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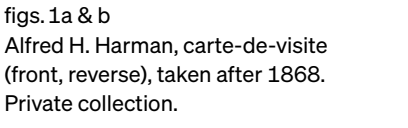
Keeping out the Fog: Atmospheric Contamination and Control in the Industrial Darkroom

Michelle Henning



figs. 1a & b
Alfred H. Harman, carte-de-visite (front, reverse), taken after 1868. Private collection.

As early as 1937, industrial scientists were aware of ongoing global warming caused by fossil fuels.[1] Some writers have claimed that global warming resulting from industrial emissions was a topic of discussion before the Great War, while others trace the discovery further back to the nineteenth century, particularly the work of Swedish scientist Svante Arrhenius in the 1890s.[2] Yet these nineteenth- and early twentieth-century scientists did not necessarily see an industrially transformed climate as a bad thing, and they underestimated the growth in the use of fossil fuels. Even so, by the late-nineteenth century, coal smoke was increasingly recognised as dangerous to the wider environment and human health; for example, the meteorologist Francis Albert Rollo Russell in his 1880 book *London Fogs,* described how "only lately has the sudden, palpable rise of the death-rate in an unusually dense and prolonged fog attracted much attention to the depredations of this quiet and despised destroyer."[3] Additionally, there was a growing awareness of the destruction of the environment by industrialisation.

The chemical photography industry was part of the wider chemical industries responsible for an irreversible contamination of the earth through the production of coal tar dyes, used as photographic sensitizers, pesticides and poison gases, and through other toxic chemicals. Industrialisation disrupted the nitrogen cycle through the extraction of nitrates for fertilizers and explosives, first from South American guano and caliche and then (since 1913) through the Haber-Bosch process which extracts nitrogen from the atmosphere. Coal mining, burning and coking for gas and electricity production, and also to produce new chemicals, led to an excess in the atmosphere of: carbon dioxide, the largest contributor to global warming; methane, also a greenhouse gas; and nitrous oxide, which is also emitted in the production of nitric acid.

Photographic materials manufacturers depended on these wider industries for their supplies, but they were also manufacturing products that were highly sensitive to contamination and to transformations in the atmosphere. To protect their sensitized plates and films, factory darkrooms had to become purified spaces. To achieve this, new technical systems were introduced, themselves increasingly making use of damaging chemicals including, from the 1920s, fluorinated gases, the fourth of the

1 — Guy Stewart Callendar, 'The Artificial Production of Carbon Dioxide and Its Influence on Temperature', in: *Quarterly Journal of the Royal Meteorological Society* vol. 64, no. 275, 1938, 223–240.

2 — François Jarrige and Thomas Le Roux, *The Contamination of the Earth: A History of Pollutions in the Industrial Age,* Cambridge Mass, 2020, 133; Bert Bolin, *A History of the Science and Politics of Climate Change,* Cambridge, 2007, 4–8.

3 — Francis Albert Rollo Russell, *London Fogs,* London, 1880, 4.

so-called greenhouse gases and, in the period I am looking at, coal and coal derivatives. These systems are described as air-conditioning systems, a term first used in a patent by Stuart Cramer in 1906, and which covers "humidifying and air cleaning and heating and ventilation" even though today we might associate air conditioning more with cooling systems.[4]

In present-day India, as Dipesh Chakrabarty points out, there is a rising use of relatively cheap air conditioning systems (for cooling) that use hydrofluorocarbons (HFCs) to trap heat, despite concerns about the role of these gases in increasing global warming. This is because these systems are the most affordable and least toxic, and desirable in India's densely populated cities as a means to combat the high temperatures caused by global warming.[5] Chakrabarty cites the economist Michael Greenstone: "The very technology that can help protect people from climate change also accelerates climate change."[6] Or, to quote philosopher Roberto Eposito from his book *Immunitas:* "the risk from which the protection is meant to defend is actually created by the protection itself."[7]

In the early systems that I am discussing, it was not the heat of global warming that factories were protecting themselves against (although coal burning produces CO_2 and is a major contributor to global warming) but the contaminating fog, constituted by smoke from the same fuel (coal) needed to drive the air conditioners. This paradox is part of what I want to address here, along with the fact that over the period of industrialisation, beginning in Europe in the eighteenth century, industries have responded to attempts to regulate and control emissions with technologies that give the *appearance* of regulation, control and cleanliness. I will show how this plays out in the photography industry by looking at the industrial manufacturing darkrooms as spaces of purification in the context of a foggy, polluted London.

The photographic darkroom as capsule

My story begins, like the story of the industrial revolution, in a cottage: specifically, at no. 3 Albert Cottages, Hill Street, Peckham, South London. This cottage, since demolished, was the home of Alfred H. Harman, founder of the company which later became Ilford Limited. By 1864 he had another darkroom at his new business address at Gunnersbury Villas, Harders Road – the name "Villa" indicates the larger scale of the building – and four years later he had a bigger studio and darkroom at 79 Peckham High Street, and had moved out of the city to 110 Ewell Road, Surbiton, in Surrey (to the West of London) where he built another darkroom at his home.[8] Harman was one of many photographers producing cartes-de-visite and cabinet cards for a growing clientele demanding portraits in the 1860s – the period of "cartomania". He was not a notable or innovative photographer, judging by portraits from the 1860s and '70s, but he was a successful one (→ figs. 1a & b). He began copying and providing enlargements and retouching services for a clientele of amateur photographers. He also did mail-order, using the highly efficient Victorian railways to dispatch work across the country. In these darkrooms, he was not simply developing and printing photographs, but coating his own plates. In 1879, he gave up the studio

4 ___ Cramer cited in Reyner Banham, *The Architecture of the Well-Tempered Environment,* London 1969, 81.
5 ___ Dipesh Chakrabarty, *The Climate of History in a Planetary Age,* Chicago 2021, 96–99.
6 ___ Cited in Chakrabarty 2021 (reference 5), 99.
7 ___ Roberto Esposito, *Immunitas: The Protection and Negation of Life,* Cambridge 2011, 141.
8 ___ See the New York Public Library's photographers' identities catalogue at <https://pic.nypl.org/constituents/289732> (23.6.2023).

business to focus on producing dry plates, establishing his new factory, the Britannia Works, in the village of Ilford, to the east of London.[9]

The story of Harman's business might help to focus our attention on the darkroom as a space, as it moves from cottage to villa, city to suburb, and eventually to the factory. There are at least two kinds of darkroom in a photographic factory: the developing and processing darkrooms, which Ilford Limited opened at their Selo Works, in Brentwood, Essex, in the 1920s, and the darkened spaces necessary for the manufacture of emulsion, and the coating and drying of sensitised plates, films and papers. These manufacturing darkrooms are my main concern here.

One concept which is useful for thinking about the darkroom as a partitioned-off interior space is "encapsulation" – a term used by the historian Chris Otter. This describes a process that begins with people becoming more accustomed and acclimatised to life inside buildings, and with the division of domestic spaces or vernacular buildings into discrete rooms given over to distinct functions (dining rooms, bedrooms, kitchens, and so on), and that ends with a "technosphere" – something Otter describes as "a giant apparatus within which encapsulated beings are fed, watered, mobilized, entertained, and maintained in states of historically unprecedented bodily comfort."[10] The term "technosphere" seems to have been coined by the geologist Peter Haff in 2014, who uses it more broadly than Otter, to describe the sum of the global technical infrastructures on which humans depend – something akin to what Walter Benjamin meant when, influenced by Georg Lukács' use of the term, he described technology as "second nature."[11] Otter's reworking of the concept, more relevant to my purpose, draws both on Benjamin and on the philosopher Peter Sloterdijk to connect this notion of the technosphere to the idea of sealed interiors or capsules and artificial atmospheres.

The home darkroom is a capsule within a capsule. It is one of the first spaces in domestic settings (along with the larder) to take the partitioning of space to the point where temperature, atmosphere and illumination are distinct from the rest of the dwelling. During use, the door cannot be opened, all windows must be covered, even the keyhole may need to be stuffed with tissue to prevent daylight invading – and ideally, the darkroom is situated in a windowless cellar or shed. While these precautions might protect photographic materials from light, they also prevent a flow of air, and since the darkroom is full of chemical fumes and vapours, lack of adequate ventilation can become dangerous. Spaces such as cellars could also be damp, and the dust, moisture and cold detrimental to photographic materials. Thus, the domestic darkroom becomes a regulated space, in which light, temperature, and humidity are kept in a range that may be different from the rest of the dwelling.

The manufacture of photographic materials requires that darkrooms become further partitioned, as a series of different operations must be carried out in varying degrees of darkness, and at different temperatures and humidity. When Harman became a dry plate manufacturer, the domestic and the industrial were not fully separate: his first factory, the Britannia Works, was actually a house in Ilford.[12] In this building,

9 ___ Robert J. Hercock and George A. Jones, *Silver by the Ton: The History of Ilford Limited, 1879–1979,* Maidenhead 1979, 15–16.
10 ___ Chris Otter, 'Encapsulation: Inner Worlds and their Discontents', in: *Journal of Literature and Science,* vol. 10, no. 2, 2017, 56.
11 ___ Peter Haff, 'Technology as a Geological Phenomenon: Implications for Human Well-Being', *Geological Society of London Special Publications,* vol. 395, 2014, 301–309; and Walter Benjamin, 'The Work of Art in the Age of Mechanical Reproduction', in: *Illuminations,* translated by Harry Zohn, London 1992, 211–244.
12 ___ Hercock and Jones 1979 (reference 9), 16.

the separation of spaces begins: the basement was devoted to emulsion making (using a secret formula) and to coating, and other work took place on the other floors.

In keeping with the domestic setting, the secret emulsion was, according to one chronicler, "prepared by Mr and Mrs Harman assisted at times, by their housekeeper" (Mrs Harman and the housekeeper disappear from later accounts).[13] The emulsion was poured onto the glass plates with a teapot and these were "placed in racks in a cupboard and dried with warm air."[14] It is at this point of drying that the plates are most vulnerable to spoiling, so drying began be conceived as a separate activity, requiring its own climate-controlled space. As the business expanded, the darkrooms split into different buildings: a cottage for the manufacture of emulsion, a house for plate coating, and so on, which meant emulsion had to be carried in light-proof containers from one building to the next, always with the risk of spillage or light leaks. Eventually, in 1883, Harman had a factory purpose-built, and then a second in the 1890s.[15] The inner workings of these factories were secret, no visitors were allowed, but we know that in similar factories plates were moved on conveyer belts through coating and drying rooms and into packing rooms – all of which, of course, were also darkrooms in the broadest sense.[16] We also know that from 1895, the company was operating an air cooling system.

The darkroom must be safe for the humans within it, but the priority is to protect the sensitive photographic materials. While the photographic journals and newspapers were peppered with horror stories of deaths and poisonings in the darkroom, *The Ilford Manual of Photography* gave very limited attention to health and safety in the darkroom – early editions (through to 1920) devoted only one page to darkroom ventilation on the grounds not of chemical fumes but human emissions:

A point of the greatest importance is the proper ventilation of the workroom and neglect in this matter leads to unpleasant consequences, which are often erroneously attributed to other causes. It is indispensable that there should be an exit for foul air and entrance for fresh air, a small room, if not ventilated speedily becomes so filled with products of respiration as to be distinctly injurious to health.[17]

Generally, and despite the hazards to humans of the vapours given off by chemicals such as potassium cyanide and potassium bichromate, atmospheric control in the darkroom and the factory was principally about ensuring a conducive environment for photographic materials. Although writers who have studied mechanical air conditioning tend to see it in terms of human comfort, air conditioning would sometimes actually increase the discomfort of people: in factory settings the protection of sensitive materials and goods was at least as much of a priority as the protection of workers. There are many examples of climate control systems pioneered for commodities: such as the cooling systems for food preservation used in European colonies, and the mechanical systems for ventilating and heating glasshouses for tropical plants, both of which also show how artificial atmospheres are the products of capitalism and colonialism.[18] Like tropical plants, photographic materials demanded their own micro-atmosphere in order to thrive. Other commodities did

13 ___ A.J. Catford, 'Our First 75 years', Unpublished manuscript. 90/359/E1/6 Redbridge Museum and Heritage Centre.
14 ___ Hercock and Jones 1979 (reference 9), 24.
15 ___ Hercock and Jones 1979 (reference 9), 17–19.
16 ___ Hercock and Jones 1979 (reference 9), 28–29; Catford (reference 13).
17 ___ C.B. Bothamley, *The Ilford Manual,* edition undated: 54–55. <https://archive.org/details/in.ernet.dli.2015.127670/ > (23.6.2023).
18 ___ See On Barak, *Powering Empire: How Coal Made the Middle East and Sparked Global Carbonization,* Oakland, 2020, 16, and Dustin Valen, 'On the Horticultural Origins of Victorian Glasshouse Culture', in: *Journal of the Society of Architectural Historians,* vol. 75, no. 4, 2016, 403.

too – heating, ventilation and air conditioning systems were first introduced in factories to cool beer, dry out tea, control the humidity of fibres in weaving, and prevent mould growth on celluloid.[19] Sometimes the factory environment was made hotter and more humid to make raw materials easier to manipulate.[20] In the case of the industrial darkroom, workers must adapt to the needs of the materials, most obviously by working in low light or total darkness.

The dirty old smoke

Ilford Limited's venture into air conditioning was a response to a specific pollution event and to the ongoing negative effects of the polluted London fog on their product (we could call it smog, but I am using the terminology common at the time). Despite its picturesque qualities, fog had long been the bane of photographers or, as an 1870 article in the *British Journal of Photography* (BJP) described it, "the great winter enemy of London photographers" (→ fig. 2).[21] During a fog, it was almost impossible to take photographs, not only outdoors but even within photography studios. The monstrous fog penetrated the studio and the darkroom, even the camera. It was far easier to keep out light. In 1881 an article in the BJP discussed fog entering the photographic studios of London photographers, and commented that the studios' own heating contributed to the problem since rooms were heated by coal.[22] Another BJP article published in November 1898 talks of the fog entering the studios of commercial portrait photographers and that "however brightly the sitter may be illumined, the fifteen or twenty feet of smoky fog intervening between the sitter and the lens necessarily mars the brilliancy of the picture."[23] Additionally, for the nineteenth-century photographer, the distinctive yellow colour of the 'London particular' or 'pea-souper' made exposures especially difficult for the yellow-insensitive photographic emulsion of the time. Hydrogen sulphide in the fog affected emulsions and developers. By the 1890s it was noticed that sulphur compounds in the atmosphere were causing silverware to tarnish more rapidly.[24] By then, Ilford knew that the coal fires in surrounding houses, and the fumes from the gasworks, as well as the London fogs, were affecting their photographic plates in the factory drying rooms.[25]

fig. 2
Topical Press Agency, *October 1919: An iceman is busy delivering ice despite a London fog.* Hulton archive. Licensed by Getty Images.

19 — Banham, 1969 (reference 4), 174.
20 — Marsha E. Ackermann, *Cool Comfort: America's Romance with Air-Conditioning,* Washington DC 2002, 2.
21 — 'London Fog', *The British Journal of Photography,* vol. 17, no. 544, 7th October 1870, 476.
22 — 'Dust and Fog', *The British Journal of Photography,* vol. 28, no. 1079, 7th January 1881, 2–3.
23 — 'November', *The British Journal of Photography,* vol. 45, no. 2012, 25th November 1898, 757.
24 — W. J. Streeter, *The Silver Mania: An Exposé of the Causes of High Price Volatility of Silver,* 1984, 125–126.
25 — Hercock and Jones 1979 (reference 9), 47.

The London fogs had been worsening throughout the second half of the nineteenth century, caused by a combination of misty river basin weather conditions in winter and vast amounts of coal smoke from both industrial and domestic sources. Gas was promoted as a cleaner fuel and indeed it did help to clean up the air in the city centre, but the gas industry was coal-fired, so that while it was relatively clean at the point of use, and air quality improved as a result, it was filthy at the point of production (→ fig. 3). Polluting the air with smoke and particles, and the soil and waterways with "ammoniacal liquors" and surplus tar, the early gasworks also produced hydrogen sulphide with its familiar "rotten eggs" smell by purifying the gas stream using lime.[26] By 1900, London's gas companies were consuming about 4 million tons of coal a year.[27] The gasworks proliferated and expanded at the margins of the city and in working class communities. They displaced the fog and pollution from the city centre to the suburbs and to the dockland areas of the East End. Their acrid fumes also drove the middle classes to flee from these areas, which became increasingly impoverished. As one article in an 1864 London newspaper commented, "Wherever a gas-factory – and there are many such – is situated within the metropolis, there is established a centre whence radiates a whole neighbourhood of squalor, poverty, and disease."[28]

fig. 3
Fred Marsh, *Gasworks, Charging Retorts.* Reproduced in *The Photographic Journal,* XXII, no. 1 September 1897, Illustrated Catalogue of the Royal Photographic Society's Exhibition, September to November 1897. Supplement to *The Photographic Journal,* vol. XXIL, Pl. XXXII. Reproduction courtesy of Michael Pritchard.

In the 1880s, the town of Ilford had escaped the worst of the manufacturing industry and chemical works – the "unfragrant" and "offensive" trades proliferating in other Essex towns on the periphery of London, in the late-nineteenth century – and it had a relatively affluent population.[29] It already had a small gas company – the Ilford Gas company – which dated back to 1839, the same year as the arrival of the railway in Ilford and the announcement of the new invention of photography to the world. However, by contemporary standards, the air was fresh and sweet in Ilford. Maps from the 1890s demonstrate how rural it still was, but also how closely located the gas works and the Britannia Works were (→ fig. 4).

Photographic manufacturers, and later, the film studios, all wanted to avoid the pollution of the "big smoke" but needed to benefit from London's trade links, so they chose locations just outside the metropolis, which also had the advantage of lower land prices. The attraction of Ilford to the photographic manufacturers was evident: clean air, clean water in the River Roding and easy access by rail and road

26 ___ A. O. Thomas and J. N. Lester, 'Gaswork Sites as Sources of Pollution and Land Contamination: An Assessment of Past and Present Public Perceptions of their Physical Impact on the Surrounding Environment', in: *Environmental Technology,* vol. 14, no. 9, 1993, 801–814.
27 ___ Peter Thorsheim, *Inventing Pollution: Coal, Smoke, and Culture in Britain since 1800,* Chicago 2006, 137.
28 ___ Cited in Thorsheim 2006 (reference 27), 140–141.
29 ___ By the 1910s, an unusually high number of the population seem to have commuted to London for work in professional and clerical positions. See W.R. Powell, *A History of the County of Essex: Volume 5,* London 1966, 9–21. *British History Online,* <http://www.british-history.ac.uk/vch/essex/vol5> (23.6.2023).

fig. 4
Detail from Ordnance Survey Map of Ilford, LXXIII.NE published 1898. Map of Ilford in 1893/94 showing the Britannia Works and the Gas Works on opposite sides of the River Roding. (Colour on original map).

fig. 5
Detail from Ordnance Survey Map of Ilford, London Sheet H, published 1921. Map of Ilfold in 1914 showing the Britannia Works and the Gas Works on opposite sides of the River Roding. (Colour added to highlight river).

to the city. When Harman moved his business there, the first factory had green fields on three sides and the population was about seven thousand. But as London rapidly grew, and as it expanded into Ilford, it brought with it new industries and a larger population, all heating their homes with coal fires. By 1900 there were over forty thousand people, and the factory – as you can see on a map from 1914 – was enclosed on all sides by houses (__fig. 5).

As London came, the London fogs came too, and especially to districts like Ilford, located to the east of the city since the prevailing wind was from the West. Later, in the early-twentieth century, the film studios would attempt to outwit the fog by situating themselves on higher ground to the west, yet even they were beset by fog, to the point that they either had to embrace the low-contrast, soft-focus aesthetic that resulted, or shut entirely during winter.[30]

As the population grew, the gas company expanded and, in June 1899, the Ilford Gas company gained statutory powers and resisted an attempt by the local authority to compulsorily purchase it and turn it into a municipal supplier.[31] That year, the gasworks began to manufacture sulphate of ammonia from their ammonia by-products, to sell as fertiliser. The resulting fumes were highly damaging to wet photographic emulsion. In 1899, in just one day, 25,000 photographic plates were ruined through fogging in the drying rooms at Ilford's factory. Company historian and factory manager A. J. Catford placed the blame for the incident firmly on the sulphurated hydrogen emissions from the Ilford Gas Company's new works.[32] The loss of these plates, and a further thousands of pounds worth of damage caused by the gas works fumes entering the photographic paper factory, meant that the firm was faced with three options: first, to try to limit the pollution from the gasworks; second, to escape the polluted air by physically moving away from it; and third, to create an isolated pocket of purified air.

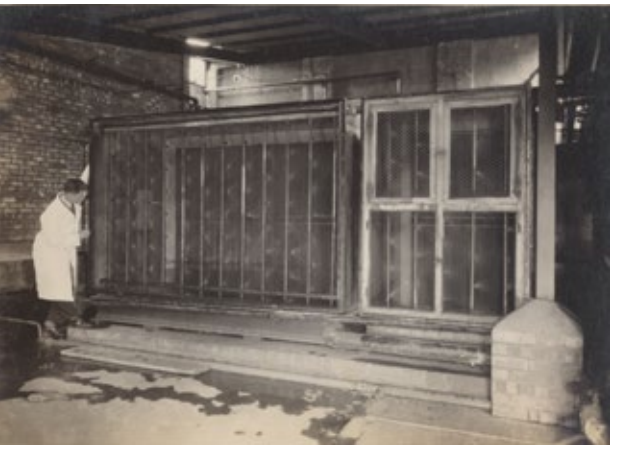


fig. 6
The Air-Washers at an Ilford Limited Factory, 1938. Photograph album of Selo Works in Brentwood (box1354), courtesy of Redbridge Museum and Heritage Centre (90/359/D2/A7).

They chose all three. In May 1900, they issued a writ against the gas company. They designed and built a new factory further out of London, in Brentwood, and they made changes to the existing factories in 1902 and 1905. These changes included a novel solution: an early form of air-conditioning. Of the three options this was the most successful. The writ against the gas company was withdrawn, and although an elaborate new factory was built in 1901, it closed only nine years later (reopening after the war as the Selo roll-film factory).[33] These two strategies had been premised on the notion that the firm could out-run, or combat, the spread of pollution. But the air conditioning solution was different, because it was premised on the idea of creating a space of exception within the larger polluted environment. It meant accepting that pollution of the wider environment was, if not inevitable, then unstoppable. Instead of supporting the regulation of pollution, the firm would focus on creating a regulated factory interior. They brought in a consultant engineer to come up with a means to purify the air in the glass plate drying rooms. This involved filtering the air, washing it with water, cooling it to remove the water vapour, reheating it and then circulating it into the rooms (__fig. 6).[34]

30 __ Richard Farmer, 'Meteorology and British Film Studios: An Article of the London Fog', in: *Historical Journal of Film, Radio and Television,* 2021, 4.
31 __ Powell 1966 (reference 29), 37–47.
32 __ Catford 1969 (reference 13).
33 __ Hercock and Jones 1979 (reference 9), 48.
34 __ Both Catford, and Hercock and Jones describe this process (references 13 and 9).

Climate control

Writing about the difficulty that eighteenth-century scientists had in isolating air as an object of study, Steven Connor says they had to learn to enclose the air, to create "new pockets of exception in the immersive totality."[35] Ilford Limited set out to do something similar, to isolate a purified atmosphere from the contaminated one beyond the factory walls or even just beyond the drying rooms. In separating the atmosphere of the factory from the external atmosphere, air-conditioning was not only a practical solution, but also embodied a new concept of mechanically controlled atmosphere that went beyond earlier heating and ventilation systems. The year that Ilford introduced air conditioning is 1902, the same year that American engineer Willis Haviland Carrier (the self-proclaimed "father of air conditioning") installed his first climate control system in the Sacklett-Wilhelms printing plant in Brooklyn, and the same year that the Royal Victoria Hospital in Belfast became "the first major building to be air-conditioned for human comfort" according to Reyner Banham.[36]

As Catford put it, "our company was a pioneer not only in the manufacture of photographic material but also in the manufacture of weather, or as it later became known, air conditioning."[37] Another term for air-conditioning, used well into the 1930s, was indeed 'man-made weather.'[38] The irony is that the weather outside was (as we now know too well) also increasingly 'man-made'. It's this external 'man-made weather' (the polluted fog) that drives the production of the purified interior. Rises in industrial emissions and specifically coal burning, are among the factors that spur the development of air conditioning, and this is explicit in the Ilford Limited example.

In common with other factories, photographic manufacturers moved the product through a series of specialist rooms, in which distinct tasks were performed. The difference was that, unlike many products, the coated glass plates and films were highly sensitive, not only to light but to other kinds of contamination too. Dust was a big concern: the cutting of plates and films produced it, electric fans spread it, workers risked carrying it into the factory. At different stages in the process, the coated plates and films required warming or cooling. The design of the factory gradually incorporated different lighting conditions and different climates within a series of differentiated spaces, each partitioned from the last. Even in the earliest of Ilford's factories, there were micro-environments for coated and uncoated plates: washing rooms, coating rooms, chilling tunnels used to set the emulsion, and heated drying rooms or tunnels.[39]

Thus, the capsules proliferate as spaces are subdivided, like cells, each with their own distinct environments. Encapsulation involves the spread of climate-controlled spaces. As Otter writes, it "generates innumerable climate bubbles proliferating across the earth [...] everything – humidity, temperature, dust, smell, sound and light – is meticulously regulated."[40] These systems needed to be driven by an energy source, and generally in Britain, this would be coal. A drawing of the first of Harman's factories, which appeared in the BJP on 29 June 1888, shows a large chimney emitting either steam or smoke (→ fig. 7). The new factory, built in the 1890s, had a boiler and steam engine driving the machinery, both coal fired. It also had an engine and dynamo to drive the electric lighting. The Selo factory at Brentwood included an

35 ___ Stephen Connor, *The Matter of Air: Science and Art of the Ethereal,* London 2010, 30.
36 ___ Carrier is named by Banham as the "father" of air-conditioning, a title Ackermann says Carrier actively pursued. Ackermann 2002 (reference 20); Banham1969 (reference 4), 81.
37 ___ Catford 1969 (reference 13).
38 ___ Banham 1969 (reference 4), 172.
39 ___ Hercock and Jones 1979 (reference 9), 132.
40 ___ Otter 2017 (reference 10), 58.

electricity generating plant (coal fired) and a refrigeration plant. The Ilford factories moved from manually cranked machinery to machines driven by steam and later by electricity, but all, ultimately by coal.[41]

Otter writes: "Climate engineering, then, aspires to create spaces which are atmospherically sealed from a dirty, noisy, turbulent outside".[42] He points out that these spaces are always connected to the outside, by infrastructure, by the raw materials they depend on, and by treating that outside as a 'sink' into which waste is put. We can see this in the case of the Ilford climate engineering. The clean air of the drying rooms requires an infrastructure (cooling and heating systems and fans), which pulls the outside in, and that depends on a supply of steam and coal. Dirty air – expelled outward – is produced at the same time as purified air is drawn inwards. The system ends up purifying the air that it has itself polluted.

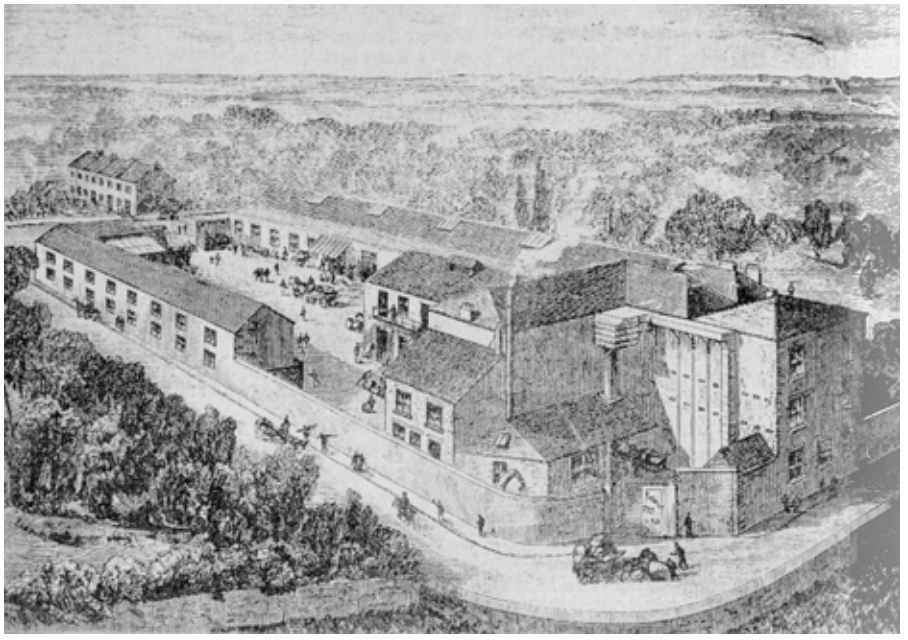


fig. 7
The Britannia Works, Ilford. Illustration from the *British Journal of Photography,* Vol. 35, Issue 1469, June 29,1888.

Climate control appears in the Ilford darkrooms at the beginning of a century in which fossil-fuelled HVAC (heating, ventilation and air-conditioning) systems would become ubiquitous in domestic, industrial and public buildings. Their own fuel produces the contaminated or unbreathable atmosphere that they then work so hard to wash and filter. These systems contribute to the dirty air they clean, again, "the risk from which the protection is meant to defend is actually created by the protection itself."[43] However, air conditioning's role in the production of an ever more degraded world, from which it is intended to create safe haven, is not just about the exclusion of chemical and particle contaminants. It is simultaneously a symbolic detachment of interior from exterior, which, in the search for an ideal interior environment, brackets off the exterior altogether. The process of encapsulation relies on an opposition of inside and outside that makes the outside more easy to neglect, less visible. Thus air conditioning contributes to the degradation of that which it excludes as impure. There is a parallel to this in the proliferation of what the architect Rem Koolhaas calls "junkspace," which he describes as "the product of an encounter between escalator and air-conditioning, conceived in an incubator of Sheetrock."[44] The degraded junkspace environment is what is ejected and rejected by technologies of interiorization and encapsulation.[45]

This privileging of interior over exterior has roots in a paranoid, imperialist mentality first noted by Walter Benjamin whose hashish-inspired description of the bourgeois domestic interior informs Otter's concept of encapsulation. Benjamin writes that such spaces involve secluding oneself "within a spider's web", from

41 ___ Hercock and Jones 1979 (reference 9), 35, 140, 132.
42 ___ Otter 2017 (reference 10), 59
43 ___ Esposito 2011 (reference 7), 141.
44 ___ Rem Koolhaas, 'Junkspace', in: *October,* vol. 100, 2002, 175.
45 ___ Koolhaas 2002 (reference 44), 175.

which "thoughts of the 'outside' become almost agonizing."[46] The imperialist bourgeoisie brought the empire home in the form of hothouse plants, but in the colonies they treated themselves like the plants, isolating themselves within environments increasingly designed to accommodate white 'thermal comfort' and to exclude a tropical nature and colonized peoples viewed as suspect, potentially hostile, and definitely contaminating. So practices of encapsulation and the production of micro-climates are linked to colonial anxieties about the dangerous, uninhabitable tropics.[47] Moreover, the darkroom, the bourgeois living room, and Koolhaas's junkspace bring the outside inside, in tamed and controlled forms —as picturesque landscapes, potted palms and water features — at the same time as they participate (directly or indirectly) in the degradation of the environment in which they are situated.

Regulation and modernisation

In the early-twentieth century, technological solutions to environmental hazard were increasingly seen as both morally desirable and essential to modernization. This is reflected in Ilford Limited's decision to introduce new technological systems and build a well-equipped new factory. To sue the gasworks would have set the company against modernisation and progress whereas a technological solution is a modernising solution. Modernity was associated with rationalisation and control, and another way of looking at the air-conditioning systems installed at Ilford Limited's factories is as systems for the regulation of exposure, and mitigation of risk. Even before this, new ventilation and heating systems in photography studios were described in terms of control and regulation. For example, in 1897, the magazine *Scientific American* reported on the technical improvements made to Lafayette's photography studio, to rid the studio of "fog – one of the most deadly enemies of the camera." The article describes how the air as it comes into the building is filtered and then warmed using steam, then moved by a fan through ducts in the ceilings and drawn out through outlets at the bottom of the rooms – "both in winter and in summer the warming, cooling, and ventilation of the building is under entire control."[48]

By 1939, Ilford's publicity was keen to emphasise the well-disciplined and orderly nature of their factories, and they did this by drawing attention to the use of air conditioning and to the cleanliness of the interiors. As *The Ilford Courier,* a company magazine explained:

… there is nothing haphazard in the manufacture of Ilford and Selo materials. Everything works with precision. Air is purified and washed before it enters the factory. Dust which might be carried into the factories by employees is eliminated by vacuum cleaning the staff before they enter the coating, drying and packing rooms, and floors and passages are cleansed thoroughly every day with special electrically driven machines.[49]

Here technology serves both a practical and symbolic function in relation to risk. Practically, it helps to remove or lower the chances of the photographic materials be-

46 ___ Walter Benjamin, *The Arcades Project,* translated by Howard Eiland and Kevin McLaughlin, Cambridge Mass 1999., [I2,6], 217, drawing on Walter Benjamin, 'Main Features of My Second Impression of Hashish', in: Michael W. Jennings, Howard Eiland and Gary Smith (eds). *Walter Benjamin: Selected Writings, Vol. 2, 1927–1934.* Cambridge, MA. 1999, 85–90.

47 ___ Dustin Valen argues that artificial climates were used "to create new spatial gradations of inclusion and exclusion in colonial settings …": Dustin Valen, 'Imperial Atmospheres: Race and Climate Control on the Niger', in: *ABE Journal. Architecture beyond Europe,* vol. 17, 2020.n.p. Also, colonial plantations contributed to the dangers that white settlers identified with the tropics: for example, through deforestation and the proliferation of stagnant water around plantations, which encouraged mosquitoes carrying yellow fever and malaria. See Etienne S. Benson, *Surroundings: A History of Environments and Environmentalism,* Chicago 2020, 53.

48 ___ 'Fog and Photography', in: *Scientific American,* vol. 76, no. 23, 5th June 1897, 355.

49 ___ *The Ilford Courier,* vol. 8, no. 2, 1939, 5.

ing exposed to damaging chemicals or particles, or excessive moisture. Symbolically, it communicates to customers, investors, and the wider world that the company is competent and able to manage any risks it faces.

Historically, ideas about routines, regimens and regulation are connected to moral ideas of discipline and orderly living. By the twentieth century, methodical routines and regimens were embodied in machines, and mechanical climate control systems can be understood as motivated by ideas about the well-regulated modern life.[50] These are not just technologies but "cultural techniques" in Bernhard Siegert's sense. Cultural techniques are the means by which "the symbolic is filtered out of the real," the means by which signal is made out from noise, sense from nonsense, culture from nature. They create "order by introducing distinctions".[51] As well as being air-filtering and washing systems, the Ilford factories HVAC systems were cultural filters, techniques designed to produce a specific cultural order of things. Air conditioning helps to standardise the quality of the product, to ensure uniformity and consistency.[52] But regulation is also about visibility, about the construction of appearances. The regulation of the factory environment and manufacturing processes, expressed in terms of cleanliness, rigorous procedures, and technical equipment, seemed to speak of a responsible, modern and efficient firm. Why else advertise the factory's air conditioning system or the procedures for removing dust from workers?

The whole concept of risk became central to capitalism from the mid-nineteenth century. It's an ambivalent idea – risk taking was associated with immorality and gambling, but at the same time the financial structures of capitalism had risk management built into them. It was a core feature of new kinds of speculative commerce, such as the future markets. In his writing on risk and regulation, Michael Osman has argued that speculative futures markets were enabled by new technologies, specifically cold storage systems for perishable goods. These made it possible to exchange contracts in which buyer and seller agreed to sell perishable commodities at a set price on a future date.[53] In fact, the futures markets frequently operated without the physical goods ever exchanging hands, but refrigeration units acted as a guarantor, making it possible to believe that delivery of a commodity was at least contemplated between the traders. Cold storage, like air-conditioning later, was symbolic.

These kinds of risk-managing or regulatory technologies substituted themselves for another kind of regulation: that of the atmosphere and environment beyond the factory. They increased as environmental regulation decreased or became more ineffectual. For example, in France, the existing regulatory system regarding pollution was beginning to be dismantled as early as the 1770s, under pressure from capitalists who regarded it as "holding back competition and stifling innovation."[54] Over the course of the nineteenth century, according to environmental historians François Jarrige and Thomas Le Roux, while old regulatory systems were attacked as out of date and more appropriate to artisanal production, new factories were presented as well-regulated, with the division of labour, and segregated, streamlined production suggesting a moral and modern sense of control and efficiency. By the early-twen-

50 ___ On regimens and regulation, see Vladimir Jancović, *Confronting the Climate: British Airs and the Making of Environmental Medicine,* London 2010, and Michael Osman, *Modernism's Visible Hand: Architecture and Regulation in America.* Minneapolis 2018.

51 ___ Bernhard Siegert, *Cultural Techniques: Grids, Filters, Doors and Other Articulations of the Real,* New York 2015,13, 23.

52 ___ Arthur Pereira 'The Exhibition Reviewed: "The Life of a Film"', *The Photographic Journal,* vol. 75, Dec 1935, 637.

53 ___ Osman 2018 (reference 50).

54 ___ Jarrige and Le Roux 2020 (reference 2), 77.

tieth century, new institutions and inspectorates oversaw pollution but, unlike the older regimes, they prioritised economic interests, and "resulted in a greater tolerance for pollution, justifying its ubiquity in the name of economic liberalization and expanding wealth."[55]

In 1935, the Royal Photographic Society held an *Exhibition of Kinematography,* at the Society's headquarters at 35 Russell Square, in Bloomsbury, London. The exhibition did not show actual cinema films, but photographs, including film stills, and pieces of cinematic equipment (such as cameras). Ilford's chemists were very active in the society and Ilford Ltd., along with other "leading firms" had provided much of the exhibition material. The very first exhibit – in the first section of the exhibition entitled *The life of a film* – showed a photographic factory's air conditioning plant. As a contemporary reviewer described it,

The series of illustrations starts off with an air conditioning plant. Extraordinary pains are taken to avoid the presence of dust in a coating room, where the emulsion surface, still moist, positively invites the attention of floating particles. The whole ensemble of such a place recalls, in its scrupulous cleanliness and the white-shrouded workers, the operating theatre of a hospital. The air admitted here has not only been filtered, but frozen to remove excess of moisture which would otherwise have hindered the film from drying in scheduled time.[56]

If the darkroom is an immaculately clean hospital, it is a maternity ward in which two things are being brought into the world: one is photography, breathing the newly purified air and protected by the velvety darkness around, the second is something monstrous, expelled, and disavowed. An exemplary capsule, the industrial darkroom produces an outside that becomes ever more abject and degraded, even as it produces the sensitive material capable of documenting it. Techniques of atmospheric and environmental control within the factory, designed to minimise and ideally banish contamination, served the function of promoting the modern, highly regulated firm, underwriting the consistency and quality of its products. Silver recycling and waste management plants, as well as the shift to newer air conditioning systems, would reduce the pollution from photographic factories over the coming decades. In the meantime, contamination of the atmosphere and waterways was concealed behind the image of the factory as a well-regulated machine, with a precise division of labour, streamlined production and perfectly vacuumed workers.

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55 ___ Jarrige and Le Roux 2020 (reference 2), 78.
56 ___ Pereira 1935 (reference 52), 637.