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The Mind's Eye: Nonverbal thought in Technology

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In lieu of an abstract, here is a brief excerpt of the content:

Leonardo, Vol. 11, pp. 131-139. Pergamon Press 1978. Printed in Great Britain THE MIND'S EYE: NONVERBAL THOUGHT IN TECHNOLOGY* Eugene S. Ferguson** This scientific age too readily assumes that whatever knowledge may be incorporated in the artifacts of technology must be derived from science. This assumption is a bit of modern folklore that ignores the many nonscientific decisions, both large and small, made by technologists as they design the world we inhabit. Many objects of daily use have clearly been influenced by science, but their form and function, their dimensions and appearance, were determined by technologists—craftsmen, designers, inventors, and engineers—using nonscientific modes of thought. Carving knives, comfortable chairs, lighting fixtures, and motorcycles are as they are because over the years their designers and makers have established shape, style, and texture. Many features and qualities of the objects that a technologist thinks about cannot be reduced to unambiguous verbal descriptions; they are dealt with in his mind by a visual, nonverbal process. His mind's eye is a well-developed organ that not only

reviews the contents of his visual memory but also forms such new or modified images as his thoughts require. As he thinks about a machine, reasoning his way through successive steps in a dynamic process, he can turn it over in his mind. The designer and the inventor, who bring elements together in new combinations, are each able to assemble and manipulate in their minds devices that as yet do not exist. If we are to understand the development of Western technology, we must appreciate this important, if unnoticed, mode of thought. It has been nonverbal thinking, by and large, that has fixed the outlines and filled in the details of our material surroundings for, in their innumerable choices and decisions, technologists have determined the kind of world we live in, in a physical sense. Pyramids, cathedrals, and rockets exist not because of geometry, the theory of structures, or the thermodynamics, but because they were first a picture - literally a vision in the minds of those who built them [11]. This article attempts to clarify the nature and significance of nonverbal thought. It traces the development of nonverbal thought as practiced by technologists since the Renaissance, points to the many drawings and pictures that have both recorded and stimulated technological developments, and reviews the graphic inventions, such as pictorial perspective, that have lent system and clarity to nonverbal thinking. A concluding section considers changing attitudes toward the nonverbal component of technology as they have been reflected in engineering curricula and suggests some effects of such changes upon the nature of our technology.

*Abridged version of article in *Science* 197, 827 (No. 4306, 1977). Copyright © 1977 by the American Association for the Advancement of Science. Published with permission. **Historian, University of Delaware, and curator of technology, Hagley Museum, Greenville, DE 19807, U.S.A.

The Nature of Design There may well be only one acceptable arrangement or configuration of a complex technological device, such as a motorcycle, but that arrangement is neither self-evident nor scientifically predictable. The early designers of motorcycles could not ask science to tell them where to put engine, battery, fuel tank, and spark coil; they had to make their choices on other grounds (Fig. 1). In time, wrong choices would be revealed, but not by scientific analysis. Making wrong choices is the same kind of game as making right choices; there is often no a priori reason to do one thing rather than another, particularly if neither had been done before. Nor has the plight of designers changed fundamentally in the 20th century. They must still weigh the imponderable and sound the unfathomable. All of our technology has a significant intellectual component that is both nonscientific and nonliterary. The creative shaping process of a technologist's mind can be seen in nearly every man-made object that exists. The sweep of a suspension bridge, for example, is much Fig. 1. Alternative arrangements of the elements of motorcycles being produced in 1900 [54]. 131 more than an exercise in geometry. The distinctive features of individual bridges reflect more strongly the conceptualization of their designers and the times of their construction than they do the physical requirements of their respective sites. Different builders of large power boilers...

THE MIND'S EYE: NONVERBAL THOUGHT IN TECHNOLOGY*

Eugene S. Ferguson**

This scientific age too readily assumes that whatever knowledge may be incorporated in the artifacts of technology must be derived from science. This assumption is a bit of modern folklore that ignores the many non-scientific decisions, both large and small, made by technologists as they design the world we inhabit. Many objects of daily use have clearly been influenced by science, but their form and function, their dimensions and appearance, were determined by technologists—craftsmen, designers, inventors, and engineers—using non-scientific modes of thought. Carving knives, comfortable chairs, lighting fixtures, and motorcycles are as they are because over the years their designers and makers have established shape, style, and texture.

Many features and qualities of the objects that a technologist thinks about cannot be reduced to unambiguous verbal descriptions: they are dealt with in his mind by a visual, nonverbal process. His mind's eye is a well-developed organ that not only reviews the contents of his visual memory but also forms such new or modified images as his thoughts require. As he thinks about a machine, reasoning his way through successive steps in a dynamic process, he can turn it over in his mind. The designer and the inventor, who bring elements together in new combinations, are each able to assemble and manipulate in their minds devices that as yet do not exist.

If we are to understand the development of Western technology, we must appreciate this important, if unnoticed, mode of thought. It has been nonverbal thinking, by and large, that has fixed the outlines and filled in the details of our material surroundings for, in their innumerable choices and decisions, technologists have determined the kind of world we live in, in a physical sense. Pyramids, cathedrals, and rockets exist not because of geometry, theory of structures, or thermodynamics, but because they were first a picture—literally a vision in the minds of those who built them [1].

This article attempts to clarify the nature and significance of nonverbal thought. It traces the development of nonverbal thought as practiced by technologists since the Renaissance, points to the many drawings and pictures that have both recorded and stimulated technological developments, and reviews graphic inventions, such as pictorial perspective, that have lent system and clarity to nonverbal thinking. A concluding section considers changing attitudes toward the nonverbal component of technology as they have been reflected in engineering curricula and suggests some effects of such changes upon the nature of our technology.

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The Nature of Design

There may well be only one acceptable arrangement or configuration of a complex technological device, such as a motorcycle, but that arrangement is neither self-evident nor scientifically predictable. The early designers of motorcycles could not ask science to tell them where to put engine, battery, fuel tank, and spark coil; they had to make their choices on other grounds (Fig. 1). In time, wrong choices would be revealed, but not by scientific analysis. Making wrong choices is the same kind of game as making right choices; there is often no a priori reason to do one thing rather than another, particularly if neither had been done before. Nor has the plight of designers changed fundamentally in the 20th century. They must still weigh the unpredictable and sound the unfathomable. All of our technology has a significant intellectual component that is both non-scientific and noniterative.

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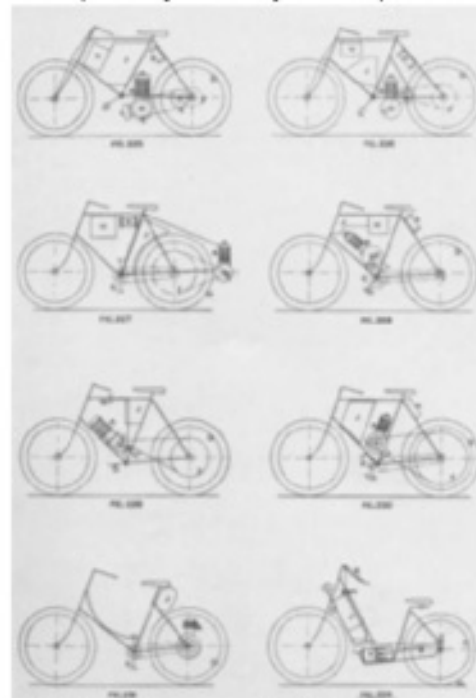


Fig. 1. Alternative arrangements of the elements of motorcycles being produced in 1900 [34].



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