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“Laboratory in a Dirty Sky”: Aerial Media, Art, and Air Pollution in Project Da Vinci (1974–1979)

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This article develops the idea of aerial media as a way of grasping the conceptual and empirical intersection of geographies of air pollution, artistic experiment, and media. To do so it revisits Project Da Vinci (1974–1979), a series of balloon flights devised by artist and aeronaut Vera H. Simons that combined scientific research into sulfate pollution in the United States, experiments with aerial art, and forms of public engagement. Drawing on original archival research, the article begins by foregrounding Simons’s pivotal role in Project Da Vinci as part of her wider contribution to cultures of aerial experimentation in the United States and beyond. Focusing on how the project sought to understand the dynamic geographies of sulfate pollution plumes, the article then examines how this aim became articulated through a more ambitious effort to generate public engagement with air quality in the United States. Taken together, Da Vinci’s flights enacted a distinctive form of aerial media that combined the drift of airborne craft with moving air, artistic interventions within the air, and public engagement from the air. The category of aerial media, the article argues, therefore encompasses more than the use of airborne devices for the distribution of traditional media forms or the production of views from above: It also involves specific ways of moving that make air explicit as a medium of concern. *Key Words:* *aerial media, air pollution, art-science experiment, public engagement.*

The November 1976 issue of *National Geographic* magazine featured two stories about the Earth’s atmosphere. “What’s Happening to Our Climate?” was a feature-length survey of growing concerns about climate change (Matthews 1976). The second story, immediately following the first, was considerably narrower in scope and scale. “Laboratory in a Dirty Sky” focused on a balloon flight above St. Louis, Missouri, investigating the city’s “contaminated air” as part of a wider project named Da Vinci (R. Engelmann and Simons 1976, 616). Relatively light on text, the article was dominated by photographs of the balloon and its crew picking up, traveling with, measuring, and being exposed to a plume of “carbon monoxide, hydrocarbons, and oxides of nitrogen from automobiles and industrial sources; sulphur compounds from power-plant smokestacks; and the chemical combinations of all these in the atmosphere” (S. Engelmann and Simons 1976, 619).

The first story reveals a problem of planetary scope becoming visible as a “matter of concern” (Latour 2004) for certain publics—it provides an indication of how, in the mid-1970s, climate change was becoming the focus of an emergent gathering of ideas, investments, and sites. In this light, the focus of the piece about Da Vinci seems little more than a curious footnote documenting a minor and localized episode in the investigation of air pollution in the skies above the United States. What then might be learned by revisiting the aims and achievements of Project Da Vinci at this juncture? My argument here is that doing so offers an important opportunity to deepen the conceptual and empirical scope of the cultural-historical geographies of air pollution in the context of wider engagements by geographers and others with air and atmosphere (e.g., Adey 2010; Mahony 2019; Noterman 2023). More specifically, I use an encounter with Da Vinci to bring together ongoing work in two areas. The first concerns

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diverse efforts to explore how the “boundary object” (Mostafanezhad, Evrard, and Vaddhanaphuti 2024) of air pollution is rendered public as a matter of concern across different modes of expertise and experience (e.g., Cupples 2009; Jokela-Pansini and Militz 2022; Kenis and Loopmans 2022; Mansfield 2022). An important strand of this work focuses on how artistic experiments, often but not always in collaboration with scientific expertise, allow air quality to be made public (Born and Barry 2010; Calvillo 2018; S. Engelmann 2015; Gabrys 2022; Landau and Toland 2022). Such experiments cultivate diverse orientations toward air while also making the “dynamic geography” of air quality explicit (Born and Barry 2010, 114). The second area of research centers on the elaboration of environmental or elemental forms of media (e.g., Peters 2015; Starosielski 2019; Furuhashi 2022). Much of this work emphasizes the dynamic materiality of media devices and infrastructures in relation to the environmental processes on which they depend and in turn condition (S. Engelmann and McCormack 2021). As Peters (2015) argued, rendering media more environmental foregrounds relations of technical, representational, and artistic mediation that work across bodies, craft, and their elemental surrounds, notably air and water (see also Horn 2018). Critically, in such work, air figures as more than matter. It also becomes a differentiated *medium* (or set of mediums) in relation to which the geographies of diverse forms of media need to be understood.

This article develops the idea of *aerial media* as a way of grasping the conceptual and empirical intersection of geographies of air pollution, artistic experiment, and media. Aerial media, I argue, encompasses more than the use of airborne devices as platforms for producing aerial views from above or remotely sensed images (Kaplan 2018; Doucet 2021) or for distributing forms of representational media from those platforms. Instead, informed by archival research into Vera H. Simons and Project Da Vinci,¹ my argument is that the concept of aerial media centers air, including polluted air, as a medium of experimental concern through movement with and *within* that air. This argument is developed as follows. I first situate the article in relation to ongoing work on air pollution, artistic experiment, and elemental media. I then foreground Simons’s role in Project Da Vinci as part of her wider contribution to cultures of aerial experiment in the United

States. Focusing on how the project investigated the dynamic geographies of sulfate pollution by moving with and within pollution plumes, the article then examines how this aim became articulated through an ambitious effort to cultivate public engagement with air quality across the United States. Taken together, I argue that Da Vinci’s flights enacted a form of aerial media combining the drift of airborne craft with moving air, artistic interventions within the air, and public engagement from the air. The category of aerial media, I conclude, encompasses more than the use of airborne craft for the distribution of traditional media forms or the production of views from above: It also involves specific ways of moving within air to make air explicit as a medium of experimental concern.

Air Pollution, Art, and Aerial Media

Although air pollution is a long-standing focus of geographical research, the volume of such work has grown significantly in recent years in the context of wider engagement by geographers with air and atmosphere (see, e.g., Adey 2010, 2015; Tripathy and McFarlane 2022). In such work, air pollution emerges as a hybrid problem (Cupples 2009) and a boundary object (Mostafanezhad, Evrard, and Vaddhanaphuti 2024) shaped by and refiguring a range of political, economic, and social processes and questions (Buzzelli and Jerrett 2004; Buzzelli 2008; Gabrys, Pritchard, and Barrat 2016; Kenis and Loopmans 2022). Air pollution’s geographies link sites and bodies of emission and exposure through questions of toxicity, violence, and public concern (Lora-Wainwright 2016; Davies 2018; Liboiron, Tironi, and Calvillo 2018; Garnett 2020). Breath and breathing are central here (Kenner 2021), not least because they reveal how exposure to air pollution is implicated in forms of racialized and intersectional violence (Pulido 2017; Mansfield 2022; see also Allen 2020).

Given the complexity of geographies of air pollution, geographers and others have multiplied the sites and sources of expertise via which these geographies are made explicit and made public. The imperative here is as political as it is technical because, as Mansfield (2022, 1212) argues, dominant “modes of knowledge production” often render invisible air pollution and the experiences of those exposed to it. Countering this is part of geographers’ interest and participation in experiments in citizen science and

activist engagement with air pollution (e.g., Born and Barry 2010; Gabrys, Pritchard, and Barratt 2016; da Schio and van Heur 2022; Landau and Toland 2022; Booker et al. 2023; Shilon and Marom 2023). In much of this work, scientific models of air pollution are mobilized alongside understandings of air as a milieu in which forms of life are immersed, experienced, and governed (Véron 2006; Foucault 2007; Whitehead 2009; Graham 2015; Nieuwenhuis 2016; Gandy 2017). This work is also often attentive to cultural perceptions, rhythms, and embodied experiences of exposure to air pollution (e.g., Adey 2015; Hodgson and Hitchings 2018; Zajchowski and Rose 2020; Mostafanezhad 2021; Walker, Booker, and Young 2022). In this context there are important emerging “intimacies” between artistic engagements with the “poetics” of air (S. Engelmann 2015, 2020) and scientific techniques of measurement and monitoring (Calvillo 2018; Calvillo and Garnett 2019). Developing these connections, Landau and Toland (2022) survey five different activist-artistic approaches, each of which engages the “senses to make air pollution and its political implications visible, tangible, or otherwise experiential” (629). Although diverse, for Landau and Toland these works contribute to a “sensory politics of air” in the Anthropocene.

Where geographies of air pollution are linked with questions of media, this is usually in relation to how network and social media shape understandings of that pollution (Kay, Zhao, and Sui 2015; Kenis and Barratt 2022). Generative connections can be made, however, between research on air pollution and ongoing work on elemental media (Peters 2015; Starosielski 2019). On one level, the category of elemental media encourages attention to the material infrastructures and substrates of media, paralleling similar claims within geography about the importance of understanding media representations in relation to a wider set of materialities (Adams 2017; Grandinetti and Ingraham 2022). This category, however, also revives the traditional idea that the elements, including air and water, are mediums, albeit impure and differentiated (see Horn 2018; Young 2020). In these terms, air becomes a multiplicity of mediums of exposure, exchange, and life, mediating and being mediated by bodies, infrastructures, and devices. In turn, thinking of air via elemental media amplifies the long-standing claim that air, polluted or otherwise, is a medium of artistic

experiment (Randerson 2018) as much as something to be measured and represented (see Kenis and Barratt 2022). Understanding air, including polluted air, as a medium of aesthetic experiment therefore brings together cultural geographical concerns with the materiality of aesthetic practices and the specificity of artistic experiments with environmental issues (see also Hawkins 2021).

In this article I draw together ongoing work on air pollution and elemental media to develop an account of *aerial media*. By this term I mean, broadly, a set of more-than-representational (Lorimer 2005) material relations of mediation with and within air as a diverse and differentiated medium. In developing this concept I build on work by geographers and others on how different devices for becoming aerial have made mobile a range of representational media practices, including art, cartography, and photography (Adey 2010; Dorrian and Pousin 2013; Kaplan 2018; Bender and Kanderske 2022; Ritter 2024). My claim here, however, is that an account of aerial media also includes attention to the relations of mediation that exist between bodies, devices, craft, and air as an elemental medium or surround.

Although it has wider implications, this understanding of aerial media is especially helpful for understanding what Born and Barry (2010, 116) call the “specificity, heterogeneity and complex genealogies” of art-science experiments designed to make air explicit and public. Born and Barry (2010) highlight the specificity of techniques for revealing “the dynamic geography of air quality” (114) using the example of PigeonBlog, a citizen science project in which pigeons moving through polluted air were equipped with sensors (see also Haraway 2016; Kenis and Loopmans 2022). Such experiments make visible what Noterman (2023) calls the “fugitivity” of air pollution. As Noterman illustrates in the context of a discussion of dust, pollution is “fugitive” because the trajectories of its dispersal are often unpredictable (see also Sabin and Cantos 2023). The fugitivity of air pollution more generally is always multidimensional because the Earth’s atmosphere itself is differentiated, composed of various bodies and volumes moving at a range of speeds, altitudes, and changing under many different influences. Modeling air pollution therefore involves tracking the dynamic mobilities of volumes of air as they travel and transform under the influence of various factors.

This article revisits Da Vinci as a relatively modest but nevertheless significant episode in the recent cultural-historical geographies of experiments with the fugitivity of air pollution. Such historical work offers important opportunities for conceptualizing contemporary efforts to grasp the elemental circumstances of the present through experiments with aerial media. More specifically, by revisiting Da Vinci I contribute to understandings of aerial media by focusing on three aspects of that project. First, by dwelling on the contribution of Vera Simons I place the project in the context of historical-cultural geographies of aerial experiment. Second, I show how in Da Vinci air pollution was modeled by moving with and within—as distinct from moving through—that pollution. Finally, and third, as I show in what follows, Da Vinci allied this project with an effort, instigated by Simons, to devise an aerial platform for generating public engagement with the air as a medium of concern.

Devising Da Vinci

The geographies of Project Da Vinci cannot be understood without attention to the biographical details of the figure who devised it, Vera H. Simons.² Simons's development of Da Vinci must be placed, in turn, in the context of her negotiation of and contribution to cultures of lighter-than-air experiments in the United States during the middle to latter part of the twentieth century. Born in Germany as Wera Maria Habrecht, Simons moved at age thirteen with her family to Detroit, where her father became a society portrait photographer. In 1941, she married Otto Winzen with whom, in 1949, she cofounded and coowned Winzen Research Incorporated (WRI) with money borrowed from her parents. WRI, of which she was vice president from 1950 to 1960, fabricated polyethylene balloons and specialized capsules for high-altitude experimental balloon projects funded by the U.S. government (see Winzen and Parks 1958), including Stratolab and the aptly named Manhigh. Many of these projects exemplified a form of “frontier verticality” in which the upper atmosphere was explored via balloon as a precursor to the space program. During these flights, figures like Malcolm Ross (see McCormack 2017) and David G. Simons became experimental subjects for the physical and psychological evaluation of exposure to the conditions of near space.³

In contrast to the public profile of figures like David G. Simons (who appeared on the cover of *Life Magazine* following his Manhigh flight), Vera Simons's ground-based role at Winzen was less public, focusing on the design, manufacture, and inflation of balloons. This role seems to reinforce the vertical division of labor that dominated high-altitude ballooning during the 1950s and 1960s. Indeed, in one account, Simons emphasized the gendering of fabric handling, claiming that “we can't trust men for this job. ... It is something only women can do. I get a little jumpy even when my husband starts handling the balloon while it's being inflated. There's something feminine about a balloon through and through” (cited in Haymaker 1956, 155). Simons's evolving career complicated these divisions, however. She became a noted balloon pilot who, in contrast to the verticality of projects like Manhigh, used the balloon as a platform for drifting within and understanding the lower atmosphere. The trajectory of Simons's career as a balloon pilot is therefore implicated in, while also deviating from, the gendered geographies of twentieth-century aerostatic experiments.⁴

Simons's participation in these geographies is even more interesting given her artistic work, which she considered more important than her career in ballooning. Before meeting Otto Winzen, Simons studied at the Walker Art Center (1946–1950) and the Minneapolis School of Art. Later she attended the Corcoran School of Art in Washington, DC. During the 1960s, Simons became interested in and influenced by forms of pneumatic art, producing inflatable sculptures for exhibitions at the American Federation of Arts, New York (1968), the Contemporary Arts Museum, Houston (1968), and the Jewish Museum, New York (1969). During 1970 and 1971 her work was included in group exhibitions in New York, San Francisco, Sao Paulo, Sydney, Boston, and Caracas, and at MIT. In the late 1960s, Simons was a visiting fellow at the Center for Visual Arts at MIT, where she encountered Otto Peine, a key actor in the Sky Art movement (Piene and Russett 2008). Although inflatable work remained part of her practice, during the early 1970s Simons brought together her artistic interests and ballooning in a series of aerial works beginning with her participation in a 1971 group exhibition at the Stedelijk Museum in Amsterdam. Her contribution, “Drift Amsterdam,” included a balloon flight over the city, during which Simons made time-lapse photos

from above and dropped leaflets with an invitation to whomever found them to visit the museum, where they would be photographed as part of the work's documentation (Holmes 1971). Simons was familiar with such leaflet drops. During the 1950s WRI had been commissioned by the U.S. government to "produce small pillow balloons to drop leaflets over Hungary, in connection with Radio Free Europe" (Holmes 1971).

The Amsterdam flight encouraged Simons to develop a balloon platform with which to combine concerns with air quality in the lower atmosphere, artistic experiments, and forms of public engagement. The balloon would move within the air as an "ecologically pure platform, slow moving, and stable ... , an observatory moving in and with a weather mass and not through it" (The Da Vinci Project n.d., 2). This platform would "become as nearly a part of the Elements [sic] as is possible" (Simons 1972a, 1), allowing the artist to "experience environmental elements, to portray them, and capture the feeling of the interaction between the elements that comprise the whole environment" (Simons 1972b). Here Simons was articulating an aesthetics of elemental immersion that has long been part of the promise of balloon flight and the cultivation of atmospheric and aesthetic sensibilities (S. Engelmann 2020; S. Engelmann and McCormack 2018; McCormack 2018). Simons was also clear that Da Vinci was an art-science collaboration, claiming that "scientists especially can be an enormous creative stimulus for the artist where there is communication between them" (Simons n.d.-b, 1). Early descriptions of Da Vinci claimed it would "combine art and science, melding these talents to measure and portray quantitatively and qualitatively the environment" (The Da Vinci Project n.d., 1).

After devising the project, Simons "spent considerable of her own resources identifying the crew and motivating the art and scientific communities" (R. Engelmann 1974, 2). Early supporters included the Atomic Energy Commission (AEC), the National Geographic Society, and the Atmospheric Sciences Laboratory of the Army Electronics Command. A key person here was Dr. Rudy Engelmann, a meteorologist with the AEC and the Energy Research and Development Administration (ERDA). Engelmann was enthusiastic about the potential of Simons's aerial platform for understanding industrial air pollution plumes, a problem that became the organizing principle of the first three Da Vinci flights.

Moving With/in Pollution Plumes

The problem of such industrial pollution plumes had long been recognized in the United States (Tarr 1984, 10). Efforts to regulate the problem were made throughout the twentieth century, mostly at a local and municipal level, where the "the primary criterion of an air pollution nuisance was based on perceptible ground level effects" (Tarr 1984, 14). Framing air pollution as a localized, ground-level problem contributed to the popularity of one solution—the tall chimney stack. Stacks up to 700 feet high were constructed to force pollution higher with the aim of dispersing it away from cities. These stacks permitted industrial emitters to avoid violating local air pollution controls by, in effect, elevating emissions above the jurisdiction of those controls. The "considerable merit" of stacks was supported by the 1965 Air Conservation Commission of the American Association for the Advancement of Science (Tarr 1984, 15). In addition, the 1970 U.S. Federal Clean Air Act reinforced local enforcement of effective controls to meet national air quality standards, further reinforcing the appeal of stacks.

The assumed effectiveness of these stacks was undermined, however, by scientific concerns about the effects of sulfur dioxide emissions from coal-powered electricity generation and smelting plants. The recognition that harmful sulfates formed in the atmosphere after the emission of SO₂ was especially important here. A vital research question concerned the "rate of reaction by which sulfur dioxide [was] converted to sulfate" in a pollution plume (Forrest, Schwartz, and Newman 1979, 157) as it drifted away from a stack. This question became an organizing focus for Da Vinci's multiagency scientific aims. Rudy Engelmann outlined the scope of the sulfate problem thus:

The critical factor in the formation of the sulfates, the fact that requires a multistate-scale research program, is the circumstance that the conversion from SO₂ to sulphates occurs slowly in response to the meteorological situation and the presence of other pollutants. Therefore, the sulfates make their appearance at great distances from the combustion centres and result in a widespread pollution pall which, with current coal utilization practices, extends hundreds of miles either side of a line between Chicago and New York. (R. Engelmann 1975, 4)

The complexities of volume and verticality intersect in efforts both to disperse pollution plumes away from sites of emission and to make their fugitivity explicit through measurement and modeling (see Elden 2013; Eriksen and Turnbull 2022). In this context, the scientific aims of Da Vinci became focused on collecting data with which to model the dispersal and transformation of sulfate pollution plumes. The immobility of ground-based methods put them at a disadvantage with respect to the movement of such plumes. Although aircraft could fly higher, they could not stay with the plume as it moved.

By floating and drifting at different altitudes and directions, the balloon offered a semidirigible platform for moving with and within a volume of polluted air and for tracking its transformation in relation to its elemental surrounds. During the flight, air samples could be collected at regular intervals. The speed of the air relative to the balloon could also be measured by releasing smaller balloons with colored lanterns attached (see Figure 1). Data acquired during the flight could then be used to model the pollution plume. Understanding how air pollution is modeled is an important element of grasping the significance of Da Vinci's method. As with water pollution, there are different ways of modeling air pollution dispersal as a process of fluidity and flow. In a discussion of the movement and materialities of oceans, Steinberg (2013) notes how a Eulerian perspective models fluid motion from the fixed point of view (or point of measurement) of a notional observer (or a series of observers) watching a fluid pass by. As Steinberg continues, the fixed points of measurement of this perspective represent a geography existing prior to the movement they model. In contrast, a Lagrangian perspective begins in the middle of the movement of a fluid, which is modeled from the perspective of a notional observer (or particle) situated within and moving with that fluid. In this case the space of the fluid "is less a thing or stationary framework than a medium that is constantly being made by its dynamic constitutive elements" (Steinberg 2013, 161).

This difference is important for understanding Da Vinci as an experiment in an expanded sense of aerial media. Specifically, it draws attention to how some of the properties and composition of air as a dynamic medium (or set of mediums) in movement can be understood by moving with and within that



Figure 1. Balloon crewmember, possibly Dr. Rudolph J. "Rudy" Engelmann, releases a small "tetron" test balloon from the gondola of Vera Simons's Da Vinci balloon, probably during the first Project Da Vinci flight, November 1974. From the Vera Simons papers, NASM.2016.0013, used with permission of the National Air and Space Museum, Smithsonian Institution.

medium rather than being measured from a distance. This Lagrangian perspective foregrounds how such understandings are facilitated by the balloon as a distinctive aeromobile craft (see Adey et al. 2024) that can situate itself in a volume of moving air as it is modified in relation to its elemental surrounds. A Lagrangian approach provided the rationale for much of the scientific research on Da Vinci. Rudy Engelmann described the approach in the following terms:

In this project we regard the Lagrangian reference frame as moving with the mean flow of an assembly of air parcels, the assembly being large enough to encompass the balloon and gondola. Such an assembly possesses diffusive characteristics, mean values, and deviations from the mean values of temperature, trace constituents, etc. The assembly of parcels is, of course,

exchanging parcels at its imagined boundary, and, thus, gradually changing its mean qualities. The balloon is able to stay with such an assembly for an unknown time which appears to be long enough to achieve most desired “Lagrangian measurements.” (R. Engelmann 1975, 3)

The balloon therefore provided a platform with which to operationalize a mobile Lagrangian perspective. It allowed observers, taking the perspective of an idealized “parcel” of air, to become immersed in and move with a larger volume of air—in this case a plume of pollution—as a method to obtain the data with which to model how that volume traveled and changed over an extended period. This was combined with data from ground-based stations, a chase vehicle, and an aircraft. In effect, the balloon was at the center of a mobile assemblage that included the pollution plume.

After a test flight in New Mexico, this Lagrangian perspective informed the second and third Da Vinci flights, both of which took place over St. Louis (see Figure 2). By the 1970s, the air around that city had become amongst “the most studied in the nation” (R. Engelmann and Simons 1976, 619), with the EPA in 1974 choosing St. Louis for its Regional Air Pollution Study, cementing the city’s status as “a test bed for scientists concerned with comprehending urban air pollution, and its long-term—and long distance—consequences” (Posey 1976, 72). St. Louis’s location on a regional boundary between polluted air to the east and cleaner air to the west was a significant factor here, making it easier to differentiate between discrete pollution plumes and ambient air pollution around the city. Air flow above St. Louis was also unobstructed by mountains and comparatively unaffected by emissions from other cities. Given its significance, various agencies became involved in the Da Vinci flights over St. Louis, including the ERDA, the National Oceanic and Atmospheric Administration, and U.S. Environmental Protection Agency. They sponsored experiments on cloud and ice-nuclei counts, light scatter, atmospheric diffusion, infrared radiation, aerosol concentrations, particle-size distribution, incident ultraviolet flux, ozone and sulfur dioxide, eddy diffusivity, and wind field.

The first St. Louis flight (Da Vinci II) launched on 8 June 1976. An air pollution alert had been called for the city, and the balloon picked up the plume from a power plant before drifting 200 miles

over a twenty-four-hour period. Da Vinci III, launched in July of the same year, struggled initially to pick up a plume before eventually doing so. After about 125 miles the balloon lost the plume when trying to avoid a storm, continuing to fly until the following day. Both flights were nevertheless considered to have generated important scientific findings. Following Da Vinci III, Rudy Engelmann (1976, np) wrote to the National Geographic Society’s Committee for Research and Exploration, reporting that “the data coming from the flights are truly unique and valuable. These are the most comprehensive data sets ever taken, and for longer times, on the character, transport, and transformation of urban pollution.” The project findings emphasized simultaneously the extended spatial coherence of pollution plumes and their rate of transformation as they were mediated, or not, by their surrounds. An ERDA (1976) press release noted that the initial data demonstrated that “under appropriate conditions, the highly polluted air which builds up over a city can be transported in an atmospheric layer well above the ground for long distances at night, with very little dilution of the pollutants” (3). Other agencies interested in the problem of air pollution reported the project findings. In October 1976, the American Lung Association noted that,

It had been thought [pollution dispersed] in normal weather and [ceased] to be a problem. Instead, it holds together remarkably, altering with time and sunlight and the nature of the chemical mix, and the next day it is brought back to earth as the air at the earth’s surface warms, rises, and mixes with the now cooler air above. Meantime, if sulphur dioxide, hydrocarbons, and nitrogen oxides are among the emissions, the sun has changed some of these pollutant gases to ozone and tiny, respirable-sized particles of sulphate, sulphite, nitrate, and other possibly equally harmful compounds. There is nothing quaint or romantic, then, about the immediate lesson from Da Vinci: National air quality standards cannot be achieved by such actions as isolating refineries or putting stacks on power plants tall enough to keep the plume away from the local monitoring station. (Corman 1976, 14)

Numerous local and national newspapers also ran stories reporting the finding that tall chimney stacks “do little more than pass the pollutants to others who live downwind” (Clemens 1976, 1; *The Washington Star* 1976). A memorandum prepared to generate support for the fourth, even more ambitious Da Vinci flight, claimed the earlier flights had



Figure 2. Oblique aerial view of the city of St. Louis, Missouri, showing the Gateway Arch and Mississippi River at center, with a DaVinci helium balloon in flight. From the Vera Simons papers, NASM.2016.0013, used with permission of the National Air and Space Museum, Smithsonian Institution.

proved “airborne pollutants travel cohesively for great distances, posing even greater threats to air quality in city and country than had been perceived previously” (DaVinci TransAmerica Memorandum n.d., 3). The first three Da Vinci flights could therefore be judged scientifically successful. They provided data with which to model the transformation of sulfate plumes in motion while articulating the relations between sites of emission and of exposure (see also Decker et al. 1978). They revealed how air pollution transformed as it traveled via its exposure to elemental forces including sunlight. In the context of growing interest in sulfate plumes emitted from tall chimney stacks, DaVinci became what Rudy Engelmann called “a laboratory without walls” (cited in Posey 1976, 72) that complicated any straightforward mapping of the dynamic geography of air pollution onto local regulatory jurisdictions and instruments.

Aerial Media Above America

As experiments in aerial media, the first three Da Vinci flights, and the second and third in particular, showed how moving with and within volumes of air pollution rendered explicit the dynamic and fugitive geographies of that pollution in distinctive ways. The fourth and final Da Vinci flight aimed to develop further such understandings by picking “up a relatively clean parcel of air coming into the western United States and study its modification by nature and man [sic] as it traverses America” (Da Vinci TransAmerica Memorandum n.d., 4). The flight was also intended to allow the artistic aims of Da Vinci to be realized more fully, after they had been relegated behind the scientific focus of the earlier flights, including the one featured in *National Geographic* magazine. During those flights Simons had, however, undertaken some modest artistic

activities. She had used time-lapse photography with cameras pointed directly downward and had begun to experiment with coloring clouds—activities to which Simons hoped devote more time during the TransAmerica flight. Simons also planned to use art to generate public engagement with air quality. The artistic dimension of the TransAmerica flight was intended to produce a distributed experience of aesthetic and elemental immersion in a medium Simons felt that many Americans had forgotten (see Sanford 1976). In advance of the flight Simons outlined her intention:

I want to make people think about certain relationships between human beings, mechanical objects, and nature. Most of all, I hope to provide an intense aesthetic experience for a very wide audience. In Da Vinci TransAmerica, I am trying to create this experience, not by representing these relationships, but by living them and by bringing about a situation in which other people can live them as well. (Simons n.d.-a, 1)

Da Vinci TransAmerica was launched from Tillamook, Oregon, on 26 September 1979, with its intended destination Norfolk, Virginia. Onboard were Simons, Rudy Engelmann, and two other crew members—Dr. Fred Hyde and Randy Burch. The latter was there to film the flight for NBC, with whom the Da Vinci team had negotiated broadcast rights. After an encouraging start, the crew encountered various difficulties, including the failure of their main radio system. The balloon drifted south of its planned route, struggling to pick up winds that would have helped it reach Norfolk. Eventually, the balloon was forced down in northwest Ohio on the evening of 2 October, a rough landing during which Simons's leg was broken by an unsecured NBC camera. By then the balloon had drifted over Washington State, Idaho, Wyoming, Colorado, Kansas, Iowa, Missouri, Illinois, and Indiana (see Figure 3).

Da Vinci TransAmerica did not reach its intended destination, nor was it as scientifically significant as the project's earlier flights. It is especially interesting here, however, as an experiment in aerial media. In a conventional sense of aerial media, TransAmerica's performance of a national aerial event rehearsed histories of balloon flight as a mediated spectacle (Kim 2004; Keen 2006). The flight was publicized widely through broadcast media channels, although Engelmann and Simons would

subsequently enter into a dispute with NBC about network exclusivity over any footage. Da Vinci TransAmerica also aimed to capitalize on the public profile of long-distance balloon journeys following the success of the earlier Double Eagle II transatlantic flight in 1978, especially because overland flights could generate a potentially larger public to track the progress of the balloon and witness it in the sky. In an artist statement released before the event, Simons envisaged distributed and multimodal public engagement with the “work.” TransAmerica could be, she wrote,

Experienced directly, by seeing it yourself, or indirectly on television, or through documentation: my own documentation from the balloon and other peoples' documentation of the flight. Anyone who sees any of these things is experiencing the work. To experience the whole event, you should see a fragment of the flight with your own eyes, which is all you can, and use T.V. and documentation to extend it in time. But best of all would be to be a participant as well: to be one of those who provides the feedback which makes the work complete. (Simons n.d.-a, 2)

A media event of this ambition and duration was also an advertising opportunity. Commercial sponsorship of balloon flights was nothing new, nor was corporate involvement in art-science aerial or atmospheric experiments. In the 1960s and 1970s, notably, organizations like Experiments in Art and Technology (EAT) had attracted corporate sponsorship for interdisciplinary media experiments (see Furuhashi 2022). Da Vinci's public relations firm sold TransAmerica rather grandiosely as a marketing opportunity akin to the Wright Brothers or Charles Lindbergh (Project Da Vinci TransAmerica Outline n.d.). They estimated that publicity for the flight would “reach over 50% of the population ... either in person (flight path) or by radio, TV, newspaper, or magazine” (Project Da Vinci TransAmerica Outline n.d.). One corporation that bought into this promise was Seven Up, a subsidiary of Phillip Morris, with whom Simons had a professional connection, having been involved in designs for inflatable-based advertising for its products. In a press briefing, Seven Up president Edward Frantel called Da Vinci TransAmerica a “message to America” that would “show us the way to a better knowledge of our earth and our skies, and the data it gathers will tell us things we must know about our planet in our age” (Frantel 1979, 1).



Figure 3. Route map of DaVinci TransAmerica's 26–31 September 1979 flight across the continental United States. From document “Da Vinci TransAmerica” (1979, 3). From the Vera Simons papers, NASM.2016.0013, used with permission of the National Air and Space Museum, Smithsonian Institution.

Da Vinci TransAmerica's significance as an experiment in elemental media is not reducible to its implication in commercial advertising, however. It was also very much an aerial experiment in mixed media (Hawkins 2021), deploying a range of artistic techniques that recalled and reworked older histories of the balloon as a platform for aesthetic practices (see Kaplan 2018). During the flight, Simons explored further the relation between vision and verticality with downward-pointing cameras recording time-lapse images of terrain below the drifting balloon, with other cameras capturing images of the changing sky. Echoing remarks by many balloonists about the distinctive quality of sounds heard aloft, Simons also recorded the “sounds of America, its forests, fields, highways, urban areas, wild animals, farm animals, birds, generators, other mechanical equipment and even human voices” (Simons n.d.-c, 1). Revealing the influence of Sky Art, Simons

experimented with modifying the air as an artistic medium, creating artificially colored clouds around the moving balloon (see Figure 4). She also generated paintings by exposing chemical reactants to air pollution, and undertook a light show of sorts by directing high-powered spotlights at clouds, with the lights sourced from General Electric (n.d.). During the flight, various objects were released and allowed to drift away from the balloon, including Simons's own floating sculptures. Seed packets sponsored by a forestry company were dropped from the balloon instead of conventional ballast.

As an experiment in aerial media, TransAmerica also involved the generation of distributed atmospheres of public engagement, with a planning document for the project claiming that “the balloonists will create their own atmosphere” (DaVinci TransAmerica Memorandum n.d., 4). In practice, this meant generating anticipation for an unfolding

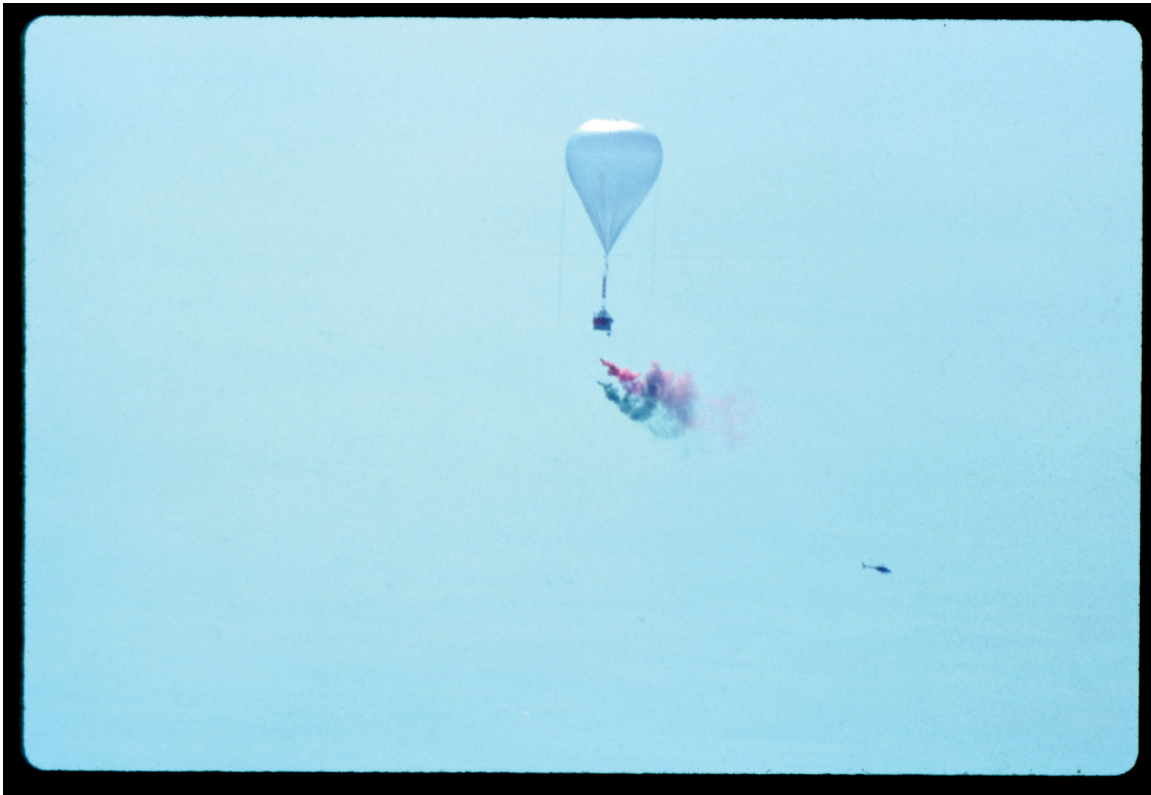


Figure 4. Distant view of Da Vinci TransAmerica in flight shortly after releasing colored smoke; plumes of red and dark green smoke can be seen dissipating beneath the balloon gondola, 1979. Helicopter in flight in lower right background. From the Vera Simons papers, NASM.2016.0013, used with permission of the National Air and Space Museum, Smithsonian Institution.

aerial experiment. Revisiting her involvement in balloon-borne Cold War leaflet distribution, Simons scattered preaddressed postcards with decals designed to “develop a trajectory of people” along the flight path (Simons *n.d.-c*, 2). The decals had the following message: “This decal is a gift dropped to you from on board the Da Vinci balloon. I would like to know more about the people who find my messages. Could you please send back this card, describing yourself and your feelings about the flight. ... I will use the cards in an art work so you will become the artists with me.” Many postcards were returned to Simons, including one from a police officer in Denver, Colorado, who wrote that he had “watched this card and the decal float down” and that “the balloon was a great attraction as it passed over Denver” (Simons papers, Box 17, *n.d.*).

Insofar as it generated an atmosphere of public engagement with its progress, Da Vinci TransAmerica was reasonably successful. Its journey was reported nationally and locally on a daily basis, and much of this reporting drew attention to the project’s

ambition to raise awareness of air pollution. The national prominence of the TransAmerica flight is indicated by Simons’s receipt of a congratulatory letter from President Jimmy Carter, in which he also wished her a speedy recovery. These wishes were echoed in letters sent to Simons by school children. One eleven-year-old in Bellevue, Washington, wrote that their whole class “followed the Da Vinci balloon flight by reading newspaper articles and watching the Today news show. We also used an anemometer and wind speed indicators to test wind currents” (Simons papers, Box 17, *n.d.*). It is difficult, of course, to use such comments to assess the impact of the flight, or to evaluate the degree to which people were moved to think differently about air quality. Part of the difficulty is, of course, due to the processual nature of Simons’s work, whose dynamic geography was not defined by fixed points but by the perspective of a body of air in motion. This meant that Da Vinci’s notional “public” was radically local and distributed rather than ever gathering together in a real or digital forum.

Crucially, as an experiment in aerial media, TransAmerica exemplified a distinctive form of elemental mediation. It deployed a mobile craft as a device for moving with a volume of air (J. D. Peters 2015; see also K. Peters 2015) as that volume, in turn, was mediated by its surrounds. This process of multiple mediation in movement was central to Simons's vision of the flight as an "art event," "a kind of performance, a Happening, an organized but unpredictable process" (Simons n.d.-a, 1). For Simons,

the balloon is not the artwork, any more than the air or the sky, but they are part of it. The balloon is a pure form, a poetic sight; it looks fragile and fleeting, and indeed is fragile and temporary. When the flight is over, it ceases to exist. That is why the documentary works I plan to do on board are so important to me: they will be all that is left. (Simons, n.d.-a, 1)

Revealing the influence of various artistic developments on Da Vinci as a postrepresentational form of performance sky art, such statements are also reminders that from the outset Da Vinci was staged as an event in which air—including polluted air—was more than something to be represented artistically. For the project, air instead provided the very medium in which sensing, and aesthetics, took place (see also S. Engelmann 2015).

In the wake of Da Vinci, Simons continued her artistic career. She used photographs taken during the flights to produce numerous artworks including montages that experimented with fragmented vision and mobile verticality. Simons was also commissioned to produce inflatable sculptural installations including *Aerial Crown* (1986), a structure of white tubular columns on the roof of the National Gallery of Scotland in Edinburgh (Saltman 1986). She undertook a number of aerial drift works, the most notable of which, *Aeolus* (1984), involved three illuminated hot air balloons tethered together and piloted above New Mexico. Nevertheless, Simons regretted that Da Vinci's artistic aims were occluded by its scientific ambitions, and indeed by the very spectacle of the TransAmerica balloon journey. In 1986, *The Washington Post* ran a feature about Simons that noted she was unhappy that "[TransAmerica] was wrongly interpreted by just about everyone as a feat of ballooning, instead of kinetic art" (Saltman 1986, B7). Others evaluated the artistic element of the project in more favorable terms, however, situating it in wider trajectories of

postrepresentational, situational, and action-oriented environmental art. Simons's efforts could be framed very much in terms of "conceptual art" that involved "a reaching out to people through space, and a minimizing of actual distances" (Holmes 1981, 6).

For one commentator, with Da Vinci TransAmerica Simons had performed an aerial version of the artist as a figure generating scenes or spectacles around which people can gather rather than producing aesthetic objects (Sundell n.d.). The same commentator observed that Simons's work shared the "objectives of Experiments in Art and Technology" as they both sought to "reconcile art and science and at the same time to reintegrate the artist into society by the creation of collective projects" designed "specifically to appeal to a mass audience." The piece concluded that "Simons' strategy of using the media to document and transmit her performance while it was in progress successfully combined advanced aesthetic theory and populist goals. Millions of average Americans were exposed to an esoteric form of Post-Object art, and they seem to have loved it" (Sundell n.d.).

Conclusion

By revisiting the details of Project Da Vinci, this article has made three contributions to the cultural-historical geographies of aerial experiments. The first contribution is biographical, and centers on the role of Vera Simons as an innovative figure in cultures of aerostatic experiment in the United States from the 1950s through the 1970s. Devising and undertaking Da Vinci as a major public art-science work about air quality was a singular achievement at a time when such collaborations were relatively rare, and especially so given the legacies of the gendered divisions of labor that shaped cultures of aerial experiment. Simons complicated these divisions by cultivating forms of expertise required to facilitate and participate in interdisciplinary aerial projects, ranging across science (although she herself was not a scientist), detailed knowledge of synthetic materials, balloon piloting, photography, artistic techniques, and public engagement. In this respect Simons's vision for Da Vinci anticipates more recent configurations of expertise mobilized in speculative attempts to imagine and inhabit air otherwise, including those found in feminist approaches to air, atmosphere, and weather (see S. Engelmann et al. 2022).⁵ Although

no evidence exists that Simons articulated her interests in these terms, she did participate in artistic events during the late 1960s and into the 1970s in which feminist approaches to art were influential. Read retrospectively through the sensory politics of air pollution in the Anthropocene (Landau and Toland 2022), Simons's experiments might not seem especially radical, nor particularly political. Understood contextually however, these experiments, by moving within polluted air, performed a version of what, following Jackman and Squire (2023), might be called a gentle reorientation of public attention toward air.

Empirically, through an account of Da Vinci, the article has contributed to understandings of how forms of air pollution and air quality were rendered explicit and public in the United States during the 1970s. More specifically, Da Vinci reveals how the problem of sulfate pollution plumes from urban industrial chimney stacks generated novel airborne experiments. These experiments involved moving with and within pollution plumes as distinct from tracking them from the ground or flying through them. In that sense, the article has highlighted the value of cultural-historical research into the specificity of experimental techniques through which the dynamic geographies (Born and Barry 2010) of air pollution are measured, mapped, and made explicit. One way of understanding this might be to think of Da Vinci as part of a set of practices for making air explicit as a Latourian (2004) "matter of concern" through gatherings of involvements and attachments organized around air quality as a problem. Latour's idea certainly provides one way of grasping how air pollution is made public through, without ever being reducible to, different modes of invested expertise and experience (see da Schio and Van Heur 2022) including artistic experiments. The account of Da Vinci presented here, however, would suggest that "medium of concern" is preferable. Thinking of air as a medium of concern rather than a matter of concern foregrounds how air provides a condition within and from which concerns emerge as much as it becomes an object around which an issue coheres. Importantly, medium also connects a sense of conditional immersion with versions of artistic practice (Hawkins 2021). In the case of Da Vinci, air was both a medium of movement and a medium of artistic invention. Da Vinci TransAmerica, in particular, can be understood as an experiment combining such

aerial medium-specificity with an effort to catalyze a distributed geography of public concern toward the condition of air. The specificity of the idea of medium of concern nevertheless needs some qualification. Air is not a single medium (see Horn 2018). It is composed, instead, of many mediums, which include pollution plumes, each of which in turn, is in a process of dynamic composition and material transformation under the influence of different factors.

The idea of medium supports the key conceptual contribution of this article, which centers on the elaboration of the idea of aerial media. This idea draws together work on the geographies of air pollution with elemental understandings of media (J. D. Peters 2015; Jue 2020; Starosielski 2019). The category of aerial media, as a subset of elemental media, signals the medium-specificity (Jue 2020) of processes and forms of mediation in and with air, including polluted air. As I have argued, this means that aerial media is a category that includes, but goes some way beyond, the use of aerial devices as platforms for representational practices like painting, photography, advertising, or propaganda. It also goes further than the claim that air pollution is made explicit through various social and news media channels and platforms (Kay, Zhao, and Sui 2015; Kenis and Barratt 2022). Critically, by extending understandings of air pollution as hybrid matter (Cupples 2009) and as an interdisciplinary boundary object (Mostafanezhad, Evrard, and Vaddhanaphuti 2024), thinking in terms of aerial media foregrounds understandings of how the dynamic elemental materiality of air/pollution is "constituted through movement" as much as it is through chemical or particulate composition (Steinberg 2013, 165). This, in turn, points to the importance of understanding the value of moving with and within air pollution as a process of mediation. The Da Vinci balloon exemplifies this: Its movement was mediated by the air through which it moves at the same time as it contributed to the Lagrangian modeling that air and, in turn, of making its composition public. The scientific and aesthetic aspects of this way of moving are not mutually exclusive but combine measurement and abstraction with modes of immersive and remote sensing (see also Hepach and Lüder 2023). In the context of contemporary engagements with the "fugitivity" (Noterman 2023) of pollution in its various and insidious forms, such experiments are

arguably even more necessary. Although it does not provide anything like a template for future experiments, Simons's work with Da Vinci does point to the continued importance of understanding how forms of aerial media can, through different aeromobilities (Adey et al. 2024) including floating (S. Engelmann 2021) and drifting (K. Peters 2015; Szerszynski 2018), contribute to the process of making sense of the dynamic geographies of air as an impure elemental medium.

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Notes

1. The Vera Simons Papers, Accession 2016-0013, National Air and Space Museum, Smithsonian Institution, Chantilly, Virginia, Udvar-Hazy Center. All archival references are from this collection.
2. This focus is informed by scholarship on how biographies are implicated in complex geographies (DeLyser 2014; MacDonald 2014; Lorimer 2015).
3. David G. Simons married Habrecht following the breakdown of her relationship with Winzen (she subsequently retained Simons's name when she and Simons later divorced).
4. Simons was not the only woman to stretch the envelope of aerostatic experiment in the twentieth century. Jeannette Picard, the first woman to obtain a balloon license in the United States and to ascend to the stratosphere, was especially significant (see

Hill 2009). On how women navigated the gendered geographies of aviation more generally, see also DeLyser (2011, 2014).

5. Aspects of Da Vinci anticipate more recent efforts, notably the Aerocene project initiated by Tomas Saraceno, to make air quality public through combining capacities to move with and track volumes of moving air (see S. Engelmann 2020).

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