Glass: The Art and Technology of a Material of the Information Age

Peter L. Bocko Ph.D.
CTO – Corning Glass Technologies

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Glass is one of the earliest engineered materials

- Glass articles have been manufactured for more than 4,000 years
  - The history of glass making can be traced back to early bronze age Mesopotamia (about 2,300 BC)
  - Early artifacts from Mesopotamia and Egypt show substantial glass chemistry know-how and sophistication
  - Compare 40 centuries of silicate glass know-how (versus just two centuries for silicon)
- Glass has been one of the most versatile family of materials in human history

8th Century B.C. glass jug

Glass has fulfilled many roles in history

Decoration

Revelation [1]

Illumination

Information Display

CRT Bulbs

LCD Glass

Information Processing

Wafers & Interposers

1500BC | 1000BC | 100AD | 1500 | 1600 | 1800 | 1900 | 1950 | 1960 | 1980 | 2000 | 2010

Containment [2]

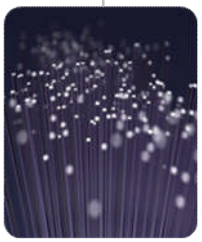
Fenestration [3]

Telescope
(Galileo-1609)

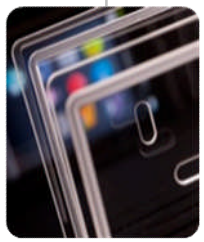
Microscope
(van Leeuwenhoek-1674)

Discovery

Semaphore Lens



Fiber Optic



Cover Glass

Information Transmission

Information Appliance Protection & Interface

1-2 © Corning Museum of Glass
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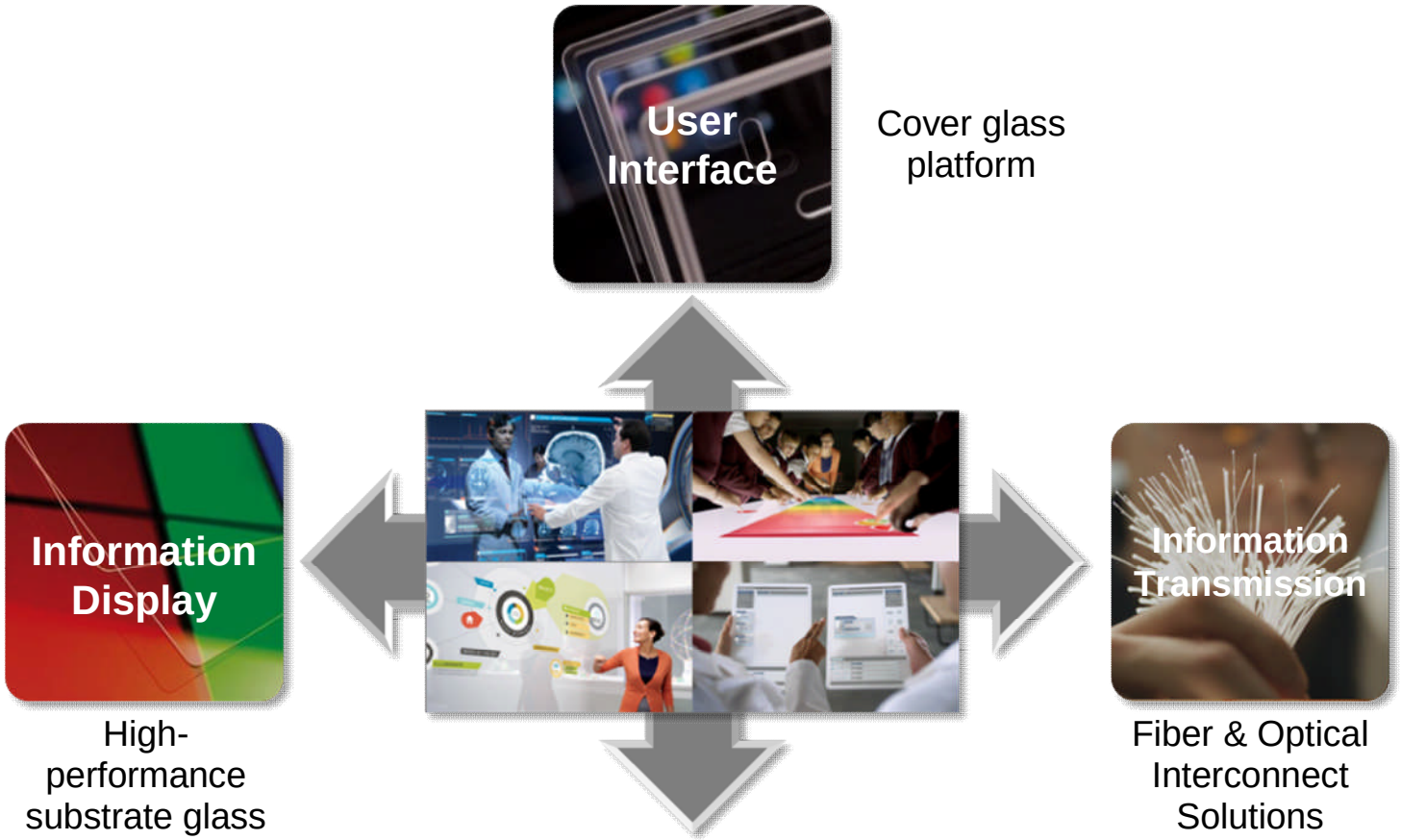
Which have been proliferating in the information age



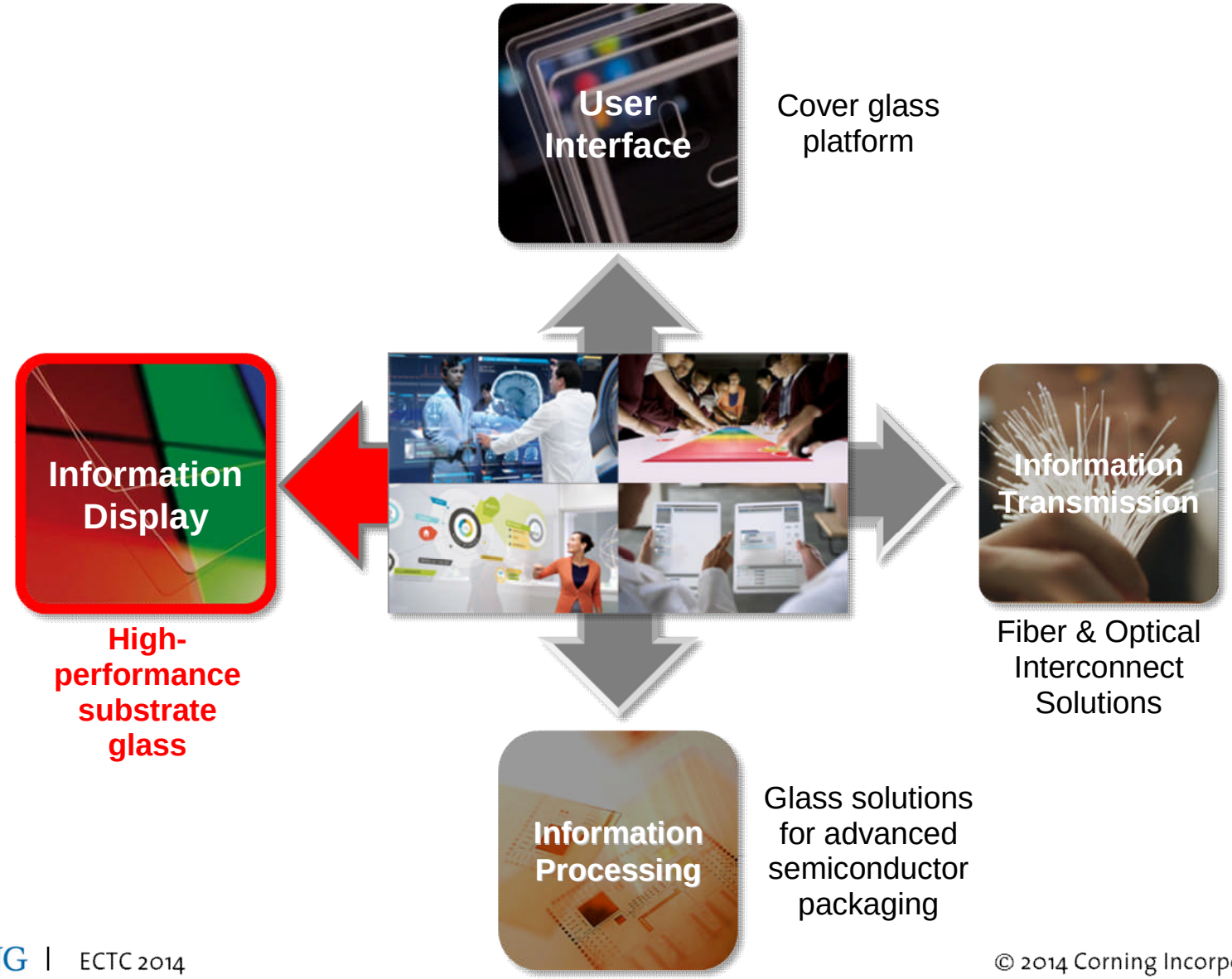
Today glass has become the common denominator in one of the most dramatic developments of the modern era:

Information Immersion & Comprehensive Interconnectivity

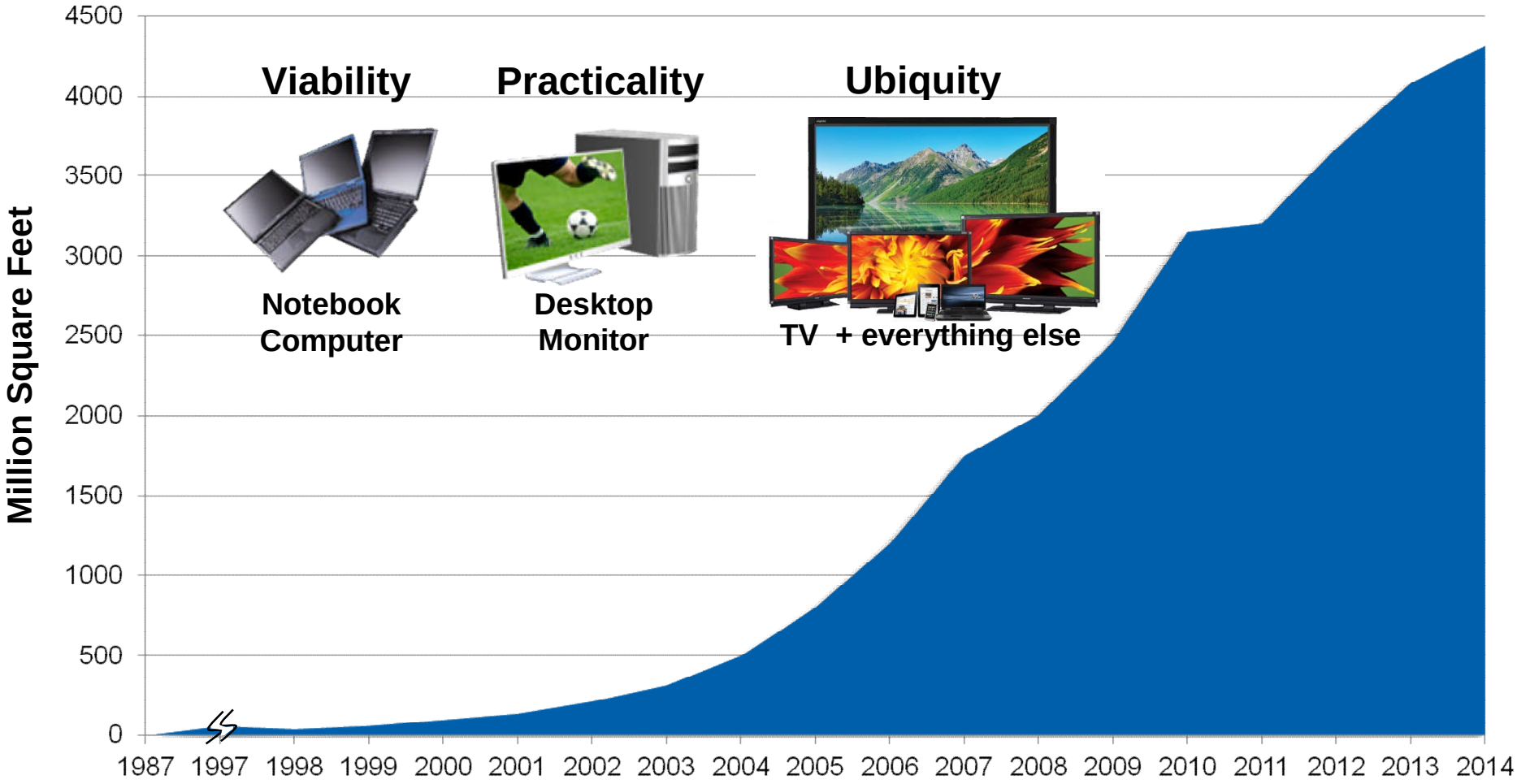
A Day Made of Glass –

Corning's Vision of the Future Role of Glass in the Information Age

Which have been proliferating in the information age

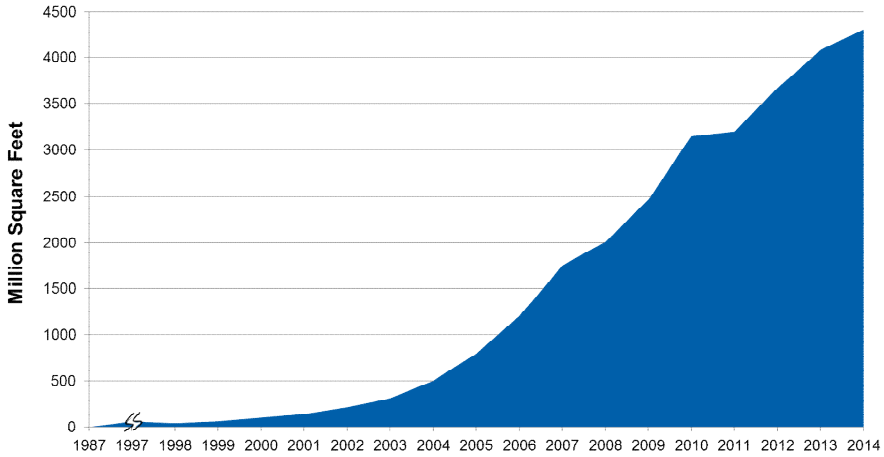


LCD platform has grown through successive application to 2013's glass substrate consumption of over 4 B ft^2

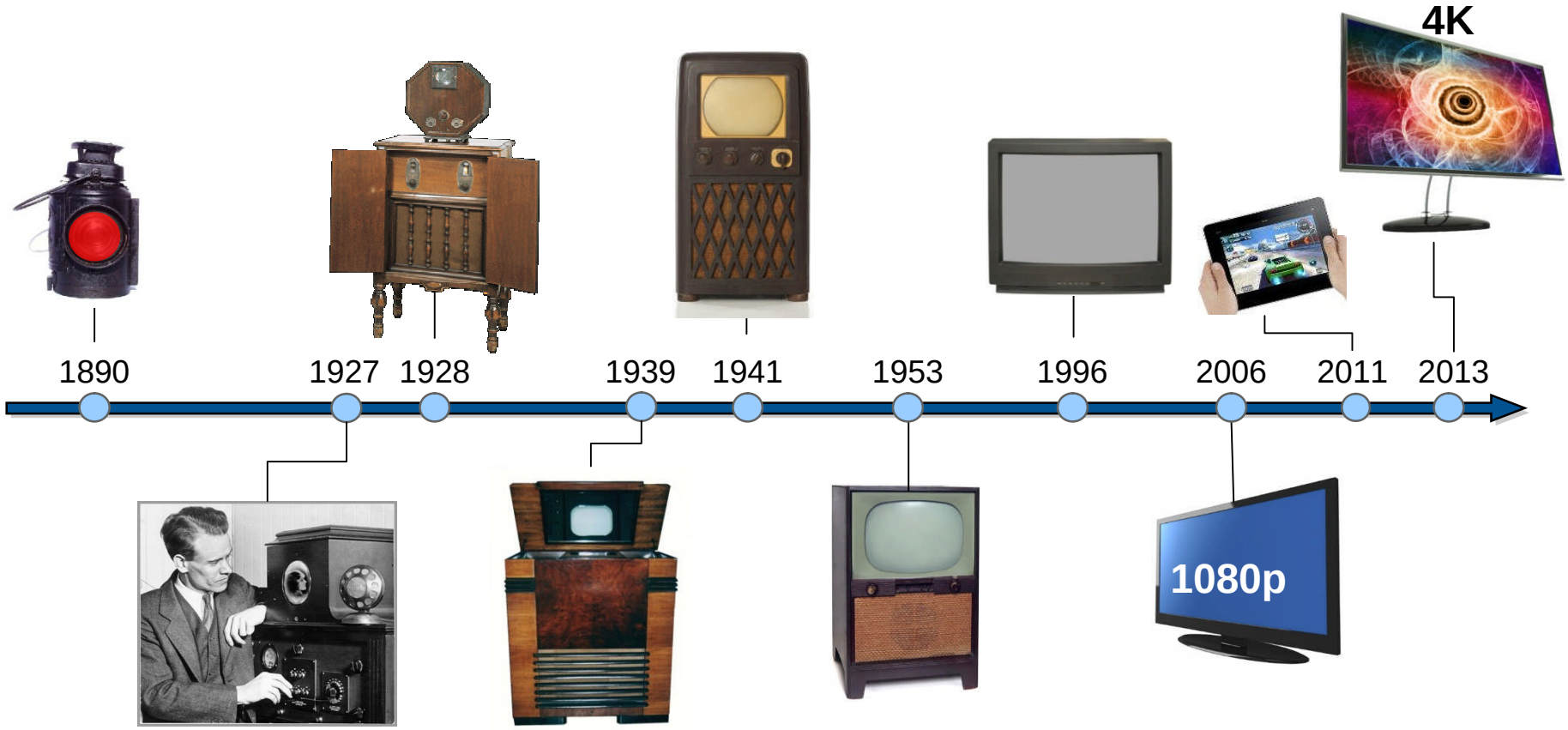


Since the beginning of the LCD revolution… about 24B ft^2 of glass has transformed in displays

This is enough glass to create a continuous ring of 100” LCD TVs circling the earth and the moon.



The LCD platform has accelerated the trend to increased density of visual information



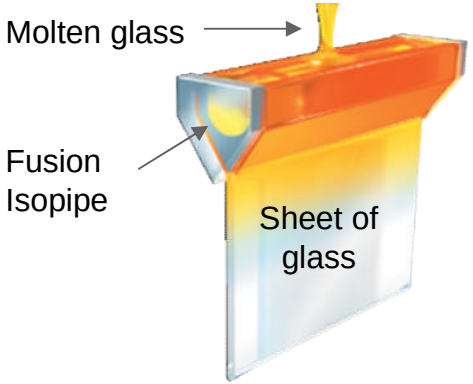
Number of Pixels

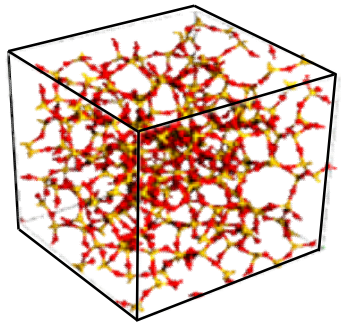
One | 100s | 1000s | 10,000s | 100,000s | 1M | 2M | 8 – 32M

How did engineered aluminosilicate glass deliver 25 years of sustained value in the LCD glass industry?

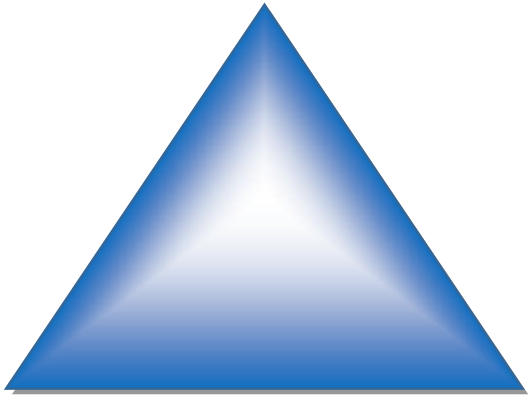
Advanced optical melting + fusion sheet forming process

Innovative aluminosilicate glass compositions



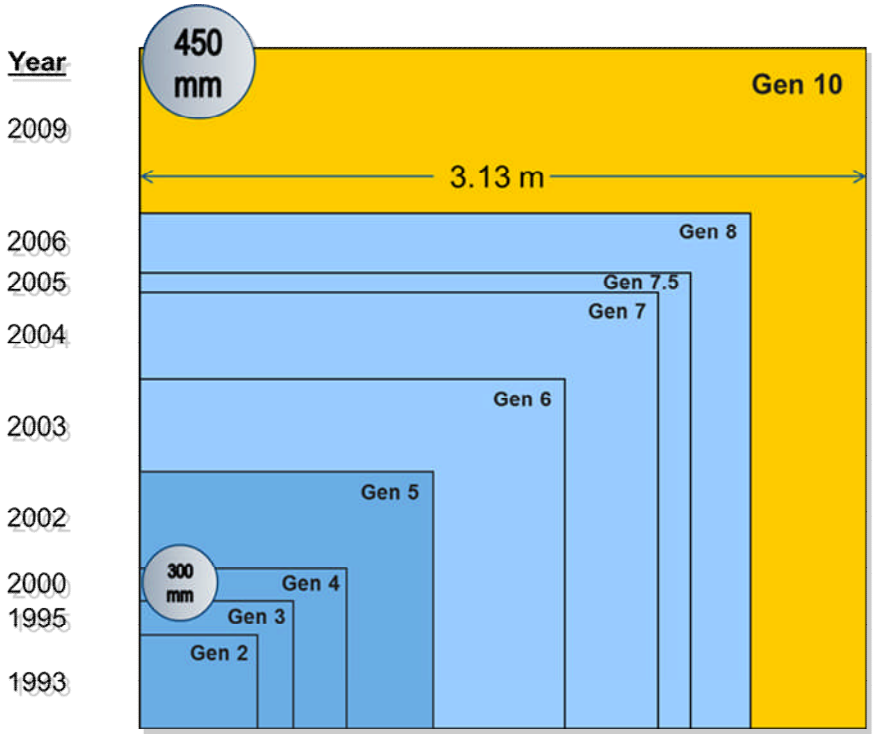


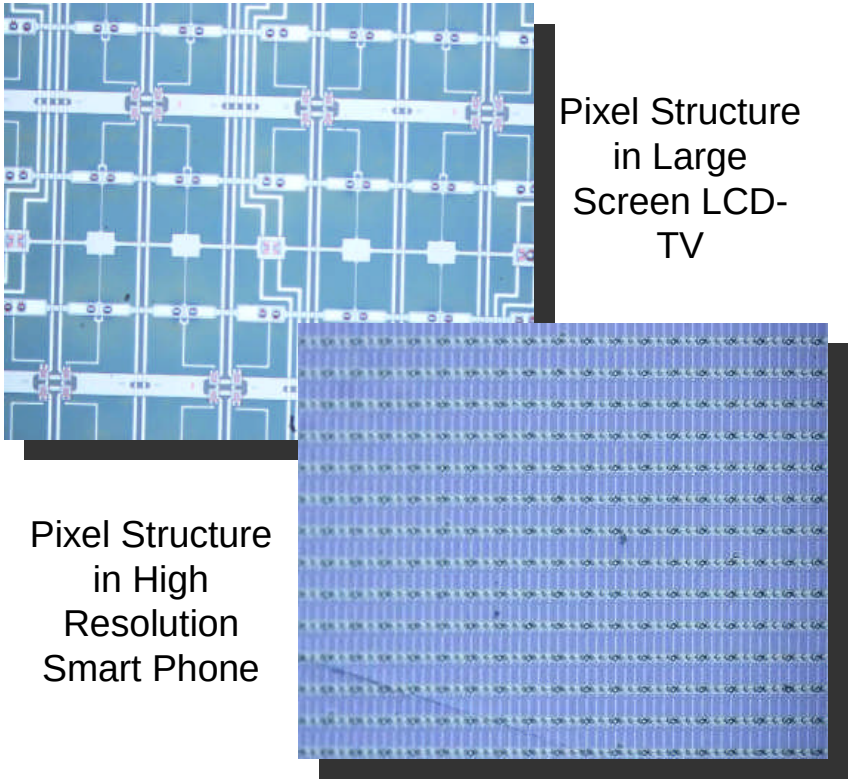
Clean



Stable Flat

Is there a Moore's Law for display? Kind of…





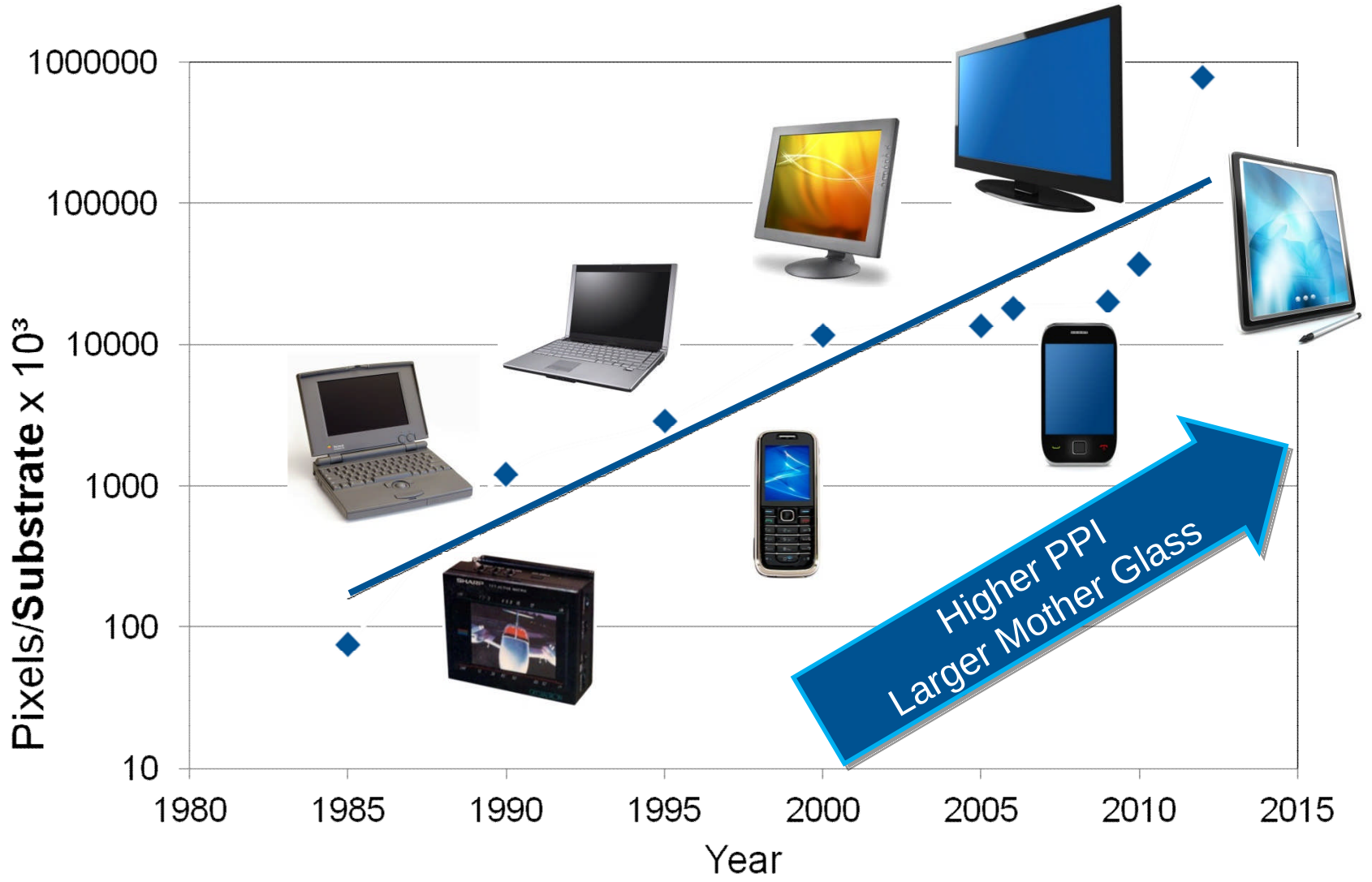
Pixel Structure in Large Screen LCD-TV

Pixel Structure in High Resolution Smart Phone

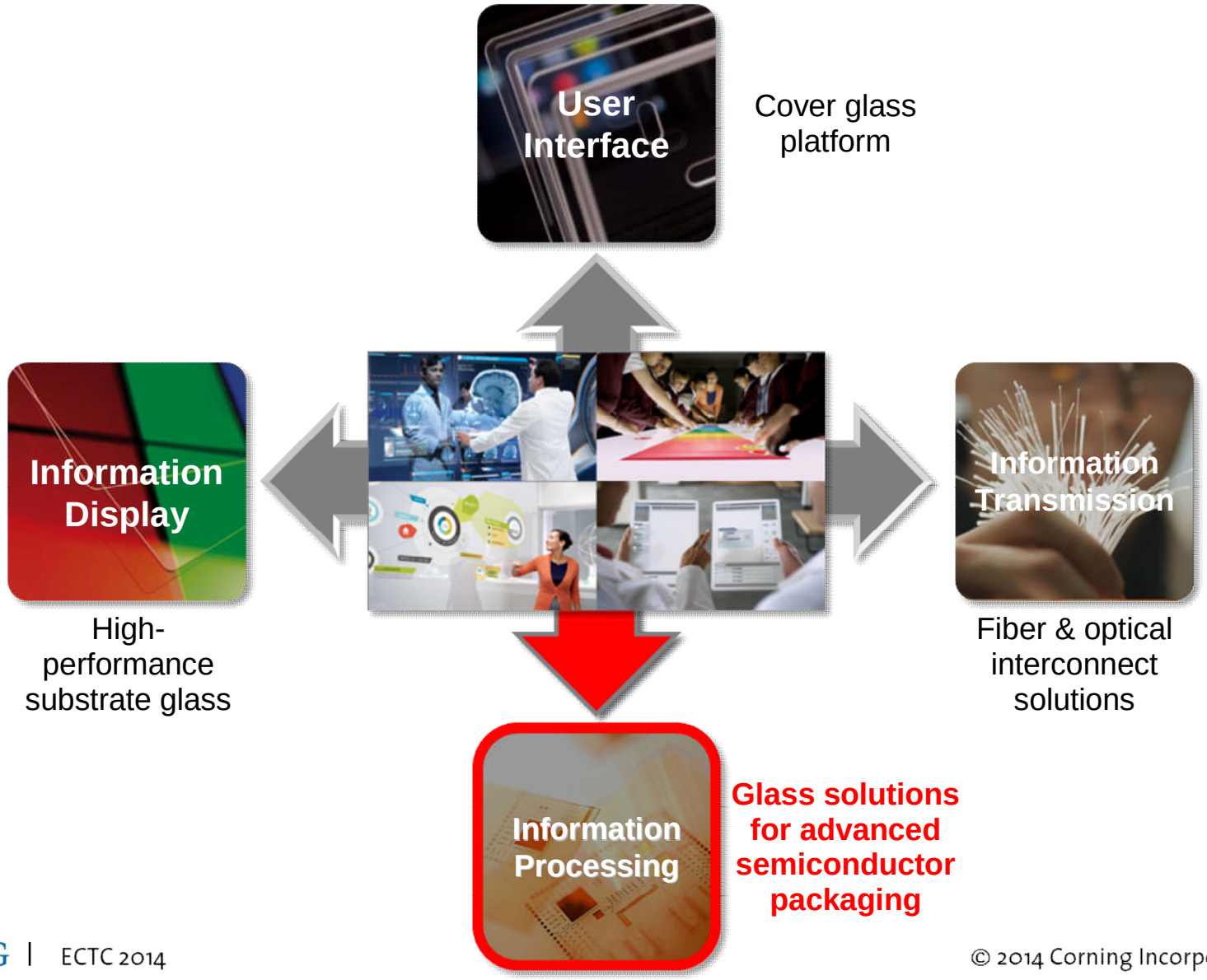
Large mother glass used for multiplicity of display panels + **Higher resolution in small & intermediate mobile devices**

Resolution + Large Mother Glass

Moore's Law for LCD manufacture



Which have been proliferating in the information age



IC packaging solutions that enables more agile wireless communication and faster device processors

- Interposers are being introduced in advanced IC packaging to increase reliability, interconnect density and speed of RF and digital processors
- For many applications, glass is proposed to be the optimum interposer material because of its stability and surface properties
- Technologies for mass production of vias are in latter stages of development

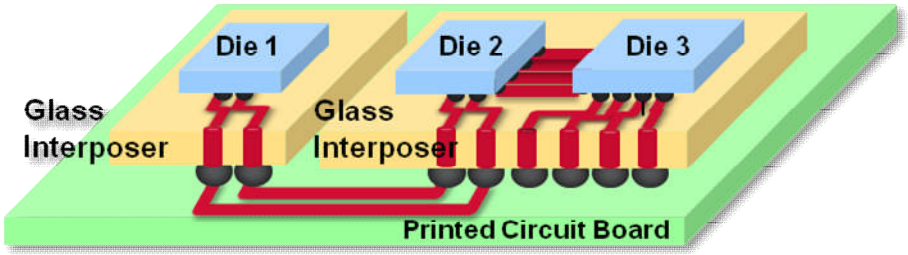
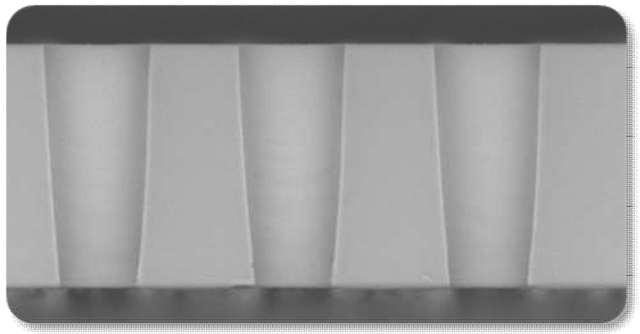


Illustration of one possible IC package using glass interposer & circuit board

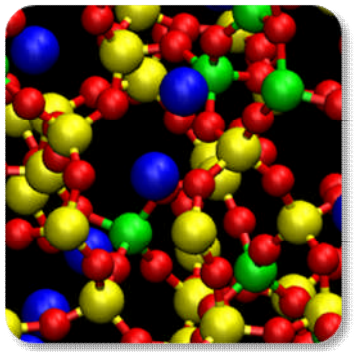


Micrograph of glass vias made by proprietary Corning process

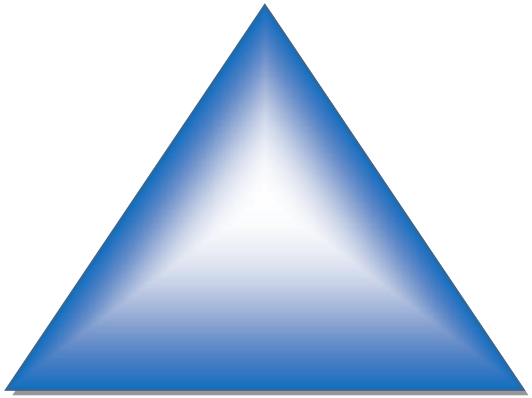
You will find that the value equation for glass in the Information Age can be generalized across all applications

Agile & scalable specialized manufacturing process

Glass formulation engineered for intended application



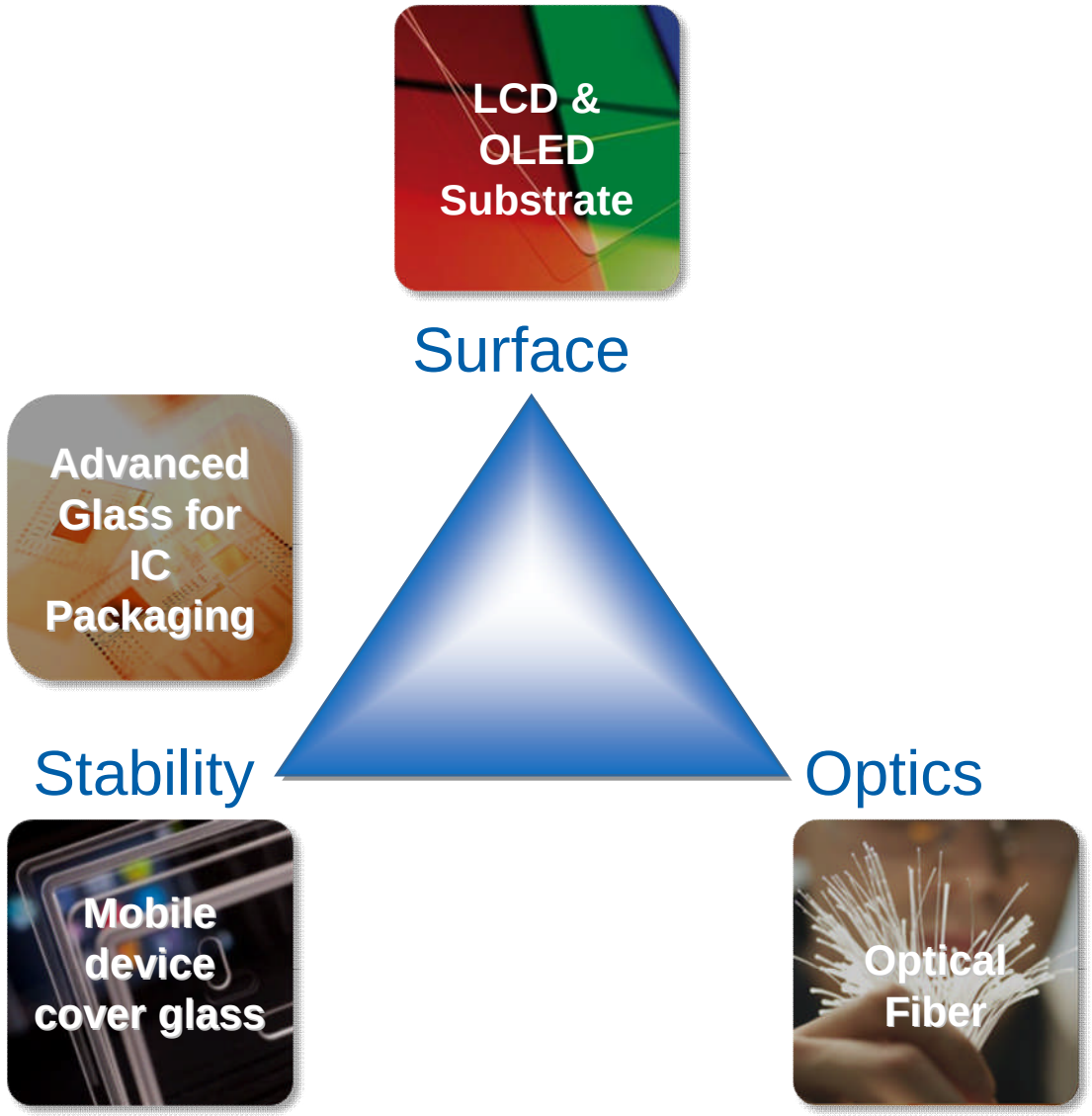
Surface



Stability

Optics

And the importance of these three attributes vary according to their value in the specific application

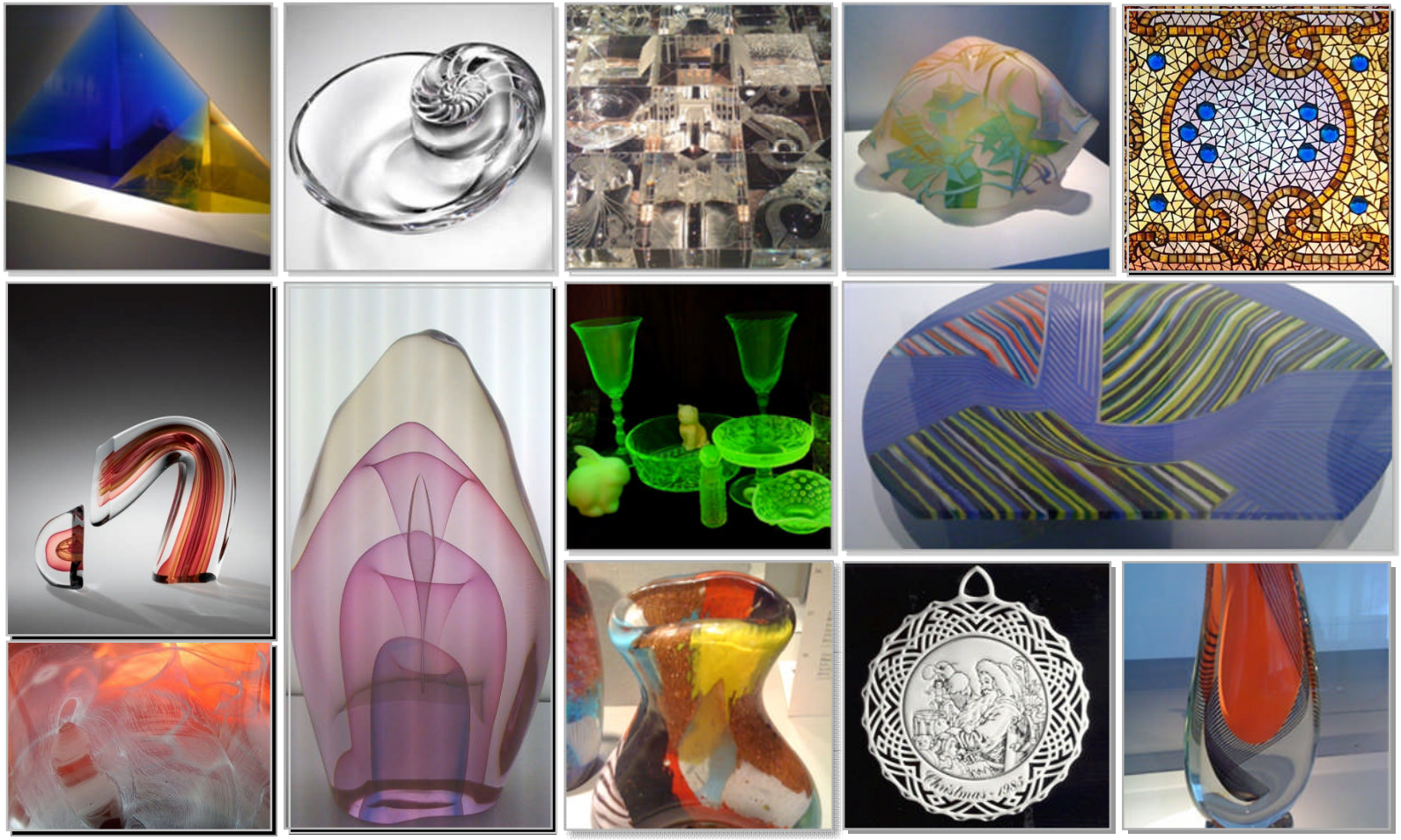


Technology trends in glass in the information age

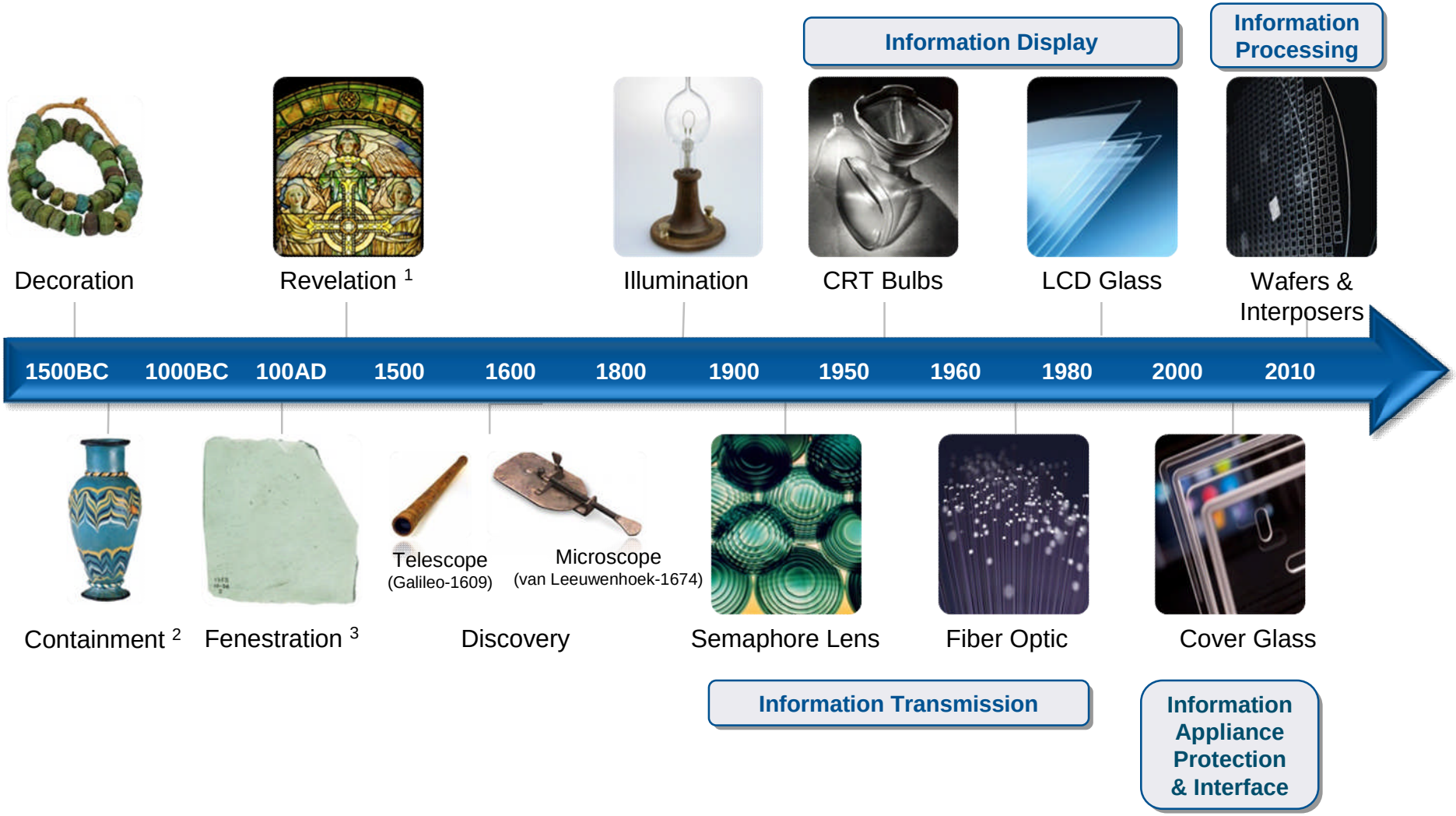
- Glass will be increasingly an environmental presence driven by pervasive connectivity
  - Ubiquitous display: blurred device boundaries (client/host) and even less distinction between real and virtual worlds
  - Unbroken glass path from content to consumer (required by gigabit/sec information density)
  - “Hidden glass” improves device performance (3DIC & touch)
- Glass functional range will expand beyond the traditional roles
- Traditional roles of glass will be increasingly customized by application
  - Commodity → Specialization

Glass as a Medium for Artistic Expression & the Studio Glass Movement

The first and most enduring function of glass has been as a vehicle for artistic expression

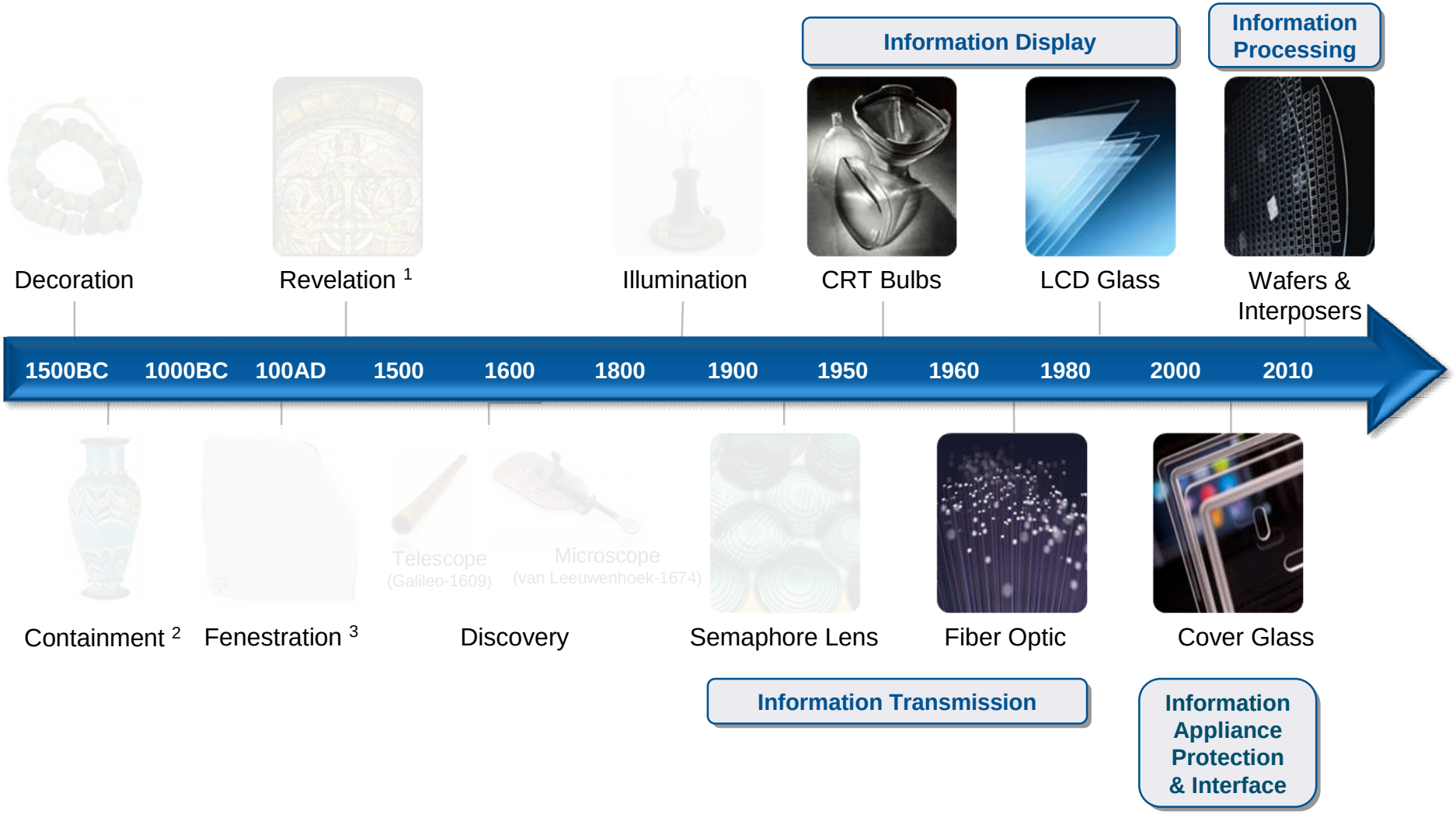


Starting with the functional roles of glass in history…



1-2 © Corning Museum of Glass
3 © Trustees of the British Museum

Focus on the proliferation of glass applications in the Information Age…



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The emergence and proliferation of glass as an artistic medium coincided with the technological…

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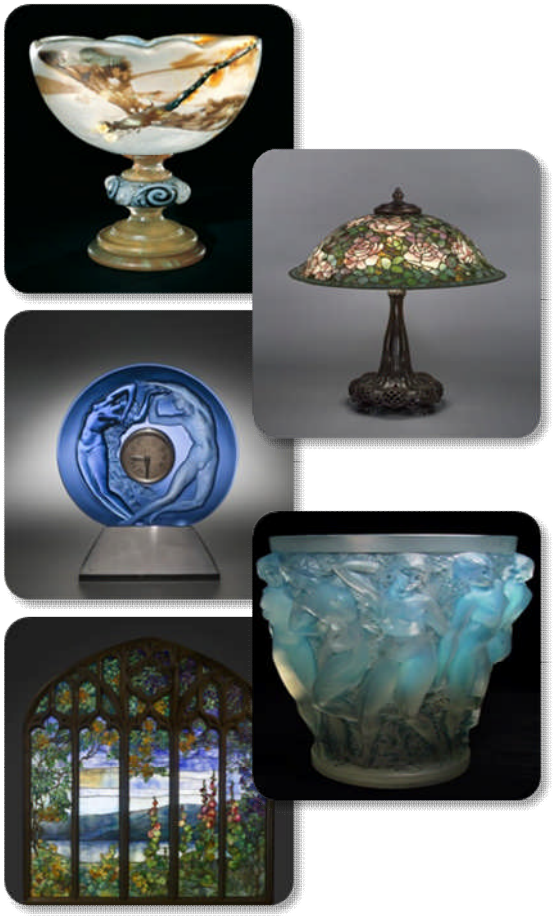
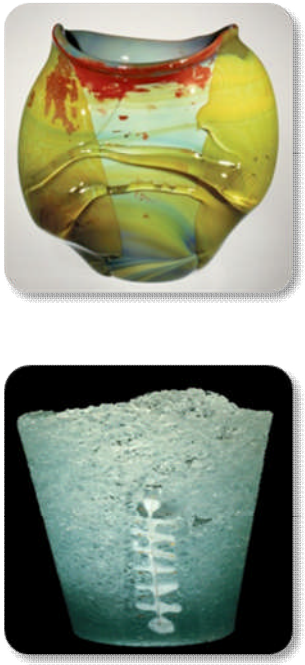
Specifically, 1960 was a discontinuity from functional forms to purely expressive non-functional glass art

Functional





ca. 1960

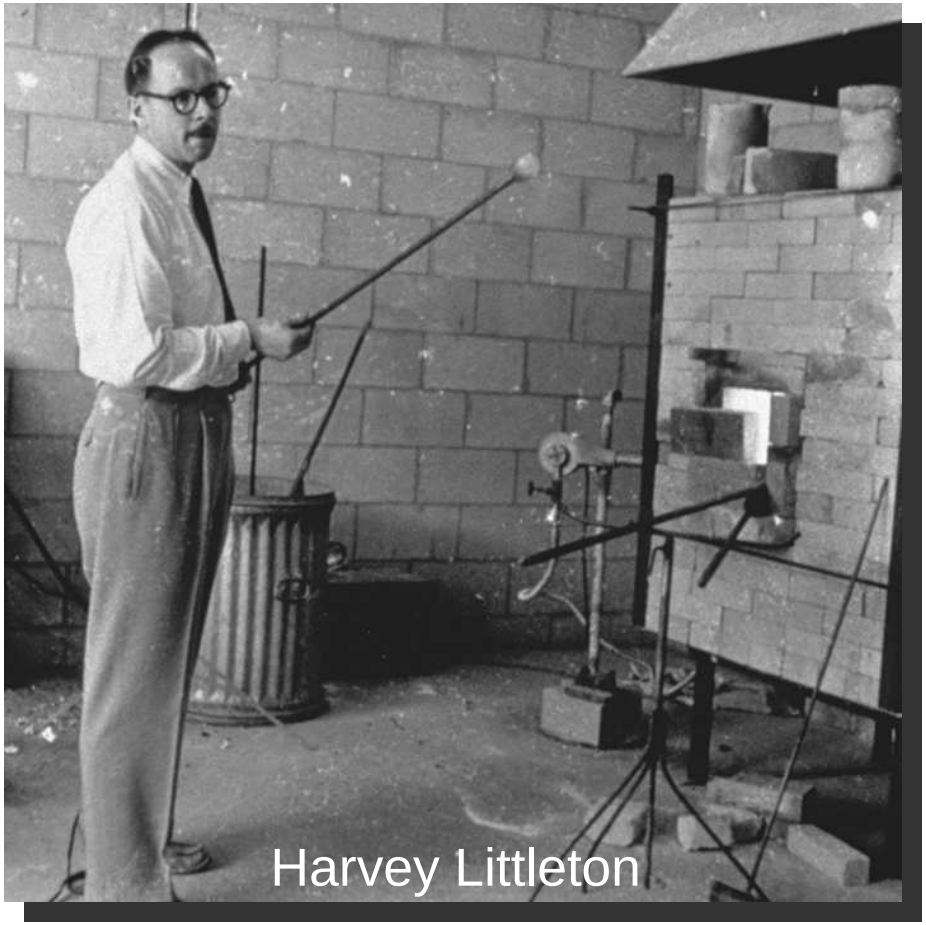
Non-Functional

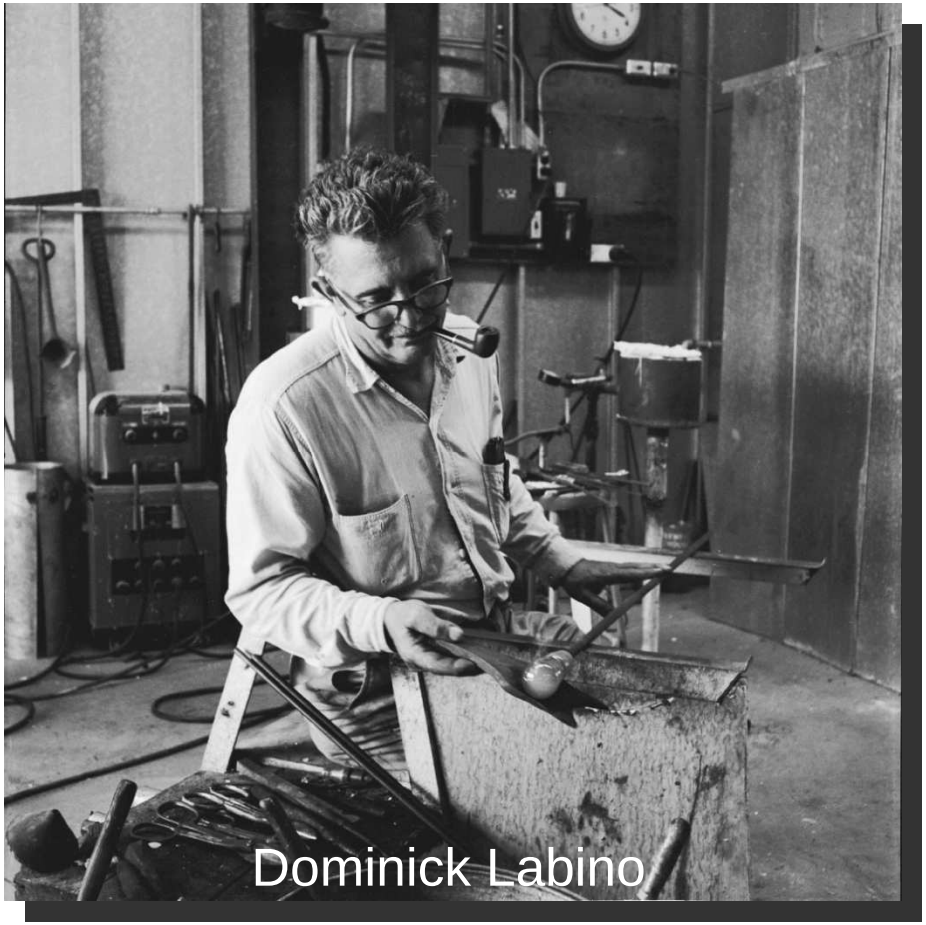
Another major change that occurred around 1960 was the exodus of art glass from mass production to the artist's studio

Iconic Art Nouveau Glass: René Lalique's 1927 Opalescent Bacchantes Vase Leveraged Mass Production Glass Factory

Source: http://www.finesse-fine-art.com/Showcase/Lalique/BacchantesOpal/index.htm

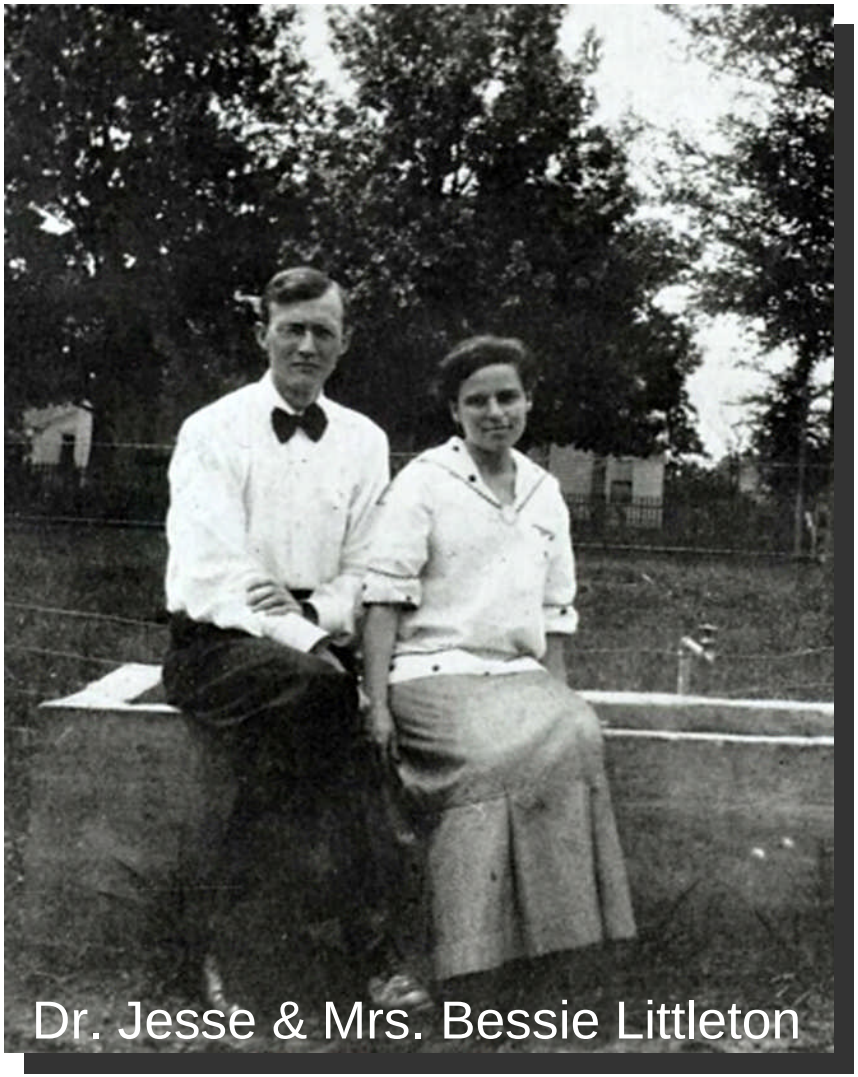
This discontinuity was nucleated by the founders of American Studio Glass Movement





Photos from www.cmog.org

Harvey Littleton came from a famous glass family


Dr. Jesse & Mrs. Bessie Littleton

Advertisement for Pyrex® glass dishes, 1916. Images courtesy Corning Incorporated, Corporate Archives.

Art + Technology: Labino & Littleton in Toledo (1962)

"Littleton and Labino held two seminal glassblowing workshops at the Toledo Museum of Art, where artists were introduced to molten glass as a material for contemporary art. This experimental activity changed everything about how glass might be made, and how it might be expressed in art, craft, architecture, and design."

~Tina Oldknow

www.cmog.org

Harvey Littleton, Vessel (1965)

"This small vessel is witness to a revolution: not a social one, but a material one."

~Tina Oldknow

http://blog.cmog.org/2013/12/18/harvey-k-littleton-american-1922-2013/?utm_source=rss&utm_medium=rss&utm_campaign=harvey-k-littleton-american-1922-2013

Harvey Littleton, Red/Amber Sliced Descending Form (1984)

http://www.cmog.org/audio/redamber-sliced-descending-form-557

"Capturing the transient qualities of glass is the challenge of the material… All of these physical and chemical properties are ordinary to the glassworker. Making them apparent to the public will suffice for the present, but the artist must penetrate beyond what is commonplace to create new form statements from qualities inherent in the material"

~Harvey Littleton

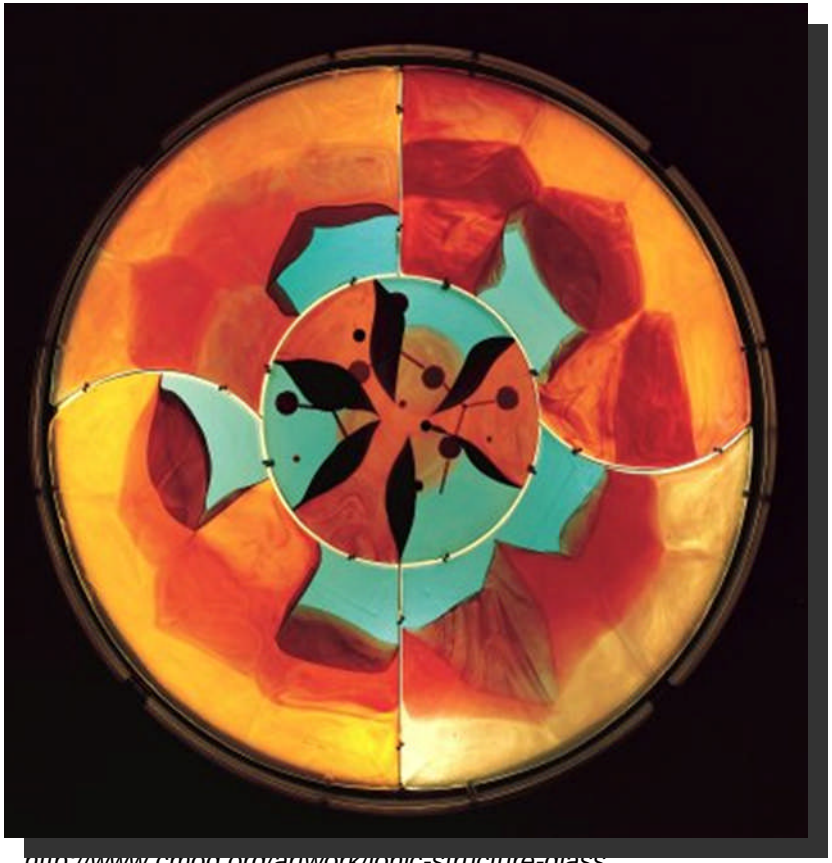
Harvey Littleton, “Gold and Green Implied Movement” (1987)

The sense of arrested movement and the multiplication and magnification of light inside the glass are characteristic of Littleton’s sculptures of the 1980’s. Littleton explained the making of such sculptures as “action, reaction and the force of heat and gravity”

(commentary adapted from Corning Museum of Glass exhibit)

http://www.cmog.org/artwork/gold-and-green-implied-movement

Ionic Structure of Glass – Dominick Labino (1979)



http://www.cmog.org/artwork/ionic-structure-glass

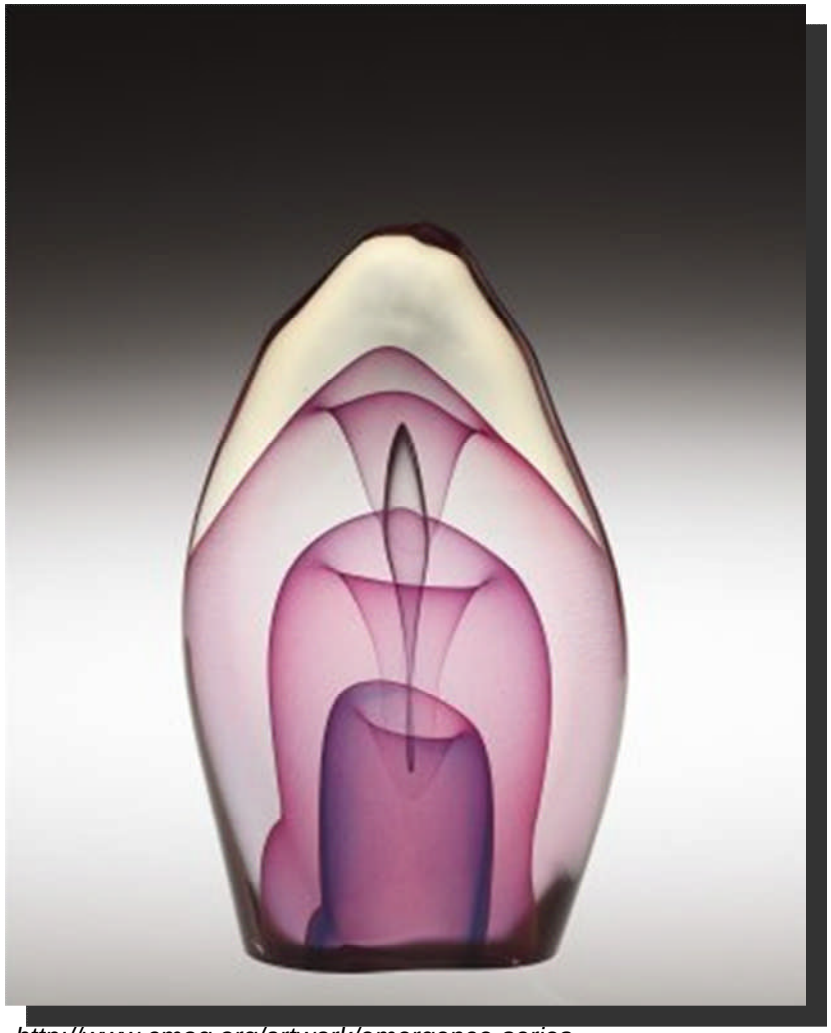
"The possibilities are all inherent in the glass itself, in the blowpipe and in yourself."

~Dominick Labino, Ceramics Monthly, 1967

"How many years will I have to stay here until I can decide to do something that I don't have to get approved by fourteen to twenty people.“

~Dominick Labino

Dominick Labino – “Emergence Four-Stage” (1980)



http://www.cmog.org/artwork/emergence-series

“It helps light the darkness, screen the elements, sharpen the acuity of vision, magnify the infinitesimal, and plumb the heavens. It transmits electronic signals across continents and may someday spawn a superbreed of ultrafast computers. Protean glass can also soar with a sculptor’s imagination, as in Dominick Labino’s nine-inch-high rhapsody in rose hues titled “Emergence Four-Stage”.

William S. Ellis, “Glass: Capturing the Dance of Light”, National Geographic, v. 184, no. 6, December 1993, p.37.

Students of Littleton played seminal roles in raising the awareness of studio glass around the world.

Harvey Littleton and Dale Chihuly blowing glass at Pilchuck Glass School, 1974 (Marvin Lipofsky Archive, Rakow Library, The Corning Museum of Glass)

Dale Chihuly

"Glass…is a continuing source of inspiration for me. It is transparent, translucent, and opaque – anything you want it to be. And you can make form with your own human breath. Just think."

~Dale Chihuly

Dale Chihuly, “Fern Green Tower”, (1999, reconfigured 2013)

“Although a stellar product of the studio glass movement which made it possible for individuals to work directly in hot glass, he is unique in his ability to work through others. Lots of others. In short, he inspires. Like Emile Galle and Louis Comfort Tiffany his designs, his ideas are brought into existence by specialized craftsmen. But unlike them, he is not a factory owner but rather the leader of a team which forms and reforms as projects and production require.”

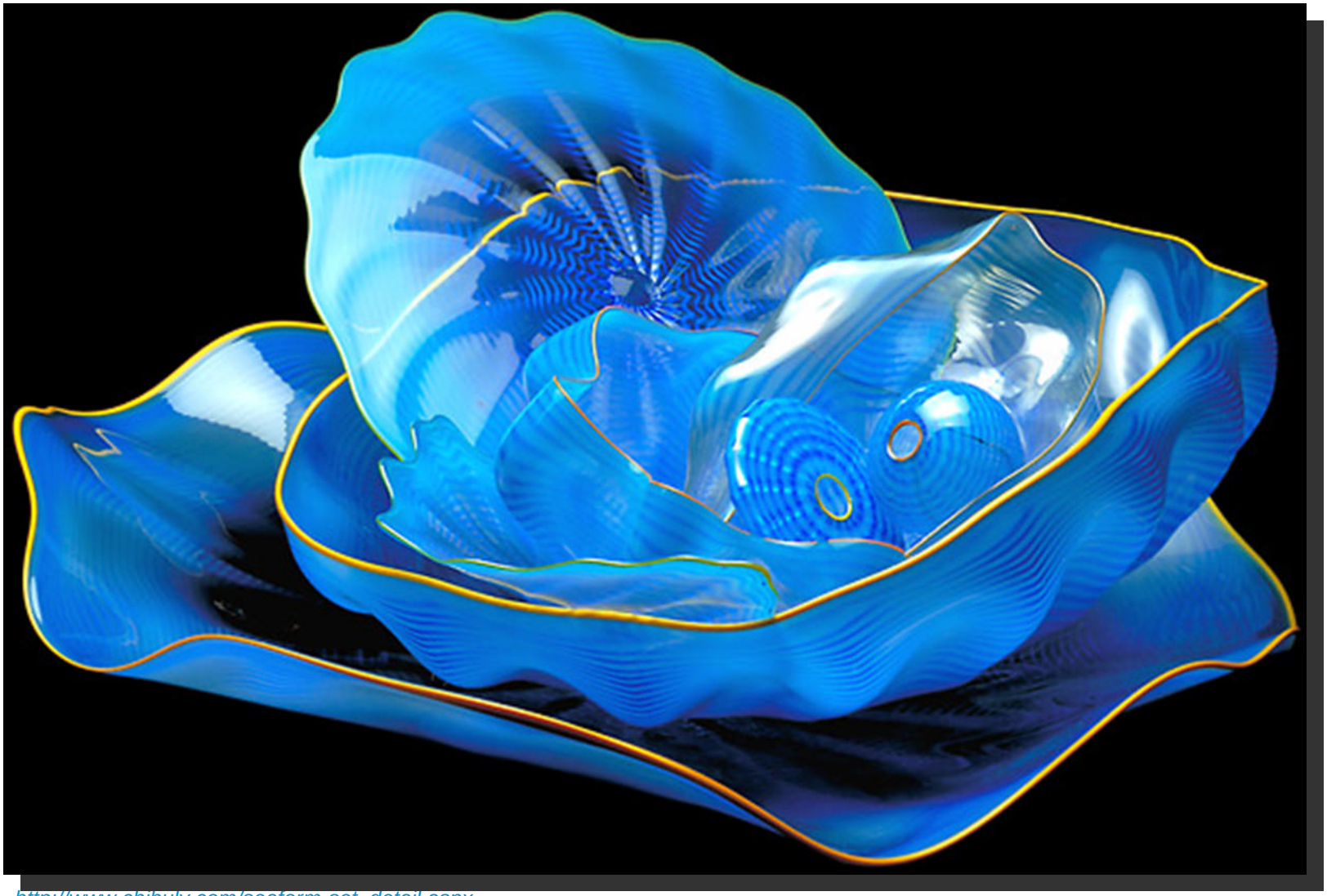
~Thomas S. Buechner

Dale Chihuly, “Erbium Chandelier with Gilded Putto”, (1993)

“(I tried) to make the forms appear as natural as possible, using as few tools as I could. I wanted to concentrate on using the fire from the furnace as well as centrifugal force and gravity. This meant letting glass find its own form, so that the pieces could appear very fragile and natural.” Dale Chihuly, (Published in Chihuly's Pendletons, Portland Press, 2000)

http://www.cmog.org/artwork/erbium-chandelier-gilded-putto

Dale Chihuly, “Honeysuckle Blue Seaform Set with Yellow Lip Wraps” (1990)



http://www.chihuly.com/seaform-set_detail.aspx

Dale Chihuly, “Fiori di Como” (1998)

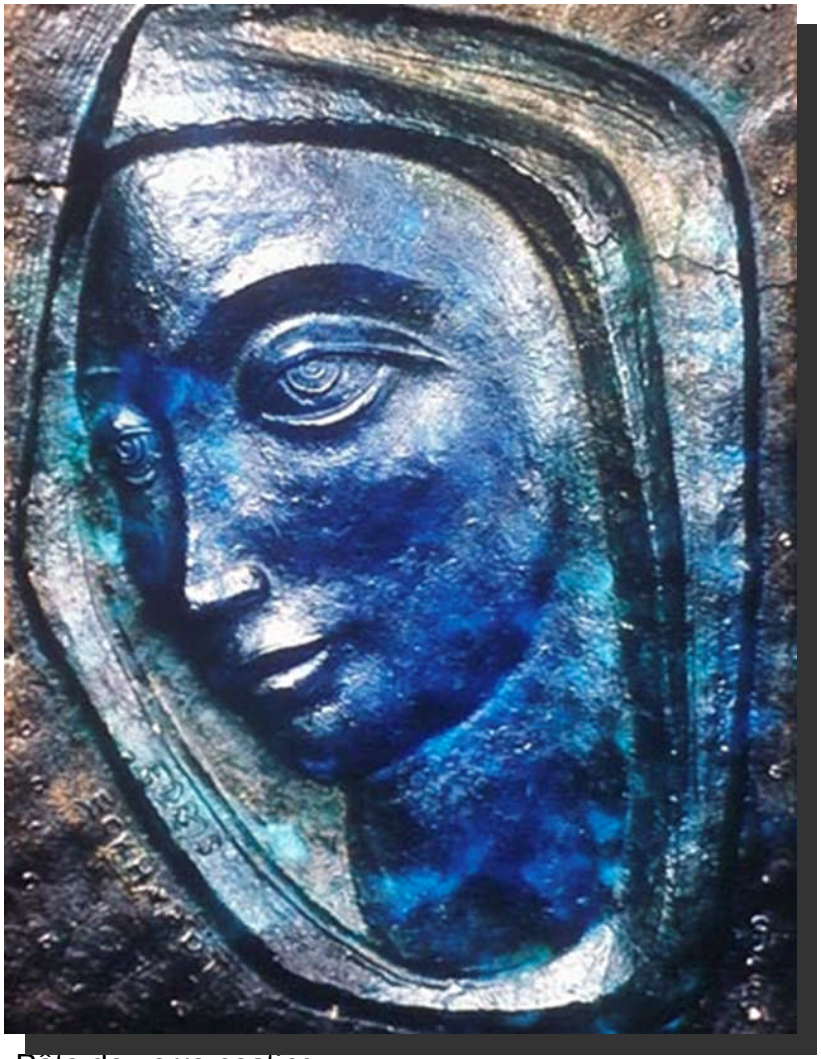
rumored to be a $40M commission

**BELLAGIO RESORT,
LAS VEGAS. NV**

http://www.chihuly.com/bellagio-selected_detail.aspx

A brief digression: Studio Glass Pioneer: Sculptor & ceramist Edris Eckhardt was an innovator in “warm glass” techniques.

Courtesy of Joe Kisvardai



Pâte de verre casting

Edris Eckhardt, “Dream Sequence” (1974)

http://americanart.si.edu/collections/search/artwork/?id=7877

Eckhardt started working in glass in the 1950s, inspired by ancient Roman and Egyptian pieces. Between 1953 and her death in 1998, Eckhardt produced and sold more than four thousand objects, and her patrons included Eleanor Roosevelt, John F. Kennedy, and Queen Elizabeth II.

Among her accomplishments were recreating ancient techniques combining gold foil and glass and combining bronze and glass

“Every artist must occasionally take stock of himself, his time, his relationship to it. He must constantly change, enlarge, diversify or be left stranded on an island of his own making while the stream of life

flows by.”

~Edris Eckhardt

Evening Dress with Shawl – Karen LaMonte (2004)

Photo by the author, Corning Museum of Glass

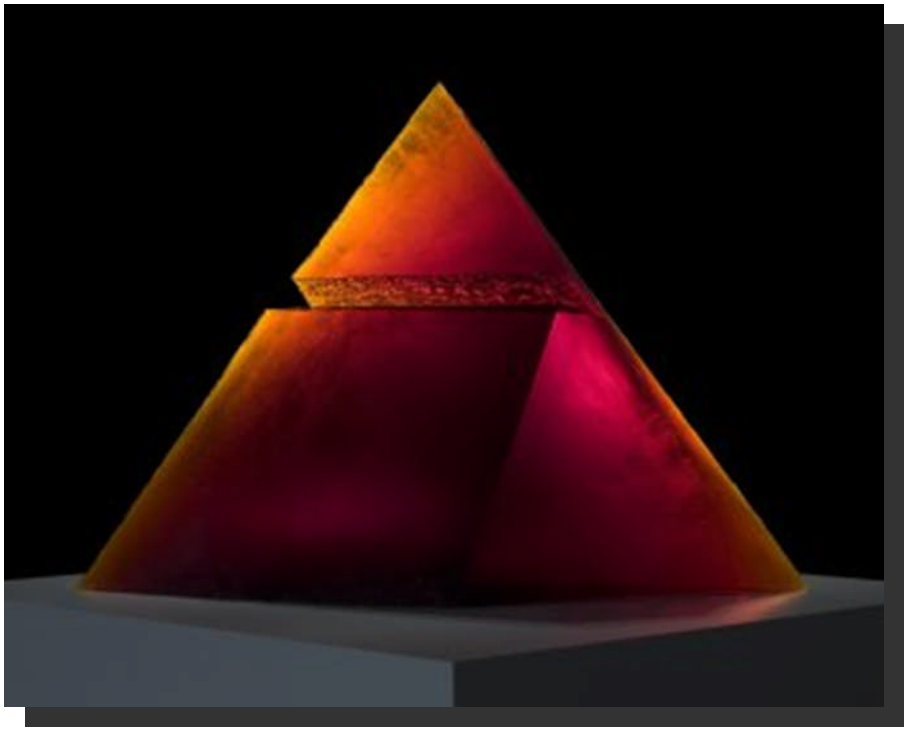
"I use clothing as a metaphor for identity and human presence. Rendered in glass, clothing becomes a window to the interior, where on the impression of the physical body remains."

Karen LaMonte as quoted in Corning Museum of Glass exhibition of "Evening Dress with Shawl".

Jaroslava Brychtova & Stanislav Libensky, “Heart/Red Flower” (1976) and “Red Pyramid” (1993).

“Someone once said, ‘Science is a ladder which you can climb rung by rung, but art has wings.’”

~Stanislav Libenský



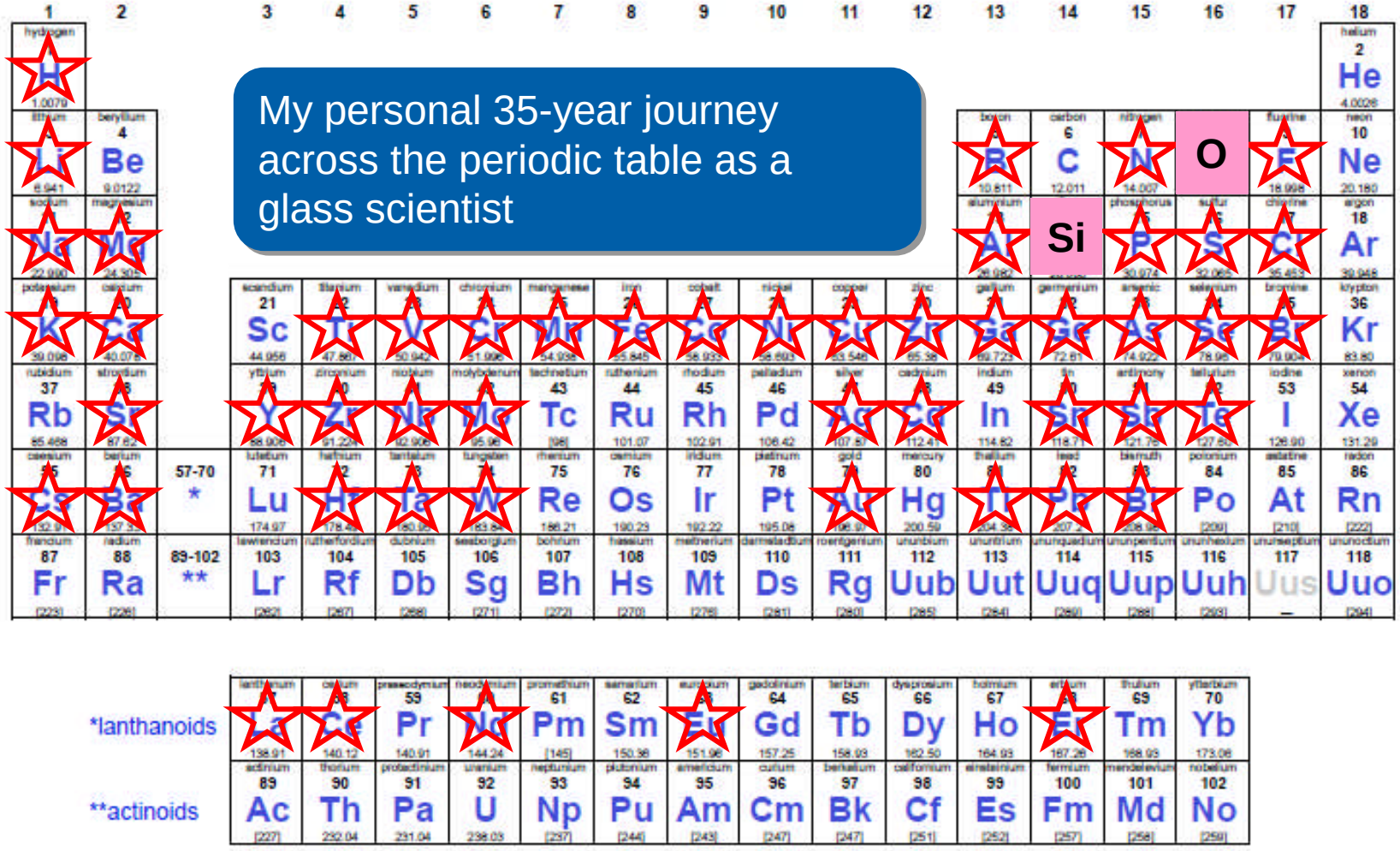
Why is it about glass that captures the imagination of artists? *(My list adapted from artists and critics)*

- Glass has substance that you can see through.
- Glass is versatile in its ability to "hold light" and can do so employing the entire optics palette: transparency, opacity, translucency, iridescence, birefringence, diffraction…
- Glass has a contradictory nature exhibiting at the same time strength & fragility, vitality & inertness, mass & buoyancy…
- Glass is often called (incorrectly) a "rigid liquid," and has unique abilities to give form to the amorphous & fluid, such as water, air and light.
- Glass can be machined, etched, abraded, fractured & pulverized and then through fire, healed in all or in part or, indeed, transformed to have no memory of its history.

Underlying reasons for the synchronicity of Information Age Glass & Glass as an Artistic Medium

- Is there a shared enabling technology?
- Are they different manifestations of the same sociological trends?
- or…is this a cosmic coincidence that arises from the Nature of Glass Itself?

The one common technology that was enabling both was the periodic table…but this dates to 1868.

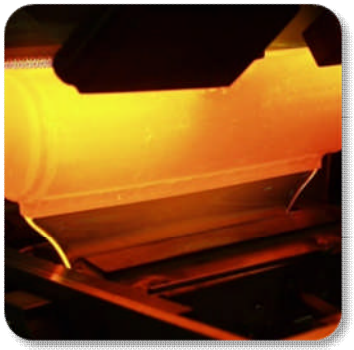


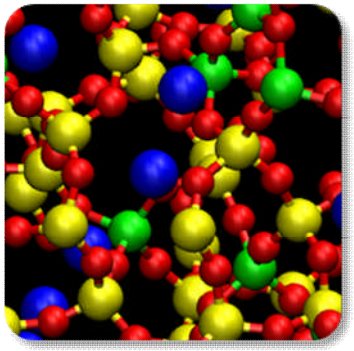
Thanks to Marv Bolt, Science Curator at CMOG

My conclusion is that it is a Cosmic Coincidence that is based on shared value equation with technological glass.

Agile & scalable specialized manufacturing process

Glass formulation engineered for intended application





Surface

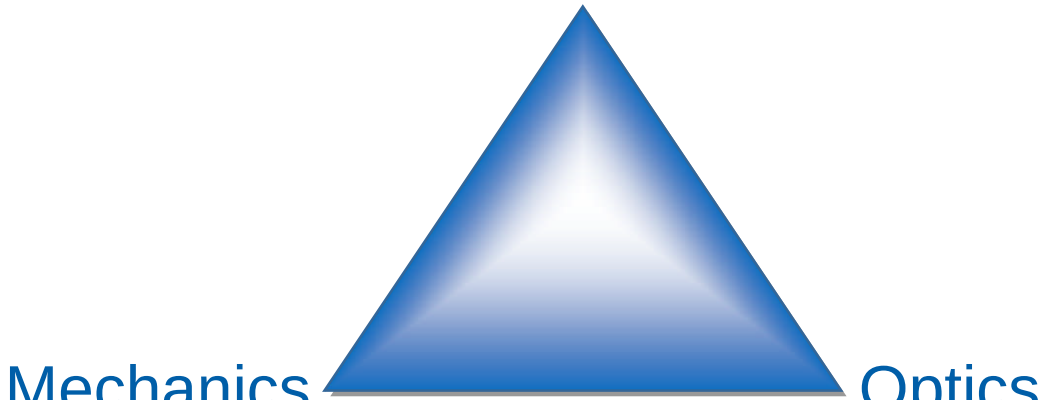
Mechanics

Optics

My conclusion is that it is a Cosmic Coincidence that arises from a shared value equation of art & technical glass

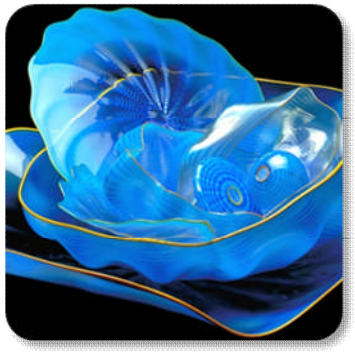
Personal & collaborative fabrication & transformative tools for crafting the artistic vision

Palette of glass intrinsic & extrinsic capabilities combined with those of other materials

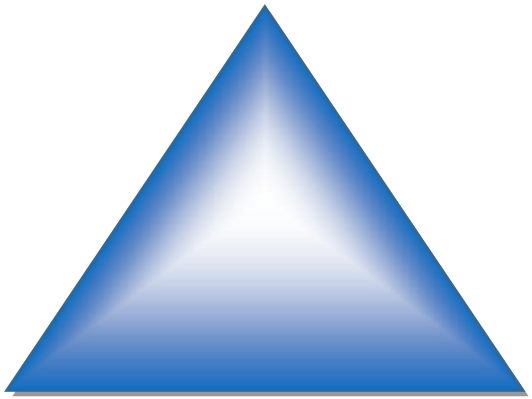


How does the artwork shown today map to this value equation?

Texture



Form

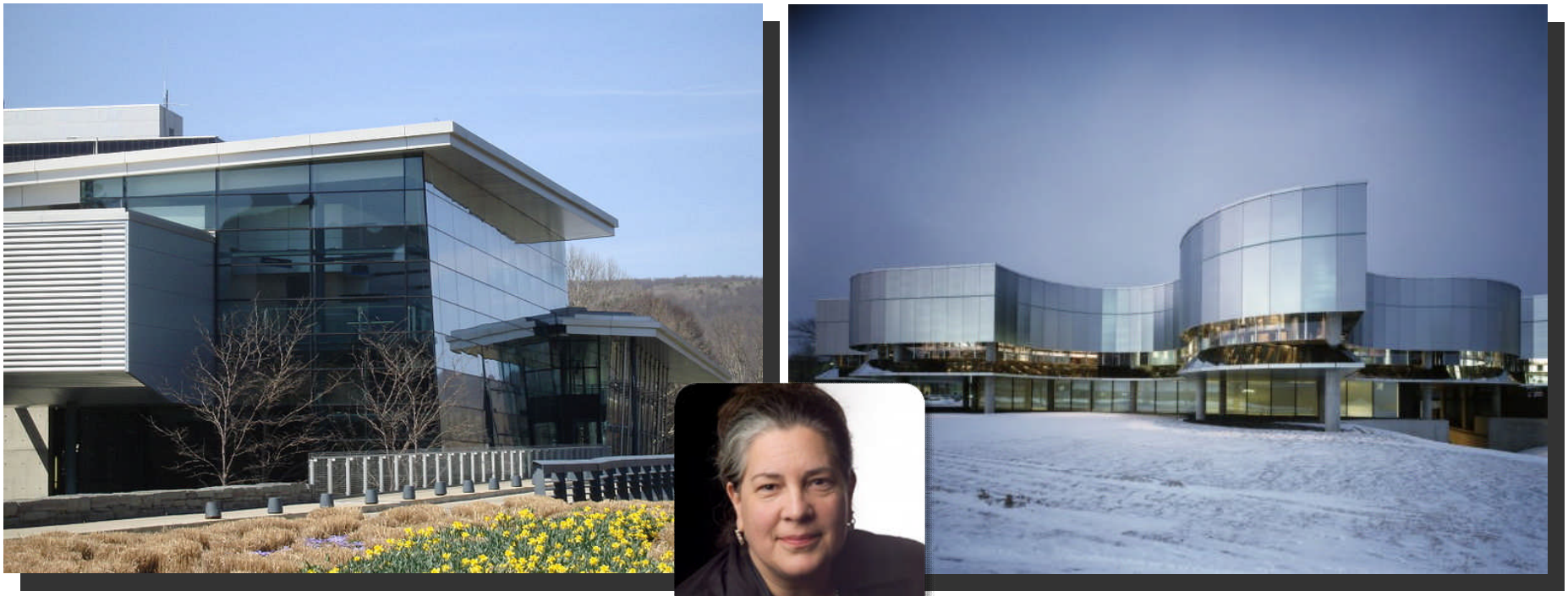


Light

Conclusion

- As we converge on a future of Information Immersion & Comprehensive Interconnectivity depicted in the Day Made of Glass, functional roles for glass have proliferated.
- Coincident with these trends, the use of glass as a purely expressive artistic medium has also flourished.
- It is proposed that this is a Cosmic Coincidence arising from the unique & transcendent ability of glass to mediate human communication through form, surface & light.
- I encourage you to visit Corning Museum of Glass and explore these themes yourself!

The author expresses deep gratitude to Corning Museum of Glass (CMOG) & especially Tina Oldknow for insights & guidance



http://www.cmog.org/

Tina Oldknow,
Senior Curator of Modern and Contemporary Glass

In December a 100,000 ft^2 expansion of CMOG includes a spacious contemporary art gallery & new 500-seat hot glass blowing theater

http://www.cmog.org/

CORNING