Vision of the Gods:
An Inquiry Into the Meaning of Photography

by
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Photography is ubiquitous within global culture, but we hardly understand its meaning. And we have only a dim comprehension of its origin. Unlike cinema, which contains the complexities of motion and montage, the photograph is simple and, for the most part, brutally realistic. Perhaps the photograph has seemed too obvious to merit prolonged scholarly attention. Histories of the medium abound, but their authors follow a pattern exemplified by Alison and Helmut Gernsheim's distinguished *History of Photography*, first published in 1955. By the standard account, the first inklings of photography appeared when a 5th century scholar noticed a camera-like phenomenon, and culminated in the 1820s, when Nicephore Niepce doped a pewter plate with light-sensitive chemicals and exposed it within a camera obscura. At their most comprehensive, standard histories include references to the mediaeval scientists who experimented with pinhole optics and ultimately invented the camera obscura.

Though the standard account is correct in its details, it neglects the broader context of photography. Photography is an evolutionary phenomenon, not a fixed process, and it has drastically altered society at each stage of refinement. Starting with simple devices, the medium has branched into an enormous family of technologies that includes cinema, television and digital imagery. Individuals use cameras, but the medium is far more powerful in the hands of corporations and the state. Optical media entertain and inform, impress and oppress; they permeate everyday life, yet cultural theory does not approach this variety from a coherent base of understanding. What ties together snapshots and surveillance? Theorists perceive the social effects of mass media, which range from liberation to abject dehumanization, but the origin of these effects has not been outlined. We need a paradigm that captures the common thread of photographic technologies, one that matches the sophistication of contemporary engineering. Current theory of the photograph depends on the camera, but the physical device is insufficient to

explain the evolution of the optical media, particularly as it progresses toward the dematerialized realm of digital imagery and virtual reality.

Much has already been written about virtual reality. Though the medium is not yet viable, it has ample precedents ranging from Plato's Cave Passage to nineteenth century dioramas. The strongest precedent, however, is the virtual experience offered by photography and cinema, both of which derive, like the examples I just gave, from reflection upon optics. Whether or not it comes to pass, the idea of a virtual environment should serve as a boundary condition for photographic theory, because it illustrates the profound impact of optics on society. For most of its existence humanity has experienced the world through natural faculties, but the introduction of optical media has reorganized perception and replaced subjectivity. As a consequence, individuals have become part of increasingly larger collectives where both thought and experience are defined by objective standards. The environment has become mediated, defined by surveillance and institutions, and, as Jean Baudrillard has poignantly described, experience is often equated with media.

The central issues in photographic theory are defined by the history of optics. The study of vision and light has an ancient pedigree which scholars have only nodded toward when discussing photography. Scientific optics matured by the 3rd century BCE, when Euclid codified its principles alongside its parent discipline, geometry. Organized as a set of formal principles, Euclid's *Geometry* describes the construction of forms in an abstract space, giving their appearance to an ideal intelligence. In contrast, his *Optics* described the behavior of light in relation to a situated viewer. Taken together, the two works present a theory of how the physical world is constituted in reality and appearance, with the latter describing how light transmits information from the physical, geometric realm to the eyes.

Euclid's optical study represents a high point of knowledge that remained almost unmatched until the scientist Ibn al-Haytham published his optical treatises in the 9th century.[1] Building on the work of Euclid and his successor, Claudius Ptolemy, Al-Haytham founded physiological optics, which distinguished the functioning of the eye from the behavior of light. He also laid the groundwork for the camera obscura by accurately explaining the pinhole effect which underlies its mechanism. Several centuries later, well after al-Haytham's *Optics* passed into Europe, the camera obscura emerged from the laboratory as a tool for artists, but it was not until the 1600s that Johannes Kepler discovered the proper operation of the eye. Much like a

camera, human eyes augment the pinhole effect with a lens, bringing an inverted image to bear on a light-sensitive surface, the retina. (See Figure 1)

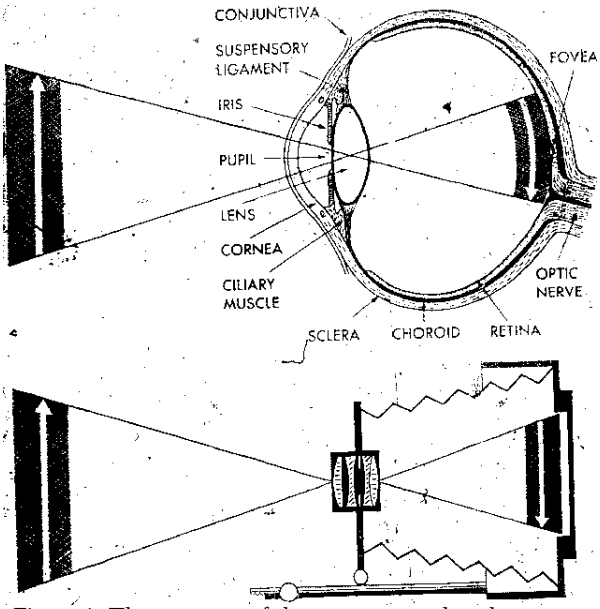

Figure 1: The structure of the eye compared to the camera (Wald, 1953)

Unlike those who followed, Kepler considered retinal inversion to be an important problem. But he despaired of solving it and left its resolution to later generations.[2] Progress came slowly. Little was known about the nervous system until the nineteenth century, and only recently have scientists learned how to inspect thought in real time. Now we know how the brain apprehends the retinal image. But many questions still elude us. What effect does media have on perception? Has sharing images—sharing perceptions—affected individuality? Optical technologies permeate daily life, and, by bridging vast distances, they have changed the nature of vision. The personal has become institutional, mediated by cameras and computers, and we inhabit virtual bodies created by photography, the telephone and television. So our primary question might address how technology affects biology. Is technology a form of evolution? Has social evolution superseded biological evolution? Will governments and corporations completely subsume the individual, limiting choice to matters of consumption? In confronting these questions, optics is relevant to some of the most pressing issues in cultural theory and, for that matter, human existence.

Photography represents the growing intimacy of humanity with machines. Tools originally amplified physical strength, but, with the advent of tools like the abacus, the compass and eyeglasses, they have been applied increasingly to mental faculties, giving us both modern media and digital computers. And recent advances in bioengineering are giving tools a quasi-organic status, merging them with our bodies. In 1950, biologist George Wald said photography was the product of convergent evolution:

> Of all the instruments made by man, none resembles a part of his body more than the camera does the eye. Yet this is not by design. A camera is no more a copy of an eye than the wing of a bird is a copy of that of an insect. Each is the product of an independent evolution; and if this has brought the camera and the eye together, it is not because one has mimicked the other, but because both have had to meet the same problems, and have frequently done so in the same way. This is the type of phenomenon that biologists call convergent evolution, yet peculiar in that one evolution is organic, the other technological.[3]

Wald then makes structural, mechanical and chemical comparisons between eyes and the photographic process. The similarities are numerous. Both use a lens to project an image within a dark chamber, both correct for aberrations in form and color, and both apprehend images through a grid of photosensitive receptors. As the capstone to his argument, Wald ends his essay with a discussion of optography, the art of making images with eyes.

Willy Kuhne, a professor of physiology at the University of Heidelberg, invented optography in 1878. Kuhne was studying rhodopsin, the retinal pigment that changes state in response to light. During the course of his experiments, he realized that he might be able to take pictures with a living eye. He immobilized a rabbit and forced it to look at a window for three minutes. He then decapitated the animal, sliced open its eye, and soaked its retina in alum to fix the rhodopsin. The next day the dried retina revealed an image of the window. Two years later he repeated the process with the head of an executed criminal. The resulting optigram, which he reproduced in a drawing, is the only known picture taken with a human eye. Unfortunately, the scene it displayed was unidentifiable. (See Figures 2 and 3)

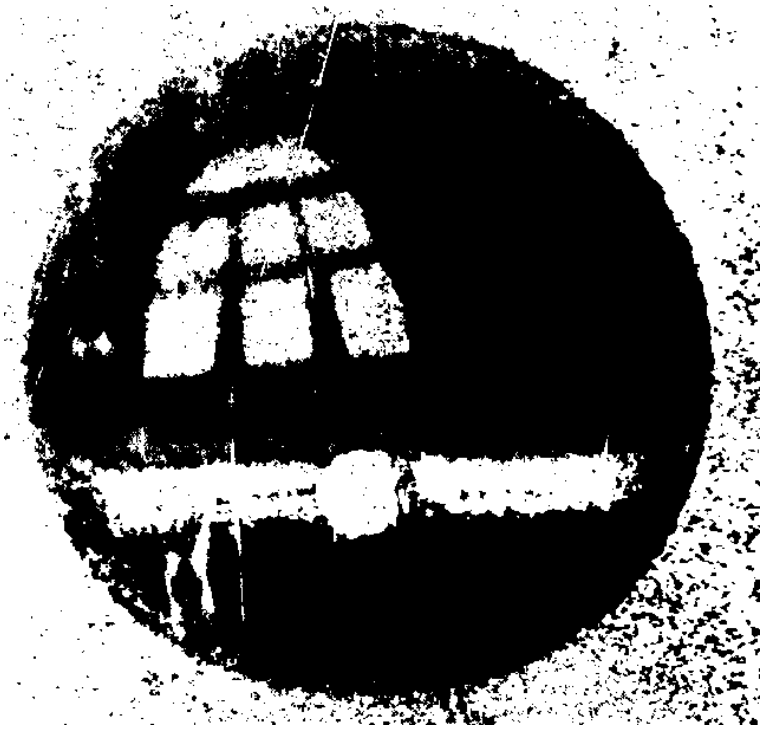

Figure 2: The rabbit's last view (Wald, 1953)

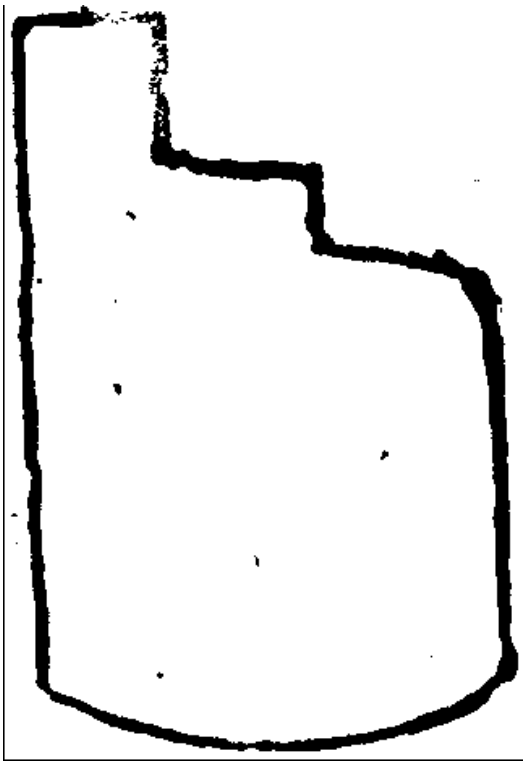

Figure 3: A human optigram
(Wald, 1953)

Evolutionary convergence explains the utility of cameras and casts a revealing light on media theory, particularly the work of Marshall McLuhan. McLuhan's descriptions of how media affect cognition seem hyperbolic, more metaphor than science, but if we accept Wald's conclusions, then the spread of media has a biological basis. Photography is an auxiliary form of perception. It amplifies vision, takes it to extremes of size, distance and speed. It extends the human nervous system, particularly when coupled to electronic distribution. Visual media are among the cornerstones of modern civilization, found in the service of law, science and industry, as well as the arts and personal life. When we examine the category of photography as a whole, including cinema, video and digital imagery with paper and film, we find a medium that mimics vision, providing sensations that bridge space and time. Photographs are concrete perceptions that orient groups of people around a singular, objective experience. Along with social hierarchy, and other technologies of communication, photographic images constitute a body social that behaves according to common impulses.

Photography has thus developed along two axes. The first is a train of technical and scientific discovery that stretches deep into history. As far as we know, optics was invented by the mathematicians of ancient Greece, but its parent science, geometry, is of far older pedigree, having reached an advanced state in the pre-Classical cultures of Mesopotamia and Egypt. The other axis derives from the communication needs of the cultures that developed photography and related technologies. Each axis reinforces our understanding of the other, and, by linking the two together, we can describe the evolution of technologies which led from archaic times to photography then cinema, television and virtual reality. As I discuss in a larger work, *Archaeology of the Photograph*, a consistent set of social, political and economic goals has driven the emergence of these practices, and photography stands as the paradigm of both their physical appearance and mechanical functioning.

The Ontology of the Photograph

CAMERAS ARE THE MOST OBVIOUS ELEMENT OF PHOTOGRAPHY, but we should not stay preoccupied with them. Photographs are conveniently rendered by cameras, but the information within a photograph—the information that defines it—can be generated in several ways. Photorealist imagery can be produced by hand and computer, so we cannot rely solely on the camera to define photography. Nor can we place cameras at the beginning of the medium, for we still need to ask the question, "What is the origin of the camera?" Many histories of photography have been written, but only lately with the emergence of satellite surveillance and virtual reality, can we completely define the paradigm of optics. An unwritten history lies behind the development of photography.

To access this history, we cannot, as scholars have traditionally done, treat photography as a discrete industrial process. Photography is not a specific activity but a way of seeing, a mechanized form of perception. It is a technical approach to visual representation based on optics. (Or perspective: they mean the same thing in their original usage.) And photography is ultimately geometric since optics/perspective derives from the investigation of space. As we shall see, photography also relates to the physiology of vision, and its advances have tracked fundamental progress in the scientific understanding of cognition. Starting with its invention in the nineteenth century, photography projects forward into cinema, television and digital media. And

it telescopes backward into earlier modalities based in painting, drawing, cartography and geometry. Media scholars have hinted at this history, but engineers have written it, and it remains inscribed in generations of tools. Photography is paradigmatic act of representation, one which blankets the environment with information. The expression of photographic technology has followed a path set in the formative days of civilization, and, ironically, its purpose is clearest in its earliest forms.

Like most machines, cameras automated processes previously done by hand. The tools of Renaissance painters are obvious forebears to the camera which makes photography closely related to classical modes of representation like architecture and mapping. If we trace these practices—perspectival painting, architecture and cartography—to their collective origin, we arrive at the archaic civilization of Sumer and the technology of land surveying, or applied geometry. Surveying occupies a privileged place in the history of photography and, more generally, of technical drawing. It inspired theoretic geometry, which in turn spawned optics, astronomy and cartography, the first sciences. I will collectively refer to these geometric disciplines as technologies of perception. Succeeding civilizations around the Mediterranean and Europe have adopted these perceptual practices, and a direct line of transmission links Sumerian land surveying to present-day photography and electronic media.

Within this article, I will describe some of the connections between archaic surveying and modern technology. An important premise of my discussion lies in the nature of automation or, more precisely, the definition of the machine. I mentioned above that preoccupation with cameras can lead to misunderstandings about photography. The photographic camera is a machine for taking pictures, and it thus seems different in kind from any other apparatus, even the camera obscura, which still requires an artist to draw the image. But since a photograph is simply information—the information specific to a visual display—we need to question whether cameras are necessary to produce a photographic "thing," that is, an optically correct image. This is clearly not the case. Renaissance painters and their successors devised accurate methods for producing optically correct images, and their work conditioned the emergence of the camera obscura and photographic machinery.

I submit that the work of perspectival artists—a group that ranges from Donatello to the photorealists—lies between intuition and automation. In

other words, perspectival drawing lies between the delicate naturalism of Paleolithic painting and the stark realism of photography. During the Renaissance, the production of art began to be mechanized, and picture making went beyond expression to become media.

The work of Lewis Mumford may clarify my position. In *Technics and Human Civilization*, Mumford introduces the concept of the megamachine, a social machine that coordinates human rather than nonhuman energy. Arising in early civilizations, the megamachine arose when leaders used scientific principles to increase the size, power and precision of work crews. By coordinating human labor with precise measurements and tools, early leaders were able to direct the construction of massive pyramids without the use of engines and other advanced technologies. Unlike many other human endeavors, a primary feature of the megamachine is the dominance of method. Like an inorganic mechanism, workers applied tools of measurement that let them precisely engineer buildings according to plan. Their own judgment was auxiliary to measurements and central direction.

Like earlier surveyors and architects, Renaissance painters allowed scientific principles to determine the structure of their work. Their work was closely allied with engineering and architecture. Optical effects were difficult to realize with medieval tools, so artists quickly adopted more advanced machines to assist their efforts. The requirements of perspective conditioned the emergence of the camera obscura in the late Renaissance, and the desire of successive generations to fully automate image production led to photography. The process continues today. Electronic processing is dematerializing the camera into the universal machine (and universal medium) of computers. New technologies like digital animation and virtual reality use optical principles, but, like Renaissance painting, they posit the camera as an ideal machine, a perspective that organizes representation according to a coherent point of view.

Photographs function by reproducing the vantage of the eye, and the analogy between eyes and cameras runs deep. As Kuhne first demonstrated, the eye is a camera, and vice versa, and they can sometimes be exchanged. Our understanding of the brain is on the increase; it seems likely that, in the near future, cameras will induce vision through direct neural implants.[4] When fed directly to the brain, media becomes immediate, more like an environment than an overlay. McLuhan's description of an optical-electronic nervous system may have sounded fictional when he uttered it, but it is rapidly

becoming true in the fundamental sense, mainly because media now integrates our perceptual apparatus. The convergence of technology with biology continues on the level of image processing. Like human vision, the camera produces internal representations of the world which can be recalled and manipulated. Fidelity is key to photography and natural perception because both are directed toward depicting an environment that must be exploited for navigation, communication and survival. Thus the ontology of the photograph derives from its fundamental utility as a representation of the visual environment—and from the act of vision itself.

Andre Bazin presented one of the first theoretic statements regarding photographic realism in his essay, "What is a Photograph," which appeared in 1937. He attributes a simple realism to the medium, as he opens and shuts the door on a theory of photography.

> Besides, painting is . . . an ersatz of the processes of reproduction. Only a photographic lens can give us the kind of image of the object that is capable of satisfying the deep need man has to substitute for it [the object] something more than a mere approximation . . . The photographic image is the object itself, the object freed from the conditions of time and space that govern it. No matter how fuzzy, distorted, or discolored, no matter how lacking in documentary value the image may be, it shares, by virtue of the very process of its becoming, the being of the model of which it is the reproduction; it *is* the model.[5]

Even as he gives the final word on photography, Bazin indicates that cinema is a much richer field for theory, closing with, "On the other hand, cinema is also a language." Bazin subsequently founded the field of cinema studies, and for decades scholars had little to say about photography. In the late 1950s, Roland Barthes discussed photographs, taking a linguistic approach adopted in the 1970s by a coterie that included Alan Sekula, Victor Burgin and Judith Williamson. Since then a field of critical photographic studies has emerged to analyze the various uses of photography in propaganda, advertising, surveillance and personal life.

Though placed in a multitude of disciplines, most studies of photography are either sociological, seeking a language of photography within its human elements, or phenomenological, attending to the mysteries of perception at a

distance. Some claim that perspective is simply a Western convention for representation, though such arguments are difficult to maintain against optics. The dawn of the digital era has added a twist to writing on photography, giving a new generation of scholars the opportunity to decry a post-objective era.

Current scholarship on photography is fragmented because it possesses no disciplinary paradigm. Beyond an unproductive dichotomy between realism and conventionalism, and an often-blurry technical history, we have no concrete understanding of how photography emerged, let alone how it engages the social mechanism. What forces gave impulse to the camera and its trajectory of development? While Bazin painfully emphasizes the objective realism of photography, and derails further study, he points to a generative function within the medium. The photographic image is not just an ersatz representation. It reproduces the environment, the thing itself, and becomes an ideal (or virtual) reality for the viewer. Bazin introduces photography with a discussion of cave paintings and Egyptian mummification. These practices, he claims, reveal the primal motives of artistic representation. He justifies this strange comparison by claiming our ancestors sought to overcome space and time by preserving appearances. In other words, to control life by constructing an idealized, artificial environment. Though concerned at this point with the plastic arts, from an historical perspective Bazin has approached the crux of photography and the technologies supporting it. While the comparison of mummies to photographs may stretch our powers of analysis, we can find other representational practices in ancient cultures which do not.

Land surveying has been a profession for over six thousand years. First invented in Sumer and spreading quickly to Egypt, it emerged as one of the essential technologies of civilization, and it underlies virtually every advance in urban culture, technical representation and mass communication. It is a critical form of organized perception, but its contributions to society are often overlooked. Neither cities nor social hierarchies could exist without surveyors and the property boundaries they create. Estates, buildings, roads, and aqueducts all depend on the related acts of surveying, planning and impressing new designs into the earth.

Bazin described mummification as a primal impulse behind photography, but study of surveying provides far more insight. Beyond the fact that optics derived from geometric investigation, surveying also plays the preservative

role described by Bazin. Since ancient times surveyors have preserved the state and its social organization by defining property boundaries. Herodotus's description of ancient Egyptian land surveyors is no less apt today.

> For this cause Egypt was intersected. The king moreover (so they said) divided the country among all the Egyptians by giving each an equal square parcel of land, and made this his source of revenue, appointing the payment of a yearly tax. And any man who was robbed by the river of a part of his land would come to Sesostris and declare what had befallen him; then the king would send men to look into it and measure the space by which the land was divided, so that thereafter it should pay in proportion to the tax originally imposed. From this, to my thinking, the Greeks originally learnt the art of measuring land.

Like photography, surveying was invented to extend perceptual powers. Urban planners could not comprehend the expanses necessary to build cities and empires, and surveying was the first in a long series of perceptual technologies invented to create objective, accurate images of the environment. It functioned as the eyes and visual memory of the early megamachine, a state bureaucracy that created specialized labor and social hierarchy. In contrast to cave paintings or mummification, the goal of surveying and related practices is to inform, not to express aesthetic or ritual values. At the core of a survey map is data, a representation of visual space which conveys useful information.

We should keep in mind that visual representations are not necessarily pictorial. Archaic survey records, or cadastres, do not contain visual representations; they are nothing more than tables of measurements which, if associated with a particular area, describe a plot of land. In form and content they resemble digital databases which exist for the same purpose. However, by 2300 BCE an interesting parallel to the evolution of digital computing occurs in Mesopotamia. Cadastres had been growing in both size and detail since their invention in the fourth millennium, and an unknown surveyor in the service of the great UR III bureaucracy introduced an innovative means to displaying geometric data: a graphic interface. We would now call this device a map.[6] Survey maps developed rapidly within Mesopotamia, becoming a means to manipulate land through urban planning. Maps were used to manage estates, design buildings and govern cities. (See Figure 4)

Much like the modern GUI, the cadastral map appealed to the innate capacities of human vision. While tables continued to exist, then as now, the map was a preferred means of displaying complex environmental data in some situations.

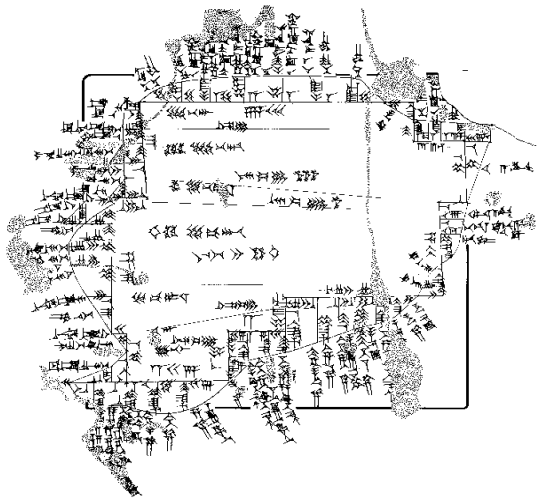

Figure 4: An UR III Empire survey map, dating from approximately 2300 BCE (Nissen, 1993)

Another telling parallel exists between archaic and contemporary civilizations. When placed alongside an early cadastral map, an aerial photograph reveals the origins and purpose of our quintessentially modern art. (See Figure 5) Both present an expanse of land, and both achieve geometric accuracy by assuming an ideal aerial perspective. More importantly, both are directed at the same purpose: the comprehension and management of productive earth. Despite the distance of time, the Mesopotamian scribes who staffed the first bureaucracies would have understood the function and purpose of our late model GIS computers, the Geographic Information Systems that overlay representations of land with useful information about productivity, access and ownership.[7] (See Figure 6)

Figure 5: An aerial photograph (*Space Imaging EOSAT Notes*, 1997)

Bazin's recognition that the photograph is a model for reality, as well as an objective reality in its own right, aim at the core of photography and related practices. We often think of perception, visual or otherwise, as passive, oriented only toward accurate representation. Photography has often been treated in a similar manner, as a wax tablet supplying "truth at twenty-four times a second" but little more. But the ontology of truth tells only half the story. In practice neither vision nor photography has ever

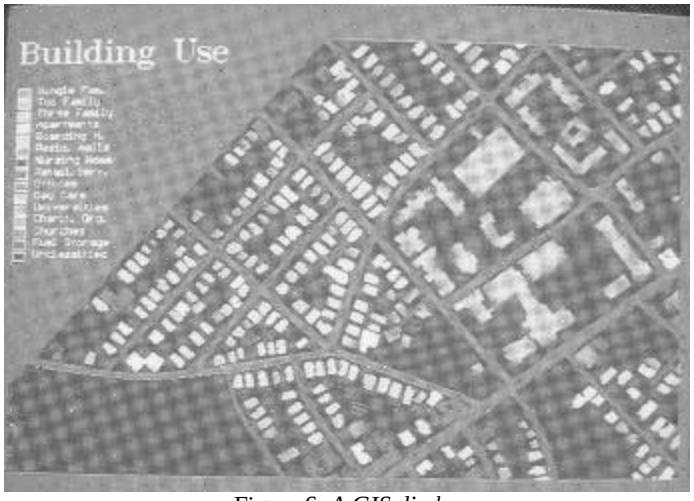

Figure 6: *A GIS display*
Like the earliest survey maps, Geographic Information Systems display an image of terrain overlaid with information such as ownership, usage, disposition of the soil. (Antenucci, 1991)

been passive. Each supplies information as a means to action, and, like the related practices of surveying and architecture, each provides a medium for the redesign of the environment. Like life, which sustains its own biosphere, humanity generates a milieu friendly to its needs. Vision, architecture and the intermediate technologies of photography, surveying and planning are the means to creating a genuinely human environment.

The Idiot King

SURVEYING EMERGED WITH THE EARLY city-state, and it has served the cause of urban civilization ever since. The ancients did not have distinct concepts of technology, science and politics, but their ideologies, which are religious in nature, still reveal the essential relationships between their disciplines. Prior to urbanization, Mesopotamians adhered to animistic beliefs similar to those of contemporary tribes. After the advent of cities, they developed state ideologies based on the sovereignty of sky gods like Inanna and Ningursu. Divine sanction conferred legitimacy upon rulers, and worship occupied most ceremonies of state. Sky gods were associated with planets—Inanna rose with Venus—and their celestial vantage revealed their transcendent authority. Hovering over their lands, they were the lords of all they saw, and their followers built ziggurats as aerial vantages for divine supervision. Mesopotamian hymns capture the awe, and lack of privacy, early civilization felt before these symbols:

> It [the temple Eninnu] kept an eye on the country;
> no arrogant one could walk
> in its sight.
> awe of Eninnu
> covered all lands like a cloth.[8]
>
> Toward [the temple] Shugalam, dread place
> the place from where [the god] Ningursu
> keeps an eye on all lands . . .
> Thrust against heaven
> is its dread halo,
> and over all lands hovers
> great awe of my house[9]

The urban state has unfolded from the concept of the sky god, idealized as a tyrant who governs the earthly state through all-encompassing vision. Aerial perspective—conceived as a divine seat, but realized as the technology of surveying—was a key advance in the feasibility of state institutions.

Surveying realizes the perspective of the Inanna and her ilk, and architecture embodies their creative will, which depended on their ability to view land from an objective vantage. From its first appearance in land surveying, the organization of vision has driven the development of optics, and the drive to merge individual and collective perception continues. Architecture and media both derive from the objective gaze, and the modern spy satellite, surveying the masses below, is its virtual embodiment. In non-political terms, we could say that photography arose from a concern with method. What is the proper way to represent the environment? Whether manifest in Sumerian surveying, Renaissance painting or aerial surveillance, this question bears on the aesthetic, political and scientific concerns surrounding perceptual technologies. Though technical in nature, it is wrapped in the institutions of power—property and architecture—that caused it to emerge.

How do we define property as a practical concept? Sumerian religion provided the first transactive language, or code, for comprehending land in terms of legal ownership. Pre-urban societies assign landholdings according to organic need, and the size of plots are naturally limited by the ability of owners to manage an area. Sky gods owned the land beneath their gaze, and they conveyed ownership to select classes within society as a legal right. By underpinning the legal doctrine of ownership, the sky god constituted the state and simultaneously posed a perceptual problem to its adherents. Ownership demanded management, but Mesopotamian leaders could only comprehend small areas with their native faculties—an area big enough to feed themselves and their families. In order to govern larger areas, they needed to attain the perspective of the sky god. Land surveying solved their problem. By combining simple surveying techniques with advances in accounting, early managers could remotely manage their estates, an ability which greatly extended their capacity to rule. The priests of Mesopotamia used geometry to attain the vision of gods.

In contemporary terms, we might call this action at a distance telepresence or virtual experience. The key to understanding why these terms apply lies in our definition of reality. If “real” means a visually correct image of a distant place, then they are certainly inappropriate. But if “real” describes an accurate

representation, then a bureaucrat reviewing survey maps surely has experienced a distant place in a meaningful way. Mathematical knowledge lies at the basis of perceptual technology, and the data generated by technology is independent of a particular display. We admire photographs for their resemblance to vision, but both photography and vision operate by decomposing a visual scene into components. We can hardly say that photographs carried within television signals, or a computers, have lost their identity. They have simply changed mode, a process that occurs when our brains translate retinal images into neural impulses.

Geometry derived from conscious reflection on material practices. As a cognitive process, it is related to our ability to communicate and coordinate the self within society. Despite our singular feelings of value, self-awareness may have evolved as an outgrowth of language, perhaps simply to facilitate cooperation. But this does not mean consciousness is merely the capacity for symbolizing. Thought lacks direct instrumentality, arising as it does from the unique situation of the body in its environment. It is the awakening of symbol to itself, the realization of the capacity to communicate through structured discourse. Through its embodiment, its placement in a desiring body, consciousness projects thought onto its environment, understanding its surroundings through stories that reflect its awareness of self, situation and desire. Aside from sheer presence, which demands acknowledgment, the gap between situation and desire, between the real and the ideal, is the primary motive for conscious beings to communicate. We imagine a better situation, and then, with the aid of others, try to realize it. Individual desire calls society and its tools for communication into being.

Millennia of social development preceded the relatively quick formation of the first city-states in Mesopotamia. It is not a given that archaic Mesopotamians were evolving toward urban civilization. Instead it seems likely that they confronted conditions such as drought which forced them into progressively smaller regions. Necessity demanded they create efficient organizations of production and distribution, and bureaucracy emerged to handle the administrative load. Sky gods emerged to consolidate Mesopotamian society within state institutions, and, though our society is more sophisticated, we are still realizing the consequences of Sumerian ideology.

Ancient priests may have conceived social hierarchy, private property and land surveying as a religious exercise, but their practical intent was the

maintenance of cities. These institutions have persisted until today, gaining in variety and complexity, but never losing the ideal form of legal sovereignty and unchallenged will. To be effective, Sumerian religion absorbed the natural sovereignty of individuals, who gradually became subjects of the state and its dictates. By appropriating taxes and labor, the state constituted itself as a corporate regime defined by the active surveillance of territory. The image of the sky god gained force over time, and it eventually entered the divinely ordained king whose will embodied the political state.

Though symbolically concentrated in his body, the king could hardly manage every facet of daily administration. As a practical matter, the royal will and its divine legitimacy was dispersed among a hierarchy of officials. In many modern states, every individual bears some degree of legal sovereignty, though their liberty is constrained by law. In all states, property ownership is a key signifier of status, and it became the basis for the division of physical and cognitive labor. Property constituted the *res publica* by situating individuals within abstract mechanisms of hierarchy, land rights and surplus value. On this basis, the state and its institutions could organize themselves as virtual bodies, performing their duties in urban interiors according to rational divisions of labor. Surveying and bookkeeping documents mediated communication within states, sending information from the peripheries and directives from the center. As Herodotus notes, records migrated toward central locations, archives that contained virtual images of land. Maps, calendars and accounting tables became essential tools within complex civil societies, serving as percepts that greatly expanded the faculties of their users. Mediated by tablets, papyrus and pens, and transported throughout the nation, these representations became a sensory apparatus, one that supported the state through disciplined perceptions.

Early technologies like surveying clarify the essence of later practices like photography, mass media and digital imagery. For centuries the Mesopotamians did not distinguish the representation of land from other forms of information. Aside from its tools of measure, geometry was not treated as a special discipline, and cadastres contained only written measurements accompanied by descriptions of location. Later sketches displayed the same prosaic attitude, although it was no doubt difficult, if not impossible, to achieve visual effects on a clay tablet. But the first maps nonetheless transformed raw information into something resembling vision, and they inspired a transformation of the way we understand our visual environment.

The transformation accelerated when the sciences of Mesopotamia and Egypt passed into Greece. A critical attitude evolved within Greek science, perhaps because thinkers tried to reconcile alternative systems. By the sixth century BCE, Greek artists began to display a concern with realism, and we see the beginning of furious philosophic debates over proper representation. Investigations into visual truth began emanating from workshops and academies, and over centuries painters adapted the techniques of perspective, laying the foundation for optical science. Greek investigations into scientific representation culminated in Euclid's *Geometry* and *Optics*, which were completed in the third century BCE.

Among their many accomplishments, Euclid's mathematical studies reconcile the dualism that plagued Platonic philosophy. Plato denigrated perception because the shifting appearances of things contradicted what we know. In mathematical terms, geometry describes what we know, and optics describes how we see. By deriving optics from geometry, Euclid demonstrated the validity of visual information. Vision distorts geometric space—it distorts reality—but it does so systematically. As any surveyor knows, by accounting for the effects of perspective, we can glean accurate data about visual objects. The obvious solution to Plato's dilemma is to systematically relate optical "slices," individual perspectives, to a coordinated, geometric whole.

Thinkers from Claudius Ptolemy[10] to Rudolph Arnheim[11] have proposed something like Euclid's schema, and Stephen Kosslyn's work *Image and Brain* extends that work to the imagination. When we remember a visual image, the visual cortex hosts an event physiologically similar to actual perception. We may recall James Gibson's arguments against mental imagery, but Kosslyn presents convincing experimental evidence for pictorialism and the matter should be closed.[12] However, we can still query the human visual system, questioning why it evolved as it did. Could we have evolved a "sightless vision," the cybernetic vision Paul Virilio describes in *The Vision Machine*? We sometimes perceive without sensation, as when we automatically block a stray ball. There are alternative forms of visual perception that do not rely in internal representation, for instance, in computers that use neural nets for navigation. The human brain is often described as a neural net. Could consciousness have evolved differently? What role does preconscious processing play in our responses? How does vision relate to faculties like language?

Visualization became important when Paleolithic toolmakers began working together. Unlike most animals, humans have few inborn skills, so their survival depends on creativity and learning. Even when chipping rudimentary knives, early humans needed mental conceptions, and probably verbal descriptions, to guide their activities. Speech and imagination sufficed to organize society until the advent of city-states, when large projects demanded precise and durable forms of visualization. Thousands of workers often contributed to a project, and monumental works could not be built without coordinating (and subordinating) their judgment. Leaders needed objective standards to manage projects, and they invented the disciplines of measurement and quantitative analysis. Perceptual technologies coordinated the social body, allowing large groups to behave as one. While planning scribes would gather physical data such as size, weight and volume. They would then devise schedules by analyzing productivity, available labor and other factors. Deployed within a social body, geometric representation formed a matrix of objective perception, and the mechanical accuracy of surveyors enabled the functioning of social technics, the megamachine described by Mumford.

> *And what of our human art? Must we not say in building it produces an actual house, and in painting a house of a different sort, as it were a man-made dream for waking eyes?*
>
> Plato, "The Sophist"

I have described perceptual technologies as activities that coordinate an autonomous social body. But, from the individual standpoint, the products of surveying and related technologies create far more than external pictures. They constitute institutions, and they structure society by defining relations of property, administration and commerce. Unlike natural vision, which views the environment as a continuum, perceptual technologies couple attention to social boundaries consisting of laws, architecture, contracts, receipts and deadlines. By organizing perception into an objective whole, they create a secondary environment based on institutional rather than individual imperatives. Property lines, buildings, calendars—none of these are pregiven in experience. They are human creations that reenact nature.

Subjectivity and objectivity take on new meanings in this context. Like geometry and optics, they refer to strategies of political organization, not

scientific truths. Taking the state as an analytic condition, we might speculate on the next stage of perceptual technology. Surveying produced perspective, which in turn led to photography and television. Engineers are already producing immersive digital environments, some of which may do away with cameras and material displays. Direct neural couplings will be widely available in the foreseeable future. Scientists have already bypassed eyes and ears, and advanced haptic interfaces could simulate the balance of senses. There is no reason to feed real-world camera images into a neural coupling—digital environments would work just as well. Artists and engineers have already started designing imaginary spaces, giving us a taste of possible future environments. (See Figure 7) In a stable virtual world, neurally induced experiences could collapse the opposition between subject and object, along with distinctions among vision, photography and architecture. As our senses adapted to the new environment, culture might evade nature altogether, referring only to itself. What sort of societies might evolve in such a space?

Figure 7: *A Virtual Space*
Designed by the NOX studio in Rotterdam, this virtual space is accessed through head mounted goggles. Within a few years, the environment may be accessed through direct neural coupling between the brain and the computer which generates it. (Zellner, 1999)

Strict control of virtual worlds could create a kind of planetary dungeon. Economics would dictate the rhythm of daily life, which would be governed by a central body according to laws of consumption and production. Freedom could be severely curtailed in this environment, which might resemble a digital version of Jeremy Bentham's panopticon. Proposed in the eighteenth century, the panopticon was designed as an ideal prison which concealed nothing from the guards. Misbehavior was unlikely in such a place. More advanced technologies are beginning to impose a similar effect on

society at large. Surveillance cameras blanket most cities, and authorities are using computer networks to increase their effectiveness. Complemented by satellite-based surveillance, an immersive cyberspace could completely assimilate individual faculties to objective data. Privacy would be impossible since every perception would be controlled, even witnessed. Videotapes in arcade games capture the completeness of digital surveillance. People can either join the game, or they can observe it from the perspective of one or more players.

On the other hand, these same technologies could celebrate an extreme form of individuality. A wave of progress in genetics and engineering could take humanity well beyond its current state, and, driven by the urge for self-fulfillment, an elite, or perhaps an entire society, might decide to fuse with machines and retreat into cyberspace. Here they would develop a poetics of technology, crafting experience with unlimited mental resources.[13] Freed from productive labor, these cyborgs might reject the objective order altogether. Imagination would become the organizing principle of experience. (See Figure 8) It may be difficult to sustain a collective under such conditions, particularly if companionship could be provided by one's own creations. Unchecked individualism could break down society, creating a future bizarrely reminiscent of myth. Living in a programmed environment, bodies and the world could assume any shape, support any whimsy. Computers would then plunge individuals into a kind of idiocy—immersed in technology they would be playmates who met only for companionship. Or who never met at all. Confined to their individual worlds, each person would exist as a mechanical god, an idiot king presiding over a terrain of information.

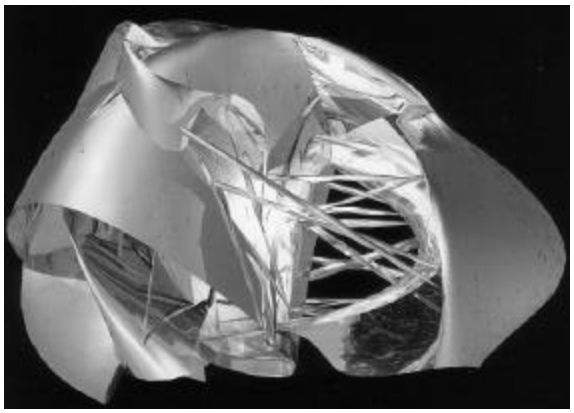

Figure 8: *Architecture of the Future*
Marcos Novak designs virtual environments according to poetics rather than gravity. Unencumbered by mass and utility, they function as fantastic playgrounds for the mind. (Zellner, 1999)

The scenarios outlined above describe the polar tendencies toward freedom and tyranny inherent within perceptual technologies, the machines we use for observation and communication. As a concept, the sky god displays both tendencies, and, when applied within society as an ideology, it creates the primal existential dilemma. What is the role of the individual within society? The previous scenarios represent extreme possibilities in the development of media, and we can hope that society evolves within their balance. It is hard to predict what scenario may come to pass. Biotechnology is advancing more quickly than we would have imagined even ten years ago, and engineers are busy devising new ways to reconstruct our senses. Already we largely dwell within a virtual reality, an artificial world enclosed by architecture, media and telecommunication. But we may never build a completely cybernetic world, preferring to simply augment natural perception with layers of information.

The sky god can model transcendent freedom, or it can subsume the individual to a corporate will. We see within it the modern individual who uses machines to control destiny. In the beginning this power was wielded only by kings, but, since the beginning of urbanization, more and more individuals have gained the power to structure their world. Personal liberty has never been greater except perhaps in certain tribal cultures. At the same time, the ability of central authorities to control expression, movement and now biology has advanced immeasurably, and we always stand on the brink of totalitarianism. Whether concrete or digital, our cities embody the creative

gaze and the architectural will of the sky gods. Though our kings have lost divine right, we have launched the sky god into orbit, just as the Sumerians conceived. The constant presence of surveillance cameras, whether hanging from buildings or satellites, should remind us of the potency of such vision, and how it might alter our environment. However it evolves, virtual reality will bear the imprint, and the dangers, of the ideal state and the vision of the gods.

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ACKNOWLEDGEMENTS
I would like to thank Douglas Kellner of UCLA, Robert Solomon of University of Texas at Austin and Steve Best of the University of Texas at El Paso for their comments and encouragement.

Notes

[1] Sabra, A. I. (1989) *Ibn al-Haytham's Optics*. London: The Warburg Institute.

[2] This important episode on the history of optics has often been misconstrued by modern commentators, for example, in *Techniques of the Observer* (Crary, 1990: 27, 35, 38). In support of his statements, Crary cites David Lindberg. Crary seems to have missed the conclusion of Lindberg's argument. At one point, Lindberg states that Kepler was familiar with the argument that an earlier attempt to construe the eye as a camera obscura. But on the next page, the comparison capitulates to a powerful counter-argument (Lindberg 1976: 182-206). Other inaccuracies in Crary's work include the surprising assertion that Euclid and Aristotle were familiar with the pinhole effect (Crary, 1990: 27).

[3] Wald, George (1953) 'Eye and Camera' in *Scientific American Reader*. NY: Simon & Schuster: pp. 555-68.

[4] Research in this area has made great strides. Scientists at both the University of North Carolina and MIT have developed retinal implants that carry impulses from a camera directly to the optic nerve, temporarily giving limited vision to blind people. Reports are available in the websites of their respective universities.

[5] Bazin, Andre (1967) "Ontology of the Photograph" in Trachtenberg, Alan, (ed.) *Classic Essays on Photography*. New Haven, CN: Lee's Island Books: pp. 237-245.

[6] Stephens, Ferris. J. (1953) "A Surveyor's Map of a Field." *Journal of Cuneiform Studies* 7 (1) 1953 and Nissen, Hans (1993), Robert K. Englund and Peter Damerow. *Archaic Bookkeeping*. Chicago: University of Chicago Press.

[7] Antenucci, John (1991) with Kay Brown, Peter Croswell and Michael Kevany. *Geographic Information Systems: An Introduction to the Technology*. New York: Van Nostrand Rheinhold.

[8] Jakobsen, Thorkild (1987) *The Harp that Once . . .* New Haven, CT: Yale University Press, p 422.

[9] Ibid., pp. 398-400.

[10] Ptolemy, Claudius. *The Geography*. New York: Dover Publications, 1991.

[11] Arnheim, Rudolph (1969) *Visual Thinking*. Berkely, CA: 1969.

[12] UCLA neurosurgeon Itzhak Fried and a team of researchers reported in *Nature* that the mind's eye—the imagination or mental view—generates mental pictures by using the same neurons that were activated when it saw the object or image. "Our study reveals that the same brain cells that fire when a person looks at a picture of the Mona Lisa are, in fact, the same neurons that excite when that person is asked to imagine the Mona Lisa." (Fried, 2000)

[13] Zellner, Peter (1999) *Hybrid Space: New Forms on Digital Architecture*. New York.