

# Four reflexions on plexiglass

by misha volf

## 01 INVENTION

*Material is from what we make. To take the word at its Latin root, it is that which comes from 'mother earth' (mater). Or, in a less extractive formulation, material is substance, that which stands below, the ground on which things rest. Materials shape and structure the made world. But, while materials possess this aura of primacy, what often goes unobserved, is that materials themselves are inevitably products that must be made. Another set of ends from preceding means. This means-to-ends procession, like artifice itself, is a human invention, since what 'mother earth' immediately provides is not inherently useful towards making, and thus not a material.<sup>1</sup> Ore is made into a material by mining. Nothing usable exists as is; we make it so.*

As cars began to mature in the 1920s, windshields became a major concern for automobile manufacturers. Made from plate glass, windshields would often shatter even in minor accidents, causing gruesome injuries to passengers and drivers.<sup>2</sup> Seeing an opportunity, a

young chemical company called Rohm and Haas pursued the development of a shatterproof, laminated safety glass with an acrylic based interlayer. Working in his lab, Otto Rohm and his assistant Walter Bauer formulated a new compound, methyl methacrylate, which they hoped would produce a superior laminate. During one experiment, the liquid compound was poured between two sheets of glass and exposed to light in order to trigger the hardening process. When the team attempted to examine the composite however, they were surprised to find that the top sheet of glass slid right off, separating cleanly from the inner layer, revealing a perfectly transparent, smooth-as-glass sheet of acrylic.<sup>3</sup> This is Plexiglass, the trade name for an acrylic thermoplastic, which is brilliantly clear, shatterproof, weather resistant, half the weight of glass, easily formable with heat, and rigid when cool. By pursuing shatterproof glazing, Rohm and Bauer found a plastic with all the benefits and none of the vulnerabilities of glass.

What's happened? Plate glass, which has worked for horse carriages, no longer works for cars. Automobiles move faster and collide more often. The material's prime property, transparency, is suddenly compromised by its hitherto sufficiently mitigated, secondary property, fragility. Rigid iron framing of early cars in tandem with motorized speed break the glass, not only in its produced manifestation, but also as an idealized material;<sup>4</sup> glass becomes deficient because the things made from it, demand more from it. A reinforcing attempt is made with acrylic in order to address the deficiencies, but glass resists the reinforcements. Instead, acrylic directly receives, by polymerized transmission, the rigid, translucent properties of glass. Acrylic becomes glass that bends and doesn't shatter into sinister slivers. Acrylic becomes glass that is beyond glass. Acrylic becomes a material.



FIGURE 1A

# 02 PLANES

*The made world is made from materials based on their capacities, vulnerabilities, histories, and associations. The things that emerge from these materials are not only oriented towards their intended use, but also refer back to the material's attributes. The thing engages the material in a fundamental way. Just as material becomes itself in the moment of its production, in that it becomes workable, this 'becoming itself' happens again but in a different way, when material is worked into a thing and the material's attributes are activated to serve the thing. The thing and the material are in a dialectic; the material passes its attributes to the thing, while the thing shapes the material towards its own function.*



FIGURE 1B

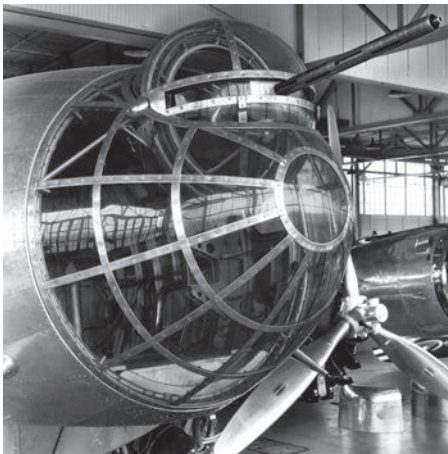
**FIGURES 1A, 1B, 1C.** Development of the acrylic nose in the B-17 Bomber.

*Note how 2a, a 1935 prototype – Model 299, shows a completely conical, segmented 'greenhouse' nose. In the 1939 model shown in 2b, the shape of the nose of the B17-B, develops a flattened underside to accommodate the Norden bombsights. 2c shows a B-17F, with a completely frameless nose, and bombsight visible inside.*

Rohm and Haas saw applications for plexiglass right away as they pursued military contracts. The material's ease of forming and resistance to impact made it ideal for airplane canopies, turrets, and gun blisters, giving pilots and gunners panoramic views of terrain and enemies (see *Figs. 1a-c*). In 1942, the *New York Times* described the air battle experience this way: "Butt-End Charlie [...] is the gunner who mans the 'stinger' in the rear of the big bombing planes [...]. Riding backward in his tiny plexiglass-walled cubicle, [...] he squints through his gunsight at a dark speck swooping down from the blue."<sup>5</sup>

The acrylic was most essential in the front noses of bomber planes, where wide and unobstructed fields of view were required to accommodate the Norden Bombsight, an aiming mechanism developed by the U.S. military in its pursuit of

FIGURE 1C





**FIGURE 2** nose of the plane. Note the lack of wavy distortion in the triangular section in the center, and the effect of the distortion on the rest of the material.

strategic precision bombing. This presented a challenge to plexiglass. The heat forming process that was used to make the cone shaped noses would introduce minor optical distortions, negligible for general landmark identification and way finding, but inadequate for the bombsight, which required a higher degree of clarity through a small section of the nose. To resolve the issue, this section was cut out from the completed form and then reinstalled as a separate, detachable plate, cut from flat, unformed and undistorted stock. If damaged, it was easily produced and replaced in the field, eliminating the need for rehabilitating the damaged plexiglass component.

The Norden, the plane, the crew, the designers of the plane, the field repair technicians, and the plexiglass now enter a conversation. The plane needs to be aerodynamic, so a smooth curved shape is required. The bombardier needs an unobstructed view, so the nose develops from a segment-

ed 'greenhouse' configuration to a frameless bubble. Finally, the Norden needs a flat, optically pristine surface through which to aim, so the nose is reshaped with a flattened underside and a removable, interchangeable sight window (see *Figure 2*). As acrylic sheet is deformed, a capacity alien to its glass progenitor, it forfeits some of its vitreous quality. Flat stock, having undergone fewer transformations after its production, is in this sense closer to glass, and retains its pristine transparency.

# 03

## MAGIC

*The thing, then, is already in the material. Not unlike sculpture from stone, the thing emerges from the material through the material's attributes. As things and materials interact with other things and materials, their attributes also interact; histories mingle with capacities, vulnerabilities reject associations. Celluloid, an early plastic invented to replace ivory in billiard balls, failed for being too soft. It did, however, inadvertently replace tortoise shell used in hair combs.<sup>6</sup> Nevertheless, thing and material never separate. Material is inescapable. The more a thing emerges out of the material, the more treacherously the material closes in on the thing. The thing becomes the material as the material disappears.*

There is a scene in the 1939 film *Eternally Yours*, where Loretta Young's character, an angelic maiden, is synthesized in a giant lab retort by a magician-chemist. The film made an effort to make the retort look and sound like glass, as evidenced by the resonant knock the magician gives the retort. In fact it was made from clear acrylic by Dave Swedlow, a California designer and fabricator who made early use of the material in furniture and small household objects. "Gleaming, clear, light in weight, and almost impossible to smash," the San Bernardino County Sun raved about Swedlow's work, "these new ornaments and furniture will add light and beauty as well as 'newness' to your home."<sup>7</sup> The scene's less than subtle coding of science as magic, signaled the arrival of a new age where anything seemed possible with science and technology—from concocting a perfect female, to any number of new synthetic materials with incredible properties, to an abundance of products restyled and updated annually to add "newness." What Loretta Young seemed to deliver as she

**FIGURE 3** Loretta Young in *Eternally Yours*, 1939, emerging from a plexiglass retort.





**FIGURE 4.** A woman posing for a photo at the Douglas Aircraft Company Plant, emerges through the Norden Bombsight section of a B-17 bomber nose. Her yellow tag says 'Temporary Employee #3007.'

emerged from the chemistry mixture was the modern promise of progress, transcendence of nature through artifice, and the self-assurance of absolute technical prowess. In a similar sense, this is what Temporary Employee #3007, also from a plexiglass bubble, delivered to the U.S. military in the form of a frameless bomber plane nose (see *Fig. 4*).

The true magic of acrylic lies in its power to reveal, whether the object is target or product. At the 1939 World's fair, General Motors showed a transparent Pontiac Deluxe Six with a body made of formed plexiglass, showing the inner construction of the vehicle.

Across the fair grounds, another manufacturer was also revealing the innards of a new product through clear acrylic. RCA produced a plexiglass replica of an early television, which gave the "public [a] close-up view of mysterious parts that the owner would never see in his receiver." The announcement in *Popular Mechanics* magazine continued:

*Some of the secrets of television reception are disclosed to the public by a glass-encased receiver .... Those who see the set gain an impression of the genius out of which grew such an involved and intricate piece of magic in this newer field of radio.<sup>8</sup>*

"These are the days of miracle and wonder," Paul Simon sings in his song "The Boy in the Bubble."

In an age of wonder and amazement at technology that is beyond immediate comprehension, the way things work becomes spectacle. As the bombardier gazes from his plexiglass bubble at the infrastructure of cities below, he too observes how they work, and subsequently intervenes in their working from his divine vantage. But the bombardier is not just the observer. He, along with the .5 caliber machine guns, and the bombsight, is the technology inside the acrylic display case. The subject object relationship becomes unstable. Like the bombardier, the car and the television set become participating agents, re-making the outside world as much as being made by it.





**FIGURE 5** *The Pontiac Deluxe Six, "Ghost Car" with a plexiglass body produced by Rohm and Haas for the 1939 World's Fair in New York.*

## 04 CONVERSIONS

Velocity penetrates glass as if it isn't there; a surface dematerialized because it is invisible. Cars, airplanes, bullets, people, stones—all projectiles marking a path through Newtonian space and time, meeting and annihilating glass with the power of speed, making the surface visible just as it ceases to be a surface. No, this is not the material of the imagined, hurtling modernity. The truly modern plane of impact between transparency and projectile is plexiglass. This relationship between carbon-based acrylic, a chemically synthesized thermoplastic, and glass, its inorganic, much less pliable predecessor, provides a complex screen through which to observe the making project. That transparency is such a ubiquitous experience of the 20<sup>th</sup> century—the most destructive on record—points to a power and a fragility embedded in exposure.

Plexiglass, so often used as a material, is itself a product, made from acetone and hydrogen cyanide. These two components are of course products themselves: acetone of petroleum and hydrogen cyanide, a formulated compound used as poison gas and as an electroplating agent in precious metal mining operations. The material becomes a thing that's at the same time deeply steeped in its materiality. Entities shuttle freely between states, presenting attributes selectively. Insofar as we make from the already made, the thing-material dialectic ultimately serves to weaken the dichotomy. The ends to means conversions keep coming.

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