

# Intelligent Tools: The Cornerstone of a New Civilization

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## Abstract

The following article briefly describes the developments of tools and knowledge in human history and states that these two phenomena co-exist only in intelligent tools. It focusses on the productive merits of the past intelligent tools and discusses the social and biohuman). Moreover, since human beings were unable to produce an intelligent tool capable of outperforming man<sup>1</sup> as a tool, the technological basis of slavery continued to persist throughout history. The article then examines the current achievements of computer technology in producing intelligent tools. It argues that the *production* of intelligent tools makes it possible to bypass the social and natural *limitations* of all past intelligent tools. Once these tools *outperform* humans as intelligent tools, man will no longer be indispensable as a production tool. Consequently, the inception of these new tools eradicates the *technological* basis of the subjugation of man by man. This eradication may start a new civilization by effecting higher human intelligence, more economic wealth and greater socio-political freedom in man's future society.

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## Tools and Tool-making in History

Although anthropologists have different appraisals of the role of tools in the evolution of primates, they are unanimous in recognizing tool-making as the most important differentiation of our ancestors from other primates. Making tools enabled us to pursue our intentions with means *separate* from our bodies. Tools, in contrast to our limbs, could develop apart from the life and death of every in-

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<sup>1</sup>The masculine expressions in this article were used only as generic terms. Although we would prefer to eliminate even their generic use, we found it very difficult to edit the article on this account. Please pardon us if any unintentional bias has ensued.

dividual member of our species, thus handing down the fruits of past productive activities to new generations.

Other animals occasionally use natural objects as tools, but their tools do not develop very far beyond the form or state of their natural source. Man-made tools, on the other hand, have become more and more discernible from natural objects as we have moved away from the animal kingdom. The reason lies in the preconditions of our species prior to tool-making. The articulation and mental capabilities of our ancestors were mature enough to spawn human intelligence and language. As both tool-making and communication were social activities, advances in one reciprocally affected the progress in the other. Thus, being a social animal, man's higher form of communication between individuals (*i.e.*, language) evolved alongside tool-making.

Language made possible the retention and transfer of human knowledge apart from and independent of the life and death of individuals. In this way, knowledge could be transferred from one generation to another by a means other than genetic heredity. The advent of writing also enhanced the linguistic transfer of knowledge. Spoken language conveyed knowledge via memory, habits, expertise, and cultural assimilation; whereas written language made knowledge transferable in greater detail and exactness, and less dependent on particular moods of individuals, *i.e.*, more *objective*.<sup>2</sup>

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We are indebted to the many individuals whose fruitful criticisms improved this paper: William Clancey, whose reflections on an earlier draft spurred us to clarify some elusive passages; and Robert Englemore, whose editorial comments were also cogent and well-founded. Nonetheless, we are solely responsible for this final manuscript. We acknowledge the controversial nature of our article and hope it kindles further discussion and debate from our readers.

<sup>2</sup>Tools, language, and writing strengthened human abstract thought. Mathematics and tools to perform mathematical operations (*i.e.*, a type of mental work) are found very early in human history—maybe

Writing made possible the use, criticism, and development of knowledge by individuals spatially and temporally apart; *i.e.*, knowledge became more objective and a world in itself, discernible from the natural world as well as the

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subjective world of every individual. Similarly, tools—as distinct from natural objects—constituted another world stamped by human knowledge yet separate from it. They were used for physical as well as mental work and were partly automated in later industrial developments.

Knowledge and tools were the ingredients of all future human progress (or even the setbacks). Using knowledge and tools in production and all other aspects of life reciprocally affected individuals physically, mentally, and socially. The tremendous progress of our species can be more clearly understood by observing how children acquire a vast amount of knowledge and learn to use a great variety of tools in a very short time. Humans are the only species on Earth who use knowledge and tools in all aspects of their lives. In a word, we can say that tool-making was the most important activity differentiating our ancestors from other primates, and human beings are uniquely recognizable by their production of knowledge and tools in the world of animals. No other technological upheaval or socio-political development has caused such a tremendous distinction between our own and other species.

The world of knowledge and the world of tools have concurred only in one special phenomena: Intelligent tools (*e.g.*, police dogs). These tools were used by man, but not produced by him. The possession of sensory perceptions and locomotion, the capacity to communicate with man, and the ability to learn a special skill necessary for a specific task were the ideal qualities sought in intelligent tools. These tools were peculiarly related to man's knowledge and needs. Ordinary tools were used and improved by human knowledge to fulfill human needs and their development was limited only by the state of technology. Intelligent tools were also limited by natural evolution which, until the advent of genetic engineering, has been almost exclusively uninfluenced by human knowledge. The natural limitations of intelligent tools have mostly been a "good" reason for the philosophers and historians of tools to pay little attention to these tools. Nonetheless, modern intelligent tools are not only influenced by human knowledge,

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from the time humans used their fingers for counting. Tools similar to the abacus are traceable to the dawn of civilization. These tools and mathematics further helped the objectification of knowledge.

but are more and more becoming the embodiment of our knowledge. The current capabilities in the *production* of such tools make it imperative to review their past social impact as well as to speculate on their future effects.

### Intelligent Tools of the Past

Animals are the first intelligent tools used by man. The use of animals as tools dates back to primitive man. One may mention the use of horses as tools in transportation, dogs in trailing fugitives, doves in carrying messages, falcons in hunting birds, and many other examples. Using intelligent tools is not new in human history (even some animals use other animals or members of their own species as tools). Nevertheless, producing intelligent tools is a fairly new phenomenon and their improvements are not limited by natural evolution. We will discuss this point more thoroughly in the next section. However, now we would like to draw attention to some of the peculiar features of past intelligent tools; for this purpose, we will concentrate on the use of horses as tools.

Horses, as tools of transportation, were used for their locomotive power. Their biological characteristics provided ease of use, speed, and environmental adaptability. They (along with camels, llamas, etc.) were preferred over many stronger animals, as means of transportation, mainly because of their capacity to act as tools, *i.e.*, to yield to control. For example, it is interesting to note that gorillas are both more intelligent and stronger than horses, but yet they lack the capacity to yield to control. Yielding to control or following orders may not make an animal intelligent, but surely makes it tool-like. Hence, horses were not selected because of their intelligence (or even their common sense) but rather for being a tool-like locomotive system.<sup>3</sup>

The above can even be confirmed by the eventual replacement of horses by cars. Cars outperform horses, both in their locomotive power and in yielding to human control. But the most stupid horse would recognize a ditch, even if the rider does not notice; whereas a car may crash if the driver fails to see a ditch. However, this important difference did not cause humans to even pause before replacing horses by cars; because the main reason for choosing horses in the first place was *not* their *intelligence* but was rather their locomotive power and capacity to perform like a tool. The same can be said about dogs and other animals. Of course, this is not to say that humans always disliked the advantages of common sense in animal tools, but that it was not the primary reason for selecting them as intelligent tools.

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<sup>3</sup> It is obvious that these animals could never lose their intelligent characteristics and humans did not treat them as mere tools either. Feelings and even affectionate relations between man and dogs or horses are commonplace in all civilizations. But these relations existed whenever animals were considered as companions, not as tools (the same is true in the relations between humans themselves).

Why then was the intelligence in these tools of little importance to human users? We think the answer lies in man's choice of having a better *general-purpose* intelligent tool that could be applied to all tools (*i.e.*, animals included). This tool was nothing but man *himself* in the role of a tool. Only when an intelligent characteristic was not available in man, were animals used for their *intelligence*, and then in a limited domain. For example, the strong sense of smell in dogs gave them an edge over humans as tools for detecting smell and humans relied on even the dogs' wit for trailing fugitives. Otherwise, man was preferred over animals whenever more intelligence than just following orders was desired in a tool.

Thus, in order to understand the significance of intelligent tools in history, we should not focus on the use of animals but rather on the use of man himself as a tool. Man was used as a tool whenever his sense perceptions and locomotive abilities, language understanding, and special skills were utilised as *means of production* (*i.e.*, means to an end). To the degree man is clipped of his versatility and his freedom is limited in order to conform to the production process, the more tool-like he becomes. In contrast, man remains an *end in himself* and is not reduced to a special tool to the degree versatility, knowledge, and sophistication prevail in his productive activities.

The more complicated the society, the harder it is to draw a line between these two kinds of human activity; but still, control determines the character of each kind. As long as a better alternative to man as an intelligent tool did not exist, there necessarily developed social relations to compromise the natural equality of all men and man's use as a tool. These social relations have constituted the main part of all social relations in human history. As a result, it is often difficult to determine whether an individual is performing as a free individual or as a special-purpose tool. Only slavery had the clearest distinction of the two *kinds* of man: The slaves who, as tools, yielded to the control of their owners, and the slave-owners who ruled over their slaves and regarded them as mere tools.

Slavery was the first important use of man as a tool. Slaves were not allowed to have independent judgment—submission to the control of their owners was the “virtue” expected from them. They were even *owned*, like any other tool, as a private property. There were different kinds of slaves trained for particular undertakings, and there were laws that prevented slaves from developing into whole individuals, such as those forbidding participation in many social activities, including education.

The use of man as an intelligent tool made it possible for a large part of the free citizens to distance themselves from direct contact with tools. Thus, their role in the production process resided in the realm of control, with knowledge and decision-making as their primary tasks. In other words, possession of intelligent tools relieved them

from working for their basic needs.

The great construction works of ancient times were not surpassed until the Industrial Revolution. Inanimate tools accompanied with intelligent tools (slaves) required only their owners' knowledge and decision-making to become a wealth-producing system. It was like having a smart machine which would start production by verbal orders, would change shape and improve by our desires. What a long way from the times primitive man had to achieve everything by his own hands! This is how intelligent tools supplemented inanimate tools through man's journey of progress.

Although the state of technology in slave society furnished a good technological basis for using man as an intelligent tool, the disappearance of slavery was not due to the eradication of that technological basis. In fact, the revival of slavery in early United States history demonstrated that even the tools of modern America could be well-used by slaves. In other words, the disappearance of

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slavery was due to the social unacceptability of the shameless treatment of our own kind as mere tools. The more civilized we became, the less could we endure such inequalities. Needless to say, the whole mental framework of a slave society was the assumption or perception of slaves as mere tools—an assumption which certainly was contrary to the truth and was bound to be challenged by some from both sides. Nevertheless, as long as the human race lacked intelligent tools that could outperform man as a tool, some form of subjugation of man by man, or even the possibility of a revival of slavery, could continue to exist.

Besides the social problems that accompanied the use of animals and man as intelligent tools, there was another important difficulty to their use (prior to genetic engineering): Their natural limitations. Other tools were improved and refined for new tasks. Only the current state of the technology limited their progress. Animals and man as tools were not only limited by the state of technology, but their progress as tools was limited by their confinement to natural evolution—the main obstacle. For example, it was impossible to extend the length of man's hands two fold or increase the speed of a horse two times in thousands of years; in particular, the life span of these tools was technologically unsurpassable. In comparison, the length of cranes has been extended, the speed of cars has been increased, and the durability of steel has been enhanced several times during the last fifty years.

What made intelligent tools special, *i.e.*, their senses, reasoning, and capacity for communication, could hardly improve significantly in centuries. The past intelligent tools (*e.g.*, man) not only had difficulties performing as tools (due to social reasons), but their very biological existence imposed a serious handicap on their progress as tools. Both these negative elements are absent in the contemporary intelligent tools, *i.e.*, intelligent robots.

### Artificial Intelligence: A New Alternative

In order to start from a common understanding of new intelligent tools, we have summarized the historical milestones of the computer revolution in the following three paragraphs:

The developments of computer technology can be divided broadly into two categories: Number processing and symbol processing. The first category has made information much more accessible, retainable, and transferable than all the improvements of printing technology.<sup>4</sup> Computers have surpassed all past calculation tools (*e.g.*, abacus or slide rules) in speed, functional variety, and ease of use. Consequently, by extending automation to monotonous mental labor, information processing is expanding the scope of the printing press and the industrial revolution to new frontiers.

The second category, *i.e.*, symbol processing or artificial intelligence (AI), enables computers to simulate sensory perception and locomotion, reasoning and problem-solving, natural language, and many other human capabilities.<sup>5</sup> Already intelligent vision systems have been introduced to the production process, working alongside human workers.<sup>6</sup> Knowledge processing has been used to make expert systems for a variety of tasks such as medical diagnoses.<sup>7</sup> Also, natural language query systems have been on the market for quite some time.<sup>8</sup>

Regardless of the philosophical controversies surrounding the nature of intelligence, all the above tools perform tasks previously considered to require intelligence and thus could be well called intelligent tools in the narrow sense of the term. In other words, artificial intelligence is presenting a new kind of alternative to all past intelligent tools. This reality is prompting philosophers of AI to shift their focus from the realm of the philosophy of mind (*i.e.*, whether it is possible to have intelligent machines!) to the realm of socio-political philosophy and look at the social impact of intelligent tools on our society. Below, we

demonstrate how these newly *produced* intelligent tools bypass the limitations of past intelligent tools. AI artifacts, outperforming man as a tool in the near future, may become the cornerstone of a new civilization free from the subjugation of man by man.

Present-day intelligent tools are called intelligent robots. They are actually a unique synthesis of tools and knowledge, a historical first. They can be equipped with vision systems (plus other sensory systems and locomotion), special knowledge of various domains, and natural language capabilities of various human languages. They are not limited by natural evolution. Thus, contrary to an animal or a human, a robot's vision can be extended and is limited only by the state of technology. Its required special domain knowledge can be increased to generate the most efficient output of the best skilled laborer or expert. Its communication capacity can be extended to dozens of languages, whereas an average human worker barely manages to communicate in more than one language. In short, the only limitation to the progress of intelligent robots is the level of technology, which is in turn limited by human intelligence itself. Therefore, exhausting the capabilities of intelligent tools will be concurrent with the increase of human intelligence to levels incomparable to any past development.

We do not claim that these artifacts are presently in a position to approach human common sense. But the stone tools of Homo Sapiens could never compete with man or animals in lifting objects. It was a long time before levers and windmills were made; nevertheless, producing

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stone tools made future improvements possible such that we can have tools like lift-trucks today which exceed the power of any athlete or even strong animals. Thus, the current ability of state-of-the-art intelligent robots is not as important as their future possibilities.

For the first time in history, production of the above tools has enabled man to surpass the barrier of natural evolution for intelligent tools. This will undoubtedly be a boon to world production. Moreover, once these tools outperform humans as intelligent tools, there will no longer be any technological necessity to degrade fellow members of our own species to the rank of tools. In sum, with the production of intelligent tools, we can expect the technological basis for any kind of human slavery to disappear in the near future. We are witnessing an event as important as the first making of tools by our ancestors. This development may start a new civilization that will foster a simultaneous enhancement of our socio-political freedoms

<sup>4</sup>Although it still lacks the random accessibility of book thumbing or newspaper browsing.

<sup>5</sup>Nonetheless, the simulation of some mental processes such as postulating basic theorems, intuitive reasoning, and common sense understanding are still very much beyond reach.

<sup>6</sup>For example, Autovision of Automatix, Inc.

<sup>7</sup>Internist of the University of Pittsburgh is a noteworthy example

<sup>8</sup>Such as Intellect of Artificial Intelligence Corp

on one hand and of our economic wealth on the other—a concurrence rarely achieved in human history. In such a society, the essential human activity will resemble more the free exploration of an affluent artist than the soldier-type obedience of a fortuneless laborer.

Finally, it is appropriate to mention that in this treatise, we have examined robots only as tools. We know, as many authors have pointed out, there is a *logical* possibility that these robots could turn into a new species surpassing man's current intelligence (yet we think by then humans will also have moved far more ahead and may still be ahead of them). There are numerous possibilities that more advanced species may reside on Earth some day (*e.g.*, extraterrestrials are still a good possibility), and their origins could be in anything from genetic engineering and space travel to intelligent robot production and human evolution. Perhaps we will share mostly biological needs with animals and primarily social needs with other intelligences. This may help eliminate some of our *anthropocentric* views of the world which have been a part of our world outlook since the fall of early Greek civilization. However, these issues fall beyond the scope of this review as we have focussed solely on the technological basis of the subjugation of man by *man*.

### Future Prospects

There is every reason to believe that the progress of these new intelligent tools would cause our common sense to grow immensely by challenging it to an unprecedented extent. It will create a new civilization in which humans, for the first time, are challenged by other creatures, not only for their physical strength, but also by these new artifacts for their intelligence. The technological basis of man's subjugation by man and its degrading consequences will be eliminated in society; thus, giving rise to the potential for higher human intelligence, tremendous wealth and more socio-political freedom.

In this light, we welcome the coming of the new civilization and look forward to a better future following upon the heels of the contemporary upheaval. Pessimistic views about our future arise from viewing our own evolution to be static while intelligent tools progress. The emergence of artificial intelligence has made it feasible for human beings to be intellectually challenged by the immense tasks of exhausting the intelligent characteristics of some artifacts—a historical first. Together with improvements in genetic engineering and telecommunications, the production process will change so rapidly in this space-age society that we can barely imagine even its most general lines. But whatever shape the new social formations may take, some possible social effects of these intelligent tools may include:

- A broadened scope of our intelligence: Our common sense should become much more developed and we should expect many new discoveries, inventions, and even a new understanding of ourselves.

- A freeing of the majority of human beings from living as tools and means of production: A greater percentage of people should be able to do what they like rather than being forced to do something they dislike merely to secure their basic needs.
- A tremendous multiplication of the wealth of mankind: The opening of new frontiers before us, in space or on Earth, will certainly follow the above advancements.

At first glance, molding the new production processes, *e.g.*, building "factories and offices of the future," or "homes of the future," may appear to be the key endeavor for shaping the future. Nonetheless, the real *challenge* before future-minded individuals is the improvement and introduction of appropriate social relations if the fruits of

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these technological advancements are to be realized. The role of science will be enhanced both due to the new technical needs of sophisticated, knowledge-intensive production processes and due to the new social needs of the related human interaction. Hence, we can expect an increased sophistication of essential human pursuits; the central activity of most individuals will likely be related to the progress of social relations and the enhancement of knowledge. We may even find personal income based on a synthesis of one's intentions and needs.

The distribution of wealth and power in this new civilization will remain a social issue rather than a technical matter. Thus, whether everyone and every country will be able to avail themselves of these intelligent tools and accompanying benefits depends on future social institutions. These achievements may even add to the misery of many individuals for some time. However, we are optimistic about the future. We think that with the disappearance of the technological basis for treating any part of mankind as tools, man will, at least, be able to spend more effort on resolving social issues and on molding new social institutions. These new social institutions must address and alleviate the menace of poverty, tyranny, war, and ecological deterioration. Whether the new civilization will evolve peacefully and uniformly world-wide is still an open question.

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