



On August 4, 2020, an explosion of 2,700 tons of ammonium nitrate, improperly stored at the Beirut Port, sent a pressure wave across the city that pulverized structures in its way and shattered more than 5,000 tons of glass.¹ Broken glass was later found as far as 10 kilometers away from the explosion site.²

That day, it seemed “it was raining glass all over the city.”³ For days, glass blanketed the city’s streets, crunching beneath our feet; shards, splinters, and shavings were lodged in our shoes and furniture, and scraped our skin.

For weeks, glass plates circulated on trucks as we rushed to replace windows and doors; construction workers gracefully carried glass panes on their backs and used machinery to lift glass panels up many floors in a frenetic *ballet de reconstruction*.

For months, cardboard and nylon stood in glass’s place and glass pieces lived on in the cracks in the pavement and soils of planters.

After the rain, glass seemed to be everywhere.

1) Alex Horton, *What the Videos of the Beirut Blast Tell Us About the Explosion*, The Washington Post, August 5, 2020, <https://www.washingtonpost.com/world/2020/08/04/beirut-explosion-ammonium-nitrate/>, last accessed December 28, 2020; Rachel Lance, *The Tragic Physics of the Deadly Explosion in Beirut*, Wired, August 6, 2020, <https://www.wired.com/story/tragic-physics-deadly-explosion-beirut/>, last accessed December 28, 2020; Robert McKelvey, *In Lebanon, Blasted Beirut Windows Turned into Traditional Glassware*, Al Arabiya English, September 22, 2020, <https://english.alarabiya.net/en/features/2020/09/22/In-Lebanon-blasted-Beirut-windows-turned-into-traditional-glassware>, last accessed December 28, 2020.
2) *Expert Reaction to Beirut Explosion*, Science Media Center, August 5, 2020, <https://www.sciencemediacentre.org/expert-reaction-to-beirut-explosion/>, last accessed December 28, 2020.
3) *Beirut Blast Witness: It Was Raining Glass All Over the City*, China Global Television Network (CGTN), August 5, 2020, <https://news.cgtn.com/news/2020-08-05/Beirut-blast-witness-It-was-raining-glass-all-over-the-city-SHJuGEBS9y/index.html>, last accessed December 28, 2020.
4) Julian Henderson, *Ancient Glass: An Interdisciplinary Exploration*, Cambridge University Press, Cambridge 2013, p. 2.
5) *Glass in Nature*, Corning Museum of Glass, <https://whatson.cmog.org/exhibitions-galleries/glass-nature>, last accessed December 28, 2020.
6) Nelson Shaffer, *The Time of Sands: Quartz-Rich Sand Deposits as a Renewable Resource*, in “Electronic Green Journal”, Vol. 1, No. 24 (2006), <https://escholarship.org/content/qt6m743258/qt6m743258.pdf>, last accessed December 28, 2020.
7) Himadri Panda, *The Complete Technology Book on Asbestos, Cement, Ceramics, and Limestone*, Asia Pacific Business Press Inc., Delhi 2016, p. 438; The Editors of Encyclopaedia Britannica, *Obsidian*, Encyclopaedia Britannica, January 20, 2020, <https://www.britannica.com/science/obsidian>, last accessed December 28, 2020.
8) Lamya Khalidi, *et al.*, *Results of Geochemical Analyses of Obsidian Artefacts from the Neolithic Site of Tell Labwe South, Lebanon*, in “Stone Tools in Transition: From Hunter Gatherers to Farming Societies in the Near East”, eds. Ferran Borrell, *et. al.*, Universitat Autònoma de Barcelona, Barcelona 2013, pp. 475–494.

Today, glass is almost as widespread in our surroundings as it is old. From consumer goods packaging and tableware to architectural features and electronics, glass has countless industrial applications and everyday uses.

Long before glass was made by humans, glasses found in nature were cut and carved.⁴

In the natural world, glass forms when silica-rich sands and rocks melt, then rapidly cool. Natural glasses can be found at the sites of volcanic eruptions, meteorite impacts, and lightning strikes.⁵ The silica from which glass forms is abundant in Earth’s crust; its constituent elements—silicon and oxygen—were present in the star chunks that amassed to create our planet. Silica takes various natural forms besides glass, including quartz crystals and quartz sands;⁶ these were drawn on by humans in ancient glass-making.

Shiny jet-black obsidian is a relatively common natural glass that was chiseled into weapons and tools back in the Stone Age.⁷ In Lebanon, obsidian objects predating 6500 BC have been unearthed in the Beqaa Valley and Anti-Lebanon Mountains; these were fashioned from obsidian from Turkey and indicate early long-distance trade as well as the value ascribed to glass.⁸



The oldest glasses were made by heating a mix of silica derived from sand with either plant ash or natron from dry lakebeds and limestone. These additives contained⁹ soda, which reduced sand’s high melting point and enabled glass production in ancient furnaces, and lime, which increased the resulting glass’s durability.¹⁰

Glass was likely first accidentally made in the kilns of metal workers where silica from furnace bricks would have interacted with the ashes of plants burnt for fuel.¹¹ Some vitreous ceramics also predate glass and may have provided inspiration. In these, natron or plant ashes were glazed onto or mixed in with silica-rich stones and sands that, when fired, developed glass-like effects. Beginning in as early as the 5th millennium BC, ancient Egyptians and Mesopotamians developed various forms of such ceramics including glazed steatite, faience, and frit, all of which were meant to imitate semi-precious stones.¹² Stones like turquoise—and by extension faience—were associated with the sky and gods in ancient Egypt and possibly seen “as solidified pieces of the heavens.”¹³

Glass was likely first intentionally made around 2500 BC in ancient Mesopotamia. Opaque beads were the earliest glass objects produced. Glassmaking remained limited in scope and scale until around 1500 BC, when the first glass vessels appeared.¹⁴ Glass recipes and methods are thought to have traveled from Mesopotamia to Egypt and Phoenicia in Lebanon and from Lebanon onto Cyprus, Greece, and Italy.¹⁵

9) Brooks Hanson, *Tracing the Ancient Glass Trade*, in “Science”, Vol. 329, No. 5991 (2010), p. 492; Arun Kumar Varshneya, *Industrial Glass*, Encyclopaedia Britannica, May 10, 2016, <https://www.britannica.com/topic/glass-properties-composition-and-industrial-production-234890/History-of-glassmaking>, last accessed December 28, 2020; Michael Tite *et al.*, *The Beginnings of Vitreous Materials in the Near East and Egypt*, in “Accounts of Chemical Research”, Vol. 35, No. 8 (2002), pp. 585–93.
10) Julian Henderson, *op. cit.*, p. 5.
11) *Ivi*, pp.6–10.
12) *Ivi*, pp.13–18.
13) Paul Nicholson, ‘Stone... that Flows’: *Faience and Glass as Man-Made Stones in Egypt*, in “Journal of Glass Studies”, Vol. 54 (2012), p. 12.
14) Julian Henderson, *op. cit.*, p. 8.
15) Arun Kumar Varshneya, *op. cit.*; Richard Grossman, *Ancient Glass: A Guide to the Yale Collection*, Yale University Art Gallery, New Haven 2002, p. 6.
16) The Phoenician city-state of Byblos dates back to the 3rd millennium BC but the remaining city states begin to urbanize in the 15th century BC, when the Phoenician civilization experiences a flourishing. Department of Ancient Near Eastern Art, *The Phoenicians (1500 – 300 B.C.)*, Heilbrunn Timeline of Art History, The Metropolitan Museum of Art, New York 2004, http://www.metmuseum.org/toah/hd/phoe/hd_phoe.htm, last accessed December 28, 2020.
17) *Glass through the Ages* (Wall Text), American University of Beirut Archaeological Museum, Beirut, no date.
18) Mark Cartwright, *Roman Glass*, Ancient History Encyclopedia, August 5, 2013, <https://www.ancient.eu/article/592>, last accessed December 28, 2020.
19) Mark Cartwright, *Trade in the Phoenician World*, Ancient History Encyclopedia, April 1, 2016, <https://www.ancient.eu/article/881/trade-in-the-phoenician-world>, last accessed December 28, 2020.
20) Douglas Main, *Humankind’s Most Important Material*, The Atlantic, April 7, 2018, <https://www.theatlantic.com/technology/archive/2018/04/humankinds-most-important-material/557315>, last accessed December 28, 2020.
21) Alan Macfarlane and Gerry Martin, *Glass: A World History*, The University of Chicago Press, Chicago 2002, p. 14.
22) *Sidon Ancient Glass Center*, Ancient Glass Blog of the Allaire Collection, April 12, 2019, <https://ancientglass.wordpress.com/2019/04/12/sidon-ancient-glass-center>, last accessed December 28, 2020.
23) *Artas*, The British Museum Collection, <https://www.britishmuseum.org/collection/term/BIOG57231>, last accessed December 28, 2020; Christopher Lightfoot *et al.*, *Ennion: Master of Roman Glass*, The Metropolitan Museum of Art, New York 2014.
24) Marilyn Jenkins, *Islamic Glass: A Brief History*, “The Metropolitan Museum of Art Bulletin”, Vol. 44, No. 2 (1986); *Islamic Glass*, Ancient Glass Blog of the Allaire Collection, <https://ancientglass.wordpress.com/historical-glass-periods/islamic-glass-2>, last accessed December 28, 2020.
25) Fred Aldsworth *et. al.*, *Medieval Glassmaking at Tyre, Lebanon*, in “Journal of Glass Studies”, Vol. 44 (2002), pp. 49–66.
26) Karen Karam, *The Ancient Art of Glassblowing*, 365 Days of Lebanon, May 23, 2016, <https://365daysoflebanon.com/2016/05/23/the-ancient-art-of-glassblowing>, last accessed December 28, 2020.



The American University of Beirut’s Archaeological Museum holds an impressive collection of glassware from ancient to Islamic times. Among these are everyday wares from the Roman era, including a blue bowl (Inventory #3925) decorated with curved ribs and a fluted green flask (Inventory #4150) with grooved handles.²⁷

For over 2,000 years, these wares survived events like the earthquake and tsunami of 551 AD²⁸, which left Tripoli “drowned” and Beirut unrecovered for 1,300 years;²⁹ the Lebanese Civil War (1975–1990), which destroyed much of Beirut’s built environment; and various Lebanese-Israeli conflicts and Israeli air strikes.³⁰

On August 4, 2020, a display case of everyday Roman and Islamic glassware was badly damaged. Of the 74 wares it held, including the blue bowl and green flask, 57 were found impossible to restore.³¹

Glass’s tendency to shatter in the way it does makes the restoration of historic glassware especially difficult.³² This tendency results from how glass forms,³³ with melted silica cooling too quickly for the crystalline structure typical of solids to take shape. Not only does this give glass its much-noted “frozen liquid” or “melted solid” look³⁴, it also means that unlike a solid, which cracks regularly along its crystalline structure, glass, which lacks crystals, has myriad points of weakness and shatters in irregular ways.³⁵

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Though long-practiced, glassmaking was mechanized beginning in the late 19th century, when the Industrial Revolution ushered in technological developments like bottle blowing and flat-glass machines.³⁶ In Lebanon, glass was only ever machine-made for consumer goods packaging like bottles; the country’s two major glass factories were established in the late 1950s and early 1960s and at one point operated at relatively large scales.³⁷

Producing 200 tons of glass daily, the Maliban glass factory³⁸ was one of 127 factories that were destroyed by Israeli rockets in the 2006 Lebanon-Israel War.³⁹ Maliban was never restored or rebuilt. Producing 140 tons of glass daily, Soliver glass factory struggled for many years to balance between having to produce for its own power needs given Lebanon’s unreliable electricity grid and compete with cheaper imports. Soliver shut down almost a decade after Maliban was bombed.⁴⁰

In the story of Maliban and Soliver, glass becomes a prism through which to see the country’s trajectory from early post-colonial industrialization initiatives⁴¹ to the failure of the post-civil war state and its infrastructure projects like electrification. Today, only small-scale plants like Koubeitri (est. 1949) remain. These rely on recycled glass and use a mix of handmade and mechanized methods.⁴² As a result, nearly all glass has to be imported from neighboring countries, with imported glass sometimes reworked.⁴³

On August 4, Beirut found itself facing a glass crisis. Glass stores and warehouses in Lebanon were subsequently emptied, and glass was donated and imported by the boat-load and plane-load from Egypt to France. The land that had been crucial to the global evolution of glass—“humankind’s most important material”⁴⁴—found itself dependent on glass production from around the globe.



In the 20th century, technological developments met with aesthetic tastes to produce modern architecture and its predilection for glass.⁴⁵ With glass’s mechanization, large windows were no longer solely the domain of the rich and became increasingly common features of urban environments.⁴⁶ Glass was leveraged by modern architects to let in light and dematerialize built space.⁴⁷ Although glass for architecture was never manufactured in Lebanon, glass in buildings and glass buildings do abound.⁴⁸

The first building in Beirut to use floor to ceiling glass curtain walls was the modernist Murr Building (1957), also known as the Horseshoe Building, which lies on the busy commercial Hamra Street.⁴⁹ The Murr Building was erected at a time of rapid architectural modernization in Beirut that took place from the 1950s to 1970s. This was a time when high-rise development, especially of commercial office buildings, intensified, spurred by density-favoring land-use laws and profitable tax revenues for the Beirut municipality.⁵⁰

The post-Civil War era saw an increasing significance of rents and real estate for the Lebanese economy.⁵¹ By the late 2000s and 2010s, high-end postmodern glass towers began sprouting across Beirut. From the Four Seasons Hotel to the Marina Towers, from Platinum Tower and Sursock Tower to the Beirut Terraces, Beirut’s skyline—and real estate market—experienced a radical transformation.

Standing at 50 stories high, the city’s tallest tower, Sama Beirut—translating to “the sky of Beirut”—looms over all else; its blue glass panels blend it into its ethereal surroundings. Sama Beirut’s developers promote the tower’s “majestic” presence over the capital and the all-seeing, all-knowing views it offers of Lebanon, stretching from Mount Lebanon to the bay of Jounieh to the port of Beirut.⁵²

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Over time, high-end towers like Sama Beirut inflated housing prices in Lebanon and made real estate synonymous with investment.⁵³ Glass lined sea-view developments came to command sky-high prices affordable only to the wealthiest of residents and to constitute “safe deposit boxes in the sky”⁵⁴ for regional capital.

On August 4, sea-view glass towers like Skyline Tower and Liv Lofts were among the worst-hit. Glass’s associations with premium, luxury, and wealth were extended and came to include vulnerability and threat. Shards from towers rained over the city, killing and wounding occupants and passersby. On that day, any sense of distinction by prosperity was (momentarily) shattered as the fragility of Lebanon’s broken economy and politics was made ever so clear.

27) *Glass at the AUB Archaeological Museum*, information supplied to the researcher by the museum staff, American University of Beirut Archaeological Museum, Beirut 2020.

28) *#AUB4Beirut: Museum Recovery Fund*, YouTube, November 7, 2020, https://www.youtube.com/watch?v=_HZzNuCVPz4, last accessed December 28, 2020.

29) Ata Elias *et al.*, *Active Thrusting Offshore Mount Lebanon: Source of the Tsunamigenic A.D. 551 Beirut-Tripoli Earthquake*, in “Geology”, Vol. 35, No. 8 (August 2007), pp. 755–758.

30) *#AUB4Beirut: Museum Recovery Fund, op. cit.*,

31) *Glass at the AUB Archaeological Museum, op. cit.*

32) *AUB@Work - AUB Museum*, Facebook, August 27, 2020, <https://www.facebook.com/watch/?v=334977037551289>, last accessed December 28, 2020.

33) *Ceramics*, Chemed.chem.purdue.edu., <http://chemed.chem.purdue.edu/genchem/topicreview/bp/materials/ceramic4.html>, last accessed December 28, 2020.

34) Chris Woodford, *Glass*, Explain That Stuff, January 19, 2021, <https://www.explainsomething.com/glass.html>, last accessed December 28, 2020.

35) *States of Matter: Amorphous Solids*, Chemistry for Non-Majors, Lumen Learning, <https://courses.lumenlearning.com/cheminter/chapter/amorphous-solids>, last accessed December 28, 2020.

36) Arun Kumar Varshneya, *op. cit.*

37) Georges Nasrawi, personal communication, December 7, 2020, from here on referred to as “Nasrawi”.

38) Lysandra Ohrstrom, *War with Israel Interrupts Rare Industrial Success Story*, The Daily Star, August 2, 2007, <https://www.dailystar.com.lb/ArticlePrint.aspx?id=47270&mode=print>, last accessed December 28, 2020; IRIN, *Factories Come Under Fire*, Electronic Intifada, August 4, 2006, <https://electronicintifada.net/content/factories-come-under-fire/2650>, last accessed December 28, 2020.

39) United Nations, *Report of the Commission of Inquiry on Lebanon Pursuant to Human Rights Council Resolution S-2/1*, November 23, 2006, <https://www.un.org/ruleoflaw/files/A.HRC.3.2.pdf>, last accessed December 28, 2020.

40) Rania Ghanem, *Soliver Factory is to Close Down*, BusinessNews.com.lb, February 22, 2017, <http://www.businessnews.com.lb/cms/Story/StoryDetails.aspx?ItemID=5931>, last accessed December 28, 2020; Georges Nasrawi.

41) Lysandra Ohrstrom, *War with Israel Interrupts Rare Industrial Success Story*, The Daily Star, August 2, 2007.

42) Georges Nasrawi; Anthony Rahayel, *Al Koubaytari, Golden Glass: Recycling Glass, Producing Jars & Gallons in Tripoli Since 1949*, YouTube, August 17, 2020, <https://www.youtube.com/watch?v=ROr1AgD-b0s>, last accessed December 28, 2020.

43) Georges Nasrawi.

44) Douglas Main, *op. cit.*

45) The Editors of Encyclopaedia Britannica, *International Style*, Encyclopaedia Britannica, May 29, 2020, <https://www.britannica.com/art/International-Style-architecture>, last accessed December 28, 2020.

46) *Glass*, A Dictionary of Modern Architecture, University of Chicago, November 16, 2015, <https://voices.uchicago.edu/201504arth15709-01a2/2015/11/16/glass>, last accessed December 28, 2020.

47) Le Corbusier, *Glass, the Fundamental Material of Modern Architecture*, trans. Tim Benton, in “West 86th”, Vol. 19, No. 2, (2012), pp. 282–308.

48) Georges Nasrawi.

49) Georges Joseph Arbid, *Practicing Modernism in Beirut: Architecture in Lebanon, 1946–1970* (Dissertation), Harvard University, Cambridge 2002, pp. 120–121.

50) Maria Abunnasr, *The Making of Ras Beirut: A Landscape of Memory for Narratives of Exceptionalism* (Dissertation), UMass Amherst, Amherst 2013, pp. 245–274.

51) Hisham Ashkar, *Benefitting from a Crisis: Lebanese Upscale Real-Estate Industry and the War in Syria*, in “Confluences Mediterranee”, Vol. 92, No. 1, (2015), pp. 89–100.

52) *About*, Sama Beirut, <http://samabeirut.com/tallest-building-in-Lebanon>, last accessed December 28, 2020.

53) Kheir Al-Kodmany, *The Sustainability of Tall Building Developments: A Conceptual Framework*, in “Buildings”, Vol. 8, No. 7, (2018), <https://www.mdpi.com/2075-5309/8/1/7/htm>, last accessed December 28, 2020.

54) Oliver Wainwright, *The Truth About Property Developers: How They Are Exploiting Planning Authorities and Ruining Our Cities*, The Guardian, September 12, 2014, <https://www.theguardian.com/cities/2014/sep/17/truth-property-developers-builders-exploit-planning-cities>, last accessed December 28, 2020.