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ABSTRACT

Treating the camera as an information technology, this essay shows how the camera is a powerful theoretical disquisition on the nature of form, realism, and scientific vision. The first section presents a history of form, separate from matter, as something collectible in a library or museum. The second section discusses the photograph as a rival to painting and as the culmination of the western theory of painting which was influenced by mimesis and the "camera obscura." The third section presents the influence of photographic form on the Platonic concept of the noumenal form. The final section argues that in the early days of the modern statistical mind, visual-photographic processes were essentially statistical and that the statistical process, as a mental process, was essentially visual and photographic. (SRT)

SAMPLING FROM THE MUSEUM OF FORMS:

PHOTOGRAPHY AND VISUAL THINKING IN THE RISE OF MODERN STATISTICS

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In 1857, Oliver Wendell Holmes, father of the famous jurist, lifted a stereoscope to his eyes for the first time. After the initial strain, as the lenses forced his eyes to accommodate the different images only inches away, Holmes experienced two "visions." One emerged as the neurons were tricked into fusing two disparate scenes into one. The other was the brilliant flash of historical insight. Holmes verbalized it in a kind of Brechtian soliloquy. This he whispered into the darkness at the front of the stage to an audience far removed in place and time.

> Form is henceforth divorced from matter. In fact, matter as a visible object is of no great use any longer, except as the mould on which form is shaped. Give us a few negatives of a thing worth seeing, taken from different points of view, and that is all we want of it... There is only one Coliseum or Pantheon; but how many millions of potential negatives have they shed, - representatives of billions of pictures, - since they were erected! Matter must always be fixed and dear; form is cheap and transportable. We have got the fruit of creation now, and need not trouble ourselves with the core. Every conceivable object of Nature and Art will soon scale off its surface for us. Men will hunt all curious, beautiful, grand objects, as they hunt the cattle of South America, for their skins, and leave the carcasses of little worth. [emphasis in the original] (Holmes, 1859, p. 251f).

Holmes was examining these "carcasses" with a precision and dispassion worthy of a dean of Harvard medical school and reknowned physiologist. Holmes, like his namesake in fiction, was peering out at the world through the analytical lens of nineteenth century science. This eye of glass guided the razor edge of the scapel. Forms distant and removed in both space and time, forms both microscopic and macroscopic would now be dissected, dessicated, and described. These "skins," etched on metal plates and negatives, would be preserved and hung to dry. The new wind blowing would not carry the stench of the "thing-in-itself," but the sterile antiseptic smell of iodine, an odor common to both nineteenth century hospital and the photo developer.

Form had long been a subject of inquiry in the visual arts. Questions of "true form," "natural form," and the relation of "form and content" filled much philosophical disquisition. To questions of form and its essential locus in object, noumena, or mind have been proffered many answers, all of them bound by their history and caught within the structures of linquistic reason.

But technology asserts its own instrumental reason (Gouldner, 1976), theory manifest in creaking or humming symbol manipulators of wood, steel, or silicon. Technology is part of an instrumental reason imbedded in the texture, guided soma, and endless surface of the built environment.

As I will attempt to show in this article, the camera was a powerful theoretical disquisition on the nature of form, realism, and scientific vision. Information technologies like the camera operate at a number of levels. At the economic and sociological level, they alter the physical flow of information. This is the stuff of most histories of the mass media. Here, I will address this level in the real and abstract proposals for a "Museum of Forms."

But there are two other levels that are potentially more significant: the perceptual and the conceptual. In the first place the arrival of a medium can modify the cognitive structures which guide perception. In the beginning as the pattern of diffusion spreads the technology, perceptual and conceptual change may be visible in the social strata that first come in contact with the medium and most sensitive to peturbations in the flow of perceptual information (see Biocca, 1985, on the effect of early radio on aural perception in composers). Perception is not, as was once thought, a fixed, passive, and largely immutable process, but is in fact a profoundly cognitive phenomena drawing on highly developed visual processing routines and developed structures of knowledge representation (Arnheim, 1969; Fodor & Pylyshyn, Z.W., 1981;Gregory, 1970, 1981;Gombrich, 1969, 1982). The phylogenetic "hardware" of the senses is overlayed with an elaborate ontogenetic cognitive "software." A new information technology can redefine aspects of the cognitive structures for information by 1) increasing the range of perceptual phenomena, 2) altering the relative salience of perceptual phenomena, 3) shifting the ratio of perceptual demands made on the various senses, and 4) reorganizing the semiotic, structural, and semantic links among somaticaly sensitive conceptualizations.

It is in the latter case that we ascend to the level of the impact of a medium on systems of thought. Here, we are looking at the intellectual and cultural history of a medium (Goody, 1977; Eisenstein, 1979; Czitrom, 1982; Ong, 1982). When a technology invades the conceptual level it can provide working models and grand analogies for systems of thought. There are a number of examples in the history of thought such as Decartes mechanical universe modelled after the functioning of the watch. Today, the computer is a protean and ubiquitous analogy for many concepts, but most importantly, for our purposes, as an analogy for perceptual and cognitive processes (Cohen and Freigenbaum, 1982; Frisby, 1979).

As we will see, it is through conceptualizations of visual thinking by the pioneer in experimental exploration of mental imagery and a key founder of modern statistics, Sir Francis Galton, that photography becomes a grand analogy for mental processes and, furthermore, nothing less than a physical working model for statistical processes. The camera, the scientific eye, mental imagery, and inferential statistics would be welded together in a profound and solitary vision at the birth of modern statistics. This moment in intellectual history would only be possible because of the rise of a sampling theory of reality, the photographic subjugation of visual form, and the construction of the imaginal "museum of forms."

THE CALL FOR A MUSEUM OF FORMS

Form was now collectible. For the 19th century, just as it had been for the 17th century (Foucault, 1970), "collectibles" needed to be arranged into some physical manifestation of the classificatory logic, a taxinomia. Oliver Wendell Holmes, Sr., master anatomist, was by no means a stranger to the spirit of classification. Forms would be grouped into a massive library, dwarfing the similar project envisioned by Malraux (1967) in the twentieth century.

> The consequence of [photography] will soon be such an enormous collection of forms that they will have to be classified and arranged in vast libraries... The time will come when a man who wishes to see any object, natural or artificial, will go to the Imperial, National, or City Stereographic Library and call for its skin or form... We do now distinctly propose the creation of a comprehensive and systematic stereographic library, where all men can find the special forms they particularly desire to see as artists, or as scholars, or as mechanics, or in any other capacity...This is a mere hint of what is coming before long.(Holmes, 1859, p. 253)

For Oliver Wendell Holmes the collected forms were "skins" of objects to be displayed in the trophy room of the eye. Photography would give rise to a massive "museum of forms," collecting "essential samples" of form across cultures and across time.

But Holmes' museum of forms threatened to bury the regime of the visual with an endless superfluity of the unique. The philosopher of the photographic image, Susan Sontag, provides a pithy description of this process.

> Through photographs, the world becomes a series of unrelated, free-standing particles; a history, past and present, a set of anecdotes and faits divers. The camera makes reality atomic, manageable, and opaque. It is a view of the world which denies interconnectedness, continuity, but which confers on each moment the character of a mystery.(Sontag, 1977, p. 70*)

But Sontag fails to see that it is not the camera itself that makes these images of "reality" manageable. Paralysis came from the mesmerized eye, an eye of perfect focus but of fixed vision, a vision that does not wander but stares absorbed in the profusion of detail.

How was the community of subjects to deal with the profusion of pictorial information flooding 19th century consciousness? One way to subdue a world of pictorial detail and cultural artifact was the museum and library. There under the guidance of language, items were classified, collected, and housed. The tradition of pictorial art suggested this solution, but already in Holmes' museum of forms, there was the indication that it could not be a traditional museum. Each picture seemed like a window to a reality outside the walls of the institution. Photography resisted petrification; a kind of synthesis was necessary.

Tradition suggested other means of organizing the image.

Language and numbers were portable information; they had been organized and collected in a different way. Language had been pressed into the book, numbers scrunched into the statistical tal In the early decades of photog-aphy, a profusion of books, most travel and art, were published in honor of the new medium.

But the classificatory spirit demanded more organization than Holmes' museum of forms. How could the supervising eye collect and synthesize the "samples of realitv" contaired in the photograph? How could one turn the photograph into the portable information found in the word, the number, and the statistical table? This was a profoundly semiotic question. The mass of iconic information potentially amassed by the new communication medium needed to be systematized so that its rich store of data could be as relatively fluid and manipulable as our other primary means of communication. This fundamental problem has reemerged with the rise of the computer and the feverish pursuit of a sophisticated system of artificial intelligence. With standard graphic programs, the interface between the optical disk and the computer, and three dimensional modelling, the image once again needs to be integrated with the other symbol systems, just as it integrated in the mind itself both in primary perception (Marr, 1981) and the imaginal "medium" of the mind (Paivio, 1971; Kosslyn, 1980, 1983). There is the question of how the binary calculus of the computer can harnass not just the image as a reproduction but the image as information, connotation, and icon.

At the birth of modern inferential statistics, the word, the number, and the image would be housed just briefly in one system. The camera shutter had opened upon a perception of forms that threatened to subdivide into a series of endless categories of seamless information. It is language, verbal and mathematical language, that would attempt to arrest the multiplication.

THE RISE OF THE VISUAL SAMPLE:
TRANSFORMING THE GLANCE INTO THE GAZE:

The photograph was presented as an almost self-generated "sample" of the physical continuum. This to some degree had started with painting. According to Norman Bryson (1983) and some perceptual theories of painting, one of the goals of the visual arts was the transformation of the "glance" into the "gaze." If the moment could be stopped then the desirous eye could loose itself in this endlessly repeated moment. The observant French critic of the arts, Charles Baudelaire, had remarked with elitist disdain how the posessive eye (I?) consumed the image. Mesmerized subjects stared through "a thousand hungry eyes...bending over the peep-holes of the stereoscope, as though they were attic-windows of the infinite" (Baudelaire, 1859/1955, p. 230).

At its very moment of birth, photography began to compete with painting for the eye of the desirous subject. Photography was greeted in circles both within and outside of art, with premature declarations of the death of illustration and of painting. In 1842 a poem, a tongue-in-cheek paean to the new medium, chanted over the heads of the crowds marching in front of the lens:

Yet nothing can keep the crowd below,
And still they mount up, stair by stair;
And every morn, by the hurry and hum,...
You fancy the "last day of drawing" has come.
(Cruikshank, 1842, facsimile reprint in Newhall, 1956, p. 59).

These predictions were amended quickly under the attack of enraged artists like Baudelaire.

> The idolatrous mob demanded an ideal worthy of itself and appropriate to its nature ...I believe in Nature, and I believe only in Nature...I believe that Art is, and cannot be other than, the exact reproduction of Nature (a timid and dissident sect would wish to exclude the more repellent objects of nature, such as skeletons or chamber-pots). Thus an industry that should give us a result identical to Nature would be the absolute of art.' A revengeful God has given ear to the prayers of the multitude. Daguerre was his Messiah. (Baudelaire [1859] 1955, p. 230)

Instead of the death of painting, an amended host of "minor deaths" of realism, naturalism, portrait painting, woodcuts, engraving, etc., were proclaimed.

The "new" alien technology, the "industry" of vision, could be embraced so readily because it was not really new. The photograph was the culmination of the very theoretical goal of the western tradition (especially the less textual Dutch tradition, see Alpers, 1983), the reproduction of Alberti's window (1435/1972). Alberti, elaborating a theory of painting deeply influenced by the camera obscura, believed that at the moment the viewer's eye was positioned were the rays of light collected on the retina as in the original scene, the painting would dissolve into a "window" on the founding reality. The mediated perception would recreate the founding perception. Gombrich (1960) has illustrated the tendency to think through the schema of technique, the most powerful of which was the schema of technique embodied in technology. The Essential Sample of light had been the goal; the desire was to fix the image within the camera obscura and paint the back of the retina.

The desire to petrify the ephemeral arrays of light which compose the glance had been an obsession of artists for centuries. For some, the image of the camera obscura represented the ideal and found expression as Alberti's window. In 1760, almost one hundred years before the invention of photography, a French utopian writer, Tiphaigne de la Roche, fantasized some future subjugation of the image:

> You know that the rays of light which reflect off bodies are like an image which paints these bodies on polished surfaces, the retina of the eye, and for example, on water, and on mirrors. The elemental spirits have sought to fix these passing images. They have composed a material which is quite subtle, quite viscous which dries and hardens quickly, so that a painting is created in the blink of an eye. They utilize in this method a piece of canvas and present it to the objects they wish to paint. The first effect of this canvas is that of a mirror: one sees all nearby objects (corps) and those far away which the light transports.
>
> But what a mirror cannot do, this canvas, by means of its viscous medium retains these spontaneous images (les simulacres). The mirror renders the objects faithfully, but retains none. Our canvases do not render them any less faithfully , but retain all of them. The impression of the images is done at the instant the canvas receives them. One removes the canvas from the easel and sets it in an obscure place; one hour later the medium is dry, and you have a painting that is more precious, and more true that no art can imitate, and which time can in no way damage. 1
> (author's translation of Fournier, 1859, p. 18-20)

In 1760 De la Roche may not have had the means to fabricate an image so clear. But it is also clear that the camera obscura may have fabricated the retinal object of perfection so desired by De la Roche. The Essential Sample, the ideal determined by the technology of the camera obscura and the mirror, was the schema for perfection internalized by those who used the technology. The painting sought by De La Roche was fashioned by the warmth of light itself, and its image haunted his vision like a succubus:

> We take from their most pure source, the body of light, the colors which the painters obtain from the different materials and which time never fails to alter. The precision of line, the variety of expression, the touches more or less strong, the gradation of nuance, the rules of perspective, we abandon all of these to nature who, with its sure steps which never lie, and which trace on our canvases images which are imposing to the eye and make one doubt one's reason, so much so that that which we

call reality may be nothing more than phantoms which press upon our vision, hearing, touch, and all of our senses at once. (author's translation of Fournier, 1859, p. 20f)2

Once photography had come close to actualizing the fantasies of De la Roche, it rocked the very concept of the Essential Sample. Behind the retina, the new arrays of light were illuminating different regions and transforming the mental structures which guided vision.

Illustrative is the audible gasp which followed the publication and diffusion of Muybridge's study (1887) of human and animal movement. According to Scientific American:

> The most careless observer of these figures will not fail to notice that the conventional figure of a trotting horse in motion does not appear in any of them, or anything like it. Before these pictures were taken no artist would have drawn a horse as a horse truly is when in motion, even if it had been possible for the unaided eye to detect his real attitude. At first sight an artist will say of many of the positions that there is absolutely no "motion" at all in them; yet after a little while the conventional idea gives way to Truth ... [emphasis added] (Jussim, 1971, p. 230)

Even more revealing is Century magazine's startled reaction:

> The consecutive positions of the legs in the stride of a running horse, as revealed by these photographs, seemed ludicrous and almost impossible. Indeed, it required the combination of the positions given by the reproduction of the pace in the zoetrope to convince the skeptical that the analysis of the movement was correct... We are accustomed to seeing certain things in a certain way. When an attempt is made to represent them in another way our conventional natures revolt at the innovation. [emphasis added] (Jussim, 1971, p. 225)

Here was another level at which the glance had been stopped, and transformed into the paralytic fixation of the gaze. The number of forms for Holmes' museum of forms was steadily expanding. But this museum of forms was not yet housed in any location. Its present location was inside the mind of the observer of form. This expansion of forms required a recataloguing of the general Gestalt for form perception. The camera was joining the telescope and the microscope in expanding the range of forms. This expansion marks one phase in a two phase expansion of Holmes' museum. Later a kind of fusion was required. But first an optically transformed vision would suffer confusion under the expansion of detail.

The explosion of information which the new image represented was expressed in babbling amazement at the "detail" of the image; the discovery that issued forth from the prolonged staring within the confines of the petrified glance. Samuel F. B. Morse exclaimed at its fidelity:

> The exquisite minuteness of the delineation cannot be conceived. No painting or engraving ever approached it...In a view up the street, the distant sign could be perceived, and the eye could just discern that there were letters upon it... By the assistance of a powerful lens which magnified fifty times..every letter was clearly and distinctly legible, and so also were the minutest breaks in the lines in the wall of the buildings; and the pavements of the streets.(Jussim, 1971,p. 48)

The photograph stretched the levels of repleteness of the image, to use a term associated with the work of Nelson Goodman (1977, 1978). As in Antonioni's movie <u>Blow Up</u>, the viewer discovers more and more in the image as detail upon significant detail is blown up into the realm of the perceivable. This stretched the very topography of meaning. Photography expands by <u>ratio difficilis</u> (Eco, 1976) the continuum of material ready for semiosis. It quotes, and it quotes profusely, and through the mere act of quoting transforms the glance into the gaze. The very act of quoting a detail suggests its significance. Holmes, Morse, and others sat mesmerized in front of the photograph and the stereoscope. Eyes devoured the details, elevating them to a new level of significance. Holmes was in rapture: "theoretically, a perfect photograph is absolutely inexhaustible." (Holmes, 1859, p. 247) By its practice the camera suggested at a theoretical level that the very act of seeing was semiotic.

It is here then that Holmes' museum of forms begins to expand rapidly. By the end of the nineteenth century, its images are housed in the art book, the travel book, and the magazine. The magazines Life and Look exemplify the portrayal of the world of experience as visual feast. When in 1936, Life squeezed the image between its pages, a newborn phase of the museum of forms tumbled out before the now insatiable eye. Life itself would be drained of its pigments and slapped between glossy advertisements. The first cry of Life was really the triumphant shout of the regime of the camera.

> To see life; to see the world; to eyewitness great events; to watch the faces of the poor and the gestures of the proud; to see strange things - machines, armies, multitudes, shadows in the jungle and on the moon; to see man's work - his paintings, towers and discoveries; to see things hidden behind walls and within rooms, things dangerous to come to; the women that men love and many children; to see and take pleasure in seeing; to see and be amazed; to see and be instructed. (Life, 1936)

The name LIFE continued the promise of representation of naturalism and realism, not a noumenal truth but a sensuous one. Through the inexpensive dissemination of the printed image, the arrested glance of the photography becomes elevated into global voyeurism. By the mid 20th century Sartre (1966) could portray the existential experience of the subject as peeping through the keyhole.

In its title LOOK magazine captured the rushing expansion of the museum of images. This was more than an expression of the colonial spirit for exotica. This museum was not to be like the British Museum or the Smithsonian, a national aggrandizement of the curio cabinet. The museum of forms would become embodied in the mass media. The objects were not unique. They had no special place. They were not even moments in art. They were simply moments, and little else. But most of all, they were public moments.

The publicly displayed photograph with its beckoning familiarity tinged with a subtle and novel strangeness grabs us by the sleeve and exhorts us to LOOK, to find what is significant, to construct meaning. It demands labor of the eye. It shouts like a barker at a carnival, and presents all surfaces and wares, and all the strange "skins" it has collected. The eye searches the details for the meaning of this quotation. The eye seeks out connotations in the first milliseconds of sight (McCauley et al., 1980; Marcel, 1983); it seeks to fill with metaphor. The moment within the glance expands, until for certain images it becomes bloated with meaning.

But the regime had been upset by the early discovery that the glass eye of the camera was blind. By reflecting everything it saw nothing. What it needed from the natural eye was a greater process of selection. After all, this is the function of the fovea; a global analysis of the scene leading to a careful scanning. A fovea, so dense with connections that it commands more attention from the brain than any other sense organ, needs to scan, select, and focus on the significant. The rest of the image, the countless details, are attended in the anterior room of peripheral vision waiting to be called into the central court of consciousness.

The museum of the Essential Sample with its glass eye facing a world of surfaces needed more than the linguistic librarian in the agency of word and category - it needed an editor. But for the camera everything was in focus, and herein lay a violation of truth. The mind's eye was bombarded with detail, detail which it had never before seen and which now thrust itself into focus. In the museum of forms the images would have to be summed into larger units, composites.

THE CAMERA AND THE SCIENTIFIC EYE:
A SAMPLING THEORY OF REALITY

Holmes' museum of the photographic form reflects an interesting alteration of the classic Platonic concept of the noumenal form. Plato sought a transcendent noumenal form through abstraction and reflection. The inhabitants in the famous metaphor of the cave arrived at the noumenal source by breaking the spell of the shadows. In the 19th century the camera only enjoins the observer to gaze further at shadow after shadow. The Platonic notion of form was no longer noumenal but sensate.

The camera was an agent in the molding of a sampling theory of scientific reality which was battering the tower of the Cartesian and Platonic tradition from which intellectuals like Baudelaire hurled boulders. Below at the gates lay the new technology and for Baudelaire, "its natural ally," "the stupidity of the multitude."

As early as 1839, Talbot, the English inventor of photography, had predicted that the camera would guide the eye of science. For Talbot the camera was to embody the inductive method:

> This remarkable phenomena, of whatever value it may turn out in its application to the arts, will at least be accepted as a new proof of the value of inductive methods of modern science, which by noticing the occurence of unusual circumstances... and by following them up with experiments, and varying the conditions

> of these until the true law of nature which they express is apprehended, conducts us at length to consequences altogether unexpected, remote from usual experience, and contrary to almost universal belief. (Talbot, 1839, p. 4)

In "dustbowl empiricism" induction required the patient and tedious gathering of "objective observations." The photograph would be used to collect forms, as in Holmes' museum of forms, but now the forms would be called "data." The photograph has become an extension of the scientific eye extensively used in archaeology, geology, physics, botany, chemistry, and biology, to name just a few areas of use while not including modes of use. The camera was considered useful to "count, measure, and record infallibly all stationary evidence" (Wagner, 1979).

A modern example of this in practice is a study conducted by the British government in 1972 of a number of communities. The camera was the instrument of analysis. Cameras were set up according to a "grid of coordinates" of randomly chosen public points in the community. Each camera was not run by human hands but took sample pictures of the life-space, randomly. When a human photographer was used s/he was followed by another, and then by even more photographers over the course of two years. This practical installment of a panoptic analysis of the life-space of these small English communities was designed to "effectively identify and reduce the amount of sampling error, increase intersubjective reliability of interpretation, and in some cases provide an important test of the validity of visual statements about human subjects." (Wagner, 1979, p. 148)

While the scientific eye may have been imbued with the spirit of classification, it was also a narcissistic eye. When the camera merged its vision with the microscope, the very first picture taken was of the eye of a fly. What better image of its narcissism than for the camera to gaze at a reflection of itself: an eye that was composed of millions of details, an eye in which each cell contained one of a thousand similar images. The scopic order of the Panopticon (Foucault, 1979; Dreyfus & Rabinow, 1983) could be reduced to a portable speck and reflected in the structure of nature.

The fly speck innocence of a microscopic Panopticon is dwarfed when the sampling theory of the photo-panoptic eye gazes upon the corpus of sociology. A social world filtered and constructed through a lens can be "managed" and "guided." Here the narcissism of the scopic regime interacts with the expanding detail of the medium. The search for self discovery gazes into a mirror divided into a multitude of small rectangular frames reflecting bits of light in all directions. The narcissistic gaze becomes lost in a profusion of points of view. This is the camera in the hands of the sociologist.

A modern sociologist writes about a regime in which the human subject is now a series of frames and a camera lens.

> In "capturing the world" we can test our ideas about each other against the photographs and the realities they represent. In "creating visual statements" we manifest our understanding of the interesting and important. Through the photographs, we increase our knowledge of each other while at the same time raise questions about how well we understand our own lives. Through both <u>taking</u> photographs and <u>making</u> photographs, we casually participate in scientific inquiry. (Wagner, 1979, p. 12)

In our culture, thought itself is visual; one has a "perspective," a "point of view," or a "worldview." Herein lies the essence of the sampling theory of the photo-scientific eye. Vision, mediated vision, becomes scientific inquiry. One reaches an understanding of reality through mediated and specialized vision. The subject embodies specialized vision. One understands the shadows on Plato's cave not by turning towards the sun, the source of the forms, but by photographing all the shadows on the distorted cave wall. Understanding lies in the collection of those images.

FROM SAMPLE TO STATISTICAL COMPOSITE: RECONSTRUCTING THE ESSENCE OF THE ESSENTIAL SAMPLE

For all the photograph's striking mimesis, it was just a solitary sample of the visual reality. The true Essential Sample could not be realized in the regime of cyclopean vision. An emerging sense of reality integrated with 19th century empiricism sought the Essential Sample in the sum of sensory samples. The arrested glance had only been an embalming of the moment.

For the scientific eye peering through the telescope, the thought that "reality" might be a collection of light samples was already the obvious operant definition. A series of articles published in 1877 in Nature by Sir Joseph Norman Lockyer makes the point. Lockyer was to be the first astronomer to break samples of light into its spectroscopic elements so as to measure the stars. He described how astronomers were busily gathering "120,000 times more light."

Like the camera, the telescope was "simply...a sort of large eye" which needed and more samples of light for a "complete" portrait of its anc sitter. The stronger telescope sought by Lockyer merely offer ages from deeper into the past. He wrote "when we gaze at the heavens at night we are viewing the stars not as they are at the moment..." (Lockyer, 1877, p. 68). This to some degree was also the function of the camera. Though it could not go deeper into the past, it collected samples of light from the past, moments of flutter in Alberti's window. But the thing-in-itself continued to elude the analytical eye; with more and more samples of light each detail of vision could be added into something more essential. Reality could be reached through patient, tireless viewing, drawing samples of the object from as many perspectives as possible. The Essential Sample would need to be triangulated and clocked.

If, as Talbot had prophesized at the very birth of photography, the camera was the embodiment of the inductive method, then the truth of the image lay in moving from particulars to more general principles. The sampling frame would need to be assembled from parts in Holmes' Museum of Forms, compared and merged into higher truths. One could force the merger by imposing the foreign regime of linguistic order with its preexisting categories for form and content. But if one were to remain true to the language of the image, then one could achieve general truths through the infinite comparison, composite construction, or merger of the images themselves.

The man to do this was Sir Francis Galton, cousin of Charles Darwin, paragon of 19th century science and the inductive method. Sir Francis and his faithful student Karl Pearson (of the Pearson product coefficient) can be said to be founders of modern statistics (Pearson, 1897, 1900, 1920, 1930, 1966, 1978). Their journal, Biometrika, developed many of the statistical techniques which guide the manipulations of the social sciences, and especially psychology (Porter, 1981; Westergaard, 1932; Pearson, 1938).

Galton, brilliant even when wrong, was the spirit of 19th century quantification incarnate. With his friend, the astronomer Lockyer, he had gazed through the telescope of science, and searched to create Panoptic order from the chaos of random light rays. For him, everything could and should be quantified, from the flow of thoughts in his consciousness (Galton, 1878) to the ratio of pretty to unattractive women in London, Aberdeen, and Glasgow (Galton, 1908).

But in Galton, the "founder of eugenics," we also see the dark underside of 19th century science. He sought to analyze and classify the physiological and psychological traits of man and by so doing apply this knowledge of hereditary characteristics to the perfection of the species. His camera peered out through the slits in the central tower of the Panopticon. Along with other visual instruments of science, the telescope and the microscope, it would allow Galton to place mankind under glass. For thirty years, Galton labored in the tower with his "statistical camera," searching for the ultimate classification scheme and the ultimate Essential Sample.

In 1878 during a discussion with social-Darwinist Herbert Spencer, Galton was struck with the idea of somehow superimposing "longititudinal, transverse, and horizontal sections of heads" in a search for an ideal type, a new Essential Sample of classes of beings and objects. The first group to receive his attention in this way, were those who were already marginalized and classified in the real life structures of Bentham's Panopticon, prisoners of the justice system.

His first approach had been to slice pictures of heads into quadrants, fitting neat groups of them together into new arrangements all the while searching for some ideal type. The more successful method was to create a new composite photograph made by superimposing the exactly fitted images of more than one element of a class of persons (see Figure 1). Galton reported on his success in April of 1878 to the "distinquished gathering" of the Anthropological Institute:

> I submit several composites...The first set of portraits are those of criminals convicted of murder, manslaughter, or robbery accompanied with violence. It will be observed that the features of the composites are much better looking than those of the components. The special villianous irregularities of the latter have disappeared and the common humanity that underlies them has prevailed. They represent not the criminal, but the man who is liable to fall to crime. (Galton, 1878, p. 98)

Criminals were to be but the beginning of a scheme of visual dissection and classification that would feature the camera in the unusual role of statistician. In Galton's vision, the statistical mind would gather the photographs classified in Holmes' museum/library of forms. Here, through "scientific manipulation," each pictorial data point could be merged into something higher and more essential, the "average" image. The camera would yield what the French statistician, Quetelot (1839), had sought from his statistical computations, a physical approximation of Quetelot's "mean man." When the composite computing machine was put into action it produced not just Quetelot's "mean man," but Essential Samples, and pictorial averages of not only the "ideal criminal" but the mean family member (Galton, 1879), "military officer"(Mahomed & Galton, 1882),"tubercular patient" (Mahomed & Galton, 1882), the average American academic (!), the average cranium for a race (Galton, 1881), the average image of historical figures from coins (Galton, 1879a, 1879b), the average philosophy student (Jastrow, 1887), the average George Washington, and the average "race horse" (Galton, 1881; Pearson, 1924, p. 288). Galton's composites would rip through the museum of forms distilling the essential form of all things. For Galton and many others the composite photo would "bring out what is common to all and eliminate what is exceptional." (Pearson, 1924, p. 233)

These composites were a means of filtering the light through the emerging analytical eye. This would be a means of grappling with the profusion of detail now contained in the collections of images of forms. The merged visual images, the rapid blur of thousands of forms from Holmes' imaginary museum, would be constructed according to the new sampling theory of reality. It is in this effort, the massive summing and averaging of forms, that the 19th and, to a large degree, the 20th century's version of the thing-in-itself would emerge. If criminals could be classified, then so could races as long as the classification procedure was perfectly "random," "scientific," and above all, "statistically objective" (Gould, 1981). Given Galton's interest in eugenics and our historical hindsight, it is perhaps not surprising that Galton's composites also sought a calculus of the "Jewish type" (See Figure 2) (Galton, 1885; Jacobs, 1885).

But these pictures were not photographs as we know them. As the reader will soon see, these images were not "like" statistics, or "applications" of statistics; for the early statistical mind the composite <u>was</u> a statistical process. At the dawn of modern statistics, statistical processes were <u>visual</u> processes, which the camera and the composite simply mimicked. Galton was attempting to link psychology and physiognomy, the concept and the image. In Galton's version of the museum of forms, the librarian was not the word, not language, but the conceptual image. This essentially pictorial representation was statistical in nature. At its birth, modern statistics as it existed in the mind of Sir Francis Galton floated in a non-verbal imaginal and geometric medium. In the thirty years that Galton labored on photography, he would attempt to produce the externalized form of this statistical system, and it would be as much photographic as numerical.

To appreciate and understand fully this unusual juncture in the history of ideas, let us move backwards from the photograph to Galton's mental construct of statistical processes. Galton had absorbed the notion, which as we have seen was not uncommon during this period, that the photograph was a "sample" of reality. But as others had discovered, it was not the Essential Sample, in and of itself. Rather, the Essential Sample lay in time, or somehow behind all of these images. It is clear that Galton held this notion. His description of the capturing "the most probable likeness" of an individual is based on this underlying theory:

> Another use of this process is to obtain by photography a really good likeness of a living person. The inferiority of photographs to the best works of an artist, so far as resemblance is concerned, lies in their catching no more than a single expression. If many photographs of a person were taken at different times, perhaps even years apart, their composite would possess that in which a single photograph is deficient. A further use of the process would be to produce from many independent portraits of an historical personage, the _most probable likeness of him_. [emphasis added](Galton, 1878, p. 99)

For Galton, painters already carried out such calculations in their minds, in that they painted not exactly what was seen but a mental composite image, "the most probable likeness." But the painter was a biased sampler, and according to Galton did not weigh each image equally (Galton, 1879a). The individual then was always producing composites. The composite portrait was an exemplification of a natural statistical process. According to Galton:

> Composite portraits are, therefore, much more than averages, because they include the features of every individual of whom they are composed. They are pictorial equivalents of those elaborate statistical tables out of which averages are deduced. There cannot be a more perfect example than they afford...(Galton, 1879b, p. 167)

For Galton the composites reflected both a statistical and a mental (cognitive) process. He argued that many metaphysicians had failed to understand the subtleties of conceptual formulations such as generalizations. According to Galton, if the metaphysicians "could have seen and examined these composite portraits, and had borne in mind the well-known elements of statistical science, [they] would have written very differently"(Pearson 1924, p. 298).

But the Essential "Mean," borne of mental processes that were both photographic and statistical, required an Essential Sample to distill this generic truth. The classification process in Holmes' photographic museum of forms could yield the subject matter.

> No statistician dreams of combining objects into the same generic group that do not cluster towards a common centre, no more can we compose generic portraits out of heterogenous elements, for if the attempt be made to do so the result is monstrous and meaningless" (Galton, 1879a, p. 162).

In this context we can see that the phrase "sampling frame" has an ironic double meaning and that the images in Holmes' museum of forms would cluster into natural "sampling frames."

The composite photo had many of the properties of other statistical processes. The pictures were to be chosen at random from the naturally delimited sampling frame. Galton sought to prove that different pictorial samples yielded substantial agreement.

> An assurance of the truth of any of our pictorial deductions is to be looked for in their substantial agreement when different batches of components have been dealt with, this being a perfect test of truth in all statistical conclusions. (Galton, 1878, p. 100)

It was important that the merger of various sub-composites also yielded similar results to the mean composite of the general population. Exposure times were calculated according to an exact formula and composites determined with great "mechanical precision." Galton also counterbalanced the order of exposure of the pictorial data points to eliminate the possibility of order effects. He agonized as to whether the composite yielded a "true average" or an "aggregate." And finally, Galton hoped through the careful computation of pictorial family types to predict the appearance of various offspring (Pearson, 1924, p. 288).

I have shown thus far that in the early days of the modern statistical mind, visual-photographic processes were essentially statistical. I will now show its converse, that the statistical process, as a mental process, was essentially visual and photographic. If statistical reasoning was somehow visual or pictorial, then mathematics or at least number systems must be somehow "visual," or to put it in Galton's terms, "geometric." In the language of modern psychology, if cognitive processes of the early statistical mind were non-linguistic, then they might be part of visual-spatial pattern recognition processes, or to put it in another way part of an essentially right brain process (Springer & Deutsch, 1985). As we will soon see, Galton argued this very point in a debate with an Oxford Professor named Max Muller printed in

Nature (Galton, 1887a, 1887b)

Galton is credited with having done some pioneering experimental work in the area of mental imagery (Kosslyn, 1980). which almost a hundred years after Galton's study would reemerge as a central and important subject area of research into the cognitive systems of representation (Block, 1981; Kosslyn, 1980, 1983; Paivio, 1971). In a study of the flow of his own ideas, Galton found that over fifty percent of them were of a visual nature (Galton, 1879c). As Galton himself made heavy use of visual non-verbal thought, he was surprised when a questionnaire on mental imagery seemed to indicate a low level of mental imagery among members of the Fellows of the Royal Society and the French Institute (Galton, 1880, 1883). There is some indication that his questionnaire may have been affected by response inhibitions in a nominalist age (Kosslyn, 1980). More recent studies have indicated the heavy use of mental imagery among the intelligent, such as Mensa members (McKellar, 1965; Kosslyn, 1980). But Galton firmly believed in the reality of non-verbal thought. This led to the debate on "Thought without Words" with Professor Max Muller in the pages of *Nature* (1887a, 1887b). Here Galton argued that in his researches, he had come accross many who stated they could not think, if not in pictures, and he asserted that in some persons "true thought is habitually carried on without the use of mental or spoken words" (Galton 1887a, p. 28).

It is clear that Galton perceived many thinking processes to be primarily pictorial or non-verbal, including mathematics. In his major psychological work Inquiries into Human Faculty (1883) and two articles with the title of "Visualized Numerals" (1880a, 1880b), Galton put forward the thesis that many individuals, though not the majority, possessed or utilized visual number systems which he termed "number forms." Number forms were the spatial or diagrammatic systems by which people imagined the organization of numbers. Through interviews Galton collected over eighty of these. (See Figure 3 for Galton's examples). If number forms could be pictorial, then surely statistical thought itself could be pictorial, and possibly photographic. Karl Pearson, the faithful student and biographer of Galton, and unquestionably a major founder of modern statistics (see Hacking, 1984) reported his own curious blend of verbal and pictoral mental imagery in a footnote in Galton's biography (Pearson, 1924, p. 244). Galton had sought to refine the visual representation of statistical information including stereoscopic graph images based on three dimensional models of statistical data (Galton, 1908; Pearson, 1924). The visual representation of statistics was an important part of statistical courses of the period (Pearson, 1938, p. 143) and the use of stereoscopic graphs was even taken up by Alexander Graham Bell, a disciple of Galton, who once constructed and exhibited such pictographic statistics (Second International Congress on Eugenics, 1923, plate 4).

The visual image and the photograph seem to have haunted much of the thought, and certainly the statistical thought of Galton and some of his contemporaries. It can be argued that a number of aspects of Galton's models of statistics, human faculties, and even eugenics may have been guided by analogical reasoning directly derived from the idea of the photograph.

If modern models of memory and thought processes are based on computer analogies, then Galton's was clearly photographic. Galton's pictured a mind that stared out at the world through the camera lens and absorbed information in a flash. In the following quotation, Galton displays a tellingly photographic concept of perception:

> A useful faculty, easily developed by practice, is that of retaining a mere retinal picture. A scene is flashed upon the eye; the memory of it persists, and details which escaped observation during the brief time when it was actually seen may be analysed and studied at leisure in subsequent vision. (Pearson, 1924, p. 241).

Here memory is portrayed as a series of snapshots, always available for "study at leisure" in the photograph album of the mind. If the first traces of visual processing led to snapshots in memory, and cerebration led to activation of these images, then might not memory be composed totally of Galton's mental versions of composite photographs? In the parallel between psychological events and physiognomic ones, one finds not only a statistical model of photography but a composite photographic model of mental processes.

> Whenever any group of brain-elements has been excited by a sense-impression, it becomes, so to speak, tender, and liable to be easily thrown again into a similar state of excitement...Whenever a single cause throws different groups of brain-elements simultaneously into excitement, the result must be a blended memory...Thus some picture of mountain and lake in a country which we have recollections cannot be disentangled, though general resemblances are recognized... A generic image may be considered to be nothing more than a generic portrait stamped on the brain by successive impressions made by its component images. (Galton, 1879a, p.162).

If perception was like photography, and memory but a composite photograph, then we should not be surprised that in this visual statistical computer of the mind, memory recall resembled the "lantern slide" show. Galton's biographer, Pearson, was "puzzled by th large number of lantern slides in the Galtoniana" (collection of Galton's gadgets and devices; Pearson, 1924, p. 238.). They were there to "illustrate" lectures on imagery. Given our argument until now, it follows that Galton, thinking with and through the media, should have seen imagery as an internal projection of the image through the optic nerve to the back of the retina. (Galton, 1883). Therefore, if the capacity for the recall of imagery were sufficiently strong, then we might actually "see" or "project" images onto paper, or picture it in the "minds' eye." Galton wrote, " We should be able to visualize that object freely from any aspect; we should be able to project any of its images on paper and draw its outline there"(Galton, 1880, p. 322).

But Galton worried that the mental images were blurred and lacking in clarity. "Our mental generic composites," he argued, "are rarely defined; they have that blur in excess which photographic composites have in a small degree..."(Galton, 1879a, p.169). But Galton felt that the blur of memory could be limited if that photographic-statistical apparatus of the brain could produce true "generic" composites as opposed to imperfectly sampled "general" composites.

> The criterion of the perfect mind would lie in its capacity of always creating images of a truly generic kind, deduced from the whole range of past experiences. General impressions are never to be trusted.(Galton, 1879a, p. 168)

Generalizations were the domain of metaphysicians whose composites were composed from imperfect samples. Galton felt that the "perfect mind," not surprisingly, resembled that of the visual statistician. Galton wrote, " those who are not accustomed to original inquiry entertain a hatred and horror of statistics... But it is the triumph of scientific men to rise superior to such superstitions..."(Galton, 1897a, p. 169)

Such then, was the structure of the statistical mind in the very early days of modern statistics - a photographic model, a great statistical program, full of graphic subroutines, to use the analogies of the present.

Galton's photographic edifice is paradigmatic, because in it we can see a complex and multifaceted interaction between a medium, perception through a medium, the concept of a medium, and the medium as grand analogy. Galton goes through all the phases mentioned at the opening of this article. For Galton the camera 1) expanded the range of what was perceptable, 2) altered the flow and collection of information, 3) interacted with and helped restructure his conceptualizations of cognitive processes and mathematical thought, 4) and finally provided a dazzling analogy for statistical and cognitive processes.

Media technology are devices for more than the manipulation of information. A medium guides perception and conceptual thought. We not only think <u>with</u> media technology and symbol systems, but <u>through</u> media technology and symbol systems. Galton may have unwittingly used the photograph as a model and analogy for thought processes just as we use the computer as an ubiquitous analogy for cognitive processes.

Though statistics and the camera would part ways once they left the spacious symbiotic environment of Sir Francis Galton's mind, both in the twentieth century would carry out the agenda found in the original flash of thought escaping from Galton's statistical camera/mind late in the 19th century. The modern camera would in one of its social uses emerge as an instrument of scientific inquiry and measurement. All forms could be collected and reduced to a standard manageable size. The eye could now carry out the functions of standardization and quantification which the institution of money had carried out in the marketplace.

Holmes' great museum of forms would become an actuality. The museum of forms would never be housed in a building but would find its home in the mass media where it would permeate the culture. With the video tape, the laser disk, and the embodiment of the visual-statistical mind, the computer, everything could be captured, measured, and compared. Along with statistics it would carry out the mission of endless comparison and classification pictured in the Holmes' original vision:

> To render comparison of similar objects, or of any that we may wish to see side by side, easy, there should be a stereographic metre or fixed standard of focal length for the camera lens, to furnish by its multiples or fractions, if necessary, the scale of distances, and the standard of power in the stereoscopic lens. In this way the eye can make the most rapid and exact comparisons. (Holmes, 1959, p. 255)

Galton himself had devised a primitive "mechanical selector" for processing information (Pearson, 1924, p. 307). Unwittingly and through the course of events, the statistical mind of Sir Francis Galton would take shape in an environment of computers and visual media. As Galton himself once remarked while briefly straying from his eugenic creed, "The character of our abstract ideas, therefore, depends to a considerable degree on our nurture."

(Pearson, 1924, p. 255)

NOTES

1
[original quotation]

Tu sais que les rayons de lumière réfléchis des différents corps font tableau et peignent ces corps sur toutes les surfaces polies, sur la retine de l'oeil, par exemple, sur l'eau, sur les glaces. Les esprits élémentaires ont cherché à fixer ces images passagères; ils on compose une matière très-subtile, très-visqueuse et très-prompte a se dessécher et à se durcir, au moyen de laquelle un tableau est fait en un clin d'oeil. Ils enduisent de cette matière une piece de toile et la presénte aux objets qu'ils veulent peindre. Le premier effet de la toile est celui du miroir: on y voit tous les corps voisins et eloignes dont la lumière peut apporter l'image.

Mais ce qu'une glace ne saurait faire, la toile, au moyen de son enduit visqueux, retient les simulacres. Le mirroir vous rend fidèlement les objets, mais n'en garde aucun; nos toiles ne les rendent pas moins fidelement, mais les garde tous. Cette impression des images est l'affaire du premier instant ou la toile les recoit. On l'ôte sur-le-champ, on la place dan un endroit obscur; une heure après, l'enduit est desséché, et vous avez un tableau d'autant plus précieux, qu'aucun art ne peut l'imiter la verité et que le temps ne peut aucune manière l'endommager.

2
[original quotation]

Nous prenons dan leur source la plus pure, dan le corps de la lumière, les couleurs que le peintres tirent des different matériaux que le temps ne manque jamais d'alterer. La précision du dessin, la variéte de l'expression les touches plus ou moins fortes, le gradation des nuances, les règles de la perspective. nous abandonnons tout cela à la nature qui, avec cette marche sûre qui jamais ne dementit, trace sur nos toiles des images qui en imposent aux yeux et font douter a la raison, si ce qu'on appelle réalites ne sont pas d'autre espèces de fantômes qui en imposent aux yeux, a l'ouïe, au toucher, à tous les sens à la fois.

3At this point the distinction needs to be made between the older tradition of statistics and the modern form referred to in this paper. Statistics certainly predates Galton, but it is largely a descriptive statistics associated with government offices and the traditional accounting of "all things in the land." By modern statistics I am referring to arrival of the whole arsenal of inferential techniques used to "distill" information, test the compatability of two orders of numbers as Galton's & Pearson's product coefficients do, and the concept of probability as a means of modelling the range of potential outcomes.

CAPTIONS

Figure 1

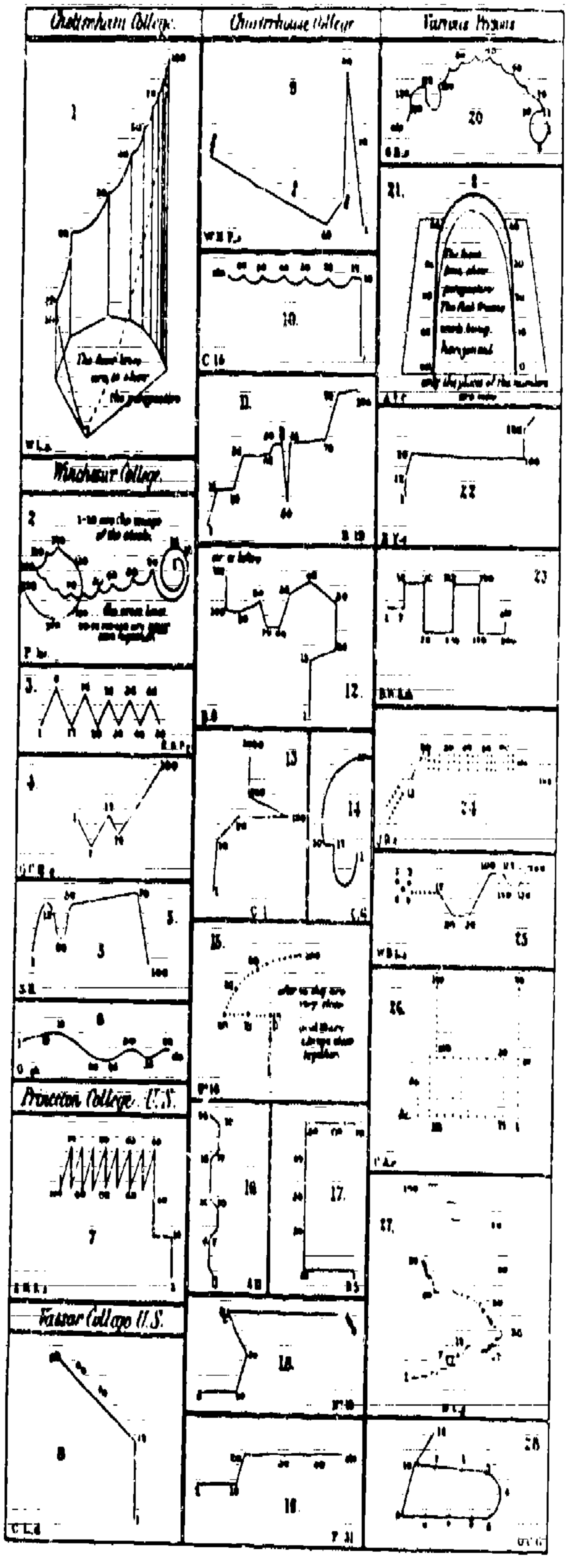
Galton's early photocomposite which "calculates" the average image of criminals convicted for murder, manslaughter, and crimes of violence (Pearson, 1924, Plate XXVIII).

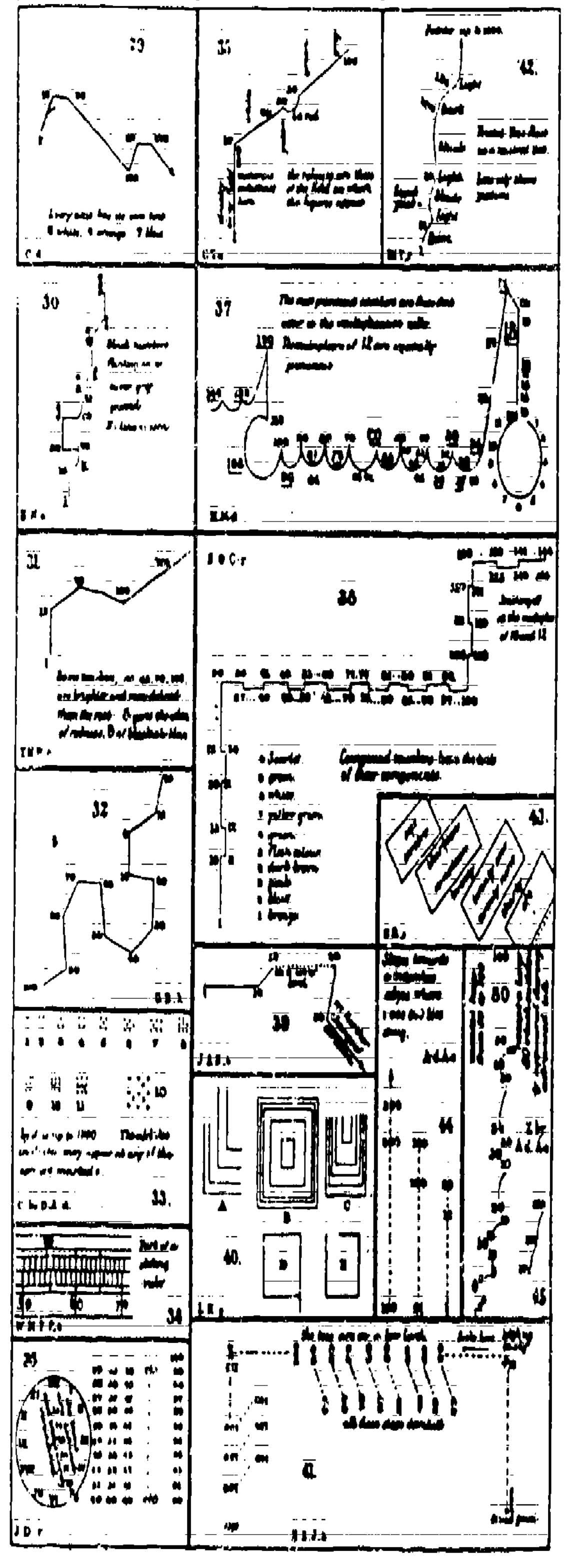
Figure 2

Photocomposite and Galton's calculus of the "Jewish Type" (Pearson, 1924, Plate XXXV).

Figure 3

Galton's collection of individual reports of their internal visualized image of the form of pure number systems (Plate XXIV).





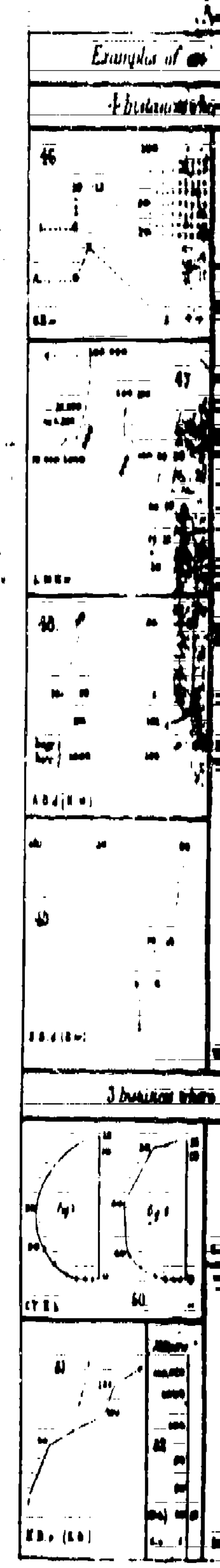


Illustration # 3

(Pearson, 1924)

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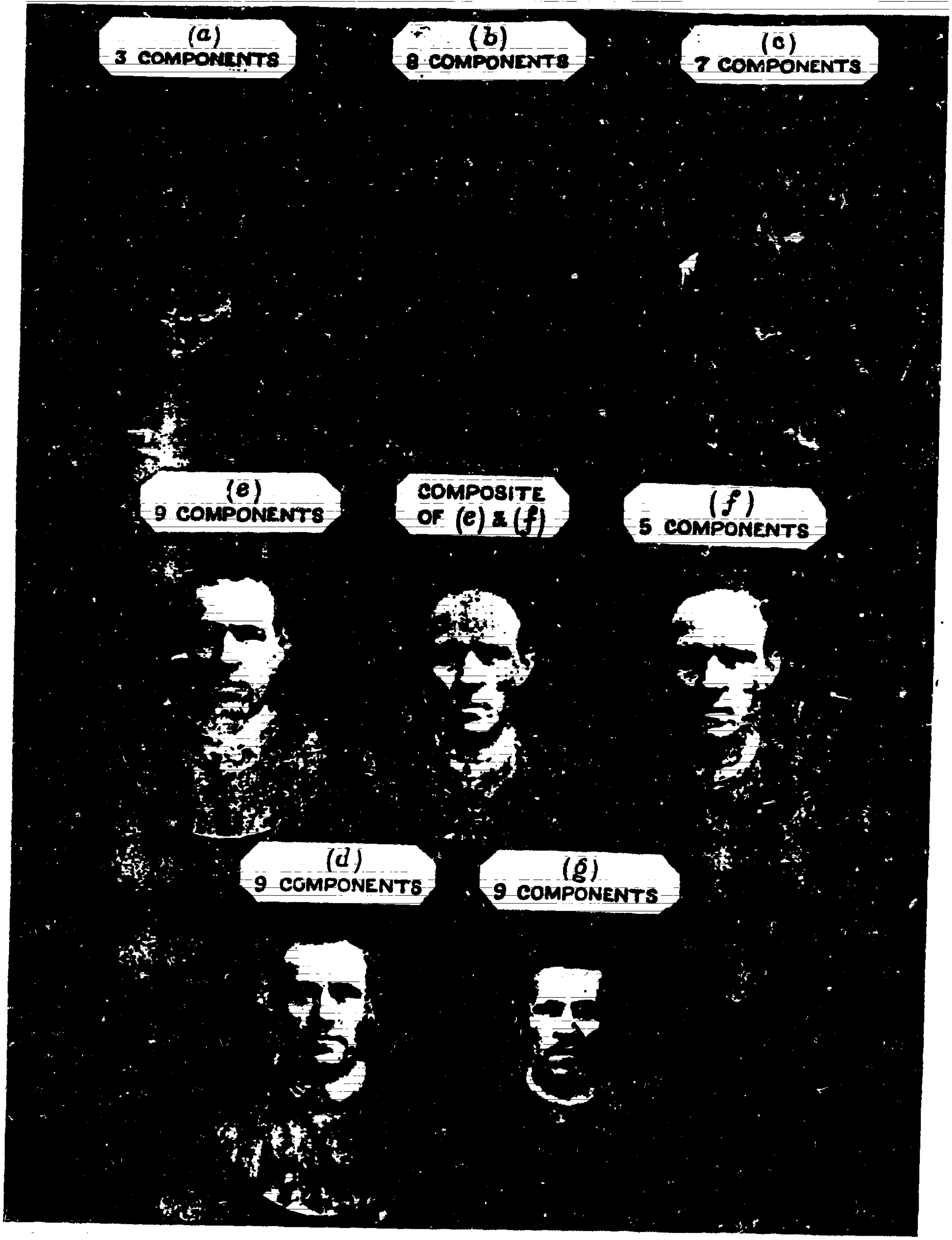

Composites, made from Portraits of Criminals convicted of Murder, Manslaughter or Crimes of Violence.

Illustration # 1

(Pearson, 1924)

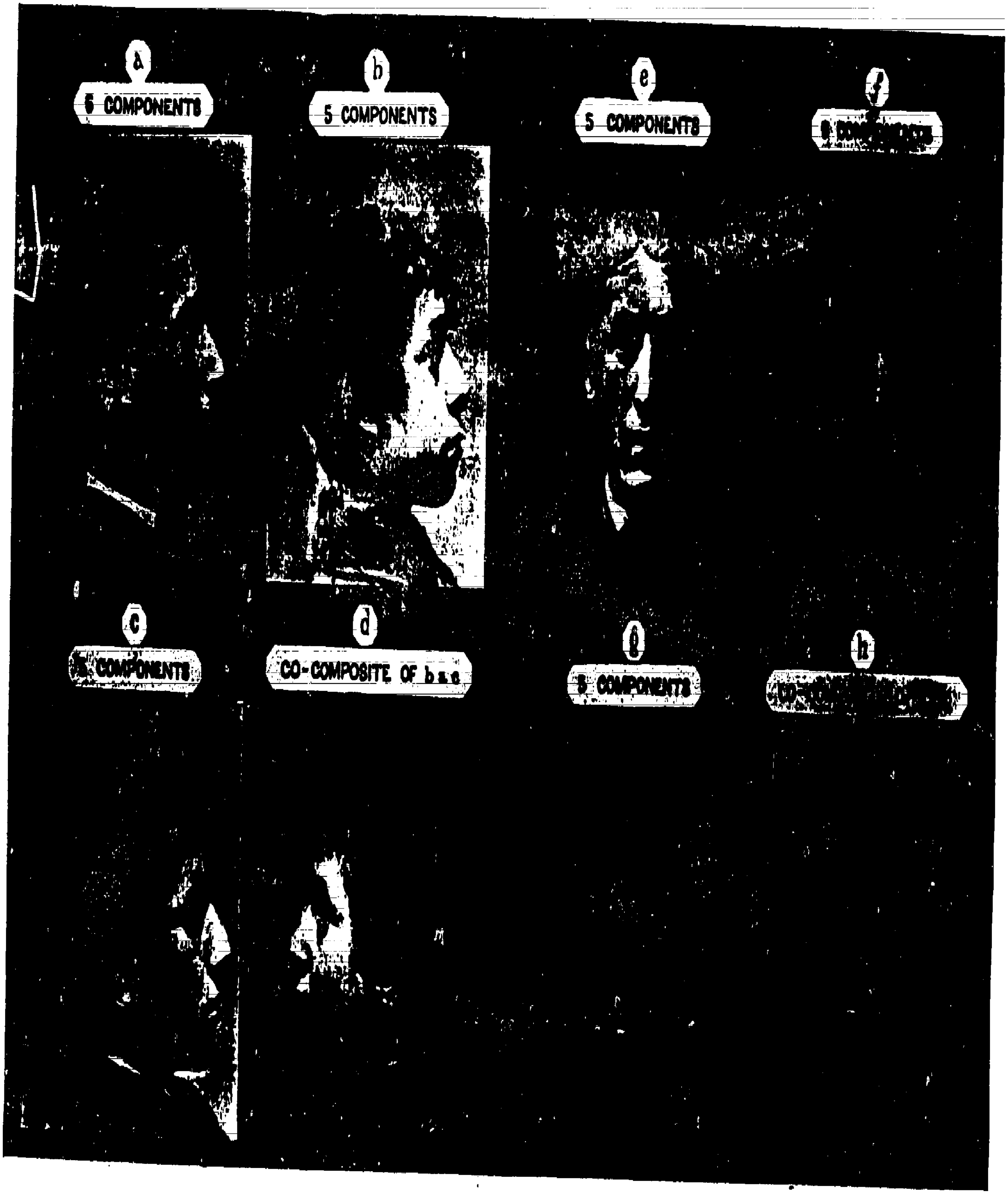

PLATE XXXV

The Jewish Type.

Profile. Full Face.

Illustration #2

(Pearson, 1924)

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