualification as to context.

Etymology.

Etymology refers to the origin of words. The word technology comes from two Greek words: τεχνη: (techne) skill, craft, trade, science; artifice, cunning, trick; work of art; and λογος (logos), a word with many meanings but, in this case, discourse and reason. So words ending in -logy refer either to a discipline or department of knowledge, the systematic study of the subject or to people who speak *about* a topic. The "o" in the middle of the word is simply the combining vowel of all declensions in Greek.

TABLE I

A. Technology from the viewpoint of practitioners:

1. Systematic study of the practical or industrial arts (OED 1.)
2. A particular practical art (OED 1c.)
3. The arts collectively as phenomenon (technics) (OED 1b)
 - 3.1 Viewed as means
 - knowledge and skills or disembodied technology³
 - devices or embodied technology
 - 3.2 Viewed as practice

B. Technology from the viewpoint of others (metatechnics):

1. Philosophical studies (the "meaning" of technology; moral questions)
2. Sociological studies (Science and Technology Studies)
 - 2.1 Social impact (technology assessment)
 - 2.2 Social shaping (or "construction") of technology
3. Economic and developmental studies
 - 3.1 Trajectory of devices (Historical Studies)
 - 3.2 Innovation (process and product)

Practitioners and others⁴

The first major distinction to be made amongst the users of the term "technology" is between the point of view of practitioners (Group A in Table I) and of that of others such as philosophers, sociologists and economists (Group B in Table I). In the course of time, Group A has become the *object* of the studies listed in Group B. A vexing nomenclatural problem has arisen because some people in Group B not only call their activities "technology" but also insist, on etymological grounds, that the term should not be used to describe A2 or A3 for which they consider the words "technique" or "technics" more appropriate. Amongst those taking this position are: Jacques Ellul, R.A.Buchanan and the early George Grant. Grant⁵ eventually overcame his etymological objections to the use of "technology" for group "A" by arguing that the scientific component of modern "sci-tech" was a sort of "logos". This looks a little like academic cleverness to me -- but, whatever works!.

The fact is that all the OED definitions of technology up to 1986 refer only to Group A and this correctly describes dominant current usage in the English-speaking world. My practice is generally to follow the OED in this matter, although I often use "technics" for meanings A2 and A3. I suggest that the neologism "metatechnics" might usefully and correctly be employed for the studies in Group B.

I shall now give examples of usage in each of the subdivisions of Table I.

A. Technology from the viewpoint of practitioners

1. Systematic study of the practical arts

The first meaning of technology given in the OED is ".....: the Scientific study of the practical or industrial arts" which follows directly from the etymology. That is close to meaning A1 on Table I, as in "Southern Alberta Institute of Technology" where what is taught is "practical professional technology"⁶. I prefer "systematic" to "scientific" in this context.

Other meanings arose historically from this root meaning.

2. A particular practical art

Meaning A2, the application of the word "technology" to a particular practical art, follows next. An emphasis on the "discourse" meaning of logos results in the following definition by Yves Deforge:⁷ "[A technology is] a formal expression and making explicit of practical knowledge." As examples I could say "The technology of computer graphics is set to revolutionize the fine arts." "In return for Russia's agreement not to sell India the technology needed to manufacture its own rockets, the US agreed to increase collaboration with Russia in space."

3. The Arts collectively

Meaning A3, the arts collectively or the "phenomenon of technology" is another meaning of the term. We could say that "The technology of the Newly Industrialized countries is in many respects as advanced as any in the world." When, in the 1930s, the American, Lewis Mumford, launched his series of critical works (*Technics and Civilization etc.*) on technology as a phenomenon, he used the word "technics", not technology, for their subject matter. The word "technics" can be applied by those who prefer it to modern technology in meaning A3. Many English

translators of French and German works have used the word "technics" as a translation of the German *Technik* or the French *Technique* - for example, in the translation of Oswald Spengler's *Der Mensch und die Technik* and of Jacques Ellul's *Le système technicien*. However, the translator of Ellul's *La technique* used "technology". The word technics is American in origin, going back to at least 1826.

In the context of meaning A3, I find that definitions of technology fall into two subgroups depending on whether they are viewed passively or dynamically.

3.1 Viewed as means

I refer to this passive definition as the "tool-box" meaning. It is very common in popular dictionaries, journalistic articles and student essays. Some examples:

(i) [Technology] is the **means and processes** through which we as a society produce the substance of our existence. It is fundamentally a human process, with people at the centre. It includes five items: tools, materials, energy forms, techniques and organization of work. (Bernard, 1989)

(ii) "Technology may be defined as the **means of work**, the means of human activity developing within a system of social production and social life." This example is important for its incidental reminder that technics is a social activity.⁸

(iii) "An inclusive definition of Technology is: a reproducible and publicly communicable **way of doing things**."⁹ This definition is rather too general to be useful.

3.2 Viewed as practice

The dynamic definition of technology as practice (or process) which falls in this category is much more appropriate to our concerns. It is in *action* that technology affects our everyday lives. Who is to know what technology will do for us, or against us, until it enters the world as an active force? The definitions in this group start with my own preferred version, which, needless to say, is built upon the prior efforts of many others.

Technology as **practice** (i.e. technics) is the socially organized application of rationally derived means (including the accumulated fund of prescriptions, tools and machines) using scientific or other knowledge to control physical and biological phenomena for practical or aesthetic ends. (Each phrase of this definition is commented upon in the **Appendix**)

My debt to Arnold Pacey will be apparent from a comparison with his definition of what he calls "technology-practice" as "the application of scientific and other knowledge to practical tasks by ordered systems that involve people and organizations, living things and machines."¹⁰

The practice meaning has been favoured by many previous scholars. The importance of practice was grasped over a century ago by Samuel Butler¹¹ when he

wrote "Strictly speaking nothing is a tool except during actual use." Oswald Spengler (1931) wrote "technics is always a matter of purposive **activity**, never of things".

Classical sociologists such as Gerth and Mills (1953) defined technology as "The **implementation** of conduct with tools, apparatus, machines and instruments, and the techniques deployed in the activity."¹²

John Kenneth Galbraith, the Canadian-born American economist, defined technology as "...the systematic **application** of scientific and other organized knowledge to practical tasks." and, Ursula Franklin (the Canadian metallurgist) said, in her 1990 Massey Lectures, "Let's look at technology as **practice**."

A definition of technology as practice is consonant with the existential philosophy of J-P. Sartre which emphasizes that "man is the sum of his acts". This seems to me implied by Langdon Winner's talk of "world-making".¹³

B Metatechnics

Metatechnics is the systematic study of technology by those who are not its practitioners. As mentioned above, some of these people refer to their activities as "technology", partly because of French usage, partly because they believe that it correctly reflects the etymology. Let me be specific with a quotation from a recent book:

"Technology is the **study** of human techniques for making and doing things".
 "Strictly speaking...it is not concerned with the mastery of the techniques which are the subjects of its study...it aims at interpreting them within a social context."¹⁴

Technology in this sense can be divided into three groups: philosophical, sociological and economic. This book is concerned with all three, but mainly with the last two.

1. Techno-philosophy

As Langdon Winner says in the first chapter of *The Whale and the Reactor*, there has not been a great deal of purely philosophical work in technology and that which has been done has not attracted a wide audience in the Anglo-Saxon world. It was at one time a subject of serious discussion in Germany and later in France. I include here the ontological aspects studied by Martin Heidegger and the moral aspects studied by Hans Jonas, who wrote "In other words, technology, apart from its objective works, assumes ethical significance by the central place it now occupies in human purpose."¹⁵

2. Science Technology and Society Studies (STAS)

2.1, 2.2 From "impacts" to "shaping"

"Technology" in the form of formal sociological studies of technology started out as "technology assessment". The Technology Assessment Board was set up by the Congress of the US in 1966. The language used in setting up the TAB assumed a quasi-autonomous technology which had impacts on society - both good and bad.

During the last twenty years the emphasis has completely changed to the theory of a socially constructed technology. In fact I think the pendulum has swung too far. This intellectual fashion is part of a more general movement that holds upbringing responsible for all the failings of a human being and, by a parallel process of reasoning, the ill effects of technology to be entirely the result of the way society has developed the technology.

Langdon Winner presents a rather different picture to support his claim that many technologies are inherently political. I discuss these matters more fully in the chapter on **Determinism**.

Technology studies thus occupy a spectrum of belief from autonomously deterministic to socially constructed, resulting in theories of social impact and social shaping respectively. I share the views of those scholars who think that a continuous mutual interaction takes place so that "We shape technology and technology shapes us."

Technobabble

In the STAS category of "technology" there are numerous books and articles that seem to relate to technology as psychobabble relates to psychology -- they could be classed as "technobabble". Technobabble consists largely of sweeping and unsupported claims for technology as a demiurge, or of a series of rhetorical questions which get us nowhere. I have to admit that there is always a danger of slipping into it.

3. Economic and developmental studies

The connection between technology and economics is extremely tight. It manifests itself particularly in economic studies of innovation and in the trajectory of devices. An endless stream of government exhortations and books by management consultants tell us that the necessary condition for a healthy economy is continuous technological innovation. A most important branch of metatechnics is the study of innovation, what conditions are favourable to it, what form it takes, what are its effects on the economic system.

3.1 Innovation

The important topic of innovation receives special attention in Parts 1 and 2 of the section on Technological Change *viz.*: Change and Innovation.

3.2 Trajectory of devices (Historical Studies).

The trajectory of devices, besides receiving the attention of economists, has also been the object of comparative study by historians of technology and by philosophers of technology attempting to discover developmental patterns. The close link with cultural studies is illustrated by the fact that the official journal of the Society for the History of Technology (SHOT) is *Technology and Culture*. The trajectory of devices is the topic discussed in the chapter on Technological Change III Trajectory..

Value-laden definitions

Some of those who attempt to define technology add the emphatic connotation that the action is always directed to a mastery of nature which is treated simply as a resource.¹⁶ That is the Heideggerian interpretation which Grant followed in his later

writing. Others incorporate a sort of technological boosterism characteristic of "technophiles" or economic cornucopians..

On the whole I think it best not to muddy the waters of a *definition* with value laden terminology. The sort of thing I mean is exemplified by McDermott in his paper "Technology: The Opiate of the Intellectuals"¹⁷ in which he takes a decidedly negative view:

[I]n its concrete, empirical meaning, [technology] refers fundamentally to systems of rationalized control over large groups of men, events and machines by small groups of technically skilled men operating through organizational hierarchy"

Other writers have produced definitions biased by unreasonable technological optimism:

- (1) The use of accumulated human knowledge to transform resources to solve problems and satisfy human needs and wants.
- (2) A process involving the use of technical tools, resources and processes to design with given constraints, solutions to problems which maximize benefits and reduce risks to people, society and the environment.¹⁸

Clearly, the atomic bomb was not the product of technology!

Ellulian technique

The great French metatechnician and theologian, Jacques Ellul, had a life that almost spanned the present century. He wrote three major works on technology and in all of them he used the French word "La technique" in a special sense which he defined for English-speaking readers as follows. "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". (Ellul's italics).

Ellul kept the French word "technologie" for meanings A1 and B*. As mentioned above, Ellul's English translations have suffered from inconsistency. In the first and third volumes of his trilogy "technique" is translated as technology but in the second volume it is translated as technique. He has protested in vain that his word "technique" has a more comprehensive meaning than the English word technology. It is obvious that his definition, though close to my A3.1 is considerably broader in scope. It covers every form of technique from laser scanning to sexual congress. He includes in "technique" a set of practices which have been called "methodology" by other people. This important topic is discussed separately below.

Money would be an aspect of technique for Ellul, so would the law. I would exclude them both from technology but Mario Bunge, late of the Philosophy Dept. at McGill, would have included them¹⁹. Technology as practice usually refers to procedures that have a material embodiment in some extension of man as well as disembodied elements of knowledge and skill. It would perhaps be wise to refer to the much wider interpretation of meaning A3 as "Ellulian technique". It would include

management, seduction and so forth. One could say that Ellulian technique equals technology plus methodology but this needs further study.

Methodology

A specific example follows of the distinction made by some information managers between technology and methodology :

Data warehousing, also known as information warehousing, is a relatively new methodology whereby an organization develops a logical way to store information so that it is able to support business needs. *Data warehousing is a methodology, not a technology and not a product.*²⁰ [My italics.]

Methodology includes such Ellulian techniques as re-engineering, organization, strategic allocation of resources and Programme Evaluation Review Technique or PERT (a critical path planning tool). There is a grey area in which we find recipes, prescriptions and manuals of instruction which are necessary for the operation of embodied technologies. For some writers (as in the quotation above)²¹ technology always involves physical objects but the Organization for Economic Cooperation and Development (OECD) includes both embodied and disembodied technologies in its studies. Furthermore, organization of some kind is an essential component of technology as practice.

APPENDIX

Analysis of "Practice" Definition

Modern technics deals with socio-technical systems. The interconnectivity of technics means that no devices stand alone. And all devices are embedded in a culture which they infect and change as it changes them. As a consequence, the **social organization** of the system provides an essential context for the technology. Success in business and manufacture is more often more dependent on good organization than on the devices making up the system. Mumford²² wrote .

Modern production has added enormously to the productive output without adding a single horsepower or a single workman. What have been the means? On one hand there have been great gains through mechanical articulation within the factory, and through the closer **organization** of raw materials, transport, storage and utilization in the factory itself. By timing, working out economic sequences, creating an orderly pattern of activity, the engineer has added enormously to the collective product.

Bruce Hanna²³, wrote:

Key people with the knowledge, intelligence, and ability to lead action taken in context of shared goals, processes and constituent success are still the core strategic resources of companies, and the most critical element of success in product development and management. . . . Strategic professional services, not

raw materials, not energy, not core technology differentiates the survivors from the losers in manufacturing as well as service industries today. Elaine Bernard wrote: "technology is tools, materials, energy forms, and most important, it's the organization of work. We often forget that with technology, as with all human endeavours [,] there is an organizational side that is not neutral, unbiased, devoid of human content, but is full of as many choices and options (*sic*).²⁴

The word "**application**" is, of course, critical in separating the practice meaning which is the subject of this definition from the inadequate tool-box meaning.

"**Rationality**" and "**efficiency**" are two intrinsic properties of technics. The nature of the rationality which governs technics lies at the heart of the conflict between technics and humanism. "Rational" is to be distinguished from "magical" which characterized technique before the Enlightenment (e.g. Alchemy); rationality is further discussed in *The Technic Frame of Mind*. *Efficiency* is the ultimate criterion appealed to in both technics and economics. It is a highly complex socially constructed idea which I attempt to deconstruct in the chapter on **Efficiency**.

accumulated fund of prescriptions, tools and machines.

This expression is quoted from the 1990 Massey Lectures of Ursula Franklin²⁵, the noted Canadian metallurgist. It therefore includes both the embodied and disembodied aspects of technology (see Table I). She contrasts prescriptive processes from holistic processes in which the worker is in control of the operation from start to finish.

"including **scientific** or other knowledge". At the present time, emphasis is often placed upon the scientific basis of our techniques. But this is a very controversial matter and many case histories point to the importance of "shop-floor" knowledge, "tacit knowledge" and "craft skill" in incremental innovation. There is a debate in STAS circles about "deskilling" in which algorithms are sought to embody these skills and thus "steal" them from the workers (including scientific researchers) who have developed them at the bench or in the forest (if we include "indigenous or vernacular knowledge"). The degree to which scientific research underlies technological innovation is discussed in the chapter on **Technological Change II Innovation**.

to control physical and biological phenomena A more fancy way of putting this might be "to change the state, behaviour or position of living or inert matter". We could say "to transform resources" but that would only describe the first step in a continuous process of transformation.

For **practical ends**. This distinguishes, in so far as it is possible, technics from both pure science and aimless tinkering. A further distinction between science and technology is that science deals with the dis-covering of existing relationships (Platonic forms) whereas technology creates new forms.²⁶

I would like to end this article with the delightful definition attributed by Max Frisch, the Swiss essayist²⁷, to his friend Hannah "Technology ... the knack of so arranging the world that we don't have to experience it".

Review questions and exercises

1. Select three books from Library of Congress Class T 14.1. Find the definitions of "technology" and assign them to the appropriate subdivision of Table I explaining your reasons and addressing any problems encountered.
2. How would you distinguish between "technology" and "methodology"? Or would you?
3. What is the role of "organization" in technology?
4. Write a definition of technology from the point of view of the Unabomber.

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²Mario Bunge, 1976, p.68.

³The "embodied/disembodied" distinction was made by the Organization for Economic Cooperation and Development (OECD) in *Technology and the Economy: The Key Relationships*. Paris: OECD, 1992.

⁴Inspiration for part of this work came from reading Yves Deforge's "postface" to Gilbert Simondon's *"Du mode d'existence des objets techniques."*

⁵Canadian theologian and philosopher. See *George Grant: A Biography*, by William Christian. University of Toronto Press, 1993.

⁶Deforge in Simondon, op. cit.

⁷Simondon op. cit. p.267

⁸Zvorikine of the USSR in a lecture given in California in 1962.

⁹Rowe, Stan () *Home Place: Essays on Ecology*, p.63

¹⁰Pacey, Arnold (1983). *The culture of technology*. Oxford: Basil Blackwell, p.6.

¹¹Samuel Butler's Notebooks, ed. by Geoffrey Keynes and Brian Hill. New York: E.P.Dutton

¹²John Eldridge, "C.Wright Mills" 1959, p.56.

¹³Winner, Langdon (1986). *The whale and the reactor*, p.17 writes "Marx and Wittgenstein share a fruitful insight: the observation that social activity is an ongoing process of world-making."

¹⁴R.A.Buchanan, *The Power of the Machine*. Viking, 1992., p.3

¹⁵Jonas, 1984, p.9

¹⁶George Grant (in an unacknowledged paraphrase of Heidegger) thus:

"I mean by that word [technology] the endeavour which summons forth everything (both human and non-human) to give its reasons ["for being" - a gloss added by Cooper in his book *Action into Nature*], and through the summoning forth of those reasons turns the world into potential raw material, at the disposal of our 'creative' wills." (*English Speaking Justice*. Sackville, New Brunswick: Mount Allison University, 1974).

¹⁷Teich, 6th Edition p.97.

¹⁸Both of these definitions were provided by Michael Hacker, State Education Department, The University of the State of New York.

¹⁹Bunge, Mario. The five buds of technophilosophy. *Technology in Society*, 1979, 1, 1, spring, 67-74.

²⁰Graham, Stephen. "The Case for Data Warehousing." *Report on Business Magazine*, CIO Supplement, October 1995.

²¹And see Charles Susskind (1973). *Understanding technology*. Baltimore: John Hopkins. He defines technology as "man's effort to satisfy his material want by working on physical objects."

²²*Technics and Civilization* p.386

²³Internet discussion.

²⁴Collaboration with the wide community. *Muse*, v.7, no.3 (Fall 1989), 16-18.

²⁵Franklin, Ursula. *The Real World of Technology*. Toronto: CBC, 1990.

²⁶Bruno Latour. *Aramis or the love of technology*. p.23.

²⁷*Homo Faber*.