



sLAB (Strategic Innovation Lab)

2013

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Suggested citation:

Logan, Robert K. (2013) Mcluhan, energy exploitation and the overextensions of man. *Razón y palabra* (84). pp. 15-29. Available at <http://openresearch.ocadu.ca/id/eprint/736/>

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MCLUHAN, ENERGY EXPLOITATION AND THE OVEREXTENSIONS OF MAN

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Abstract

We make use of McLuhan's Laws of Media and his notion that our technologies are "the extensions of man" to understand ecological issues in general and global warming in particular. We examine the evolution of humankind's exploitation of energy that have increased human wealth and well being. We identify the benefits and costs of tool making, the control of fire, agriculture, steam engines, internal combustion engines, electricity generation and nuclear power plants. Using McLuhan's Laws of Media we show that an energy exploitation technology or medium, and hence an extension of man, when pushed to its extreme can flip into its opposite an 'overextension of man.' This is certainly the case with the environmental challenges facing our planet and the survival of the human race today. These include the storage of nuclear waste and the depletion of natural resources. It is the burning of fossil fuels giving rise to pollution and the greenhouse effect, which is most troubling as the build up of greenhouse gases could devolve into a runaway effect threatening the very existence of human habitation on this planet.

Keywords

Energy exploitation; media; McLuhan; "extensions of man"; "Laws of Media"; fossil fuels; global warming.

Introduction and Object of this Paper

Humanity faces a life and death ecological challenge vis-à-vis global warming and climate change. There are some who would deny this but the preponderance of scientific opinion is that human activity is either the cause of global warming or at least is contributing to it. The danger we face is a runaway greenhouse effect. As the polar caps melt less sunlight is reflected back into space and greenhouse gases such as methane are released as the ice caps melt. Also as the oceans warm they release CO₂ gas and are unable to absorb as much CO₂ as we are generating. These effects feed on each other and it is possible that they could result in a run away green house effect like the one that took place on Venus aeons ago. This would have disastrous effects and could spell the end of human life on the planet. Another danger, less severe but still dire, that we face is the depletion of petroleum, a value source of both fuel and chemicals for manufacturing. And of course there is the ongoing problem of air and water pollution, acid rain and the like. If we look at government policies they encourage the consumption of oil in that they allow the price of this fuel used for transportation to be well below the actual cost of replacing it. The current price of oil reflects the cost of extracting it today plus a profit margin for those that extract and distribute it plus a certain amount of taxes levied by various levels of government. These marginal taxes still keep the price of oil well below the cost of replacing it in the future and as a result discourage the development of alternatives. As the infrastructure for the use of oil for transportation already exists the barrier for entry of renewable alternatives is still too high to stimulate their development. The revenue generated by taxing fuel so that it reflects the cost of replacing it rather than extracting it should go to supporting those that are trying to develop alternatives, i.e. renewable energy sources and into creating the infrastructure for alternative energy use. For example creating a network of recharging stations for electric cars just as government created the infrastructure of roads for our gas guzzling automobiles and trucks. Other projects should include building European style public transport systems throughout the world, redesigning our urban thoroughfares for bicycle lanes using the Netherlands as a model, creating geothermal infrastructure so we can tap into an almost infinite supply of subterranean energy to heat and cool our homes, giving tax breaks and even subsidies for

the installation of solar panels, supporting research to develop more efficient and environmentally friendly batteries for electric cars, etc. etc. This list is not exhaustive but is intended to suggest the kinds of projects that government should be supporting for the wellbeing of the citizens it governs. The bottom line is that we are eventually going to need a massive development for renewable energy and the funds for building that infrastructure can only come from increasing taxes on fossil fuels.

Governments tax activities that do not place a burden on the environment such as culture. If one of the factors that leads to environmental degradation is the consumption of material things then the government should through its tax policies encourage activities that do not involve consumption of material things. So for example there should be no taxes on the purchase of bicycles or on cultural activities such as theatre, film, music and the arts in general.

This is the dilemma that we face today in trying to address our environmental challenges. Making moral judgments re the practices of governments and those in the business of either the exploitation or the consumption of energy will not change anything. It is only by understanding of how we arrived at this paradox that the creation of wealth through the exploitation of energy sources can actually lead to the demise of human habitation of planet Earth. In this paper we will examine the evolution of humankind's exploitation of energy that have increased human wealth and well being through the lens of Marshall McLuhan's (1964) approach to understanding media. We will study the benefits and costs of tool making, the control of fire, agriculture, steam engines, internal combustion engines, electricity generation and nuclear power plants making use of McLuhan's tetrads or Laws of Media (McLuhan and McLuhan 1988).

Understanding Energy Exploitation as an OverExtension of Man

The title of this paper is a riff on the title of McLuhan's (1964) revolutionary book *Understanding Media: Extensions of Man*. We will make use of the inference in the title

of his book that media are “extensions of man”² and that the exploitations of energy are media and hence “extensions of man.” We establish that all technologies maximize the use of energy and that techniques of exploiting external energy from nature are technologies and hence media.

Following the work of Reiner Kümmel (2011) in his book *The Second Law of Economics: Energy, Entropy, and the Origins of Wealth* we then show that the media of energy exploitation have contributed to a steady increase in the wealth of humankind from the invention of tools and the control of fire to the harnessing of animal, wind and water power and from the invention of the steam engine and internal combustion engine to the construction of nuclear power plants. We examine the impact of each of these techniques for exploiting energy including the many instances in which these “extensions of man” have become overextended and have resulted in maladaptive practices. Although each breakthrough in energy exploitation temporarily increases wealth it does not always increase everyone’s well being. The cycle that must be broken is that of the technological imperative, which McLuhan defined as follows,

“The ordinary evolutionary and developmental attitudes towards innovation assumes that there is a technological imperative: ‘If it can be done, it has to be done’; so that the emergence of any new means must be introduced, for the creation of no matter what new ends, regardless of the consequences (McLuhan 1999, 114).” According to McLuhan all media, all technologies provide both service and disservice. The allure of the service that a technology or medium provides often blinds its users to the disservices it introduces.

We will make use McLuhan’s Laws of Media (LOM) to show that the “extensions of man” when pushed to extremes flip into the “overextensions of man.” We also show that by applying LOM to the first law of thermodynamics we obtain the second law of thermodynamics. We then apply LOM to a number of energy exploiting technologies including heat engines such as the steam engine and the internal combustion engine, nuclear power plants, the renewable energy resources such as wind turbines, solar heating, solar voltaic cells and techniques of conservation such as recycling and

conservation or energy use reduction. We then conclude our study by examining the challenges that the overextensions of the exploitation of energy create for us today.

Ground Zero of the Planet's Energy Ecology

All living organism survive and propagate their organization by harnessing natural sources of energy. Plants and certain protozoa do it by exploiting sunshine through the chemical process of photosynthesis, which uses the energy of the sun to convert carbon dioxide CO₂ into oxygen and hydrocarbons, which store energy. Animals consume plants combining their hydrocarbons with oxygen to release that stored energy which they use for their metabolism and reproduction. Exceptions to this rule are carnivores that consume herbivores and other carnivores to release the stored energy of their prey that they use for their metabolism and reproduction.

This self-sustaining and self-generating process could have gone as long as there was a sun to provide the energy to sustain this bio-ecosystem. The entry of human kind did not initially upset this delicate balance of the biosphere. Plants harnessed sunlight converting CO₂ into O₂ plus hydrocarbons storing energy. Animals converted the hydrocarbons plus O₂ into energy plus CO₂ so that the levels of CO₂ and O₂ remained in balance and the temperature of the planet remained in the moderate range that permitted life on Earth to thrive. All was well and then humans discovered heat engines and the Industrial Age took off. At first the burning of fossil fuels and the release of stored CO₂ did little to change the balance of CO₂ and O₂ in the atmosphere but the success of the industrial revolution in the creation of wealth and the rapid increase in population combined with the technological imperative now threatens to upset that balance.

Technologies and Tools are Media and as such “Extensions of Man”

Marshall McLuhan's book *Understanding Media: Extensions of Man* is built on the

notion that media are ‘extensions of man’ where a medium is not restricted to communications media but also include all forms of technology, tools, artifacts and, as we shall show, scientific laws and engineering processes. When Marshall McLuhan wrote ‘the medium is the message’ the term medium he used referred to any tool, technology, artifact or communications medium. McLuhan never made a distinction between a technology, a medium, a tool and an artifact and used these terms interchangeably. For him a medium is any extension of ourselves that intermediates our interaction with our environment.

I think of technologies as extensions of our own bodies, of our own faculties, whether clothing, housing, and the more familiar kinds of technologies like wheels, stirrups, all extensions of various parts of the human body. The need to amplify the human powers in order to cope with the various environments brings on these extensions, whether of tools or furniture. These amplifications of our powers, sorts of deifications of man, I think of as technologies (McLuhan, McLuhan, Staines 2003, 57).

McLuhan (1964, 91) wrote that, “The use of any kind of medium or extension of man alters the patterns of interdependence among people, as it alters the ratios among our senses.” In fact as we will see the use of a medium like those that exploit nature’s sources of energy can also alter the physical environment in which man lives. In fact historically the extensions of man have flipped into the overextensions of man in which humans have despoiled many of their environments, which had sustained them. Humans lived and thrived from the food they collected from the plants and from the animals of nature they hunted, some of whom they later domesticated. Their food provided the energy for their muscle power. Humans then learned to create tools to maximize their use of the energy of their own muscle power so that they could make better use of the energy bounty of nature.

McLuhan (ibid.) connected tool use to the exploitation of nature’s energy when he wrote,

all technologies are extensions of our physical and nervous systems to increase power and speed. Again, unless there were such increases of power and speed, new extensions of ourselves would not occur or would be discarded. For an increase of power or speed in any kind of grouping of any components whatever is itself a disruption that causes a change of organization.

The term power in physics has the meaning of the rate at which energy is generated or dissipated and hence McLuhan is indicating that the tools created by humankind have had the impact of increasing their exploitation of energy. One example are the tools that maximize the use of the energy due to our own muscle power such as is the case with the hammer, the lever, the knife, the spear and the wheel. Another class of tools or techniques are those that exploit the external sources energy such as is the case with biomass energy released by the control of fire; the solar energy captured by agriculture; the energy of fossil fuels exploited by steam engines, steam turbines used to generate electricity and petro-powered internal combustion engines; and the energy released by the destruction of matter in nuclear reactors.

McLuhan suggested that all tools and technologies created by humankind help them exploit the energy of nature. We can also make the reverse argument that each of the exploitations of the external energy sources of nature are themselves technologies? For example I claim that the control and use of fire is a technology. This is easily established if we consider the root of the word technology, which is derived from the ancient Greek word τέχνη (techne), which is most often translated as skill, craftsmanship, craft, or art (en.wikipedia.org/wiki/Techne). It takes skill and craftsmanship to create and control fire and hence it is a technology. The same arguments can be made for agricultural techniques, windmills, water wheels, steam engines fueled by wood and coal, internal combustion engines fueled by petroleum, electricity generation by steam turbines fueled by coal and atomic reactors as well as the various forms of green energy such as wind, water, solar and geothermal.

Before beginning our survey of the technologies of energy exploitation we should bear in mind that McLuhan observed that all technologies create both service and disservice.

“All I am saying is that any product or innovation creates both service and disservice environments which reshape human attitudes. These service and disservice environments are always invisible until new environments have superseded them [Marshall McLuhan in a letter to Jonathan Miller, April 22, 1970].”

Bearing this in mind let us survey humankind’s various forms of energy exploiting technologies carefully noting both their service and disservice.

Hominid Tool Making and Control of Fire

The first primitive human technologies that preceded the actual emergence of Homo sapiens was the creation by our hominid ancestors of hand axes, extensions of our fist; and knives, extension of our teeth. These tools maximized the use of muscle power derived from the food that we ate and hence these tools contribute to the exploitation of energy derived from nature. Scrapers for treating animal skins led to the crafting of clothing, another technology or medium and an extension of our skin.

If clothing is an extension of our private skins to store and channel our own heat and energy, housing is a collective means of achieving the same end for the family or the group. Housing as shelter is an extension of our bodily heat-control mechanisms --a collective skin or garment. (McLuhan 1964, 138).

The tools for hunting and gathering, agriculture and pastoralism are obviously examples of energy exploiting technologies as is the control and the use of fire. The release of the energy stored in plant material by combustion was a craft or skill and hence a technology, which had significant consequences for the evolution of genus Homo and was a key factor in the emergence of Homo sapiens or modern humans from our hominid ancestors.

The control of fire created many benefits including warmth, an extension of internal metabolism; protection from predators; tool sharpening and hardening, an extension of our muscles; and cooking, which increased the number of plants that could be made edible; killed bacteria and hence helped to preserve raw foods such as meat so that it also became an extension of our digestive system.

The control of fire in turn contributed to new and more complex social structures as nuclear families banded together to form clans to take advantage of the many benefits that fire offered. This led to large-scale coordinated hunting and gathering, the development of emotional intelligence and social structures. These social developments led to the emergence of two communication media. The first possibly a million years ago was non-verbal mimetic communication of hand signals, facial gestures, body language and prosody (Donald 1991). The second probably only 50,000 to 100,000 years ago was verbal spoken language, (Logan 2007). Spoken language, which permits conceptualization, represents the dividing line between our fully human species of Homo sapiens and our hominid ancestors. The simultaneous emergence of spoken language and Homo sapiens can be traced back to the emergence of mimetic communication that developed around the campfire, the first external exploitation of energy, that our hominid ancestors gathered around at least a million years ago. The emergence of language illustrates the intimate connection between bio-ecology and media ecology as was originally suggested in “The Biological Foundation of Media Ecology” (Logan 2010).

The Emergence of Agriculture

Primitive tools along with fire and the benefits that accrued such as coordinated hunting and gathering were the first “extensions of man” and they led to the first “overextension of man,” namely the overhunting of game. The rise of agriculture, the Neolithic revolution, was not the result of humankind seeking a better and easier form of existence but rather as a way to survive in those areas where overhunting had decimated the game that a hunting and gathering form of existence depended upon. The life of the farmer is

much more demanding than that of the hunter and gatherer. Humankind led a “Garden of Eden” type of existence before overhunting depleted their easy sources of food. As a result, as indicated in the Bible story of Adam and Eve, once humankind was driven out of the Garden of Eden they had to earn their living by the sweat of their brow.

And unto Adam He said, Because thou hast hearkened unto the voice of thy wife, and hast eaten of the tree, of which I commanded thee, saying, Thou shalt not eat of it: cursed is the ground for thy sake; in toil shalt thou eat of it all the days of thy life; Thorns also and thistles shall it bring forth to thee; and thou shalt eat the herb of the field; In the sweat of thy face shalt thou eat bread, till thou return unto the ground; for out of it wast thou taken: for dust thou art, and unto dust shalt thou return. Genesis 3:17-19

The Bible recounts in the story of Isaac and his two sons, Jacob and Esau, how agricultural ways supplanted those of hunting but how the nostalgia for the food and ways of the hunt persisted. Esau is the hunter and the rough one and his brother Jacob is the farmer and the gentle one. Esau sells his birthright to Jacob for a pottage of red lentils because he is upon the brink of starving to death (which I interpret as the depletion of game). “And Esau said, Behold I am at the point to die; and what profit shall the birthright do to me (Gen. 25: 32)?” Isaac as he nears the ends of his day says to Esau, “Go out to the field and take me venison; and make me savoury food such as I love; and bring it to me, that I may eat; that my soul may bless thee before I die (Gen. 27:4-5)” But Rebekah, the wife of Isaac favoured Jacob and conspired with him to steal the birthright of Esau and receive the blessing of Isaac. This is the allegory of the succession and triumph of agriculture as represented by the triumph of Jacob, the second-born and the agriculturalist over his brother Esau, the first-born and the hunter.

The techniques or technologies of agriculture and pastoralism, as difficult as they were, solved the crisis of the overextension of hunting and in the end increased the wealth of humankind but did not always increase universal human wellbeing. For example it was only with the emergence of agriculture that the pernicious practice of human slavery emerged as well as class structure, which favored the landowner over the hard life of the

slaves and peasants who were tied to the land. There were also famines due to unfavorable weather conditions that had to be dealt with.

The Neolithic revolution of agriculture and pastoralism is the systematic harvesting of the energy stored in plants and animals. In order to carry out the activities of agriculture and pastoralism, which are extremely labour intensive, a number of new ways of exploiting nature's sources of energy emerged. The first was the use of animal power to plow the fields, to mill or grind grain into flour, to move materials in carts from one place to another and to herd cattle. The milling of grain also led to the exploitation of water and wind power with windmills and waterwheels respectively. These developments gave rise to mechanical devices to transfer energy from its source to where it was needed to get a job done. In fact factories for manufacturing goods were placed by rivers to exploit the energy of the flowing water into rotary motion to drive the machinery used in manufacturing. These mechanical devices laid down the foundation for and were the forerunners for what was to become the Industrial Revolution when steam engines to power mechanical devices replaced the waterwheel and the windmill.

The triumphs of agriculture and pastoralism have allowed the human population of the planet to steadily grow but there have been many negative impacts. The world has suffered through many cycles of feast and famine and has seen vast stretches of arable land despoiled and turned into deserts. What is now the Sahara Desert in North Africa was once an arable land that became over grazed by goats. The land between the Tigris and Euphrates Rivers that was once a rich arable land was over farmed. The constant use of irrigation led to salination of the soil and the compromise of agricultural activity.

The story of feast and famine is an old one that was addressed by Joseph of Biblical fame who counseled the Pharaoh of Egypt that there would be seven rich years and seven lean years and that the storage of grain was the key to survival.

Heat Engines and the Industrial Revolution

The heat engines that would power and drive the Industrial Revolution arose as a result of another overextension, namely the depletion of firewood in Great Britain. As firewood became scarce, the Brits turned to burning coal and peat to warm their houses using strip-mining techniques to access these resources. After exhausting the supply of coal and peat near the surface they began to access the fuel they needed by digging mines deep into the ground and as they descended below the water table their mines flooded. At first water was pumped out of the mines by pumps powered by horses. Then in 1712 Thomas Newcomen invented a steam engine that could power these types of pumps using the very fuel that was being mined.

Steady improvements were made in the design of the pump making them more efficient by a number of inventors, the most important of whom was James Watt who began working on an improvement of the Newcomen engine in 1763. By 1775 Watt had increased the efficiency of a steam driven pump so that it used 75% less fuel than the Newcomen engine. More importantly Watt figured out how to make his steam engine create rotary motion. This had an immediate effect on manufacturing as Watt's rotary action steam engines began to replace waterwheels. It was at this point that the industrial revolution took off contributing to a massive shift in efficiency and productivity and a concomitant increase in the wealth of the general population.

The plight of the early factory worker left much to be desired with terrible working conditions, the exploitation of child labour and low wages. These excesses or overextensions of the factory system gave rise to reforms such as public education so that children could be looked after while their parents toiled in the factory; labour unions; and a general increase in the standard of living as industrial workers were able to earn a living wage.

By 1801 an even more efficient steam engine had been developed that could be used to power railroad locomotives and steamboats. The last development in the evolution of the steam engine was the turbine steam engine in which the pistons of the original steam engine are replaced with turbines. They are used primarily today to generate electricity from steam produced at either coal fired plants or nuclear reactors and represent the vast majority of electricity that is generated in the world.

The Internal Combustion Engines and the Generation of Electricity with Steam Turbines

Steam engines were the chief source of power generation until they were largely replaced beginning in the early part of the 20th century by internal combustion engines that dominated transportation. Steam turbines gave rise to the generation of electricity and the ready availability of electricity gave rise to the development of electric motors, which replaced the steam engine as the principal engine of manufacturing. Electricity allowed the separation of the source of energy from the place where it can be used. Electricity also gave rise to indoor and outdoor lighting, personal and household appliances, and communication media such as the telegraph, telephone, radio and television as well as information technology. All of these developments gave rise to an increased standard of living in both the First World and the Third World. They have also resulted in a dramatic increase in the world's population and an alarming increase of pollution, greenhouse gases and the planet's temperature. Once again we are dealing with an overextension of man.

Renewable Energy

The realization that our massive use of fossil fuels might have some negative effects did not dawn on society as a whole until the publication of Rachel Carson's book *The Silent Spring* in 1962. The Club of Rome sponsored study *Limits to Growth* in 1972 reinforced

Rachel Carson' observations. The general recognition that the greenhouse effect was leading to global warming and climate change can be dated to the founding of the Intergovernmental Panel on Climate Change by the United Nations Environmental Programme in 1988, which eventually resulted in the formulation of the Kyoto Protocol in 1998. Another impetus for the use of renewable energy is the dependency on petroleum, its rising cost, and the insecurity of its supply coming mainly from the Middle East. Control of the supply of oil played a large part in the two Gulf Wars as does the tension in the Straits of Hormuz.

As a result of these awakenings to the overextension of fossil fuel use, the movement to recycle our waste, to reduce energy use wherever possible and the movement to develop renewable sources of green energy have begun with a number of modest successes but far less than is needed to avoid environmental collapse and the many negative effects of climate change. We have already begun to spiral downwards with more extreme weather including droughts and forest fires, the loss of mountain top glaciers, the melting of the polar ice caps, the rise of water levels of oceans threatening low lying islands and costal areas. On top of all this there is the relentless population explosion and the growing affluence of formerly underdeveloped parts of the globe, which is a positive development in the short run, but is worrisome in the long run because at some point we will exceed the carrying capacity of the planet. We know that when an animal population exceeds the carrying capacity of its ecological niche there is a massive die off. The same dynamic applies to human life on this planet. There is limit as to how much human life the planet may support. No one knows what that limit is but with the steady increase in population and the steady increase in human consumption per capita something is going to have to give. The development of the electric car, the implementation of recycling programs, and the modest use of wind, solar and geothermal energy will not save the ultimate doom facing humankind. The only solution is controlling our addiction to energy consumption. We are energy junkies totally hooked on petroleum and what we need is a massive global rehabilitation program. We cannot go cold turkey but the first step is to realize that our energy exploitation technologies are over extended and need to be curbed, not tomorrow for it will be too late but now, today. We have to replace the technological imperative

with an ecological one: 'If living with less energy can be done, it has to be done.' And 'if substituting green energy for petro can be done, it has to be done.' And 'if making the planet a safer place for human habitation, it has to be done.'

Laws of Media: The New Science

We now turn to McLuhan's Laws of Media in order to understand why humankind continually faces the overextension of its energy exploitation technologies, which have resulted in a steady increase of human wealth but has also brought on one crisis after another throughout human history, the latest, global warming and climate change, being our most dire.

Towards the end of his career McLuhan developed a technique for studying media that he called Laws of Media. He published two short articles on this work (McLuhan 1975 & 1977) and continued to work on this project for the rest of his career with his son Eric McLuhan and at times with others including myself. Eric collected the work that he and his father had researched and published it in *Laws of Media: The New Science* (McLuhan, M. and E. McLuhan 1988). As one can ascertain from the subtitle, The New Science, the intention of this project was to place Marshall's work on a scientific basis.

The Laws of Media (LOM) for studying the counterintuitive effects of media, or technologies, scientific laws or any human-made artifact consists of the following four laws:

1. Every medium, technology or human-made artifact enhances some human function.
2. In doing so, it obsolesces some former medium, technology, or human-made artifact, which was used to achieve the same function earlier.

3. In achieving its function, the new medium, technology or human-made artifact retrieves some older form from the past.
4. And when pushed far enough, the new medium, technology or human-made artifact reverses or flips into a complementary or possibly an opposite form.

The first question that arises is whether or not we can use the LOM to analyze the processes involved in the exploitation of energy given that the media McLuhan studied with the exception of the spoken word involved some physical human artifact, technology or tool. In their book, *Laws of Media*, Marshall and Eric McLuhan (1988), however, included scientific laws and concepts as media subject to the Laws of Media. I personally developed with Marshall the Laws of Media for Aristotle's Law of Motion, Buridan's Impetus Theory, and Newton's Three Laws of Motion. We discovered each law in this series flipped into the next and the last one, Newton's Third Law, flipped into Einstein's theory of relativity (ibid., 212-14).

I recalled this collaboration with Marshall to make the point that laws and concepts of science and engineering are also media and as such are, to use McLuhan's language, "extensions of man." I do this because I wish to suggest that the exploitation of energy by humans is another class of "the extensions of man."

The Laws of Media contain within them the dynamics that describe how an "extension of man" can easily flip into an "overextension of man. It is the fourth law that seems to be the culprit as it states that pushed far enough a medium flips into its opposite form.

Let us examine the various forms for exploiting nature's sources of energy within the context of the LOM to see if we can perceive a pattern starting with the "extensions of man"

The Extensions of Man

The “extensions of man” enhance human based functions or objectives

They obsolesce whatever parts of “man” such as his hands, his teeth that were extended

They retrieve the gods

They flip into the “overextensions of man”

The Exploitation of Energy

The exploitation of energy enhances human power

It obsolesces human muscles

It retrieves the sun’s energy

It flips into entropy, the increase of disorder and pollution

The Steam Engine

The steam engine enhances rotary motion

It obsolesces the windmill, the waterwheel and animal power

It retrieves the slavery in the form of the energy slave

It flips into the internal combustion engine and the generation of electricity with steam turbines

The Steam Turbine

The steam turbine enhances the generation of electric power

It obsolesces the gas lamp and the candle

It retrieves lightning

It flips into blackouts

The Internal Combustion Engine

The internal combustion engine enhances mobility

It obsolesces the steam engine and the horse

It retrieves horsepower and the chariot

It flips into traffic jams and pollution

The First Laws of Thermodynamics

The first law of thermodynamics enhances the exploitation of energy

Obsolesces the idea of a perpetual motion machine

Retrieves nature's bounty

Flips into the second law of thermodynamics or the increase of entropy or disorder

The Second Law of Thermodynamics

The second law of thermodynamics enhances the dissipation of heat energy and the increase of entropy

Obsolesces the idea of a Garden of Eden and a free ride

Retrieves the chaos of the primordial universe without form

Flips into renewable energy

Conclusion

Our review of the various means by which humankind has exploited the energy sources of nature revealed that each time the level of energy exploitation increased there was a concomitant increase in the overall wealth of humankind. Each step forward, however, has resulted in some negative impacts that the next level of energy exploitation was able

to overcome. The use of energy, however, comes with a price, namely the increase in entropy or disorder. This is a law of nature that physicists discovered in the 19th century and which McLuhan's Laws of Media also substantiates. The 'extensions of man' when pushed far enough flip into the 'overextensions of man'

In the past the increased level of energy exploitation has resulted in an increased level of human well being. It is only in the most recent decade that human well being has shown an actual decline in the most affluent societies at the same time that well being in general has increased in many parts of what was once the Third World. The fact that life expectancy has actually declined in the First World is a signal that we have overextended our exploitation of energy. The concerns of atmospheric scientists and the science community in general regarding global warming is another signal that we have overextended ourselves.

Humanity could be facing a life and death ecological challenge vis-à-vis global warming and climate change. There are some who would deny this but the preponderance of scientific opinion is that human activity is either the cause of global warming or at least is contributing to it in a major way. The danger we face is a runaway greenhouse effect. As the polar caps melt less sunlight is reflected back into space and greenhouse gases such as methane are released as the ice caps melt. Also as the oceans warm they release CO₂ gas and are unable to absorb as much CO₂ as is being generated. These effects feed on each other accelerating global warming and it is possible that they could result in a runaway greenhouse effect like the one that took place on Venus aeons ago. This would have disastrous effects and could spell the end of human life on the planet. Other dangers, less severe but still dire, still lurk in: the safe storage of nuclear waste; the operation of nuclear power plants; the depletion of petroleum, a valuable source of both fuel and chemicals for manufacturing; and the ongoing problem of air and water pollution, acid rain and the like.

The technological imperative, ‘if it can be done, it has to be done’ has to be scrapped and replaced with an ecological imperative, ‘if it damages us in the long run, it can not be done! and it must not be done!’

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² Following McLuhan we will use the term "man" from time to time as we did above when it parallels McLuhan use of the term, but will otherwise use the more politically correct term humans or humankind, which is the meaning that McLuhan intended when he used the term "man" as in "extensions of man." The younger readers should note that McLuhan used the term "man" in the days before the sexism of terms like "man" to denote humans and "mankind" to denote humankind was recognized.