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A Mirrored City Underground: Air-Raid Shelters as Political Architectures in Barcelona and London, 1936–40

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ABSTRACT: Technological landscapes of war include a large repertoire of artifacts, both above and below ground, designed to sustain life under attack. During the Spanish Civil War (1936–39), Barcelona became a testing ground for new technological means of both destruction and protection. While the Fascist forces bombed the streets, a city of shelters emerged underground, mobilizing nature, knowledge, expertise, and community networks. On the eve of World War II, Barcelona’s civil defense experience attracted geopolitical interest and sparked heated debates in the British political arena. To shed light on the technopolitics of wartime protection, this paper delves into three types of air-raid shelters: gallery shelters, shaped by the revolutionary context and the rise of anarchism that Barcelona experienced after July 1936; cellular shelters, marked by the Communist and technocratic turn following the May Days of 1937; and Anderson shelters, representing Britain’s pre–World War II liberal politics. These shelters embodied different economics, gender constructs, and political ideologies, mirroring the social conflicts above ground.

Keywords: underground infrastructures; grassroots technopolitics; community networks; civil defense; Spanish Civil War; World War II

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Introduction

Knives, machetes, guns, missiles, and combat drones remain at the core of the most shameful chapters of world history. Yet the technologies of killing are only part of the technological landscapes of war and political violence. These landscapes are much wider and much deeper. They include a large repertoire of artifacts, both above and below ground, designed to protect human flesh and to take care of life under attack. Recent haunting images of mothers in Ukraine hurrying down to subway stations, dank basements, dark tunnels, or improvised huts in the woods evoked painful collective memories

across Europe and far beyond, reminding us of the long history of air-raid shelters. Examining this history and its remnants forces us to attend to the voices of the survivors and the shadows of the forgotten.¹ It also illuminates the entanglement between technology, politics, and the environment.

This paper delves into the history of air-raid shelters in Barcelona and London from the outbreak of the Spanish Civil War until the early days of World War II. It takes us down into the darkness of their spaces to shed light on how their underground materiality mirrored social struggles above ground. Their designs reflected disputed socioeconomic systems, gender constructs, and political ideologies. Their schemes became grounds for conflict, and their architectures were deeply political. In this sense, air-raid shelters serve as extreme examples for the historiographical task of answering whether artifacts do have politics and in which ways are they the result of political battles.² They allow us to explore “technopolitics” in life-and-death circumstances, a concept Gabrielle Hecht defines as the practices of designing and using technology to embody and enact political goals, while accomplishing effectively material purposes.³

This concept has proved highly valuable in elucidating how the state, civil servants, private corporations, and scientists have become “experts” in making politics through technological objects. However, if we broaden the definition of political participation, which is particularly important when looking at revolutionary and wartime contexts, then other less visible actors appear, such as community groups, neighborhood collectives, and women’s organizations engaged in what might be called “grassroots technopolitics.”⁴ These actors had a (literally) vital agency in imagining networks

¹ González-Ruibal, *The Archaeology of the Spanish Civil War*; Moshenska, *The Archaeology of the Second World War: Uncovering Britain’s Wartime Heritage*.

² Winner, “Do Artifacts Have Politics?”; Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763–1815*.

³ Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II*, 15–17; Hecht, ed., *Entangled Geographies: Empire and Technopolitics in the Global Cold War*.

⁴ On the need to broaden politics in this context: Jackson, *British Women and the Spanish Civil War*, 6–7. For other (less artifact-centered) approaches to the politics of “grassroots innovation” and “designs from below”: Hess, *Undone Science: Social Movements, Mobilized Publics, and Industrial Transitions*; Smith et al., *Grassroots Innovation Movements*; Valentines-Álvarez, “‘Tilting at Nuclearmills’? Wind Energy, Grassroots Networks and Technologies of Protest in Spain, 1976–1984.”

of protection, constructing architectures of sheltering, and reframing the art of living together through technology. Considering the diversity of protection experiences (spatially and socially, from above and from below), this paper seeks to unearth the politics of air-raid shelters and open up new directions for the study of the technologies of surviving.

Examining air-raid shelters foregrounds another key dimension on conflicts as widely studied as the Spanish Civil War and World War II, illustrating to what extent environmental history, urban history of science, and the history of technology are intertwined.⁵ The underground emerges as a hidden historical geography of science and technology.⁶ Both the surface and subterranean landscapes of Barcelona and London turned into huge laboratories for testing new means of destruction and protection. These cities became experimental sites, mobilizing a vast array of knowledge, people, and earth to produce connective networks and complex infrastructures of civil defense. Borrowing a concept from Sarah B. Pritchard, human and ecological entities were reblended into large “enviro-technical systems” for air-raid protection.⁷

To unveil the political and environmental dimensions of air-raid protection, this paper proposes a close reading of three types of shelters. Despite the wide variety of shelters built during the Spanish Civil War and World War II, these three types of shelters were among the most relevant for the protection of the working class.⁸ They are essential for understanding how technopolitics materializes from the very materials that make up technology.⁹ The first section of the paper analyzes

⁵ Laakkonen, Tucker, and Vuorisalo, eds., *The Long Shadows: A Global Environmental History of the Second World War*; Gorostiza, “Urban Water Supply in Barcelona and Madrid during the Spanish Civil War”; Hochadel and Nieto, eds., *Barcelona: An Urban History of Science and Modernity, 1888–1929*; Lafuente and Saraiva, “The Urban Scale of Science and the Enlargement of Madrid (1851–1936).”

⁶ Williams, *Notes on the Underground: An Essay on Technology, Society and the Imagination*; Graham, ed., *Disrupted Cities: When Infrastructure Fails*; Graham, *Vertical: The City from Satellites to Bunkers*.

⁷ Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône*.

⁸ David Gloster, “Architecture and the Air Raid: Shelter Technologies and the British Government, 1938–1944” (master’s thesis, Imperial College London, 1997); Pujadó, *Oblits de rereguarda: Els refugis antiaeris a Barcelona, 1936–1939*.

⁹ Slaton, *Reinforced Concrete and the Modernization of American Building*.

gallery shelters. These brick-lined, community-based tunnels spread throughout Barcelona, a city marked by the revolutionary context that erupted in 1936. The second section shifts the focus to cellular shelters, large concrete-based shelters which were promoted by the Catalan government, especially once Communist policies and technocratic visions gained momentum together after May 1937. Finally, the third one discusses Anderson shelters amid the international debate about Barcelona's experience. Steel based and homebound, these shelters became representative of the liberal policies of the British government. These three sections follow "connected histories" between Barcelona and London (but also between them and Rome and Dresden), offering new insights into the transnational circulation of wartime knowledge.¹⁰

Gallery Shelters

In the early months of World War II, the president of the British Air Raid Protection Institute described the Spanish Civil War as "really an experimental war."¹¹ Carles Pi-Sunyer, engineer and mayor of Barcelona, took this further, stating that the Italian Legionary Air Force and the Nazi Condor Legion "did all kinds of tests" and "Catalonia served them as a learning ground for the war they were preparing for."¹² Some years before, Asian and African landscapes had already served as horrific test sites in the search for ways to overcome the trench warfare and the barbed wire fences that characterized World War I.¹³ During the "interwar" period, colonial powers also developed air warfare techniques to destabilize economies, collapse critical infrastructures, and punish the civil populations, moving toward what became known as "total war."¹⁴ One particularly brutal instance was the combination of aerial bombing with chemical agents over Chefchaouen and Amazigh towns

¹⁰ Macedo and Valentines-Álvarez, "Technology and Nation: Learning from the Periphery."

¹¹ Perera, "ARP in Catalonia," 115; Preston, *The Spanish Civil War: Reaction, Revolution and Revenge*, ch. 5.

¹² Pi-Sunyer, *La República y la Guerra: Memorias de un político catalán*, 480. Translations are mine.

¹³ Lindqvist, *A History of Bombing*.

¹⁴ Chickering, "Total War: The Use and Abuse of the Concept."

in the Spanish protectorate of Morocco between 1923 and 1927.¹⁵ In the highly internationalized scenario of the Spanish Civil War (1936–39), aerial bombardment would befall towns in Spain.¹⁶

Barcelona endured about two hundred air raids, becoming the first European city to experience large-scale campaigns of saturation or carpet bombing (see figure 1.2).¹⁷ Fascist forces experimented with mass air raids, as part of the operational tactics known as “Blitz” or “Blitzkrieg” (lightning war), testing weapons and planes, combining explosive and incendiary bombs, and increasing bomb weights from a maximum of 100 to 500 kilograms.¹⁸ Mussolini’s Savoia-Marchetti bombers ruled the skies over the city day and night. Immediately after the fall of Barcelona, the invading forces meticulously photographed and documented the results of their deadly experiments.¹⁹ The air attacks left six thousand buildings damaged or destroyed, wounded seven thousand people, and claimed nearly three thousand human lives. Yet in this urban laboratory of destruction, the Fascists found that Barcelona’s residents were far from passive “guinea pigs.” Women, men, and children actively participated in designing, building, and maintaining a large technological system inaccurately labeled by officers as “passive defense.”

This collective effort took place in a very specific setting: the revolutionary context that Barcelona witnessed during the Spanish Civil War.²⁰ The July 1936 coup that triggered the war was crushed in this city, after a violent struggle wherein popular and anarchist forces took control of the streets. The first days of the conflict saw the weakening of the state, the flight of bourgeois employers and right-wing experts, and the political rise of the anarcho-syndicalist federation of unions, the

¹⁵ Balfour, *Deadly Embrace: Morocco and the Road to the Spanish Civil War*.

¹⁶ Balfour and Preston, eds., *Spain and the Great Powers in the Twentieth Century*; Moradiellos, *El reñidero de Europa: Las dimensiones internacionales de la Guerra Civil española*.

¹⁷ Villarroya, *Els bombardeigs de Barcelona durant la Guerra Civil*; Preston, *Spanish Civil War*, ch. 9.

¹⁸ Solé and Villarroya, *Espanya en llamas: La Guerra Civil desde el aire*, 15–19, 275; González-Ruibal, *Archaeology of the Spanish Civil War*.

¹⁹ A. Monti, “Relazione sugli Effetti del Munizionamento Usato dall’Aviazione Legionaria,” February 1939, 1/1250-N-122, ANC.

²⁰ Graham, *The Spanish Republic at War, 1936–1939*; Castells, “Revolution and Collectivizations in Civil War Barcelona, 1936–9”; Ealham, *Class, Culture and Conflict in Barcelona, 1898–1937*, 151–72; Casanova, *Anarchism, the Republic and Civil War in Spain, 1931–1939*.

National Confederation of Labor (CNT), whose membership totaled in the hundreds of thousands. Workers seized control of neighborhoods and collectivized thousands of factories, stores, religious buildings, and infrastructure. For many, it was the realization of a long-held socio-technical dream. Historian Chris Ealham explains that, for the early “revolutionary anarchists in the CNT, direct democracy would fortify the [neighborhoods], converting them into collectively run liberated zones, the raw materials for the Kropotkinian autonomous, stateless communes.”²¹

The 1920s and 1930s were marked by intense debates on effective revolutionary practice, commune-based politics, and libertarian communism, which were particularly vibrant at the CNT’s Zaragoza Congress in May 1936.²² After July, working-class neighborhoods became the fertile ground for radical endeavors and fragmented experiences that matured over decades outside of state control (and often independently of labor organizations), including popular nurseries, communal kitchens, cooperative services, cultural centers, and workers’ schools.²³ These practices were inspired by the principles of decentralization, small-scale technology, and solidarity outlined by Russian geographer and anarchist Piotr Kropotkin in *Fields, Factories and Workshops* and *Mutual Aid: A Factor of Evolution*.²⁴ Mutual aid became vital in the “struggle for life” amid aerial bombardments.

In the beginning of the war, the Catalan government posted air-raid precaution notices advising residents to “stretch out calmly on the street” and stating that “the effects of bombing are much more frightening than real.”²⁵ This misguided advice reflected not only generalized ignorance about air raids but also the state’s limited financial, technical, and political capacity to offer civil protection. In contrast, local city councils and municipal organizations proved to be more effective.

²¹ Ealham, *Class, Culture and Conflict*, 37; Oyón, *La quiebra de la ciudad popular: Espacio urbano, inmigración y anarquismo en la Barcelona de entreguerras, 1914–1936*.

²² Evans and Stainforth, “Learning to Live: Anarcho-Syndicalism and Utopia in Spain, 1931–37.”

²³ Ealham, *Class, Culture and Conflict*; Alari, Gorostiza, and Dalmau, eds., *La forja solidària d’un barri portuari: La Barceloneta obrera i cooperativa*.

²⁴ Girón, *En la mesa con Darwin: Evolución y revolución en el movimiento libertario en España, 1869–1914*.

²⁵ Comissariat de Propaganda, *Defenseu-vos dels atacs aeris*, 1936, poster, F-618; Departament de Defensa, “Instruccions per al cas de bombardeig aeri,” September 21, 1936, F-DH 3(1)/11(9), CRAI-BPRA.

This was especially the case after the creation of the Servei de Defensa Passiva Antiaèria (Air-Raid Passive Defense Service; ARPDS) in November 1936. As part of Barcelona's Urban Planning and Public Works Department, the ARPDS was headed by Manuel Muñoz, a bricklayer and president of the CNT's Building Works Union. The service collaborated with the collectivized construction companies, which were later integrated into the Agrupació Col·lectiva de la Construcció de Barcelona (Barcelona Building Collective Association).²⁶ The creation of the ARPDS sparked a flurry of activity promoting the construction of shelters and the retrofitting of underground infrastructures, such as subway tunnels, train tunnels, and sewers. Even so, the provision of civil protection was rolled out at a much slower rate than required. After the panic produced by the first dreadful bombardments in February and March 1937, Barcelona's residents began digging underground to build their own security.²⁷

A few weeks later, the ARPDS could barely keep track of the number of shelters scattered throughout Barcelona's underground. Muñoz was overwhelmed by the "absolute initiative" of the neighbors.²⁸ Although he occasionally complained about the lack of coordination, he announced that the City Council's policy "should not hinder the development of these shelters." The ARPDS even gained important lessons from these autonomous practices. In May 1937, the first booklet on civil defense was published, drawing on international studies developed during the interwar years as well as the experiences of Barcelona's residents.²⁹ Ten thousand copies were distributed throughout Catalonia, Valencia, and Madrid. By June, Muñoz issued a report documenting that 385 shelters "have been built, are being built, or are being enlarged thanks to the personal and financial effort of the . . . local community."³⁰ The report acknowledged that the actual number of shelters could be higher. By

²⁶ The CNT held different positions in the provision of civil defense in municipalities as close to Barcelona as L'Hospitalet: Ribas, "Bombardeigs i refugis a l'Hospitalet (1937–1939)."

²⁷ *Bombardeos de la ciudad, 1937–39*, 1939, maps, M101/2.6, AMCB.

²⁸ Manuel Muñoz, "Defensa passiva antiaèria: La tasca de l'Ajuntament," August 1937, 8–9, A183/GM-876, AMCB.

²⁹ *Refugios: Defensa Pasiva Antiaérea* (Barcelona: Ayuntamiento de Barcelona, 1937), 6, 61–66.

³⁰ Manuel Muñoz, "La labor realizada," June 15, 1937, 2, 14, M101/72/1, AMCB.

contrast, the sewer-type and cellular shelters planned by the City Council approximated thirty in total. Two months later, another official report said that the number of grassroots shelters had doubled.³¹ These shelters were known as gallery shelters.

Gallery shelters were tunnels carved into the city's hard clay and gravel soil (see figure 2.2).³² Usually unplanned, no two gallery shelters were alike. Some shelters were only a few meters long while others had multiple offshoots and zigzag sections. With a total of one kilometer of tunnels, Shelter Number 439 could hold up to 4,400 people. However, in general, these shelters housed between 80 and 400 people and averaged 1.2–1.9 meters wide, 1.8–2.4 meters high, and 100–200 meters long. They had at least two entrances and reached depths of six, eight, or even twelve meters. Covering the surface with the mined earth provided additional protection. For comfort and sanitation, galleries typically had slatted seats or benches carved into the earth, childcare areas, dry toilets, and small rooms for first aid, rescue equipment, and water tanks (see figure 2.2). As long as there was force and solidarity in the neighborhood, new galleries, entrances, and rooms could be added. Although these shelters were usually never completed, they provided protection for their coproducers, or “prod-users,” once the entrance stairs were ready and the first few meters of the gallery were excavated.

Gallery shelters were built using simple tools, traditional building techniques, and materials at hand (see figure 2.1). Pickaxes, shovels, pulleys, tripod hoists, wheelbarrows, and hemp baskets

³¹ Manuel Muñoz, “Defensa passiva antiaèria,” August 1937, 9, 12–13, A183/GM-876, AMCB.

³² Shelter descriptions in this section and the next section mainly draw on documents, maps, photographs, topographic drawings, and balance accounts preserved at AMCB and AAM, as well as on archaeological surveys, images, files, and maps published by the Barcelona Archaeology Service in *Anuari d'Arqueologia i Patrimoni* and on its website. Oral testimonies collected in neighborhood memory publications have been essential, including Villarroya, Pujadó and Powles, *El Refugi 307: La guerra civil i el Poble-sec*; Blanes et al., *El Poble-sec (1936–1939), un barri en guerra*; Contel, *Gràcia: Temps de bombes, temps de refugis*. For overviews of other Catalan and Spanish towns: Arnabat, “Refugios antiaéreos: Aproximación histórica, arqueológica y patrimonial”; Solé and Villarroya, *España en llamas*, 275–88; Pujadó, *Contra l'oblit: Els refugis antiaeris poble a poble*, 141–300. Local history studies have also been consulted, such as the works by Gesalí and Iñíguez (Tarragona, Ebre), Ribé (Sabadell), Dapena (Santa Coloma), Arimon (Mollet), Díaz (Terrassa), Casanovas (Vic), Peinado (València), Fornas (Alcalatén), Calzado (Ontinyent), Beneito (Alcoi), Lozano (Alacant), Selva (Albacete), Jaén (Jaén), and González (Bilbo).

proved effective in resisting the newest technologies of aerial warfare. Thin bricks, fast-binding mortar, and the tile vault called *volta catalana* (Catalan vault) were used for covering walls and reinforcing gallery ceilings against bombs. Since the nineteenth century, these tile vaults had become Barcelona's architectural backbone. Thanks to their lightness and low construction costs (no falsework was needed), Catalan vaults proved ideal for the construction of taller buildings and larger factories in Barcelona's crowded and industrialized grid. Moreover, the fine-grained know-how acquired by bricklayers fulfilled the art nouveau fantasies of the bourgeoisie, both in Catalonia and abroad. A good example in the underground is Rafael Guastavino's work at the Grand Central Terminal in New York City.³³ During the Spanish Civil War, Catalan vaults were not used for such far-fetched forms but provided flat, cheap, and quickly produced ceilings that improved capacity, comfort, and structural resistance.

Amid wartime scarcity, people ingeniously combined construction techniques, materials, and natural resources to transform gallery shelters into a kind of "creole architecture."³⁴ Recycling and repair were fundamental: bricks, tiles, wooden planks, and even toilets were repurposed from buildings shattered by air raids; stones, fences, beams, and doors were salvaged from churches that were burned during the revolutionary upheavals.³⁵ Hybridizing techniques was also crucial: When Portland cement was available, concrete slabs, about ten to twenty centimeters thick, were used over the vaults or over the surface. On many occasions, concrete was reinforced with iron bars, handrails, and balcony railings recycled from the city's ruins.

Most shelters relied on natural ventilation and oil lamps, though when possible, light bulbs were installed in the ceiling and connected to external electric power sources. In some cases, batteries, petrol engine generators, or even small water turbines connected to the water infrastructure were used

³³ Macedo and Valentines-Álvarez, "Technology and Nation," 978.

³⁴ Edgerton, "Creole Technologies and Global Histories: Rethinking How Things Travel in Space and Time."

³⁵ Largo Jiménez, "'To Recycle Is to Win!' The Recovery of Materials for War Industry and Institutional Responses in Catalonia during the Spanish Civil War, 1936–1939."

to light the galleries during power outages. Some shelters had access to fresh water from natural underground wells, while others featured vegetable gardens on the embankments covering the structures.³⁶ Gallery shelters grew unceasingly, resourcefully, and organically, much like roots seeking water.

Former neighborhood networks were vital in the creation of these shelters. Street organizations, based on family and community ties, were reorganized with the aim of constructing shelters under their own streets. Included among these organizations were cultural associations and leisure groups, which had traditionally been in charge of the street celebrations during the neighborhood fiestas. Now, monthly fees, collective savings, and typical prewar fundraising activities such as raffles were put in the service of ensuring human protection. However, cooperative work was not just about raising funds: It required hard, voluntary teamwork inside and outside the shelter. All across the working-class neighborhoods, groups ranging from 10 to over 300 neighbors worked in shifts, often late at night after the long working day. “We were all architects,” recalled one neighbor, a child at the time.³⁷ Young or old alike played an instrumental role in making wartime protection a reality. Even animals had a place in this particular “struggle for life”—dogs barking in the streets and hens clucking on the rooftops often warned the neighbors of incoming raids before the sirens sounded.³⁸

Women played a central role in the construction of gallery shelters (see figure 2.1). While largely a consequence of the military conscription of men, this role must be understood in the context of women’s increasing responsibilities in the home front economy, politics, and caregiving beyond the domestic sphere. In these years, the anarchist organization *Mujeres Libres* (Free Women) advocated for technical training for women and provided “shelter” to war-displaced refugees as part of their revolutionary practices.³⁹ Women who were less politicized also participated in the politics

³⁶ Contel, *Gràcia*, 243–59.

³⁷ Quoted in Pujadó, *Oblits de rereguarda*, 123.

³⁸ Blanes et al., *El Poble-sec*, 79, 86, 107.

³⁹ Ackelsberg, *Free Women of Spain: Anarchism and the Struggle for the Emancipation of Women*,

of protection and care.⁴⁰ One surviving report by neighbors on the construction of air-raid shelters is particularly insightful. Three days after the first aerial bombing over Barcelona in March 1937, a group of women met for the sole purpose of constructing a shelter behind their homes on Ruiz de Padrón Street.⁴¹ Five days later, neighbors began digging the first entrance. By June, the first two tunnels were constructed and connected, and the event was celebrated with snacks and drinks. Skilled workers from the neighborhood, such as a miner, an electrician, and a bricklayer from the Barcelona Building Collective Association, were hired for specific tasks. For a year and a half, the work continued relentlessly, with women at the forefront.

The Ruiz de Padrón Street Shelter report also reveals the horizontal politics behind these deep, vertical works. Decision-making was done collectively in assemblies at the Ateneu Obrer Martinenc, a working-class cultural and sports center of the neighborhood. Despite the promotion of nonhierarchical and nonauthoritarian practices, tasks were not always free of tension. These were reflected in repeated calls for residents to pay their monthly fees, participate in the digging work, and adhere to the consensual codes of conduct within the shelter. But as the report's authors noted, "Who among us would wield a whip?"⁴² And with no whip, the human chain kept on extracting earth from the galleries and the shelter grew underground.

Connections with larger working-class organizations also mattered, especially those with a strong presence on the streets. Community ties with the Federación Ibérica de Juventudes Libertarias (Iberian Federation of Libertarian Youth), which included many women members, proved key in promoting shelters in neighborhoods like Poble-sec and Can Peguera.⁴³ Direct ties with the CNT's mouthpiece *Solidaridad Obrera* or the CNT's Woodwork, Building, and Transportation unions often secured the provision of essential materials. At the same time, neighbors solicited technical support

158, 174; Nash, *Defying Male Civilization: Women in the Spanish Civil War*.

⁴⁰ Jackson, *British Women and the Spanish Civil War*.

⁴¹ "Memoria y balance que la Junta Directiva del Refugio Ruiz de Padrón," August 31, 1938, M101/72/1, AMCB.

⁴² "Memoria y balance," 6.

⁴³ Villarroya et al., *El Refugi 307*, 63, 76; Blanes et al., *El Poble-sec*, 108.

and expert advice from collectivized industries and local institutions, such the Collectivized Water Company of Barcelona and the ARPDS.⁴⁴ In fact, the ARPDS's main contribution to the civil defense system was not to build shelters. It was rather to coordinate technical inspection of communal shelters, to assess their structural resistance, and to offer topographical advice, helping neighbors "see" underground and connect the tunnels (see figure 2.2). Barcelona's local authorities partially funded only one-fifth of the officially registered shelters, provided first aid supplies to one-tenth, and eventually subsidized electricity bills.⁴⁵ Local institutions also distributed sand, cement, cement mixers, and compressors for shelter roofing, but this aid rapidly declined as raw materials and machinery soon became scarce.

Despite the shortage of cement and other binding materials, an abundance of "social binders" enabled the construction of hundreds of gallery shelters. By the end of the Spanish Civil War, around 1,400 air-raid shelters were officially registered.⁴⁶ Between 90 and 95 percent were gallery shelters built by neighbors (see figure 1.2). Although some were not actually built for geological reasons (as was the case of Shelter Number 722), there were many more self-constructed and nongovernmentally controlled shelters. These included unregistered gallery shelters, clandestine shelters behind low-rise houses, reinforced basements in tall buildings, chamber shelters behind shops, cellars in bars and theaters, covered trenches in factories, repurposed water and train tunnels, or simply holes in the hillsides that housed Barcelona's shantytowns. Together, the survivors designed, built, and maintained a large enviro-technical system underground: a community-based network of technological burrows spanning hundreds of miles. A subterranean city was born.

Cellular Shelters

Fifteen months after the outbreak of the Spanish Civil War, an engineer captain responsible for civil

⁴⁴ Gorostiza, "Urban Water Supply," 36.

⁴⁵ "Relació de refugis," 1938–39, M101/3.2.1–7, AMCB.

⁴⁶ "Relació de refugis," 1938–39, M101/3.2.3, AMCB. The Barcelona Archaeology Service has cataloged 1,293 air-raid shelters (1936–39).

defense in Catalonia highlighted that “a genuine network of galleries [is being] created underground: a sub-city that will be all the more protected the more we sink.”⁴⁷ His words, however, did not aim to encourage grassroots infrastructure of air-raid protection: “[This network] means nothing if it lacks the connections and coordination needed to constitute an organic whole. . . . Each of the elements that comprise it must fulfill its task within a previously studied plan, requiring strict discipline among the civilian population.” This statement was in line with the regular appeals from political leaders, military officers, civil servants, and engineers decrying the alleged chaos, inefficiency, irrationality, and lack of discipline in the streets, collectivized factories, and farms.⁴⁸ An article published in the newspaper *Diario de Barcelona* in April 1937 pointed out the path authorities should follow: “We lack real shelters. . . . It is time we put an end to all this spontaneity and mess. . . . The only practical and useful way to deal with this issue is to gather all the private initiatives, uniting them in a single agency.”⁴⁹

On June 9, the Catalan government created the Junta de Defensa Passiva de Catalunya (Catalonia Passive Defense Council) with the goal of regulating, controlling, and centralizing civil protection efforts. The timing of this decree is significant because it came just weeks after the “May Days.” From May 3 to 7, 1937, the heightening tensions between Republican forces and pro-Soviet Communist parties on the one hand and anarchists and dissident Communists on the other erupted into barricades and armed skirmishes in the streets of Barcelona.⁵⁰ The power struggle resulted in a shift of political control. It granted more authority to the Stalinist-leaning Partit Socialista Unificat de Catalunya (Unified Socialist Party of Catalonia; PSUC) and severely curtailed CNT’s political influence, workers’ collectivization, and neighbors’ autonomy. While asserting state reconstruction, political centralization, and the bureaucratic apparatus, the May Days also gave momentum to a less

⁴⁷ R. Esteban, “Cómo nos protegemos de los obuses . . .,” November 1937, 14–15, M101/1.4, AMCB.

⁴⁸ Ealham, *Class, Culture and Conflict*, 170; Castells, “Revolution and Collectivizations”; Valentines-Álvarez, “Seeing like a Factory: Technocratic Nationalism in Catalonia, 1930–1939,” 241–44.

⁴⁹ Florenci Tor, “Parlem de refugis,” *Diario de Barcelona*, April 11, 1937, 7.

⁵⁰ Graham, *Spanish Republic at War*, 254–315; Casanova, *Anarchism*, 130–57; Ealham, *Class, Culture and Conflict*, 168–72.

noticeable project that had marked Catalan politics since the 1929 crisis: streamlining the nation through technical expertise and technocratic proposals.⁵¹ The establishment of the Catalonia Passive Defense Council (CPDC) was part of this broader effort.

The CPDC's first regulations sought to reorganize the vertical geography of the city according to a vertical administrative structure, overseen by state engineers and officers. Each air-raid shelter depended on the Junta Local de Defensa Passiva (Local Passive Defense Council), which in turn depended on the Regional Council and, finally, on the Catalan Council. At the same time, each shelter had to comply with the guidelines of the assigned technician, who answered to the municipal engineer or architect and ultimately to the CPDC experts. Shelter delegates were appointed among the neighbors as "agents of authority" in the shelters and "to monitor compliance, in every building and in the street, of all the CPDC's orders."⁵² The few surviving minutes of CPDC meetings reveal that bureaucratization of the civil defense caused more problems than it solved and that centralization hindered rather than facilitated the much-needed efficiency, generating financial bottlenecks, logistical pitfalls, and administrative tensions for competencies with Barcelona's Local Passive Defense Council, the Catalan government's Department of Work, and the Spanish Republican Army's Division of Special Aircraft Defense (DECA).⁵³

The turning point for the CPDC came in February 1938, when Ramon Perera was appointed head of the Shelter Works Service (see figure 3.1). Perera was a young engineer trained at the Barcelona School of Industrial Engineers, where he had studied a wide range of subjects including topography, industrial architecture, structural mechanics, and concrete techniques.⁵⁴ At that time, he was a member of the Unified Socialist Party of Catalonia, which had attracted technicians, liberal professionals, middle-class shopkeepers, and small property owners in response to the growing

⁵¹ Valentines-Álvarez, "Seeing like a Factory."

⁵² *Reglament de defensa passiva* (Barcelona: Junta Local de Defensa Passiva de Barcelona, 1937), 7.

⁵³ "CPDC [minutes]," August 9–December 19, 1938, 260/1, ANC. Such problems also arose in the war industry: Madariaga Fernández, "Las industrias de guerra de Cataluña durante la Guerra Civil."

⁵⁴ "Ramon Perera Comerma," 1931, academic transcripts, AhEIB; Valentines-Álvarez, "Redefinicions socials i espacials de l'enginyeria a la Guerra Civil a Catalunya," 28–29.

influence of blue-collar workers and the CNT.⁵⁵ While a large contingent of high-rank engineers fled toward Fascist-controlled areas or sabotaged scientific facilities and war research,⁵⁶ Perera remained loyally committed to public works and the transport sector since the conflict began. In early 1938, there was not just an increasing lack of experts and resources: The Republican forces were losing territory to Fascist forces, which were intensifying air raids and advancing into Catalonia.

Nevertheless, Perera set out to transform the city into a vertical labscape, a three-dimensional laboratory landscape.⁵⁷ He viewed the streets, squares, and buildings on the surface as a site for registering and analyzing air-raid destruction, while the tunnels, basements, and shelters in the underground became spaces for researching and implementing protection. According to historians Tiago Saraiva and Antonio Lafuente, the city had long been “an experimental laboratory where machines and experts objectivized problems, gathered data and drew up plans of action.”⁵⁸ While they emphasize the importance of horizontal flows in the scientific construction of the city—with railroads, electrical systems, and hydraulic infrastructures—this article considers the relevance of vertical dynamics during wartime, with bombs falling from the sky to the ground, and people seeking shelter from the ground to the underground.

Perera undertook an ambitious field research program to document every destructive effect of air raids. As soon as the sirens stopped, Perera would leave the institutional shelter of the CPDC and drive his official Skoda car to the bomb site. Once there, he meticulously collected descriptions, images, and “specimens” of what W. G. Sebald called the “natural history of destruction.”⁵⁹ Perera’s technical notes and scientific photographs documented unexploded bombs over the ruins, the impact of bombs on the pavement, the traces of shock waves on lampposts, and shrapnel lodged in water pipes.⁶⁰ He even analyzed remains of animals and human corpses as part of the devastated landscape.

⁵⁵ Castells, “Revolution and Collectivizations,” 130; Casanova, *Anarchism*, 139–40.

⁵⁶ Lusa Monforte, “La Escuela de Ingenieros en Guerra (1936–1938),” 48–65.

⁵⁷ Graham, *Vertical*.

⁵⁸ Lafuente and Saraiva, “Urban Scale of Science,” 531.

⁵⁹ Sebald, *On the Natural History of Destruction*.

⁶⁰ Photographs 1–638, “Ramon Perera” Collection, AAM. For an analysis of the collection:

One example from the port of Barcelona illustrates Perera's daily activities.⁶¹ Since the start of the war, the port had been a frequent target of aerial attacks. Dockworkers built an improvised shelter using large concrete slabs, which were to be used to extend the breakwater. In the summer of 1938, a ninety-kilogram bomb hit the top of the shelter. None of the twenty-eight workers inside were seriously injured, save temporary deafness. Perera interviewed the workers, measured the cracks' direction, photographed the conical hole in the roof, and collected concrete samples.⁶² His analysis led him to recommend embedding wire netting in the structure and introducing breaks to halt the threat of concussion waves.

In addition to studying destruction, Perera focused on protection. While other CPDC services trained civilians in the use of gas masks or developed warning systems with siren control panels, sound locators, and telephone networks, his Shelter Works Service concentrated on structural defense. An important task was to investigate structural resistance and the mechanics of materials through tests and simulations. Concrete was at the core of this research. Outdoor simulations involved striking concrete-covered trenches with demolition balls, while indoor experiments with cement products were conducted at the *Laboratori General d'Assaigs i Investigacions* (General Laboratory for Testing and Research), located at the Barcelona Industrial School. This school was an engineering education hub where other spaces of science were put at the service of war research, such as the Organic Chemistry Laboratory.⁶³ Similarly to what happened to war industries, former state-run and private lab facilities were adapted as war laboratories. In the General Laboratory, Perera conducted cube tests using smaller proportions of cement and scrap metal shavings recycled from war industries.⁶⁴ Cement was in short supply and strictly regulated by the state. The majority of cement was reserved for

Valentines-Álvarez, "Redefinicions socials i espacials."

⁶¹ Ramon Perera, "Notes," 13–14 (photographs 421–24), "Ramon Perera" Collection, AAM.

⁶² Perera, "ARP in Catalonia," 110.

⁶³ "Laboratori de Química Orgànica," reports no. 140 and 147, June 9 and August 6, 1938, *Comissió de la Indústria de Guerra*, AMTM; Lusa Monforte, "La Escuela de Ingenieros en Guerra," 48–65.

⁶⁴ Ramon Perera, "Notes," 11–14 (photographs 284–306, 316–34), "Ramon Perera" Collection, AAM.

constructing frontline fortifications, antiaircraft batteries, and bunkers.⁶⁵ Other priorities were shelters for civilians in critical infrastructures, war industries, and official buildings, including Cornellà's pumping station, the Elizalde aircraft engine factory, and the Catalan president's residence, the CNT headquarters, and the U.S.S.R. embassy.⁶⁶

Despite these circumstances, Perera envisioned a comprehensive civil defense program based on concrete. The CPDC's records clearly reflect his vision, though they depict the inverted image of Barcelona's sheltering reality. Of the six hundred archival photographs, only 4 percent depict gallery shelters, while 90 percent document concrete-based shelters, including top-secret tube shelters, inverted slope shelters, and most notably, cellular shelters.

The cellular or cell shelter was based on the work of engineer Georg R  th. In fact, it was initially referred to as the "Ruth system" shelter.⁶⁷ R  th was a professor at the Technische Hochschule in Dresden who adhered to the 1933 Vow of Allegiance of Professors of German Universities and High Schools to Adolf Hitler. During the Spanish Civil War, the early considerations on air-raid protection in Barcelona were informed by studies conducted by French military officers and Swiss and Belgian air defense committees, as well as experts associated with the very armies that would bomb the city. R  th's scientific articles, along with popular booklets by Nazi Reichsluftschutzbund engineer Werner Peres and books by Unione Nazionale Protezione Antiaerea's head Giuseppe Stellingwerff, provided key guidelines for planning Barcelona's defense system.⁶⁸ In early 1937, the ARPDS had begun to build five shelters based on this framework.⁶⁹

⁶⁵ Mart  nez Medina, *Arquitecturas para la defensa de la costa mediterr  nea, 1936–1939*.

⁶⁶ Carme Mir   and Jordi Ramos, eds., *The City of Shelters: Catalogue of Barcelona's Air Raid Shelters*, accessed December 24, 2021, <https://ajuntament.barcelona.cat/arqueologiabarcelona/refugis/en>; Valentines-  lvarez, "Redefinicions socials i espacials," 18–22.

⁶⁷ *Refugios*, 11–18, 35–37, 50–51; Ribas, "Bombardeigs i refugis a l'Hospitalet," 58–60.

⁶⁸ R  th, "Bauliche Massnahmen des Luftschutzes"; Peres, *Das Luftgesch  tze Haus*; Stellingwerff, *La protezione dei fabbricati dagli attacchi aerei: L'applicazione del cemento armato nella protezione antiaerea*.

⁶⁹ On the legacy of the ARPDS in the CPDC's practices: "Llistat i dades de refugis," M101/3.2.5, AMCB; "Iniciaci  n en la defensa passiva," March 1938, 19–23, 260/5, ANC.

Cellular shelters encapsulated Perera's views on providing "total protection" to the civilian population through structural engineering.⁷⁰ These shelters were large concrete structures consisting of interconnected regular rooms or cells (see figure 3.2). Each cell was about three meters wide and three-and-a-half meters high, divided by strong concrete columns or walls.⁷¹ The overall layout formed a square or rectangle of 500 to 900 square meters, accommodating between 700 and 3,000 people. There were two entrances, pressure insulation, and security chambers along the sides. Although called "deep-level shelters," cellular shelters were often sunk to the top of the upper slab or were even shallower. With a layer of excavated earth and extra burster concrete slabs on top, these shelters could extend to up to four meters above the ground. The entire surface was excavated directly from the ground, and the construction therefore required what such a dense city as Barcelona did not have in abundance: large open spaces such as squares and parks.

Building these shelters also required skills, techniques, and materials that were not typically available in the community. They needed large amounts of cement, excavators, hoisting cranes, compressors, cement mixers, rotating platforms, and mine carts, as well as specialized expertise (see figure 3.1). The design and management were handled by engineers, architects, draftsmen, and topographers who worked for the state—all of them men. Additionally, about twenty unskilled male workers and a formwork operator were hired for the works. Women played a role only as typists, telephone operators, and cleaners in civil defense facilities.⁷² An official propaganda poster epitomizes CPDC's rationale: It portrays a woman with the seal of the Catalan government, caring stoically for two children while enemy planes fly in the dark sky; behind the woman, there is the CPDC's emblem. In this image, the "son" and the "youngest daughter" seem to symbolize the working class (and working-class women), while the "mother" paradoxically represents both the

⁷⁰ Perera, "ARP in Catalonia."

⁷¹ Examples of cellular shelter designs: M101/4.1542, /4.0041, /4.0319 and /4.1502, AMCB.

⁷² "Nòmina de sous," September 30, 1938, 23–26, M101, AMCB; "Oficina de Defensa Passiva Antiaèria," M101/3.4.1–18, AMCB; Photographs 637–38, N7–13 (and "Notes"), "Ramon Perera" Collection, AAM.

paternalistic role of the state and the male civil defense expert.

According to historian Amy E. Slaton, the spread of reinforced concrete in the United States during the first decades of the twentieth century was intimately linked to the reinforcement of socio-technical processes such as building standardization, scientific management, ownership of security parameters, and the growing divide between experts and nonexperts.⁷³ The aims of the CPDC during the Spanish Civil War must be also understood through this lens, even though these processes encountered specific pitfalls in Catalonia. Material shortages forced Perera to adopt hybrid techniques, replacing reinforced concrete with mass concrete and using electric-powered cranes alongside manual hoists. He also introduced what he called “adaptations” to the original cellular shelter design, such as reducing the number of cells and creating larger bays.⁷⁴ He also employed tile vaults as permanent formwork for concrete structures (see figure 3.1), building techniques familiar to architects like Gaudí.⁷⁵

Despite these innovations, cellular shelters were rigid artifacts by design, wholly dependent on centralized institutions, extensive public funding, and engineering expertise. They also relied on water, electricity, ventilation, and sewage systems, rendering them more vulnerable to disruption during air raids and political violence.⁷⁶ As Perera pointed out in the U.S. journal *Water Works Engineering*, a central duty of the CPDC was to protect urban infrastructure and the workers who maintained it.⁷⁷

According to historical sources and recent archaeological findings, the total number of cellular shelters planned in Barcelona might be no more than sixteen with a few more in the suburbs (see figures 1.2 and 3.1).⁷⁸ Some of these projects were never started or took far longer to complete than expected. Among the reasons were the government’s financial strangulation, delays in paying wages,

⁷³ Slaton, *Reinforced Concrete*.

⁷⁴ Perera, “ARP in Catalonia,” 106–7; Perera, “When Bombs Fell on Barcelona.”

⁷⁵ López, Van Mele, and Block, “The Combination of Tile Vaults with Reinforcement and Concrete.”

⁷⁶ Graham, ed., *Disrupted Cities*.

⁷⁷ Perera, “When Bombs Fell on Barcelona.”

⁷⁸ “Relació de refugis,” 1938–39, M101/3.2.5, AMCB; Miró and Ramos, *City of Shelters*.

lack of workers' commitment, limited transportation, the army's confiscation of machinery, and dependence on scarce materials such as cement, iron, and oil. As a result, construction works were often abandoned, or completed only days before Barcelona fell, as in the case of the Giner de los Ríos Shelter.⁷⁹ Critically, cellular shelters were almost useless until they were completed.

When Perera took over the reins of the Shelter Works Service in early 1938, the peak period of shelter construction in Barcelona—mostly driven by neighborhood associations—was winding down.⁸⁰ Dramatically, this decline coincided with the most brutal and intense air strikes on the city.⁸¹ The greatest challenge Perera faced in offering people “total protection” was not the scientific design of streamlined, bomb-proof structures based on concrete techniques.⁸² Rather, it was the total institutional incapacity to provide enough shelter for the general population.

Anderson Shelters

In December 1938, the British Institute of International Affairs's journal reviewed *Air Raid: The Technique of Silent Approach*, by John Langdon-Davies, concluding that the book included “an admirable number of photographs of the actual damage wreaked in Barcelona: their reproduction at lantern lectures of [civil defense] officers would afford valuable instruction.”⁸³ Amid escalating international tensions in the run-up to World War II, the “Barcelona laboratory” sparked key geopolitical interest. The circulation of knowledge on Barcelona's experience, however, was regulated like the cement. For national security reasons, the CPDC prohibited access to bombed areas, controlled the flow of information, and restricted the dissemination of documents and photographs.⁸⁴ Britain was especially determined to gather data with the help of journalists, ambassadors, military

⁷⁹ “Plaça Giner de los Ríos,” M101/4.0041, AMCB; Pujadó, *Oblits de rereguarda*, 98–104.

⁸⁰ Pujadó, *Oblits de rereguarda*, 27–45.

⁸¹ Solé and Villarroja, *España en llamas*.

⁸² The increasingly destructive capacity of heavier bombs cast doubt on the “total security” of cellular shelters. Reinforcing these shelters against bombs upward of 300 kilograms would have doubled both the total cost and demand for cement.

⁸³ Unsigned review of *Air Raid*, by John Langdon-Davies, *International Affairs* 17, no. 6 (1938): 832.

⁸⁴ “CPDC [minutes],” December 19, 1938, 260/1, ANC.

attachés, and engineers, even if it meant dodging CPDC orders. As stated in cipher documents, the Spanish government's "irritation caused by the policy of Non-intervention" made obtaining information particularly challenging.⁸⁵

The British government planned to acquire any valuable information for what, already in April 1938, was called "the next European war":⁸⁶ targets, direction, and timing of the attacks, the ratio of explosives to casualties, effects in buildings and infrastructures, and the efficacy of air-raid shelters. Accordingly, personnel of the British Parliament's Committee on Air Raid Precautions (ARP) and official commissions headed by St. Pancras ARP officer Major MacRoberts, Major Jervois, and Commander Goddard, among others, traveled to Barcelona.⁸⁷ Interest in this city surged after the carpet bombing that it suffered between March 16 and 18, 1938, which was the most devastating air-raid campaign against civilians during the conflict (see figure 1.1). A few weeks later, the Home Office and the Foreign Office secretly sent British civil servants and structural engineers to Barcelona to assess the impact of the air strikes and the effectiveness of civil defense measures, while requesting Barcelona officials to conduct (well-paid) extensive questionnaires via secret agents, diplomats, and embassies.⁸⁸

The effects of air raids on Barcelona also attracted the attention of those in Britain who opposed the government's civil defense policies.⁸⁹ The Communist Party of Great Britain, through its

⁸⁵ "Telegram (en clair) from Mr. Leche (Barcelona)," April 12, 1939, Foreign Office (FO) 371/22685/4987, NAUK. On the Non-Intervention Agreement and international context: Moradiellos, *El refugio de Europa*; Balfour and Preston, *Spain and the Great Powers*.

⁸⁶ "Information Concerning Air-Raids in Barcelona," April 13–23, 1938, FO 371/22685/4841, NAUK.

⁸⁷ "General Report by Wing Commander R. V. Goddard," February 1938, FO 371/22682/3987, NAUK; MacRoberts, *ARP Lessons from Barcelona*; Haapamaki, *The Coming of the Aerial War: Culture and the Fear of Airborne Attack in Inter-War Britain*, 97–98.

⁸⁸ "Air Raids in Barcelona: Visit of Messrs. Dodds and Hicks," April 9–13, 1938, FO 371/22685/4733, NAUK; "Information Concerning Air Raids in Barcelona," April 11, 1938, FO 371/22682/4841, NAUK; "ARP Lessons from Barcelona," June 27, 1938, FO 371/22685/8409, NAUK; "Structural Questions," [May 1938], FO 371/22685/5172, NAUK; "Air Warfare," [December 1938], FO 371/W16437, NAUK.

⁸⁹ Haapamaki, *Coming of the Aerial War*; Holman, *The Next War in the Air: Britain's Fear of the Bomber, 1908–1941*, 55–115, 206.

newspaper *Daily Worker*, repeatedly criticized the Home Office for being indifferent to the suffering of the working class and condemned its program of making “the best refuge-room for your household at home.”⁹⁰ In response, Communists campaigned for collective bomb-proof shelters and tunnel shelters, like those in Barcelona, especially after the heavy bombing of March 1938.⁹¹ A booklet published by the Hampstead Communist Party clearly stated, “We demand real protection.”⁹² Prominent geneticist John B. S. Haldane introduced the booklet. Along with other Marxist scientists and left-wing professionals, notably from the Cambridge Scientists’ Anti-War Group and the Architects’ and Technicians’ Organisation, Haldane was actively involved in reexamining the government’s proposals put forward by the Air Raid Precautions Department.⁹³

Haldane had visited Barcelona in December 1937, followed shortly by others like Francis Skinner, member of the Architects’ and Technicians’ Organisation and the Association of Architects, Surveyors and Technical Assistants.⁹⁴ Such trips provided them with expert authority and crucial insights on ARP, including gallery shelters and concrete-based construction techniques. They later analyzed how these shelter designs could be adapted to British conditions, considering local factors like weather, soil, urban planning, wages, and the economic organization of the cement industry.⁹⁵

Alongside Haldane, Skinner, and members of Cambridge’s “Visible College,” other less visible and politicized experts joined the scientific debate.⁹⁶ One of these “technical men” was the structural engineer Cyril Helsby.⁹⁷ In late 1938, the Labour Party endorsed Helsby’s visit to Barcelona, where he met with Ramon Perera and observed CPDC’s activities firsthand. Back in London, Helsby

⁹⁰ Home Office, *The Protection of Your Home against Air Raids*; Communist Party of Great Britain, *The Practical Air Raid Protection Britain Needs*; Herbert Morrison, “The Daily Worker: Memorandum,” December 23, 1940, WP (40) 482CA, B 66/14/12, NAUK.

⁹¹ Holman, *Next War in the Air*, 113.

⁹² Hampstead Communist Party, *ARP for Hampstead*.

⁹³ Cambridge Scientists’ Anti-War Group, *The Protection of the Public from Aerial Attack* (London: Victor Gollancz, 1937); Werskey, *The Visible College: A Collective Biography of British Scientists and Socialists of the 1930s*, 223–34; Holman, *Next War in the Air*.

⁹⁴ Haapamaki, *Coming of the Aerial War*, 155–57.

⁹⁵ Haldane, *ARP*, 143–81; “ARP,” *The Architects’ Journal* 88 (1938): 31–43.

⁹⁶ Werskey, *Visible College*.

⁹⁷ Haapamaki, *Coming of the Aerial War*, 180.

lobbied for abandoning ARP's emphasis on home shelters in favor of bomb-proof shelters. His critique, based on direct analyses of gallery and cellular shelters, featured in major newspapers such as *The Times*, *The Illustrated London News*, and *The Municipal Journal* (London).⁹⁸ His views also were soon heard at the Institution of Structural Engineers.⁹⁹ Along with the Institution of Civil Engineers and the Royal Institute of British Architects, this professional body was invited by the British government to provide scientific advice on civil defense.

In early 1939, Helsby and other dissident experts in ARP were invited to the Lord Privy Seal's Conference.¹⁰⁰ The final purpose of this high-profile meeting was to dampen criticism from the left and eventually reconsider ARP policies. The conference's final conclusions did not deviate from the ongoing governmental plan: "No ground is shown for departing from the policy of blast and splinter proof protection already announced," and "the attempt at the provision on any general scale of deep and bomb-proof shelters would be a mistaken policy and would prove unattainable in practice."¹⁰¹ The British government dismissed the relevance of Barcelona's experience, citing different local conditions and emphasizing the need for active defense over passive defense. There were also more hidden reasons. Britain's shelter plans were designed not only to protect the human body but also to safeguard the dominant political and economic bodies. A secret report from the Lord Privy Seal revealed the concerns that "heavy protection might involve dangers such as those of creating a shelter mentality."¹⁰² As for "shelter mentality," the report referred to an alleged psychological effect that

⁹⁸ *Times*, December 23, 1938, 9, and January 2, 1939, 10; *Illustrated London News*, January 21, 1939, 91, and January 28, 1939, 126–27; *Municipal Journal* (London) 48, no. 2399 (1939): 159, and 48, no. 2400 (1939): 209.

⁹⁹ Helsby, "Air Raids, Structures and ARP in Barcelona To-day"; "Discussion," *The Structural Engineer* 17, no. 2 (1939): 117–23.

¹⁰⁰ Armengou and Belis, *Ramon Perera, l'home dels refugis*, 196–99; Haapamaki, *Coming of the Aerial War*, 169–77.

¹⁰¹ John Anderson, "Air Raid Shelter Policy: Memorandum by the Lord Privy Seal Conference," April 15, 1939, CAB 24/285/8, NAUK; "Underground, Public and Domestic Shelters: Expert Evidence for Lord Privy Seal's Conferences (Including Experiences in Spain in 1938)," Home Office (HO) 205/162, NAUK.

¹⁰² Haley (Lord) et al., *Air Raid Shelters: Report of the Lord Privy Seal's Conference* [proof], April 6, 1939, 4, CAB 24/285/8, NAUK.

would render the masses both “coward” and “lazy.” Haldane heard from a government spokesperson that there was another reason to avoid crowding people into shelters: Crowds were “liable to emotions of which panic is not the only one: rage is another.”¹⁰³ By contrast, the dispersion and confinement of the population into independent units might help contain Communist and working-class opposition, which the government feared, having witnessed the revolution in Barcelona during the Spanish Civil War. As Stephen Hussey shows in his studies of school air-raid shelters, the British underground would soon become a space for social transformation, challenging the control of the authorities and the norms of British society.¹⁰⁴

The British government ultimately prioritized a steel-based domestic shelter for the working classes, named after the Lord Privy Seal, Sir John Anderson. In late 1938, he had commissioned his crony William Paterson, a Scottish engineer and founder of the Paterson Engineering Company, to design a cheap and easy-to-produce shelter for blast protection.¹⁰⁵ The proposed design was a three-square-meter shelter made of fourteen galvanized corrugated steel sheets, intended to accommodate a nuclear family of four to six members (see figure 4.1). In February 1939, after tests supervised by the Institution of Civil Engineers, the Anderson shelter was officially approved for mass production. Private firms produced the sets of corrugated steel sheets, while the British Iron and Steel Corporation and the national railway companies distributed them under the direction of the Home Office.¹⁰⁶ In total, hundreds of thousands of Anderson shelters were built.¹⁰⁷

The Anderson shelter was delivered as a technological kit (see figure 4.2). The kit consisted of the steel sheets, bolts, washers, rivets, a wrench, and illustrated instructions to facilitate self-

¹⁰³ Haldane, *ARP*, 162; Meisel, “Air Raid Shelter Policy and its Critics in Britain before the Second World War,” 310–11.

¹⁰⁴ Hussey, “The School Air-Raid Shelter: Rethinking Wartime Pedagogies,” 524–26.

¹⁰⁵ Meisel, “Air Raid Shelter Policy,” 306.

¹⁰⁶ O’Brien, *Civil Defence*, 187–88.

¹⁰⁷ Alternative models coexisted along class lines, and numerous shelter designs appeared in middle-class neighborhoods and areas left out of ARP programs: Gloster, “Architecture and the Air Raid”; Moshenska, *Archaeology of the Second World War*, 120–33.

assembly without the need for “skilled labor.”¹⁰⁸ This shelter was typically installed in one’s backyard, half buried (about one meter below ground) and covered with the excavated earth (about forty centimeters; see figures 4.1 and 4.2). Families often modified and refurbished their shelters, reinforcing doorways, building bunk beds, painting the sheets, or growing daisies on the roof. However, the original design did not allow for substantial changes, leaving users epistemically “captive.”

This regime of protection reinforced traditional gender roles, particularly women’s association to the Victorian ideal of domesticity. As historian Lucy Noakes points out, “Whilst the threat of aerial bombardment blurred the division between masculine combatants and feminine non-combatants, the war saw the reinforcement of traditional gender roles as dominant representations of masculinity become closely entwined with images of combat, and femininity with the home.”¹⁰⁹ Women’s roles in civil defense were also connected to liberal traditions of volunteerism and philanthropy, exemplified by the Women’s Voluntary Service. This service conveyed ARP policies at the behest of the Home Office and developed an implicit resistance to egalitarianism, curbing the influence of pacifist and working class-oriented organizations like the Co-operative Women’s Guild.¹¹⁰

Despite the government’s technological choice in favor of Anderson shelters, public debate over civil defense continued in Britain. On March 23, 1939, Helsby wrote to the *Institution of Structural Engineers’* journal: “The information which I brought back from Barcelona . . . has been completely confirmed by additional data and documentary evidence recently brought from Spain.”¹¹¹ Ramon Perera had, in fact, brought this information. When General Franco’s troops captured Barcelona in January 1939, hundreds of thousands of refugees fled to southern France, where they

¹⁰⁸ Home Office, *Directions for the Erection and Sinking of the Galvanized Corrugated Steel Shelter*, February 1939, LBY CD 133, IWM; O’Brien, *Civil Defence*, 187.

¹⁰⁹ Noakes, *Women in the British Army: War and the Gentle Sex, 1907–1948*, 104.

¹¹⁰ Scott, *Feminism and the Politics of Working Women: The Women’s Co-Operative Guild, 1880s to the Second World War*; Hinton, “Voluntarism and the Welfare/Warfare State: Women’s Voluntary Services in the 1940s,” 285.

¹¹¹ Helsby, “Correspondence.”

were forced into concentration camps. Britain's borders remained closed. The exceptions included a select few experts deemed valuable for the coming conflict. Probably the best known examples are the physician Frederic Duran Jordà and the surgeon Josep Trueta, who had developed innovative methods for blood transfusion and the treatment of gunshot wounds—both vital after aerial bombing during the Spanish Civil War.¹¹² Perera, too, became part of this particular interwar episode of “brain drain,” joining the wave of professionals into forced migration and exile from Spain.

Perera's escape was harrowing. In his autobiographical notes, he described his two-week journey after leaving Barcelona, fraught with constant route changes, extemporaneous official meetings, aircraft shelling on the roads, the crash of his car, and the loss of both his passport and most of the CPDC documents.¹¹³ On February 10, Perera and two colleagues attempted to cross the Pyrenees by foot. The path was snow covered. After reaching the French border, they decided to avoid the concentration camps and survived hidden in the forests. It was freezing. They built a makeshift shelter with metal sheets salvaged from a farm. There was no food. They rustled themselves a lamb. Perera suffered from intestinal colic. He drank wild thyme tea. Finally, on February 23, despite the risk of being identified as a refugee, Perera decided to go to the nearest village. He intended on sending a letter. Having neither identification papers nor a penny to buy a stamp, he could finally send it from the Red Cross center. The letter was addressed to Cyril Helsby.

A week later, Perera received an envelope containing 300 francs and detailed information for contacting a British secret service agent in Perpignan. There, Perera was provided with tickets to London via Paris-Dieppe and a work permit ensuring his safe passage. On March 4 at 4 p.m., he docked at the port of Newhaven. Perera was exhausted, his glasses were broken, and his shoes were hole riddled, but he accepted Helsby's invitation to attend an exhibition on shelters at Charing Cross, London, at 10 p.m. Just a few days later, Perera was working in Helsby's office near Trafalgar Square, evaluating ARP projects and planning public shelters in Westminster. As the Communist Party's

¹¹² Coni, *Medicine and Warfare: Spain, 1936–1939*.

¹¹³ Ramon Perera, “[Diary],” 29–41, “Ramon Perera” Collection, AAM.

London District Committee criticized, Westminster had thirteen times the funds per capita for shelter programs than working-class neighborhoods like Walthamstow.¹¹⁴

In late March, a former friend from the Barcelona School of Industrial Engineers offered Perera a job in a factory producing corrugated steel sheets in Chile. Perera declined the offer, as he was waiting for his Certificate of Alien Registration and, more importantly, for the British government to fulfill its promise of reuniting him with his wife in London. Ironically, after surviving in the self-built metal shelter in the Pyrenees and turning down the job offer in Chile, Perera soon stumbled upon corrugated steel architecture for a third time: the blast-proof Anderson shelter.

For many months, Perera and Helsby worked on their “final shot” at advocating a comprehensive bomb-proof shelter policy in Britain. On December 12, 1939, Perera finally delivered a lecture at the Air Raid Protection Institute.¹¹⁵ Several highly acknowledged civil defense experts attended, including Major MacRoberts and G. R. Falkiner Nuttall.¹¹⁶ Perera presented his major scientific work conducted in Barcelona, using tables, maps, graphs, and equations to explain bomb trajectories, surface impacts, and blast-wave pressure variations, and described CPDC’s tasks in data gathering, statistical analysis, and the mathematization of destruction.

However, the audience’s interest had shifted, as much of the information from Barcelona and other Spanish cities had already circulated widely. The ARP Department’s Research and Experiments Branch, later the Research and Experiments Department, of the Ministry of Home Security had been actively compiling and developing studies on bomb effects.¹¹⁷ Moreover, engineering research facilities in Britain were far more advanced and better equipped than those in Catalonia, and the main laboratories were no longer bombed-out streets but university departments and scientifically controlled outdoor test sites. The research and experiments division conducted an extensive body of

¹¹⁴ Holman, *Next War in the Air*, 109.

¹¹⁵ Perera, “ARP in Catalonia.”

¹¹⁶ MacRoberts, *ARP Lessons from Barcelona*; Hyde and Nuttall, *Air Defence and the Civil Population*.

¹¹⁷ Declassified documentation of the Research and Experiments Department and the Civil Defence Research Committee available at HO 191–98, 210, 212, 216, NAUK.

studies on the resistance of materials and the kinematics of shrapnel, using piezoelectric gauges, cathode-ray oscilloscopes, high-speed cameras, and spark photography.¹¹⁸ Experiments even tested the physical and psychological effects of explosions on rabbits and guinea pigs.

The audience at Perera's lecture was more interested in protection strategies. He presented four types of collective shelters built in Catalonia: reinforced basements, covered trenches, gallery shelters, and cellular shelters. The engineer argued that the first two were unacceptable because of "the responsibility of the government in the general program of [bomb-proof] protection."¹¹⁹ While he acknowledged some benefits of gallery shelters such as faster construction time, efficient use of space, and lower cost, he emphasized the alleged superiority of scientifically designed cellular shelters. For this purpose, Perera's account distorted four aspects of Barcelona's underground landscape of protection. First, he downplayed the fact that gallery shelters provided the largest shelter capacity in the city. Second, he concealed the limited role of the Catalan government and dismissed the relevance of neighbors' networks, municipal services, and labor unions. Third, he denied any injury or death resulting from the direct impact of bombs in deep-level shelters, insisting that there was never "any harm to the people sheltered," even though they were reported by newspapers—and later by oral testimonies.¹²⁰ Lastly, Perera asserted that Portland cement had not been scarce, even when he undertook experiments to overcome the restrictions on provisions, as seen. Instead, Perera did mention the shortage of rod steel, the primary material used in Anderson shelters.¹²¹

Perera's lecture seemed like a desperate swan song in defense of large bomb-proof shelters. In the discussion that followed, however, the arguments in favor of the Anderson shelters that had already been heard at the Lord Privy Seal's Conference and the Institution of Structural Engineers were recounted. A. H. Moberly, of the Royal Institute of British Architects, underlined a crucial issue:

¹¹⁸ "Experimental Work on ARP (abridged report)," *Journal of the Institution of Civil Engineers* 8 (1939): 237–39.

¹¹⁹ Perera, "ARP in Catalonia," 105.

¹²⁰ Perera, "ARP in Catalonia," 109, 116.

¹²¹ Perera, "ARP in Catalonia," 107, 110.

Bomb-proof shelters would divert a large proportion of human resources, materials, and money from the state's coffers, which could be better invested in improving active defense and prioritizing attack.¹²² The other key point was made by Major MacRoberts: The Anderson shelter was a “brilliant conception” because “it conforms to the basic principle of dispersion.”¹²³ Ultimately, what both MacRoberts and Helsby referred to as the “lessons of Barcelona” were soon buried in oblivion.¹²⁴

In the widely read book *ARP*, Haldane had complained that “since civil servants are not in general, scientifically or mathematically trained, they fall for quite elementary fallacies, such as the fallacy of dispersion” and warned that “the ideal civil servant (from the point of view of every British government for more than a century back) is an entirely different sort of person from the ideal engineer who is prepared to plan on a large scale.”¹²⁵ Yet despite Haldane's critique, Anderson held a science degree, British home shelters were scientifically designed by engineers, and neither other “Churchill's technocrats,” to borrow David Edgerton's term, nor Anderson's successor, Labourist Herbert Morrison, supported large-scale bomb-proof policies.¹²⁶ Contrary to the views of Haldane and dissident experts—and more importantly now, subsequent historians—politics did not win the “battle” over science in prewar Britain.¹²⁷ Rather, politics and science were always intertwined on all sides of the conflicts. Barcelona's shelters—albeit of a different kind—were also political architectures.

Conclusion

During the Spanish Civil War, Barcelona became a double-edged laboratory of both horror and hope. While Fascist aircraft tested techno-scientific tools of destruction, the city's residents mobilized

¹²² On the Research and Experiments Branch's shift “from defense to offence”: Edgerton, *Britain's War Machine: Weapons, Resources and Experts in the Second World War*, 146.

¹²³ “Discussion,” in Perera, “ARP in Catalonia,” 114.

¹²⁴ MacRoberts, *ARP Lessons from Barcelona*; O'Brien, *Civil Defence*, 172.

¹²⁵ Haldane, *ARP*, 225–26.

¹²⁶ Edgerton, *Britain's War Machine*, 93–122.

¹²⁷ Meisel, “Air Raid Shelter Policy,” 301; Armengou and Belis, *Ramon Perera*.

knowledge, skills, and care to create an underground city with over 1,300 air-raid shelters and a dense network of technological burrows. At the threshold of World War II, the results of this urban laboratory became of key geopolitical interest, particularly within Britain.

Like a mirror image, the underground landscape reflected the political reality above. The materiality, design, and organization of air-raid shelters embodied specific political regimes, gendered ideals, and socio-technical imaginaries. The three types of shelters addressed throughout this essay demonstrate how they were used for technopolitical purposes. Gallery shelters in Barcelona were coproduced and self-managed by their users, with a high participation of women, elders, and children. With no standardized layout, their construction drew on traditional techniques and the know-how of neighbors. The emergency of war, coupled with the anarchist-leaning revolution, fostered a vast, profoundly hybrid, community-based infrastructure of shelters, through which working-class organizations and neighborhood networks enacted what could be called “grassroots technopolitics.” By contrast, cellular shelters were scientifically designed shelters, managed by state institutions, and built by hired, unskilled male workers. These shelters relied on cement and concrete building techniques—that is, on state-regulated resources and engineering procedures led by experts. Cellular shelters took on a special dimension after the Communist and technocratic turn that followed the May Days of 1937. The Catalonia Passive Defense Council viewed them as a tool to centralize protection and reinforce state building.

The heated debate on civil defense in Britain was informed by the experiments held in Barcelona’s laboratory. The balance tipped toward the Anderson shelter, strongly shaped by the views of the British liberal state and the private sector. It was a prefabricated shelter for the protection of a family, which tended to foreclose the epistemic and political agency of the working class. Not only was London’s weather, soil, urban geography, and economy different from Barcelona’s, but so too was its political context. These conclusions might not lead to a deterministic, clear-cut view of the relationship between shelter architectures and politics but rather highlight the complexity of technopolitics in times of unrest. As shown, anarcho-syndicalist members in Barcelona also promoted

cellular shelters, while some Communist and socialist-oriented professionals in London advocated for gallery shelters.

Rosalind H. Williams, deeply inspired by Lewis Mumford, offers a pertinent reflection in *Notes on the Underground*: “The underground shelter is the emblem of humanity’s ancient and honorable quest for truth, power, beauty, and security through technological achievement. As our burrows become more elaborate, however, the needs of the built environment may come to take precedence over the needs of the human builders.” She warns that “our increased dependence on technological shelter may lead to the weakening of human interdependence, which is another source of security. We should not forget that society too provides shelter, and in many cases a more flexible and effective kind.”¹²⁸

In today’s world of wars and planetary crises, a major challenge is to collectively reimagine what kind of enviro-technical security we want for our survival and to reflect how we want to live—and eventually die—amid the ruins.¹²⁹ Selfish survivalists, right-wing libertarians, neoliberal corporations, and weaponized states envision extremely high-tech, deep-level shelters designed for wealthy users to continue to exist during—even though not long after—aerial bombardment, nuclear wars, tsunamis, pandemics, and “even widespread anarchy,” as advertised.¹³⁰ Yet long before these current technocratic dreams, in a context strongly marked by anarchist visions, shelters were of a different kind: They were built on—and were builders of—human interdependence, care, and mutual aid. Like the deep roots of a tree or the large mycelium of a mushroom, grassroots networks of protection steadily advanced underground, mirroring the social networks that neighbors had nurtured for decades.

¹²⁸ Williams, *Notes on the Underground*, 213.

¹²⁹ Haraway, *Staying with the Trouble: Making Kin in the Chthulucene*; Valentines-Álvarez and LoPresti, “The Atom in the Garden and the Apocalyptic Fungi: A Tale on a Global Nuclearscape,” 194–95.

¹³⁰ Vivos Global Shelter Network, accessed October 11, 2021, www.terravivos.com.

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FIGURES

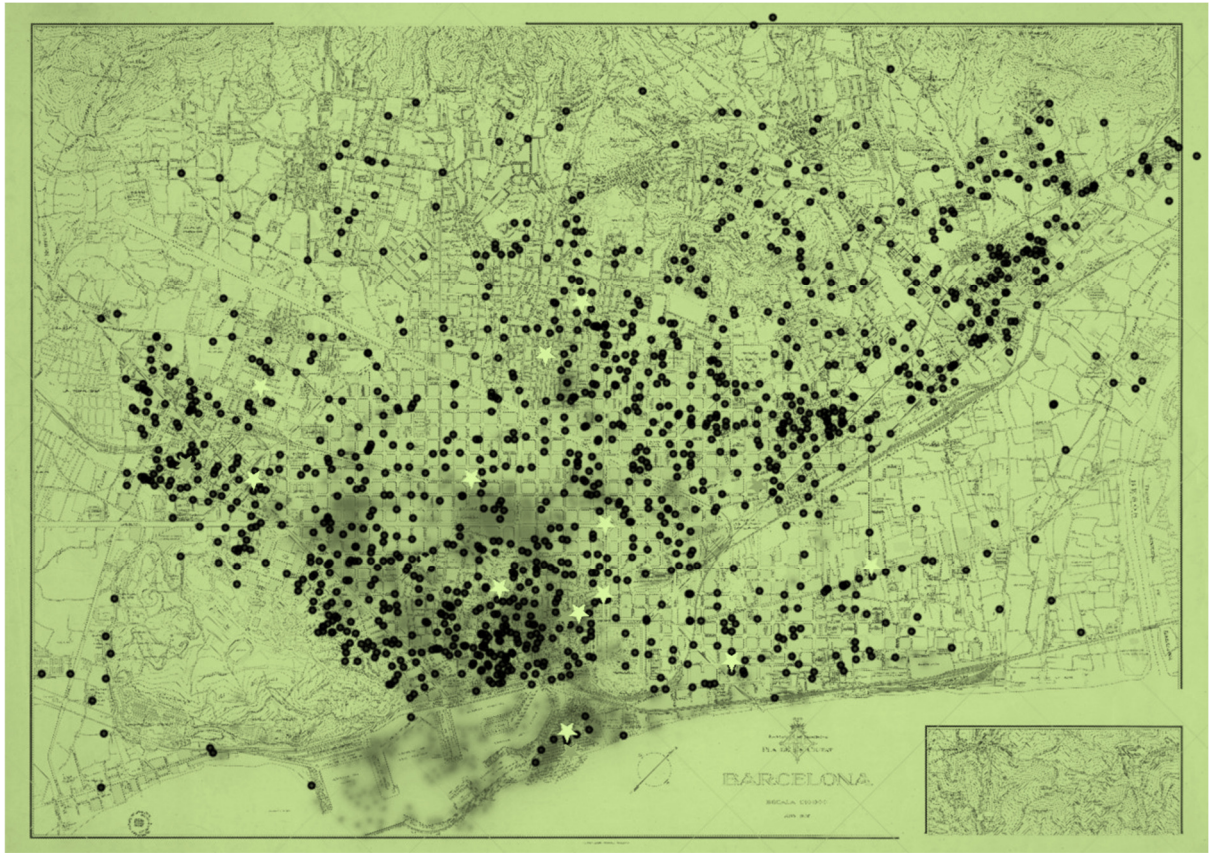


FIG. 1. Map of Barcelona’s Air-Raid Shelters. This map shows 1,293 air-raid shelters built before 1939 during the Spanish Civil War, forming a new “subterranean city”. Dots represent community-based gallery shelters, stars indicate state-produced cellular shelters, and the shaded zones highlight areas bombed by the Fascist forces. The underground landscape of shelters, mainly designed and maintained by local communities, reflect neighborhood networks and collective efforts to withstand aerial warfare (Source: Planning Office, Barcelona City Council, “Pla de la Ciutat,” 1935, C02.02/02941, Arxiu Històric de la Ciutat de Barcelona. Dots and shaded zones in this historical map were put by Miró and Ramos, in *City of Shelters*. Stars (to distinguish types of shelter in Barcelona) were inserted by the author).

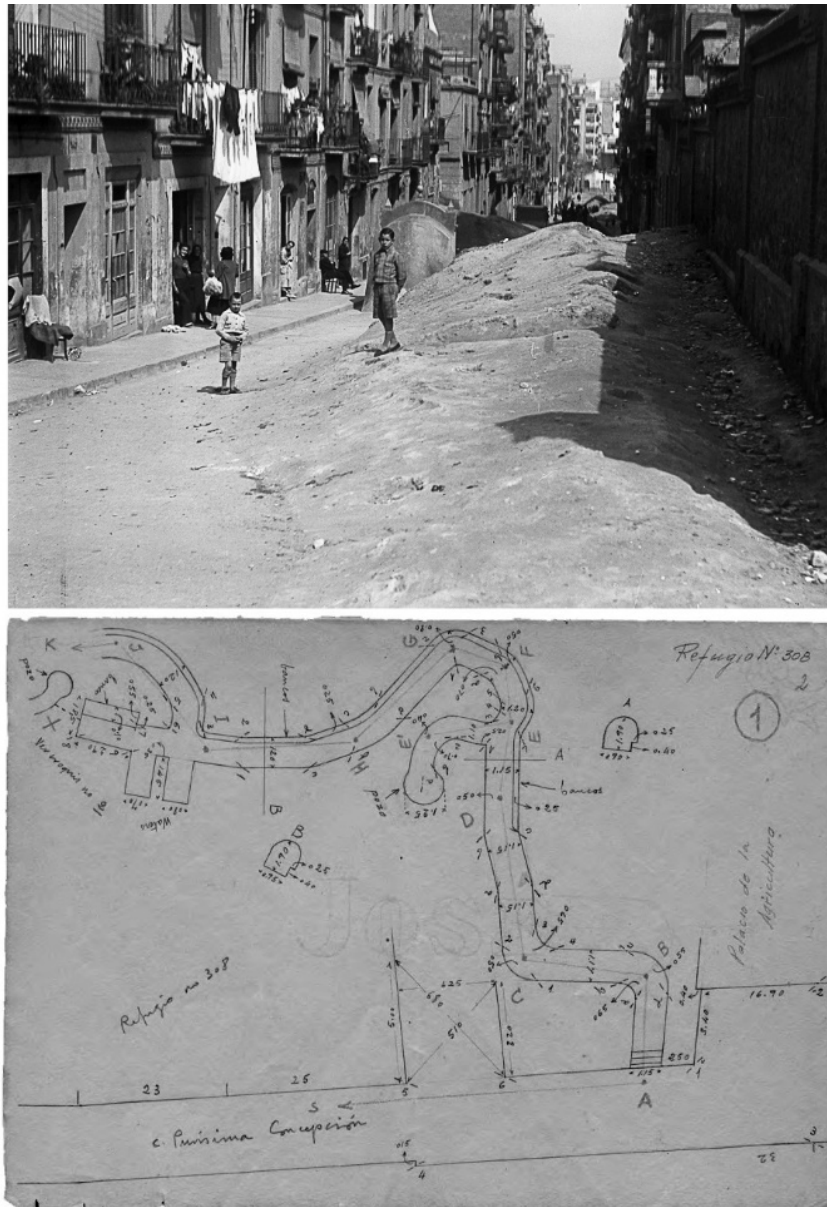


FIG. 2. Community-Based Gallery Shelters. Neighbors in Barcelona self-organized to construct shelters under their own streets. The photo below depicts a street in Poble-sec working-class neighborhood with a long pile of earth extracted from the shelter’s galleries underground, a typical image of the city during the Spanish Civil War. Children and women of the street—producers and users of the shelter—look at the photographer. Below is the floor plan of Shelter Number 308 in Barcelona, built in Puríssima Concepció Street, in this neighborhood, showing its narrow, organically shaped tunnels and carved benches. These collective shelters were effective against aerial attacks—the “Blitz” or lightning war—, embodying resilience akin to the metaphor of poet Antonio Machado (1875–1939): “To the old elm, split by the lightning and half rotten, with rains of April and sun of May, a few green leaves have sprouted.” (Source Top: Josep Domínguez Martí, “Munts de terra”, AFB3-126, Arxiu Fotogràfic de Barcelona. Bottom: M101/4.0308, AMCB. Courtesy of Arxiu Fotogràfic de Barcelona and AMCB.)

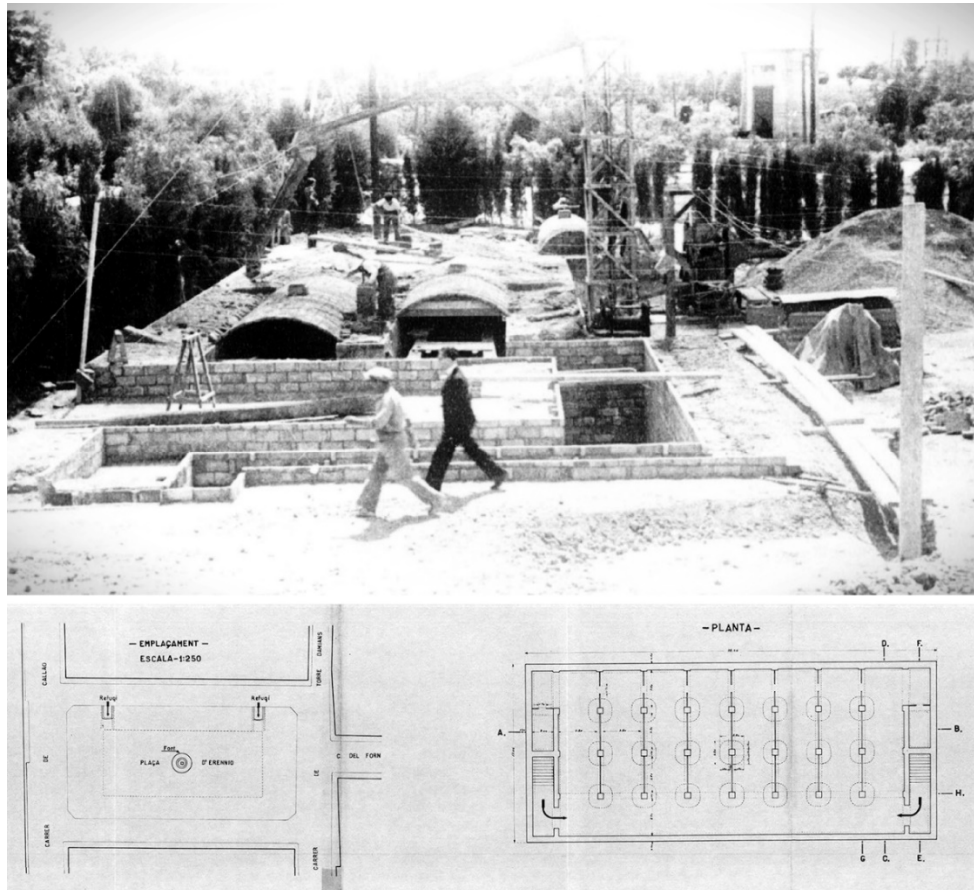


FIG. 3. State-Made Cellular Shelters. The photograph shows engineer Ramon Perera, head of the Catalan Shelter Works Service, inspecting construction on a state-funded cellular shelter at Barcelona’s outskirts in September 1938. A worker operates a crane and concrete chutes to coat the shelter’s tile vault roof with a concrete slab. Below is a technical drawing of a cellular shelter, under the Herenni Square, in the city’s Hostafrancs neighborhood, with a 688-person capacity and geometric cells, measuring 3.5×3.5 -meters. “Perhaps, it is reduced to geometry, to flattened sheets of paper, by whom readies the last shelter of all being alive,” poet Miguel Hernández (1910–42) said in *The Unceasing Lighting*. (Source Above: Photograph 350/14-4, “Ramon Perera” Collection, AAM. Courtesy of AAM. Below: M101/4.1542, AMCB. Courtesy of AMCB.)

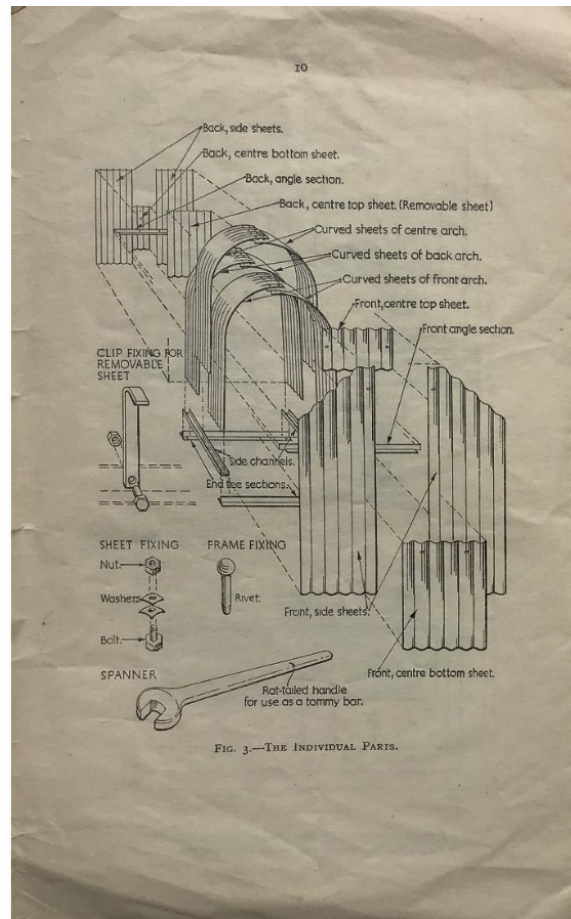


FIG. 4. Britain's Anderson Shelters. A propaganda photo shows a daughter and a son entering an Anderson shelter in a South London backyard under their mother's watchful eye in the summer of 1940. On the right, instructions detail how families could assemble these blast-proof shelters without skilled labor. Virginia Woolf (1882–1941), reflecting on shelters, in *The New Republic* on October 21, 1940, noted that community ties were vital to be freed from the state war machine: "Let us think what we can do to create the only efficient air-raid shelter while the guns on the hill go pop pop pop. . . . One of the [German] pilots landed safe in a field near here the other day. He said to his captors speaking fairly good English, 'How glad I am that the fight is over!' Then an Englishman gave him a cigarette, and an Englishwoman made him a cup of tea. That would seem to show that if you can free the man from the machine, the seed does not fall upon altogether stony ground. The seed may be fertile." (Source Left: Ministry of Information Photo Division Photographer, "A Working Class Family in Wartime," D 778, IWM. Courtesy of IWM. Right: Home Office, *Directions for the Erection*, 1939, 8–10, LBY CD 133, IWM.)