

Terrorism *and* Technology

From Dynamite to Artificial Intelligence

TERRORISM PORTAL RESEARCH DESK

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Terrorism and Technology: From Dynamite to Artificial Intelligence
Terrorism Portal Research Desk.

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This book is a work of history and analysis. It contains no instructions for making, modifying or using weapons or devices, and no guidance on selecting targets or avoiding detection. Where an episode turns on a technical detail, the text stays at the level of official public reports and peer-reviewed scholarship. It reproduces no terrorist propaganda and no images of victims.

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How to read this book

History written about terrorism has a habit of turning guesses into facts. A detail appears in one newspaper, is repeated by a second, quoted by a book, and within a decade nobody remembers that it began as a possibility. This book tries to show its working.

Where a claim is not simply established, it is marked. The five labels below appear in boxes beside the text, always with their sources. The small square fills as the evidence gets firmer, so the labels can be read even in black and white.

■ DOCUMENTED	Established by primary evidence, or by independent and authoritative sources that agree: official records, court findings, contemporary documents, peer-reviewed data.
◧ OFFICIAL ASSESSMENT	What an inquiry, an inquest or a government concluded, or said was possible. Official does not mean certain; the box says how firm the original wording was.
◪ DISPUTED	Serious sources disagree. Both positions are set out, with the evidence each relies on.
☐ PLAUSIBLE INTERPRETATION	A reasonable inference that the evidence does not establish. It is always attributed, including when the inference is ours.
⬚ UNRESOLVED	The record does not answer the question, and may never do so.

Superscript numbers lead to the notes at the back of the book. Every chart names its source, the years and the unit beneath it. Dates of technologies refer to when they became available to the public, unless the text says otherwise.

One more rule. This is a history of what technologies made possible, not a guide to doing any of it. Nothing here describes how to build, modify or use a device or weapon.

The First Technology Was a Person

Before any machine could carry, watch, find the way or speak for anyone, a person had to do it.

THE HOUSE IN ABBOTTABAD WAS LARGE FOR ITS STREET. When American officials described it to journalists in the early hours of 2 May 2011, they listed what had made it stand out. Its walls were between 12 and 18 feet high and topped with barbed wire. Two security gates controlled the way in. The main building had few windows facing outward, and the people who lived there burned their rubbish instead of leaving it out for collection like their neighbours. The property, one official said, was worth about a million dollars "but has no telephone or Internet service connected to it."[1]

The man who lived inside had spent years at the head of an organisation known to the world through satellite television, websites and video. He had no line out of the house. What linked him to everything beyond the walls, in the officials' account, was a person: "one of the few al Qaeda couriers trusted by bin Laden", whose real name had taken years to establish.[2]

A messenger carrying words by hand is the oldest arrangement there is. In 2011, in the officials' account, it was still the arrangement on which a hunted man relied, and it sent no signal over any network. It was also, in the same official account, the thread that led to the house.

This book is about the long stretch of history between those two facts. Between the moment when almost everything a clandestine group did had to be done by a person, and a present in which much of it can be done, or helped, by a machine. It is a history of terrorism told through its tools, and it asks one question in every chapter. As each new technology arrived, what could one person, or a small group, now do that they could not do before?

. . .

WHAT A FEW PEOPLE CAN DO

Terrorism has always been the work of few. Martha Crenshaw, whose 1981 essay on its causes is still a starting point for much of the field, treated it as a deliberate strategy: "at least when initially adopted," she wrote, "the strategy of a minority that by its own judgment lacks other means."[3] That judgement, she added, may be wrong.[4] The point of the strategy is a disproportion. A handful of people commit an act, and the reaction, measured in fear, attention, policy and money, is out of all scale to the act itself.

Technology matters because it changes the size of that disproportion. It can do this in three ways, and the three are worth keeping apart, because they have not changed at the same speed.

Force Tools that multiply destructive power	Movement Tools that move people, objects and messages	Attention Tools that carry the act to an audience
Dynamite	Railway	Press and telegraph
Industrial firearms	Jet airliner	Radio, television
Military surplus	Consumer drone	Satellite, Internet
Commercial explosives		Platforms, AI
Large changes with dynamite and with war surplus; little from consumer technology since.	*Changed where violence could happen, and who could be reached.*	*Changed the most, and kept changing fastest.*

I.1 Three families of technology run through this book. The notes beneath each column are this book's interpretation, argued chapter by chapter; they are not findings from a dataset.

The first family multiplies force. Dynamite is the founding example, and it is where the book begins, in the 1860s. The second family moves people, objects and messages: the railway, the jet airliner, and now the small drone. It changes *where* violence can happen and who can be reached. The third family carries the act to an audience. The mass-circulation newspaper and the telegraph, then radio, television, satellites, the Internet and the platforms built on it.

The argument of this book, stated plainly so that it can be tested, is that the third family changed terrorism the most and the first family the least. In the European Union in 2025, Europol counted 45 completed, failed and foiled terrorist attacks; where the method was recorded, the most common were stabbing, bombing, arson and shooting.[5] Knives, guns, explosives and fire: tools a nineteenth-century anarchist would recognise. What a nineteenth-century anarchist would not recognise is the audience. That is an interpretation, not a finding, and several chapters push against it. Audrey Kurth Cronin has argued that when lethal technologies become cheap, accessible and simple to use, they shift power to individuals and small groups, as dynamite did in the nineteenth century and the Kalashnikov rifle in the twentieth, and that drones, advanced robotics, 3D printing and autonomous systems have more in common with them than with the military technologies of states.[6] She is careful about the mechanism: such technologies matter, she writes, because they "help mobilize individuals, extend their reach, and provide them with unprecedented command-and-control abilities."[7] Both readings can be partly right. The chapters try to show where each one holds.

FOUR QUESTIONS

Each chapter measures its technologies by four questions. Did a technology change the *force* of the violence itself, the damage a few people could do? Did it change their *reach*, how far and how fast a person, an object or a message could travel? Did it change the *audience*, who learned of an act, through whom and how soon? And did it change the *labour*, the work a clandestine group had to do with its own people? Each chapter ends with this book's answer, which is an interpretation rather than a measurement. Alongside the four, every chapter also records the *response*: how states, companies and publics adapted, and at what cost.

The book uses the word terrorism in a working sense of its own, not as a legal definition: violence, or the threat of it, by individuals or small groups not acting for a state, meant to frighten an audience wider than its victims for a political end. Where an official body did not treat a case as terrorism, the text says so.

The chapters run in order of time, in five parts, from the dynamite of the 1860s to the software of the 2020s. Between them stand 14 short interludes, each about a single object: the problem it was made to solve, how it spread, its civil uses, and one documented case of its use in political violence, named on the object's stamp.

WHO DOES THE WORK

There is a second thread, quieter but running under every chapter.

Before any machine could do it, a person carried the message. A person watched the street and remembered who came and went. A person knew the route. A person spoke to the newspaper, wrote the pamphlet, found the printer, translated the statement. And a person decided.

Over 150 years, technology took over parts of these jobs, one at a time and never completely. The railway and the post carried what a courier had carried. The telephone and then the mobile network replaced the messenger. The camera assisted the lookout. The printed map and later satellite navigation replaced local knowledge. Radio, television and the network took over publication. In the 2020s, software began to help with writing and translation.

	1860s	1920s	1960s	1990s	2010s	2020s
Carry messages, objects, people	Courier, horse	Railway, post	Jet airliner	Jet, post	Jet, post	Consumer drone
Talk coordinate at distance	Messenger	Telephone	Radio, telephone	Mobile phone	Messaging apps	Messaging apps
Watch observe a place	Lookout	Lookout	Lookout	Lookout	Phone camera	Drone camera
Find the way navigate	Local knowledge	Printed map	Printed map	Printed map	GPS phone	GPS, autopilot
Publish make the act known	Press, telegraph	Press, radio	Television	Satellite TV, fax	Platforms	Platforms
Write & translate produce the message	Author, printer	Author, press	Author, copier	Author, PC	Author, PC	Generative AI
Decide choose to act	Person	Person	Person	Person	Person	Person

Done by people, largely unaided · People assisted by a technology · Largely delegated to a machine or a network

I.2 Who does the work? Seven functions once performed by people, and the technology that most changed each of them in each period. A schematic drawn for this book: dates refer to when a technology became widely available to the public, not to its invention, and the shading is a judgement, explained in the chapters. Not every cell is illustrated by a case in the book.

Read across a row of the chart and one function slowly passes, in part, from people to machines. Read the last row and nothing passes at all. The decision to kill has stayed with people throughout this history. That is a statement about the record so far, not a prediction, and chapter 13 looks at it again with the evidence of the 2020s.

The pattern has a second edge, and it appears in almost every chapter. Each time a human function moved into a machine, the machine kept a record. Telegrams were copied, phone calls were logged, tickets were time-stamped, cameras recorded the street. A courier on foot leaves no such trail. Most people, and most groups, cannot avoid one.

NEITHER GOOD NOR BAD

Technology is neither good nor bad; nor is it neutral.

MELVIN KRANZBERG, "TECHNOLOGY AND HISTORY: 'KRANZBERG'S LAWS,'" 1986

Melvin Kranzberg, a historian of technology, called this his first law.[8] It is quoted often and explained less often. It does not say that a tool has intentions. Dynamite was made for blasting rock, tunnels and canals, and the transistor came out of research at Bell Laboratories aimed at all-electronic switching for the telephone network. Neither was designed for political violence.[9]

The law says something narrower and more useful. Every technology makes some things cheaper, faster or easier, and so it changes what people are likely to do, including people its makers never imagined. Those effects depend on who has the tool, where, and when. In Algeria, by Frantz Fanon's account, the radio set was long shunned by most Algerians as the voice of the colonial power; once the insurgents' *Voice of Fighting Algeria* began broadcasting at the end of 1956, he wrote, Algerians bought sets in large numbers.[10] The question this book asks of each technology is therefore never "was it good or bad?" but "what did it make easier, for whom, and who noticed?"



Heleneborg, on Södermalm in Stockholm, photographed around 1900. The Nobel family's nitroglycerine works stood here until the explosion of 3 September 1864.

UNKNOWN PHOTOGRAPHER, C. 1900, PUBLIC DOMAIN, VIA WIKIMEDIA COMMONS

1

The Age of Dynamite

1860–1914

An industrial product for mines and tunnels became, within twenty years, the word that stood for fear itself. The newspapers had as much to do with it as the chemists.



ON SATURDAY 3 SEPTEMBER 1864, SHORTLY AFTER HALF past ten in the morning, the houses around Heleneborg on the south side of Stockholm shook on their foundations. Across the water on Kungsholmen, window panes broke. People who looked towards the sound saw a great yellow flame rise into the air, followed at once by an enormous column of smoke. When it cleared, nothing remained of the wooden workshop where the Nobel family made nitroglycerine but, as a local newspaper put it three days later, "a few blackened fragments, scattered here and there".[1]

For a while no one dared search the ruins in case there was a second blast. That first report counted five bodies; a Stockholm heritage history gives six.[2] Among the dead was Emil Nobel, twenty years old, the youngest of the brothers. Alfred, who was 30, was thrown to the floor and injured in the head.[3] The city banned the manufacture of nitroglycerine within its limits.[4]

Alfred Nobel did not stop. Within three months he had founded a company, Nitroglycerin Aktiebolaget, and production resumed on an old barge moored on Lake Mälaren, beyond the reach of the ban.[5]

The accident at Heleneborg is where this book begins because it shows the problem Nobel was trying to solve, and the problem was not power. Nitroglycerine was already far stronger than gunpowder. It was also a liquid that could explode when it was shaken, dropped or warmed, which made it dangerous to make, worse to store and almost impossible to ship. A substance like that could not become a product.

. . .

THE PRODUCT

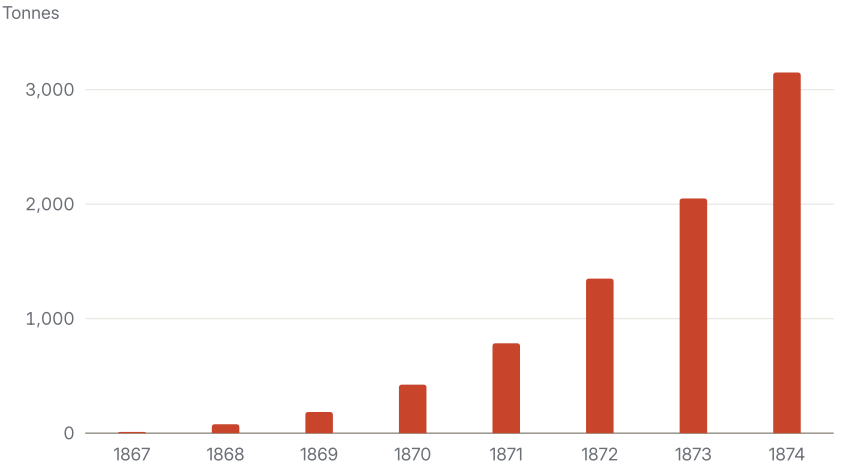
In June 1865 Nobel registered a company in Hamburg, and in October he bought 42 hectares of land at Krümmel, on the Elbe about 30 kilometres from the city, between high sand dunes and the river.[6] Production began there on 1 April 1866 with about 50 workers, many of them Swedes. In July the works blew up. Nobel moved his experiments to a raft anchored in the river while the buildings were rebuilt, further apart this time and behind high earth banks.[7]

The answer he arrived at, described in the plainest terms, was to make the liquid behave like a solid. Absorbed into a porous earth, nitroglycerine could be pressed into sticks, wrapped in paper, packed in boxes and carried by rail and ship with a far smaller risk of disaster. Nobel called it

dynamite and patented it in Sweden and in Britain in 1867, and in the United States the following year.[8]

From 11 tonnes to 3,150 in seven years

Dynamite produced at Nobel's Krümmel works near Hamburg, tonnes per year, 1867–1874



1.1 Annual output of one works, Krümmel, not of the Nobel group as a whole. Production began in April 1866; dynamite figures start in 1867.

Source: Nobel Prize Outreach, "Amount of Dynamite Produced in Krümmel" (accessed 7 October 2026); consistent with J. Mérand, *Encyclopædia Universalis*. One works only, not the Nobel group. Data: `data/processed/krummel_output.csv`.

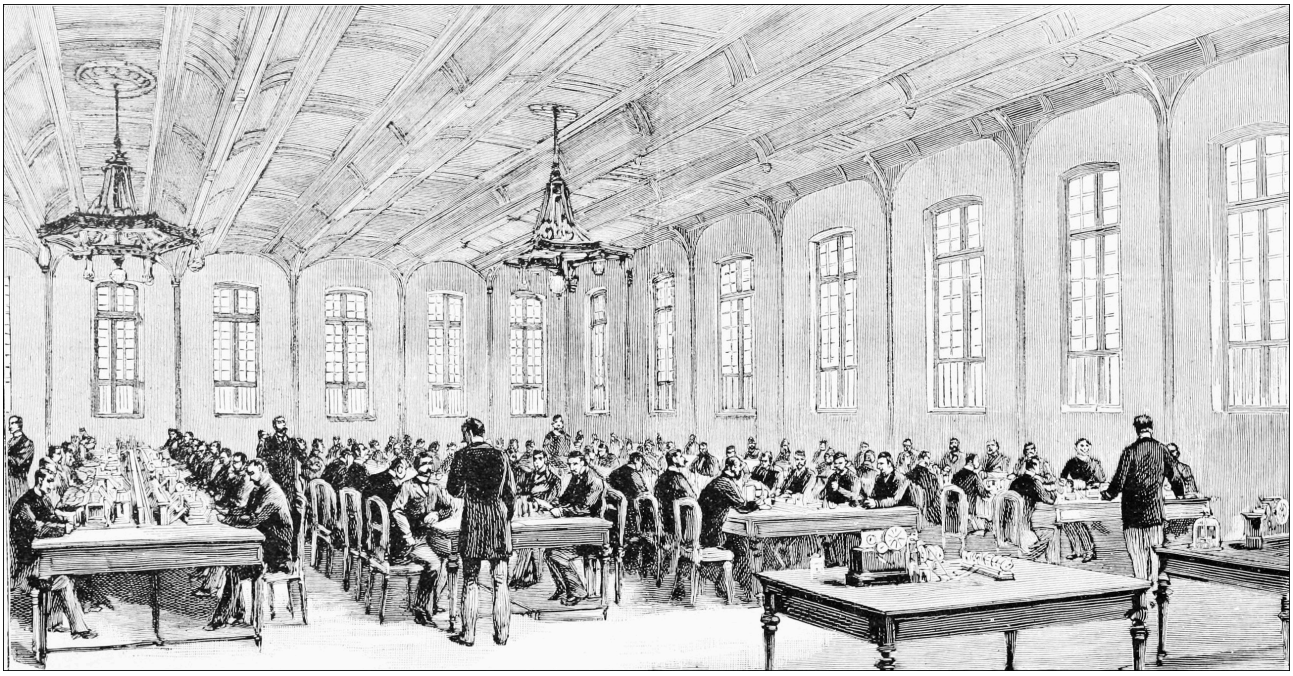
The new product sold. Krümmel made 11 tonnes of dynamite in 1867 and 3,150 tonnes in 1874.[9] By the time Nobel died in 1896 his companies ran factories in some 20 countries; sources put the number of plants at 80 or 90.[10] The buyers were engineers. Together with the detonator, which Nobel also patented, and with the new diamond drill bits and pneumatic drills of the same years, dynamite "drastically reduced the cost of blasting rock, drilling tunnels, building canals and many other forms of construction work," as the Nobel Foundation's own account puts it.[11]

This is the first thing to understand about the technology that gave its name to an era of political violence. It was not a weapon. It was an industrial commodity, made in large quantities, sold openly, carried on the same railways it helped to build. Audrey Kurth Cronin, who has traced in detail how dynamite spread among non-state groups, puts the point in its strongest form: it was sold in hardware stores and by catalogue, and its innovation was driven "not by military organizations, but from below".[12] Armies, she notes, found it too shattering and unstable for their priority of the day, long-range artillery.[13] What changed in the 1860s was not that a powerful explosive existed. It was that one could be bought.

What Nobel thought. Many sayings about war and peace are attributed to Nobel; few can be traced. The best documented comes second-hand, from the pacifist Bertha von Suttner's memoirs: "Perhaps my factories will put an end to war sooner than your congresses."[14] The historian Sven Tägil notes that dynamite "had not been developed with the idea of using it in war."[15] The story that a French newspaper's premature obituary, calling him a "merchant of death", moved him to found the prizes has never been traced to the newspaper itself.[16]

A VOICE THAT SPEAKS TO A HUNDRED THOUSAND

The years that made dynamite a commodity also made news one. On 10 October 1851 Paul Julius Reuter opened an office of two small rooms at 1 Royal Exchange Buildings, in the heart of the City of London.[17] On 27 July 1866 a member told the House of Commons that he understood the Atlantic cable "had been successfully completed, and that the first message had been received".[18]



1.2 The operators' room of the central telegraph exchange in Paris, as illustrated in *Popular Science Monthly* in 1894.
POPULAR SCIENCE MONTHLY, VOL. 44 (1894), PUBLIC DOMAIN, VIA WIKIMEDIA COMMONS

Ten years after the Krümmel works opened, a small group of European revolutionaries began to argue about a different problem. They had ideas, and almost no way of making them heard.

In August 1877 Paul Brousse, a Frenchman who had studied medicine at Montpellier and was living as a political refugee in Switzerland, where he worked as an assistant in the chemistry laboratory of the University of Bern,[19] published an article in the *Bulletin* of the anarchist Jura Federation under the title "La propagande par le fait", propaganda by the deed.[20] Read today, its most striking passage is not about violence at all. It is about the press. "There is a voice that speaks to ten

thousand, to a hundred thousand listeners," Brousse wrote: "the voice of the press." But the newspaper, he went on, had become "a productive industry, a commercial industry", built on capital and advertising, and workers could not compete with it.[21] The deed, an act people could see and touch, would reach the exhausted worker who had no time or money to read. It would march, in his closing words, "in flesh and blood, alive, before the people."[22]

Brousse's examples were demonstrations and local uprisings, not bombs or assassinations. The phrase only later came to mean the individual *attentat*.[25] But the logic he set out would survive every change of meaning. The act was a message, and the message was aimed at an audience the actor could not otherwise reach.

The irony is that the audience was reached, in the end, through the very industry Brousse despaired of. *Le Petit Journal* in Paris, sold for a single sou and printed on rotary presses that Hippolyte Marinoni developed for it from 1867, was written and priced for a mass readership.[26] Martha Crenshaw, writing a century later about the conditions that make terrorism possible, put the general point in one sentence: "Sophisticated networks of transportation and communication offer mobility and the means of publicity for terrorists."[27] David Rapoport, whose history of four "waves" of modern terrorism begins in this period, is more specific. The telegraph, daily mass newspapers and railways "flourished during the last quarter of the nineteenth century. Events in one country were known elsewhere in a day or so."[28]

Who coined the phrase? David Rapoport credits Peter Kropotkin.[23] Richard Bach Jensen calls Brousse "apparently the first person to use the phrase".[24] Jensen places that first use in an article published two weeks after the Italian anarchists' statement of December 1876; the article this book has been able to read is Brousse's of August 1877.

A HUMAN MACHINE

Yet the people who made the first great attack of the dynamite age did almost none of their work by telegraph.

Narodnaya Volya, the People's Will, formed in 1879 when an older revolutionary party split, was in its working parts a human machine.[29] Aleksandr Mikhailov, its organiser in St Petersburg, built "a whole network of hiding places and lodgings" and "controlled the illegal life of the whole organization down to the smallest details."[30] Inside the police headquarters sat Nikolay Kletochnikov, a sympathiser Mikhailov had persuaded to take a post there, who warned the organisation "of police moves and future arrests."[31] Aaron Zundelevich knew the frontiers and the smugglers who could bring a fugitive out or "a load of periodicals" in.[32]



1.3 Poster for *Le Petit Journal*, issued for the Paris Exposition of 1900, claiming four million readers: the paper's own figure, and a count of readers rather than copies.
PETIT PALAIS, MUSÉE DES BEAUX-ARTS DE LA VILLE DE PARIS / PARIS MUSÉES (CC0)

What the party valued most was its printing press. Mikhailov explained why in terms Brousse would have recognised. A clandestine paper mattered less for what it said than for what its existence showed: "The police looks for it and is unable to find it — that's what strikes the public. It's of no importance what's written inside."[33] When the police did find the St Petersburg press in January 1880, it was hidden in a flat let to two members posing as husband and wife, with a student playing their cook, chosen because she "did not look like a conspirator". The press was discovered through a forgotten practice copy of a forged passport.[34] The party's workers' paper, *Rabochaya Gazeta*, ran to three issues; one member, Rysakov, was given a hundred copies and distributed them all by hand within a week or two.[35]

On Sunday 1 March 1881 by the Russian calendar, 13 March in the West, the Emperor's convoy passed along the Catherine Canal in St Petersburg. The signal to the men waiting for it was Sofya Perovskaya's handkerchief. Rysakov threw the first bomb; a second, thrown by Grinevitsky, mortally wounded

Alexander II, who died about an hour later in the Winter Palace.[36] About twenty bystanders were wounded in the two explosions, and three of them died within hours.[37]



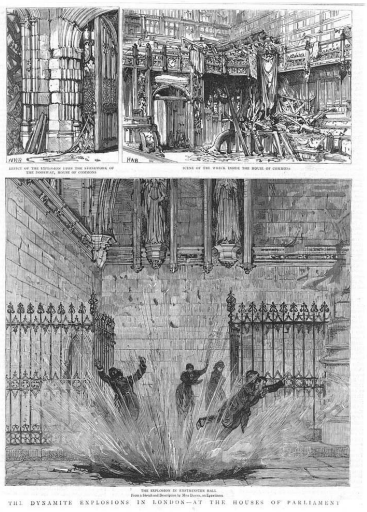
1.4 The second explosion on the Catherine Canal embankment, St Petersburg, 1 March 1881 (Russian calendar), as drawn for the weekly *Vsemirnaya illyustratsiya* in March 1881.

VSEMIRNAYA ILLYUSTRATSIYA, 14 MARCH 1881, PUBLIC DOMAIN, VIA WIKIMEDIA COMMONS

The explosive was new. Almost everything else about the attack was old: lookouts, couriers, safe houses, a hand signal, men on foot. The industrial age had given a small group a new means of force and, through the press, a new audience. It had not yet given them new ways of moving, watching or talking. Those were still done by people, and people, as the press in January 1880 showed, could be followed, betrayed or careless.

THE DYNAMITE WAR

In Britain, the dynamite age arrived from across the Atlantic. From March 1876 the New York *Irish World* ran a "skirmishing fund" to pay for attacks on Britain, an idea first floated the year before; in its first two months it raised $2,484.[38] Its money later financed explosions in Britain.[39] The small group known as the Skirmishers, in the reading of the



1.5 *The Graphic*, London, 31 January 1885: the front page after the explosions at Westminster.

THE GRAPHIC, 31 JANUARY 1885, PUBLIC DOMAIN, VIA WIKIMEDIA COMMONS

historian Niall Whelehan, understood that "by capturing headlines they could goad the more financially secure Clan", the larger Irish-American organisation Clan na Gael, "into a similar strategy".[40]

It began at Salford Barracks on 14 January 1881, where a seven-year-old boy was killed.[41] Over the next four years bombs exploded on the London Underground, at Victoria station, at Scotland Yard and under London Bridge. In one attack on the Underground in October 1883, seventy-two passengers were hurt by flying glass and debris.[42] On Saturday 24 January 1885, between two and a quarter past two in the afternoon, three bombs exploded in the Tower of London, in the crypt of Westminster Hall and in the chamber of the House of Commons. The press called it "Dynamite Saturday", and it "caused an international sensation".[43]

The campaign's toll was small by the standards of what it provoked. Between 1881 and 1885 four people died: the boy at Salford and three of the bombers, killed by their own device at London Bridge.[44] The state's response was not small. The Explosive Substances Act received Royal Assent on 10 April 1883, a day after the Home Secretary, Sir William Harcourt, had introduced it as a response to "a danger which, like Nihilism, may be called, in some sense, a new danger", and to what he called the "Assassination Press abroad".[45] That same year Scotland Yard set up a Special Irish Branch to investigate the dynamiters.[46] The government also raised the "dynamite conspiracies" with Washington.[47]

Political policing, international diplomacy about terrorism and a criminal law aimed at a technology rather than an act: all three were answers to a campaign that killed four people, and all three outlived it.

CHICAGO, 1886

On the evening of 4 May 1886, police moved to break up a labour meeting in Haymarket Square in Chicago. Someone threw a bomb into their ranks. Police opened fire. In the end seven police officers were dead, according to the Illinois Supreme Court, which reviewed the case the following year: "six policemen besides Degan were killed".[48] How many civilians died has never been settled; the best-documented accounts say only that the number is unknown.[49]



1.6 *Harper's Weekly*, 15 May 1886: the newspaper's version of the moment of the explosion in Haymarket Square, drawn from reports. No photograph of the event exists in the sources consulted for this book.
LIBRARY OF CONGRESS, PRINTS & PHOTOGRAPHS DIVISION, CPH.3A04704 (PUBLIC DOMAIN)

Several anarchists were convicted. In 1893 the Governor of Illinois, John Peter Altgeld, pardoned three of them, observing that "the state has never discovered who it was that threw the bomb which killed the policemen".[50] The court itself had accepted that "no one of the convicted defendants threw the bomb with his own hands".[51] The image of the anarchist bomber that Haymarket left behind was built around a person nobody ever identified.

THE WEAPON THAT WAS MOSTLY A WORD

By the 1880s dynamite had become the emblem of revolutionary violence. Rapoport calls it the "weapon of choice" of the first wave.[52] Cronin goes further: "Dynamite sparked action because it provided the perfect means."[53] Newspapers described its power in language that Richard Bach Jensen compares to the way Oppenheimer would later describe the atomic bomb.[54]

Yet when the record of the period's most famous killings is laid out, dynamite is rarely in it. President Sadi Carnot of France was stabbed in Lyon on 24 June 1894; the first telegram from the city, sent at 22:35 that evening, reported "un coup de poignard", a dagger blow.[55] Empress Elisabeth of Austria was killed on a Geneva quayside on 10 September 1898 with a sharpened file. King Umberto I of Italy was shot at Monza on 29 July 1900, and President William McKinley in Buffalo in September 1901, both with revolvers.[56]

DISPUTED

Was dynamite the anarchists' weapon, or their emblem?

For Rapoport, dynamite was the first wave's "weapon of choice";[57] for Cronin, it provided "the perfect means" and drove the wave itself.[58] Jensen argues that "more primitive weapons often proved more practical and lethal: ... the dagger and the pistol for the anarchists," while bombs "proved more lethal for the innocent bystanders."[59] The readings are less opposed than they look. Rapoport and Cronin explain why a wave of violence began and spread; Jensen counts what the killers of kings and presidents actually carried. Dynamite changed what was feared, and what small groups believed they could do, more than it changed what was usually used.

Rapoport 2004; Cronin 2019, ch. 3; Jensen 2009. Jensen's 2004 article on the same question has not been read for this book and is not cited; his 2014 book reworks it.

DISPUTED

How many people did this violence kill? It depends on what is counted.

Three careful counts, all excluding the Russian empire, give very different totals. Jensen, counting anarchist attacks of every kind between 1880 and 1914, finds "at least 160 people died and about 500 were injured".[60] In a later count of "real or alleged anarchist attacks" from 1878 to 1914 he gives more than 220 dead and over 750 injured.[61] Cronin, counting terrorist bombings of all political kinds from 1867 to 1934 in her own database, finds "more than 1,500 people died ... and more than 5,000 were injured".[62] The figures do not contradict one another. They measure different things: anarchists only or all movements; every weapon or bombs only; twenty-five years or almost seventy, including the violent decades after 1914.

Jensen 2009 and 2015; Cronin 2019, p. 85.

Jensen's own conclusion is the thread of this chapter. "By connecting together a disparate series of events, many having nothing to do with anarchism," he writes, "newspapers helped create the 'myth' of anarchist terrorism as a fearsomely powerful phenomenon sweeping through the world."[63] Each death was real. The sense of a world under siege was, in large part, made by the press.

EIGHT MINUTES

The clearest evidence of how far the world had changed comes from an afternoon in Buffalo, New York.

At seven minutes past four on 6 September 1901, at the Temple of Music in the grounds of the Pan-American Exposition, Leon Czolgosz, aged twenty-eight, shot President McKinley twice with a concealed revolver.[64] At 16:15 a bulletin was issued from the exposition grounds: "President McKinley has been shot at the Temple of Music. He was taken to the hospital on the Exposition grounds." The *Buffalo Evening News* printed it in a seven o'clock extra under the banner "PRESIDENT M'KINLEY SHOT!"[65] In Rochester, the *Union and Advertiser* was by that evening on its third extra edition.[66] In New York, the *Evening World* printed a sixth extra, carrying a dispatch datelined Buffalo, ten o'clock.[67]

The New York paper gave the assassin's name as Frederick Nieman, the alias he had given.[68] The wire carried mistakes as fast as facts. Seven years earlier the Paris daily *Le Temps* had printed the 22:35 telegram from Lyon about Carnot in its next issue.[69] The act and the news of the act had become, for practical purposes, simultaneous. McKinley died eight days later, on 14 September.[70]

ROME, 1898

States drew their own conclusion from the same networks. If news and people crossed borders easily, so did the threat, and no police force could deal with it alone.

The killing of Empress Elisabeth in Geneva, by an Italian, on Swiss soil, of an Austrian sovereign, made the point unanswerable.[71] On 24 November 1898, at the Palazzo Corsini in Rome, fifty-four delegates from twenty-one countries met for what Jensen calls "the only European-wide anti-anarchist congress ever held and history's first international gathering convened to combat terrorism."[72] It closed on 21 December, by which time Luxembourg's delegate had left.[73]

Its practical results were modest and lasting: secret meetings of police chiefs, an extradition clause for attacks on heads of state, and the spread of the *portrait parlé*, the standardised physical description of suspects developed by the French police official Alphonse Bertillon.[74] The French ambassador thought the final protocol "not worth the paper" it was written on.[75] It was nevertheless, in Jensen's account, the first time governments met to treat terrorism as a problem of international cooperation: a network answered by a network.

TIMELINE 1

An explosive, a doctrine and a news industry, 1851–1901

1851 TECHNOLOGY 10 October: Paul Julius Reuter opens an office at the Royal Exchange, London.

1864 TECHNOLOGY 3 September: explosion at the Nobel works at Heleneborg, Stockholm; Emil Nobel among at least five dead. Manufacture banned within the city.

1866 TECHNOLOGY 1 April: production begins at Krümmel, near Hamburg. 27 July: the Atlantic cable is completed.

1867 TECHNOLOGY Dynamite patented in Sweden (no. 102) and Britain (no. 1345).

1868 TECHNOLOGY 26 May: US patent 78,317, "Improved Explosive Compound".

1876 VIOLENCE March: the *Irish World*'s skirmishing fund. 3 December: Cafiero and Malatesta call insurrection "the most effective method of propaganda".

1877 VIOLENCE August: Paul Brousse, "La propagande par le fait".

1881 VIOLENCE 14 January: bomb at Salford Barracks. 13 March (1 March, Russian calendar): Alexander II killed in St Petersburg by Narodnaya Volya.

1883 RESPONSE 10 April: Explosive Substances Act. Scotland Yard's Special Irish Branch is set up.

1885 VIOLENCE 24 January: "Dynamite Saturday", bombs at the Tower of London, Westminster Hall and the House of Commons.

1886 VIOLENCE 4 May: bomb at Haymarket Square, Chicago; seven police officers and an unknown number of civilians die.

1894 VIOLENCE 24 June: President Sadi Carnot stabbed in Lyon.

1898 VIOLENCE 10 September: Empress Elisabeth killed in Geneva.

1898 RESPONSE 24 November–21 December: the Rome conference, 54 delegates from 21 countries.

1901 VIOLENCE 6 September, 4.07 p.m.: President McKinley shot in Buffalo. A bulletin follows at 4.15 p.m.

Sources: D. Read, *The Power of News* (1992); *Jönköpingsbladet*, 6 Sept. 1864; Nobel Prize Outreach; Hansard, 27 July 1866; Google Patents; N. Whelehan, *The Dynamiters* (2012); F. Venturi, *Roots of Revolution* (1960); Brousse 1877; Explosive Substances Act 1883; *Spies v. People* (Ill. 1887); *Le Temps*, 26 June 1894; R. B. Jensen, *The Battle against Anarchist Terrorism* (2014); Miller Center; *Buffalo Evening News*, 6 Sept. 1901.

WHAT DYNAMITE CHANGED

Set against the four questions this book asks of every technology, the half-century after Heleneborg gives a clear answer.

Reach changed most. The telegraph, the cable and the mass newspaper made an act in Lyon or Buffalo an event in Paris and New York the same night, and they did so for every act, whether or not the person who committed it had planned for an audience. Force changed too, but less than its reputation. Dynamite gave small groups the means to attempt what had needed an army, and it frightened governments into new laws, new police branches and a new kind of international

conference. Most of the famous killings were still done with a knife or a pistol.

The work itself barely changed. Messages, people and weapons still moved, for the most part, by hand. A handkerchief still gave the signal. The courier, the lookout and the hidden printer were the real infrastructure of clandestine politics, and they would remain so for decades.

What came next would begin to change that infrastructure, and not because anyone designed it for the purpose. The next chapter follows what two industrial wars taught a generation of soldiers about weapons, explosives and radio, and what they took home.

OBJECT 1 · 1867

The Dynamite Stick



LOUIS FIGUIER, LES MERVEILLES DE LA SCIENCE (1891), PUBLIC DOMAIN, VIA WIKIMEDIA COMMONS

INVENTED
1866–67, Krümmel near Hamburg

INVENTOR
Alfred Nobel (1833–1896)

PATENTS
Sweden no. 102 and Britain no. 1345 (1867); US 78,317 (1868)

MADE FOR
Mines, quarries, tunnels, canals, railways

ENTERS POLITICAL VIOLENCE · 1880S

THE PROBLEM

Nitroglycerine was far more powerful than gunpowder and far more dangerous to handle. The Nobels' own works at Heleneborg were destroyed by it in 1864, and their new plant at Krümmel in 1866.[1] An explosive that could not be shipped safely could not be sold.

WHAT CHANGED

Absorbed into a porous earth and shaped into paper-wrapped sticks, the liquid became a solid that could be packed, boxed and sent by rail and ship. Dynamite was not stronger than nitroglycerine. It was more *portable*, and that turned it into a commodity.



O1.1 Edward Penfield, *Aetna Dynamite*, lithograph poster, 1895. Dynamite was advertised and sold openly, like any other industrial supply.

LIBRARY OF CONGRESS, PRINTS & PHOTOGRAPHS DIVISION, LC-DIG-CPH-3G13310 (PUBLIC DOMAIN)

HOW IT SPREAD

Krümmel alone went from 11 tonnes in 1867 to 3,150 in 1874.[2] By Nobel's death his companies had factories in some 20 countries.[3]

CIVIL USES

Blasting rock, drilling tunnels, cutting canals and railway lines.[4]

IN POLITICAL VIOLENCE

By the early 1880s dynamite had become the emblem of revolutionary violence in Russia, Britain, the United States and continental Europe.[5] Its actual use was narrower than its reputation: the best-known assassinations of the period were carried out with knives and pistols (chapter 1).

WHAT NOBODY EXPECTED

A product designed to make construction cheaper became a symbol. Fear of dynamite shaped the first explosives laws and the first international police conference against terrorism, in Rome in 1898.[6]



A Type 3 Mk II suitcase transceiver, the British set known as the B2, on display at the Spy Museum in Berlin. Designed for the Special Operations Executive in 1942, it travelled in an ordinary-looking case.

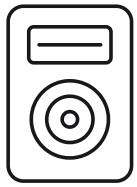
PHOTO: AVRON / WIKIMEDIA COMMONS, CC BY 3.0

2

What the War Left Behind

1914–1948

Two industrial wars taught millions of people to use machines made for killing and communicating, and then sent them home. Not everything went back into the stores.



IN THE SECOND WEEK OF OCTOBER 1943, PROBABLY ON the 13th, the Gestapo arrested a young woman at a flat on the corner of the rue de la Faisanderie and the rue Dufrenoy in Paris, close to their headquarters on the Avenue Foch. They took her wireless set, and an exercise book in which she had kept her messages.[1]

London knew her as Madeleine. Her name was Noor Inayat Khan, and she had been born on 1 January 1914.[2] She had landed in France by Lysander on the night of 16 June, "the first woman operator to be infiltrated into enemy occupied France", in the words of the citation for the George Cross she was later awarded.[3] Within weeks the network she had been sent to serve was being arrested around her. Through the late summer, on London's orders, she lay low; by the end of September she was back in regular contact with England. She had been offered a flight home and refused it until she knew who would replace her.[4]

Sets like hers weighed about thirty pounds and fitted into a smallish suitcase some two feet long. They were, the official historian of her organisation wrote, "practically impossible to disguise as anything else", and if one was found in a search, "only luck" would save the person carrying it.[5] The Germans looked for them constantly. Their wireless direction-finding teams were "numerous and efficient, probably better than the British".[6] "We had been D/Fing her for months," one of the officers involved told his interrogators after the war.[7] In the end, according to the same history, she was apparently betrayed for money.[8]

She was shot at Dachau on 13 September 1944.[9]

. . .

The suitcase in that flat was not hers in any sense that mattered. The British state had designed it, made it, trained her to use it and flown her in with it. From 1 June 1942 the Special Operations Executive, SOE, ran its own wireless service: it would "make its own sets, train its own operators, invent its own ciphers, and do its own deciphering."[10] By June 1944 it had more than 150 wireless links in France alone. Colin Gubbins of SOE later called wireless "the most valuable link in the whole of our chain of operations".[11]

This chapter is about that transfer. Between 1914 and 1945 two wars built, at enormous cost, capabilities that had belonged only to states: arsenals of portable weapons, factories that could turn them out by the million, trained soldiers by the million, radio networks, aircraft. Some of these

capabilities were handed to small groups on purpose, as Britain handed radio sets to its agents. Some leaked. Some were carried home in the heads of the men and women who had learned them. And some were simply sold. The question, as in every chapter of this book, is what a small group could now do that it could not do before. The answer after 1945 was: some of what only an army could do in 1914.

How the sets worked is not the subject of this book, as it was not of the official history from which most of this account comes. That historian put it plainly: "This is not the place, and this writer has not the knowledge, to discuss the techniques of clandestine wireless communication."[12]

A PISTOL FROM AN ARMY DEPOT

The pattern began, in the official version at least, with the event that started the first of the two wars.

When Austria-Hungary sent its ultimatum to Serbia on 23 July 1914, it attached a summary of its investigation into "the painful events of the 28th of June", the murder of the Archduke Franz Ferdinand at Sarajevo. The young men who carried out the attack, it said, had been given their weapons in Belgrade by a Serbian official and a Serbian army major, and "the bombs are hand grenades originating from the weapons depot of the Serbian army in Kragujevatz."[13]

OFFICIAL ASSESSMENT

Vienna charged that the Sarajevo weapons came from a Serbian army depot.

The charge is the accusing government's summary of its own investigation, published to justify an ultimatum, and it should be read that way.[14] Vienna blamed a public nationalist society, Narodna Odbrana. Later scholarship places a secret officers' society, Unification or Death, better known as the Black Hand, at the centre of the plot.[15] Either way, the claim is the same in kind: a state's weapons, and state officials, behind a small group's act.

Austro-Hungarian note to Serbia, 23 July 1914, appendix; D. Bakić, *Balcanica* 46 (2015). The trial record and the standard histories of the assassination have not been read for this book and are not cited.

What mattered, in Vienna's account, was where the weapons came from: not a workshop but an army depot. The question of the next thirty years would be how many such depots there would be, and how well they would be guarded.

THE POST OFFICE AND A HORSE

The first great wave of political bombings in the United States after the war needed no army at all.

At the end of April 1919, after a bomb delivered to the home of a former senator, Thomas Hardwick, had severely injured his wife and their maid, a postal clerk in New York found sixteen more packages in his office, addressed among others to the Attorney General, a Supreme Court justice, the Postmaster General and John D. Rockefeller. They carried "fictitious tags, bearing the name 'Gimbel Brothers, New York'".[16] On 2 June there were coordinated attacks in eight cities on the same day.[17]



2.1 Workers sweep up broken glass on Wall Street after the explosion of 16 September 1920. The bomb had been left in a horse-drawn wagon.

LIBRARY OF CONGRESS, PRINTS & PHOTOGRAPHS DIVISION, LC-DIG-DS-07043 (PUBLIC DOMAIN)

On 16 September 1920 a man drove a horse-drawn cart into Wall Street in New York. It exploded, in the FBI's words, "into a hail of metal fragments", killing "more than 30 people" and injuring some 300.[18] The count changed by the day: 28 or more on the first evening, 36 "after recount" on the second.[19] The bombers were never identified, and investigators found that "all the potential components were commonly available".[20]

These attacks belong in this chapter as its counter-example. They used no military surplus and no trained soldiers. They used the most civilian infrastructure there was: the mail, a shop's label, a horse and cart in a busy street. A small

group in 1919 could still do a great deal with what any citizen could buy, and the state, with all its new war capacity, could not find it.

MEN WHO HAD LEARNED

In Ireland, at the same moment, the war's other legacy was at work: people.

The Irish Republican Army that fought the British state between 1919 and 1921 counted, by one historian's careful minimum, at least 226 ex-servicemen of the British forces in its ranks. Of 121 whose roles can be traced, 34 served as instructors and 24 as commanders; "their most important contributions," Steven O'Connor concludes, "were in relation to training, leadership and intelligence."[21] Veterans served on the other side too: at least 1,496 Irish ex-servicemen joined the Royal Irish Constabulary.[22]

The war had taught a generation how to use weapons, and the training did not stay in the army.

So, sometimes, did the weapons. In June 1921 nearly 500 machine guns were found aboard the steamer *Eastside* at Hoboken, New Jersey. A federal prosecutor said they were apparently "intended for use against a friendly nation", and reports reaching government agents said Ireland.[23]

DISPUTED

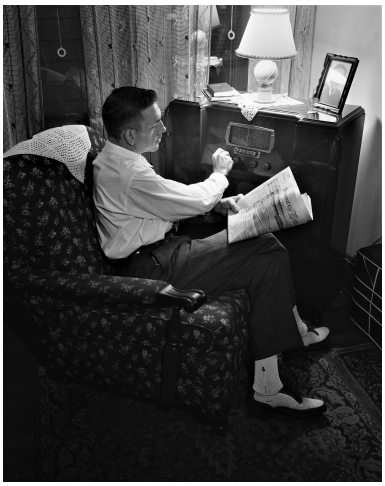
What happened to the Hoboken guns?

The contemporary press reported the seizure "last Tuesday" (14 June 1921).[24] A statement given three decades later to Ireland's Bureau of Military History by a New York priest and others dates it to a Sunday morning, and adds a story the press did not carry: that local police seized the customs men's truck as "stolen property", and that "fifty guns went back to the original owners and 450 to the Government as a result of Court order."[25] The statements were collected some thirty years after the events, and the historian who uses them warns that they were edited.[26] The seizure is documented; the story of how half of it was recovered rests on one recollection.

Omaha Daily Bee, 18 June 1921; Bureau of Military History, WS 1,057; S. O'Connor (2019).

VOICES THAT BELONGED TO STATES

Between the wars, the most powerful new technology of communication was not something a small group could own.



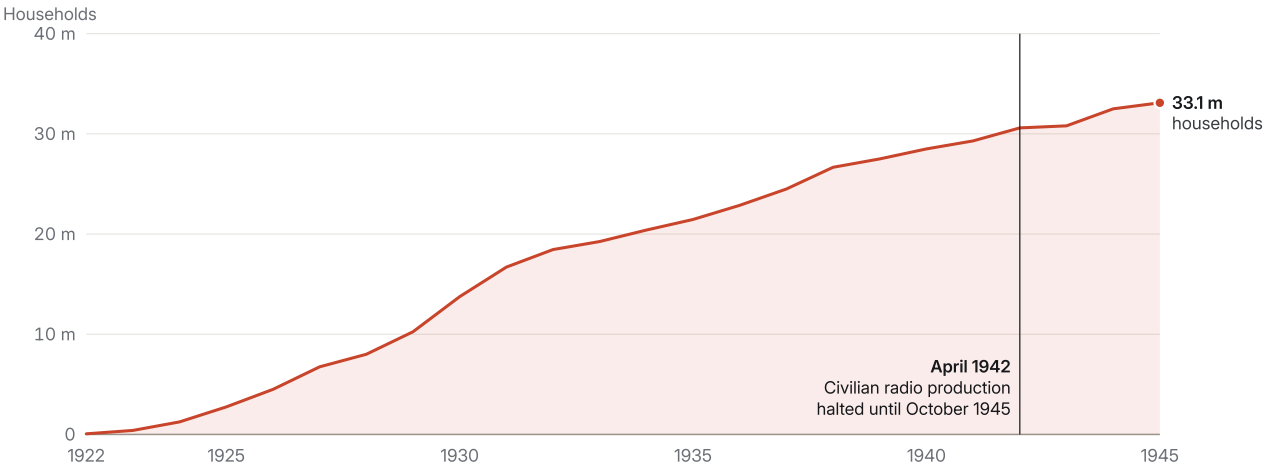
2.2 An American war worker tunes in to the war news, Rochester, New York, March 1943. Photograph for the Office of War Information.

LIBRARY OF CONGRESS, PRINTS & PHOTOGRAPHS DIVISION, FSA/OWI COLLECTION, LC-DIG-FSA-8D27674 (PUBLIC DOMAIN)

The BBC's first broadcast went out from a London studio on 14 November 1922, and in 1927 it became a public corporation under Royal Charter.[27] In Germany broadcasting was nationalised in 1932, which made it easy for the new government to take it over the following year. In August 1933 it launched the *Volksempfänger*, the "people's receiver", designed at the Propaganda Ministry's instigation and built by every radio firm to the same plan. It cost 76 Reichsmarks, against 200 to 400 for a good set. The share of German households with a radio rose from 25 to 65 per cent between 1933 and 1941.[28] The museum that gives those figures does not say how much of the rise the cheap set itself caused.

In twenty-three years the radio went from 60,000 American homes to 33 million

US households with radio sets, millions, 1922–1945 (estimates as of 30 June)



2.3 Annual figures are National Broadcasting Company estimates published by the Census Bureau; they include sets not in working order and exclude sets in businesses and hotels. The 1930 and 1940 censuses counted 12.0 and 28.0 million.

Source: US Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970* (1975), series R 104, p. 796; definitions p. 793. Data: `data/processed/us_radio_households.csv`.

In the United States, by 1945, an estimated 33 million households had a radio.[29]

Radio in these years was a one-way medium owned or licensed by states: a few large transmitters speaking to millions of receivers. The receivers ran on mains electricity or heavy batteries, and were built around valves, glass vacuum

tubes that needed power to heat them before they worked.[30] Anyone could listen. Very few could speak.

Film was the other new medium, and it reached audiences in a different way. On 9 October 1934 King Alexander of Yugoslavia and the French foreign minister, Louis Barthou, were killed in Marseille by a gunman from a Macedonian revolutionary organisation. His accomplices escaped to Italy, which refused to extradite them.[31] Newsreel cameramen had been filming the King's arrival. Within about eight days Universal Newsreel was showing American cinema audiences what it called "the First Actual motion pictures of the murder".[32]

DISPUTED

The first assassination caught on film?

Marseille is often described that way. The historian Joseph McQuade calls it "the first regicide ever caught on film", but concedes in a note that the footage does not show the killing itself: "both the build-up and aftermath were filmed".[33] In 1901 Edison had already sold a film of the crowd outside the Temple of Music in Buffalo as footage of McKinley's assassination; it shows a crowd.[34] What Marseille did show, for the first time on this scale, was a political killing turned within days into moving pictures for a mass audience.

J. McQuade (2017); Universal Newsreel, 17 Oct. 1934; AFI catalog.

The killing led to an early attempt to define terrorism in international law. The League of Nations appointed a committee of experts in December 1934, and on 16 November 1937 twenty-four states signed a Convention for the Prevention and Punishment of Terrorism.[35] Its definition spoke of "criminal acts directed against a State and intended or calculated to create a state of terror in the minds of particular persons, or a group of persons or the general public." It also required states to punish "the manufacture, obtaining, possession, or supplying of arms, ammunition, explosives or harmful substances" for such purposes: an early international attempt to treat a terrorist's access to the means of violence as a crime in itself.[36] It never came into force. Only India ratified it.[37]



2.4 Building works at the Palais des Nations, Geneva, the new headquarters of the League of Nations, on 14 May 1934, five months before the killings in Marseille.
BIBLIOTHÈQUE NATIONALE DE FRANCE / AGENCE ROL (PUBLIC DOMAIN)

The first hijacking? The US Federal Aviation Administration's world chronology of aircraft hijackings opens with a single line: February 1931, a Peruvian domestic flight, no names.[38] American diplomatic telegrams of that month describe a Panagra mail plane "held up at Arequipa by order of Prefect" during a military revolt, its manager fearing the rebels wanted aircraft "possibly for bombardment".[39] The first case on the list was a seizure by officials in revolt, not by a small private group.

THE ARSENAL OF THE FACTORIES

The Second World War turned the depot into an industry.

In 1944 American munitions output reached $61.3 billion, more than two-thirds of it combat munitions. Production had climbed from $500 million a month in 1940 to more than $5 billion a month in 1944, and the United States alone made almost 45 per cent of all the combat munitions produced by both sides that year.[40]

Some of the weapons were designed from the start to be cheap. The British Sten submachine gun "was designed to be cheap and easily made with little labour and with minimal tooling", in the words of one museum record, which adds that more than four million of various marks had been made by 1945.[41] A weapon designed to be made cheaply, with little labour and simple tools, is also easy to copy, keep and pass on.



2.5 Women workers install fixtures in the tail section of a B-17F bomber at the Douglas Aircraft Company plant, Long Beach, California, October 1942. Photograph for the Office of War Information.

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And some were sent, on purpose, to people who were not soldiers. By SOE's own reckoning, over 10,000 tons of stores were dropped into France under its auspices, well over 80 and probably over 90 per cent of them warlike. Aircraft from England dropped 73,918 containers and 20,354 packages between 1941 and September 1944.[42] The official historian warned that "several different sets of figures have been drawn up; all conflict", and his own table was offered as "a rough guide".[43]

What happened to the stores once they landed was, by the British state's own admission, unknowable. SOE's planners assumed that 60 per cent of each month's deliveries remained available for later operations. Its section historian wrote afterwards that "it has not yet been possible to discover how near or how wide of the mark this figure was, nor is it ever likely to be."[44] After the liberation the communist-led resistance "remained where they had been working, and hung on to their arms".[45]

People moved between wars as easily as rifles. In Toulouse in 1944 a Gaullist commissioner asked a new arrival how long he had been in the Resistance. "Since '36," the man answered. "I was at Guadalajara." He had fought in the Spanish Civil War.[46]

HANDING OVER

In the summer of 1945 the transfer was made explicit, on the other side of the world.

In July 1945 seven Americans of the Office of Strategic Services, the OSS, parachuted into Tonkin, in French Indochina, to work with a Vietnamese resistance movement against the Japanese. The guard that met them, about 200 men, already carried "French rifles, a few Brens, a few tommies, a few carbines and a few stens": French, British and American weapons.[47] Their host was a frail man they knew as Mr Hoo, who assured the team leader, Major Allison Thomas, that his league was not communist. Thomas's advice to his superiors was blunt: "Forget the Communist Bogy."[48]

From 9 August the Americans trained about a hundred picked men "at high speed" in American and British weapons. Training ended on 15 August, when Japan surrendered, and "not all subjects by any means had been covered."[49] Weeks later, in Hanoi, Mr Hoo revealed his real name: Ho Chi Minh.[50]

The documents do not support the later claim that the OSS built the Viet Minh's army; they record a week of training for a hundred men. What they show is the pattern of the decade in miniature. A state, for its own wartime purposes, put its weapons and its expertise into the hands of a small movement, and then the war it had been fighting ended.

In Malaya, Britain's Force 136 had armed and trained the guerrillas of the Malayan People's Anti-Japanese Army. "We knew perfectly well when we went back there that there was a considerable quantity of arms in the country introduced by ourselves," a former Force 136 officer told the House of Commons in 1948. "We had trained men to use those arms."[51] After the war the guerrillas were ordered to disband and to hand in their weapons.[52] By 1948 Britain was fighting guerrillas in Malaya again, and Parliament wanted to know where their arms had come from.

DISPUTED

Could Britain have recovered the arms it had given the Malayan guerrillas?

In the House of Lords in November 1948, Lord Mancroft blamed "our failure to round up all the arms and ammunition which we ourselves poured into the country during the war. We could quite easily have got most of them back." The minister, the Earl of Listowel, replied that the guerrillas "must have hidden large quantities of the arms and ammunition abandoned by the Japanese or dropped by Allied aircraft", and that it was difficult to tell whether this could have been prevented.[53] No figure for the hidden arms was given, then or in any source read for this book.

Hansard, HL Deb 10 Nov. 1948; HC Deb 24 Sept. 1948.

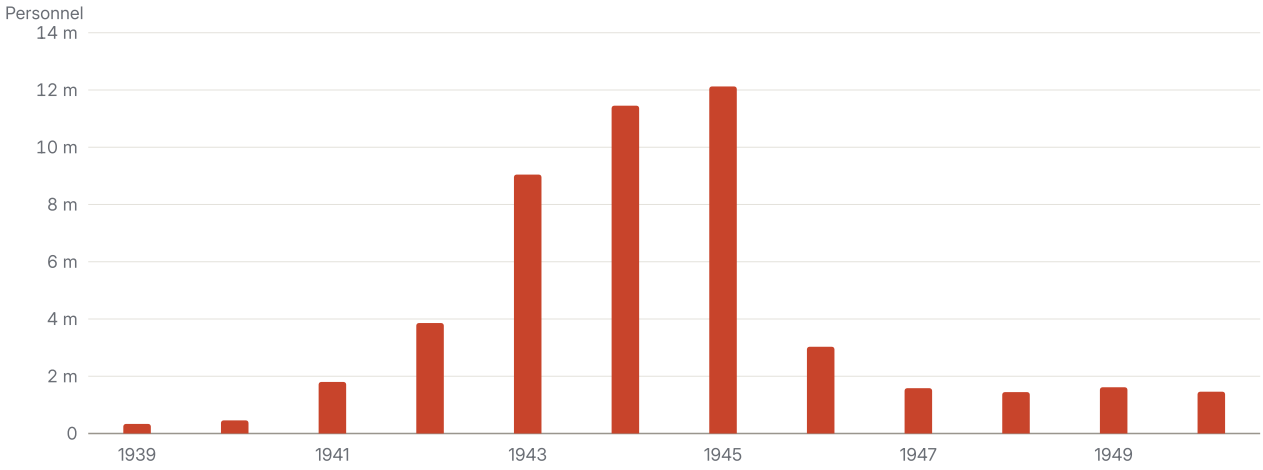
SENDING THEM HOME

The largest transfer of all was the simplest. The armies went home, and took with them what they had learned.

On 30 June 1945 more than twelve million Americans were on active duty. Two years later there were fewer than 1.6 million.[54]

Twelve million in uniform in 1945; fewer than 1.6 million two years later

US military personnel on active duty, all services except the Coast Guard, as of 30 June, 1939–1950



2.6 The figures are snapshots taken on 30 June each year: they are neither the wartime peaks nor the total number of people who served.

Source: US Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970* (1975), series Y 904, p. 1141 (Department of Defense data). Data: `data/processed/us_military_personnel.csv`.

In Britain, almost three million men and women were released from the forces between June 1945 and the end of April

1946.[55] The skills they had learned, from handling explosives to driving lorries and operating radios, went with them.

The matériel went too. A Senate committee estimated in 1948 that "approximately $51,000,000,000 worth of Government-owned surplus property" had been generated by the war, at what it had cost to acquire. Of the domestic surplus sold by March 1948, the government recovered about 28 cents on the dollar.[56] Hundreds of the SOE's own suitcase radio sets, its official historian noted, "were eventually sold off as government surplus stores".[57]



2.7 Private Bill Krepper of the Pioneer Corps chooses a civilian suit at the demobilisation centre at Olympia, London, in 1945. Crown copyright expired.

IWM BU 8063 (CROWN COPYRIGHT EXPIRED; PUBLIC DOMAIN)

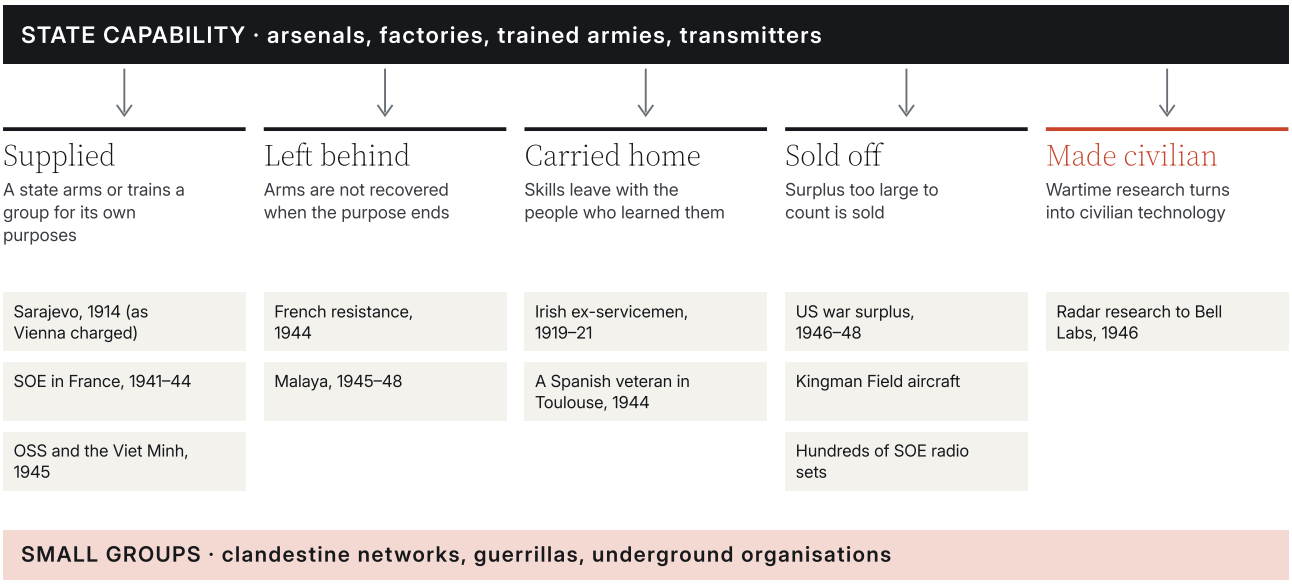


2.8 Military lorries parked in long rows beside a road in the Netherlands, 1945.

NATIONAAL ARCHIEF / ANEFO, CC0

The committee's most telling finding was about counting. The War Assets Administration had offered 5,443 combat aircraft at Kingman Field in Arizona for sale as scrap; the high bid was $2,780,000, for aircraft that had cost about $1.157 billion. When the buyer took possession, "there were actually 5,481 planes in the lot". He was "permitted to keep the 38 planes with no extra payment".[58] A government that could not count its own bombers in a field in Arizona could not hope to account for the rifles dropped by parachute into France or the radios issued to agents across Europe and Asia.

WHAT ONE PERSON COULD NOW DO



2.9 Five routes by which capabilities built by states reached much smaller groups between 1914 and 1948. Each route is illustrated only by cases documented in this chapter; the grouping is this book's.

Measured against the four questions of this book, the three decades after Sarajevo changed more than the fifty before them.

Force changed most. In 1914 a small group needed a state's depot to arm itself, or so Vienna claimed. By 1948 the weapons of two world wars had been dropped to resistance networks, hidden in caches and sold from surplus yards, and many had been designed to be simple. Labour changed with it. The skills of the soldier, the signaller and the instructor had been taught to millions, and those millions had gone home. Reach changed least for small groups: the great new medium, broadcasting, still belonged to states, and the newsreel belonged to companies. A small group could be filmed. It could not yet broadcast.

The work of a clandestine network, too, was still done by people. Noor Inayat Khan's set weighed about thirty pounds, and the work of hiding it, moving it and keeping it running was hers. The machine sent her messages faster and further than any courier could. It also gave the enemy something to listen for.

The problem was weight and power. Wartime radios were built around valves, which needed far more power to heat them than the signals they amplified.[59] In early 1946 Bell Telephone Laboratories began a programme of fundamental

research on semiconductors. Its physicists drew, as one of them later said, on "the important advances made in that period in connection with the development of silicon and germanium detectors" for wartime radar.[60] What came out of that programme would begin to shrink the suitcase.

TIMELINE 2

Two wars, and what leaked out of them, 1914–1948

1914 VIOLENCE 28 June: the Archduke Franz Ferdinand is killed in Sarajevo. Vienna charges that the bombs came from a Serbian army depot.

1919 VIOLENCE April–June: bombs sent through the US mail; 2 June, coordinated attacks in eight American cities.

1920 VIOLENCE 16 September: a horse-drawn wagon explodes on Wall Street; the toll rises from 28 to 36 in two days.

1921 RESPONSE June: nearly 500 machine guns, apparently bound for Ireland, seized at Hoboken.

1922 TECHNOLOGY 14 November: the BBC's first broadcast, from the 2LO studio in London.

1931 VIOLENCE February: a Panagra aircraft is held at Arequipa "by order of Prefect"; the FAA later lists it first in its world hijacking chronology.

1933 TECHNOLOGY August: the Volksempfänger VE 301 goes on sale at 76 Reichsmarks.

1934 VIOLENCE 9 October: King Alexander of Yugoslavia and Louis Barthou killed in Marseille; newsreels reach American cinemas within about eight days.

1937 RESPONSE 16 November: League of Nations convention against terrorism signed by 24 states. Only India ever ratified it.

1942 TECHNOLOGY 1 June: SOE takes over its own wireless, making its own sets and training its own operators.

1944 TECHNOLOGY June: SOE has over 150 wireless links in France. By September, 73,918 containers have been dropped from England.

1945 RESPONSE July–August: OSS team trains about 100 Viet Minh. June: 12.1 million Americans on active duty.

1946 TECHNOLOGY Early 1946: Bell Labs begins the semiconductor research that leads to the transistor.

1947 RESPONSE 30 June: US active-duty strength down to 1,582,999.

1948 RESPONSE May: a Senate report puts US war surplus at about $51 billion. November: the House of Lords debates how arms supplied in the war reached guerrillas in Malaya.

Sources: Austro-Hungarian note of 23 July 1914; FBI history pages; *Omaha Daily Bee* 1919–21; London Museum; FAA 1983; *FRUS* 1931; Deutsches Historisches Museum; Universal Newsreel 1934; League of Nations treaty text 1937; J. McQuade (2017); M. R. D. Foot, *SOE in France* (1966); US Senate hearings 1972; US Census, *Historical Statistics*; J. Bardeen, Nobel Lecture 1956; S. Rept. 1365 (1948); Hansard.

OBJECT 2 · 1922

The Radio Set



RIJKSMUSEUM, AMSTERDAM (NG-2009-110), CC0

BROADCASTING
BBC's first broadcast, London, 14 Nov. 1922

BUILT AROUND
Valves (vacuum tubes), mains or battery power

GERMANY'S VE 301
76 Reichsmarks (1933), against 200–400 for a good set

REACH
33 million US households (1945); 65% of German households (1941)

CLANDESTINE BROADCASTING · 1940S

THE PROBLEM

How to speak to a whole country at once, in its own homes, at the moment of speaking. Print had to be carried and read; a broadcast arrived by itself.

WHAT CHANGED

Broadcasting turned communication into a one-way system: a few powerful transmitters, millions of receivers. The transmitters were licensed, chartered or owned by states. The BBC became a public corporation under Royal Charter in 1927; Germany nationalised broadcasting in 1932.[1]



O2.1 An Atwater Kent Model 40 receiver and horn loudspeaker, an American household set of the 1920s.
PHOTO: JOE HAUPT, CC BY-SA 2.0

HOW IT SPREAD

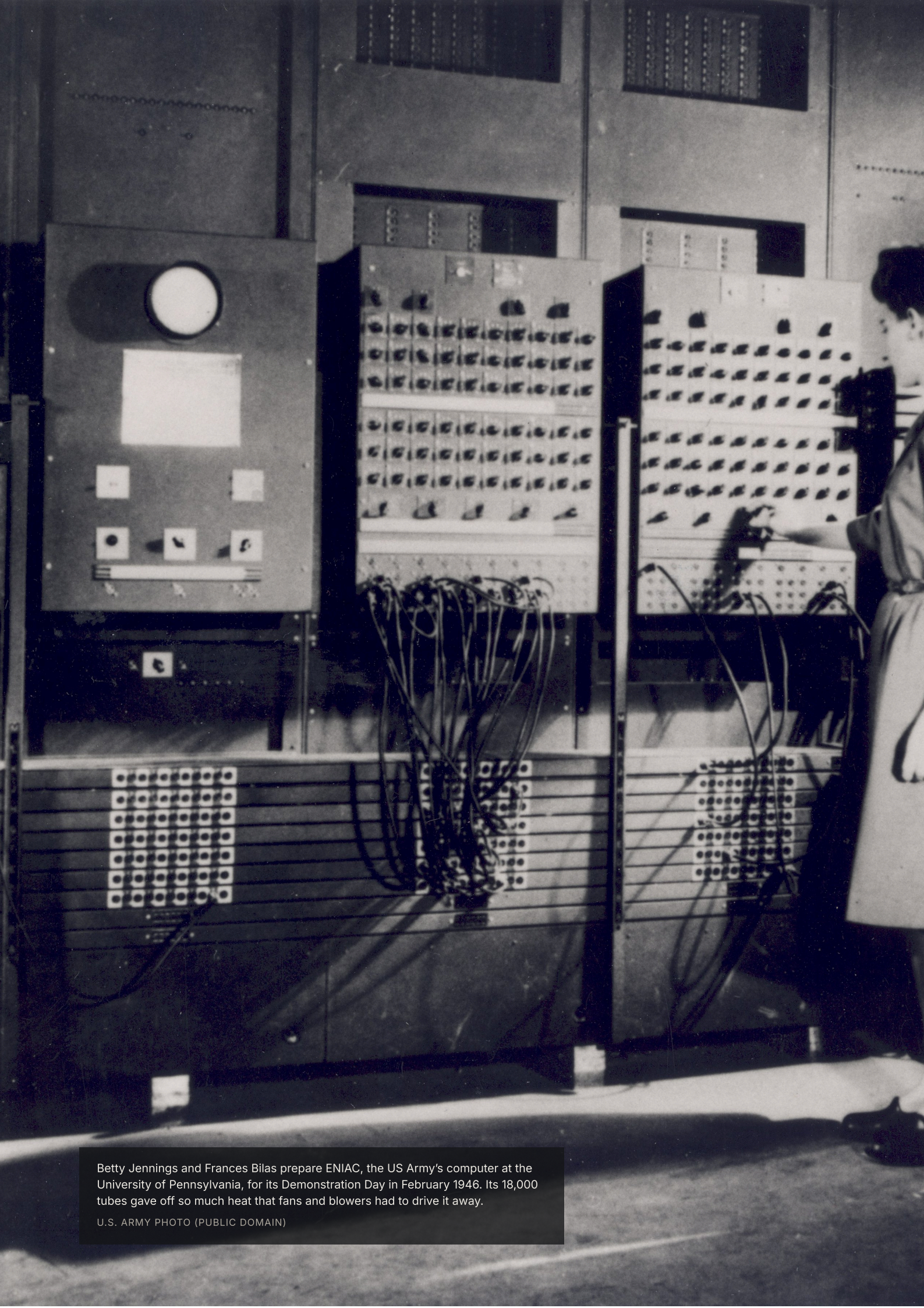
Estimated American households with a radio rose from 60,000 in 1922 to 33.1 million in 1945.[2] In Germany the cheap *Volksempfänger*, built by every firm to a single design at the Propaganda Ministry's instigation, sold for 76 Reichsmarks; the share of households with a set rose from 25 to 65 per cent between 1933 and 1941.[3]

IN POLITICAL VIOLENCE

During the Second World War the most powerful state transmitters carried messages to clandestine networks: SOE sent messages to the French resistance through the ordinary programmes of the BBC, "the most conspicuous thing SOE ever did".[4] Within a year of the war's end, an underground station in Palestine was broadcasting for itself. In July 1946 a member of Parliament read out a statement made in Palestine over the underground "Voice of Israel": "We shall use all the means at our disposal at the time we choose."[5]

WHAT NOBODY EXPECTED

The receiver went into millions of homes; the transmitter stayed with the state. The war changed that balance only a little. The device that would change it most was already being developed in a laboratory, as a replacement for the valves and switches of the telephone network.[6]



Betty Jennings and Frances Bilas prepare ENIAC, the US Army's computer at the University of Pennsylvania, for its Demonstration Day in February 1946. Its 18,000 tubes gave off so much heat that fans and blowers had to drive it away.

U.S. ARMY PHOTO (PUBLIC DOMAIN)

3

The Portable Revolution

1945–1965

In 1945 electronics meant valves, mains power and heavy batteries. Twenty years later a radio fitted in a pocket and ran for weeks on a small battery. Listening went everywhere. Speaking was still harder.



ON THE AFTERNOON OF TUESDAY 23 DECEMBER 1947, IN A laboratory of Bell Telephone Laboratories at Murray Hill, New Jersey, someone spoke into a circuit that carried the voice through a small piece of germanium with two contacts of gold pressed against it. The device was switched in and out while the others listened. "A distinct gain in speech level could be heard and seen on the scope presentation," Walter Brattain wrote in his notebook the next day, "with no noticeable change in quality."[1]

He listed some of the people who had listened: John Bardeen, his partner in the work; R. B. Gibney; G. L. Pearson; H. R. Moore, who had helped set up the circuit; William Shockley; and two senior figures of the laboratories, Harvey Fletcher and Ralph Bown. Pearson and Moore signed the page, "Read & understood", on Christmas Eve.[2] Nobody wrote down what was said into the microphone.

It had been made by hand: a film of gold laid over a small wedge, split with a razor blade and pressed onto the germanium. "In the first attempt, which was successful," Bardeen recalled in his Nobel lecture, the two contacts worked as hoped. "The point-contact transistor was born."[3] The word "transistor" did not yet exist. Inside Bell Labs the device was a "semiconductor triode", and in May 1948 a committee circulated a ballot with six possible names. The committee's memorandum explained one of them, "Transistor", as a combination of "transconductance" or "transfer" and "varistor". It won the poll.[4]

Bell told the world on 30 June 1948, in the auditorium of its headquarters on West Street in New York. Before the press saw it, Ralph Bown, the director of research, showed it to the executives of the Bell companies. Bell's journal reported him noting that it was "the first real challenge to the vacuum tube in its forty-year life". Among the things he showed was "a popular make of portable receiver whose vacuum tubes had been entirely replaced by Transistors. Reception was excellent."[5]

The *New York Times* reported it the next morning, inside its radio column, "The News of Radio", without a headline of its own and after items about traffic reports for the holiday weekend and a new sponsor for a radio programme. "A device called a transistor, which has several applications in radio where a vacuum tube ordinarily is employed, was demonstrated for the first time yesterday."[6] On the front page that day was the crisis in Berlin: "British Accept Risk of War".[7]

. . .

This chapter is about what that small piece of germanium did over the next twenty years. Its question is the one the whole book asks, put in physical terms: which capabilities that had needed large installations, mains electricity and the budget of a state or a great company began to fit in a hand, a bag or a small portable kit?

For political violence between 1945 and 1965 the answer turns out to be narrower than the legend of the transistor suggests. The new device changed listening first. A radio receiver could now go anywhere, run for weeks on a small battery and cost less every year. Transmitting, the power to be heard, became mobile too, but it stayed heavy, expensive and easy to find. And in the places where the wars of this period were fought, the set that mattered first was often not a transistor radio at all.

WHAT THE VALVE COST

To see what changed, start with what the transistor replaced.

Almost every radio, telephone amplifier and electronic calculating machine of the 1940s was built around valves, or vacuum tubes in American usage: glass envelopes with a filament that had to be heated before anything worked. M. J. Kelly, the president of Bell Labs, summed up their cost in 1958. “Cathode power for the most generally used electron tubes varies from 0.5 watt to 5.0 watts,” he wrote, and the tubes “most frequently require anode potentials of 100 volts”.[8] That power was spent before a single signal was amplified. Tubes also wore out. “The ideal transistor or diode,” Kelly added, “does not deteriorate with use as do electron tubes.”[9]

ENIAC showed what this meant at scale. Built for the US Army at the University of Pennsylvania, it used 18,000 tubes, according to the Moore School’s own report of June 1946. They generated “a considerable amount of heat”, driven off by “an elaborate system of fans and blowers”. When the machine was switched on, the heaters came on first, and only “one minute later, after the heaters have had an opportunity to warm up,” were the other supplies connected. When the machine was idle the heaters could be left on, because “it is hoped that, by cutting down the number of times that the heaters are turned on and off, tube life will be lengthened.”[10]

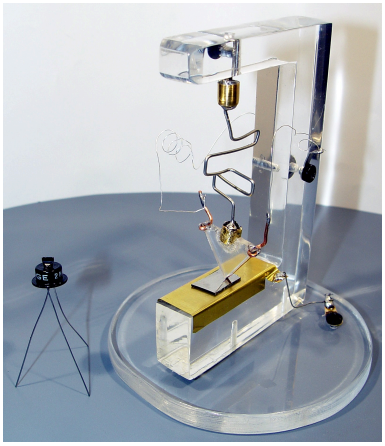


3.1 Private First Class Ragnel Lundgren of the 1st Infantry Division keeps in touch with his headquarters by handie-talkie radio in Aachen, Germany, on 15 October 1944.
U.S. ARMY SIGNAL CORPS PHOTO SC 195637 (PUBLIC DOMAIN)

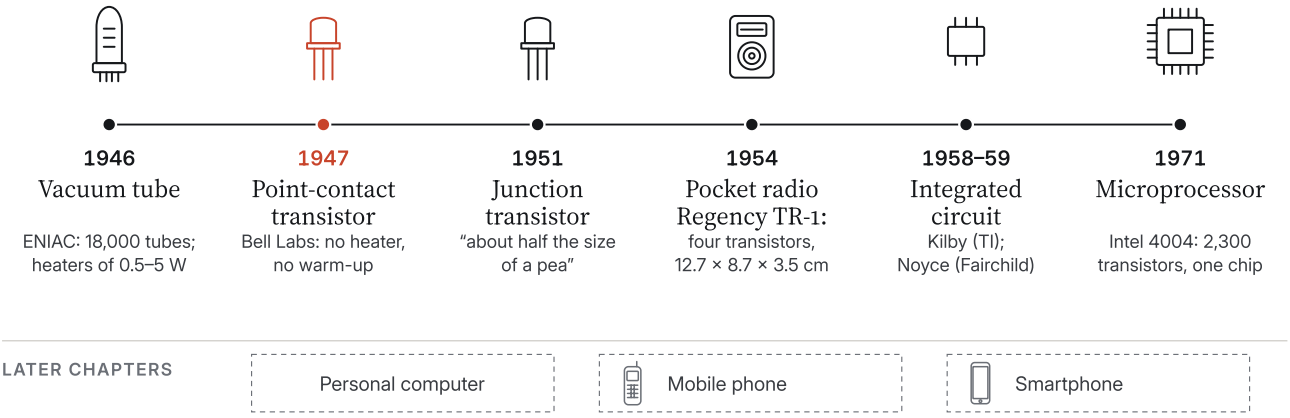
Small sets had the same problem in miniature. A portable valve set had to carry the power for its heaters with it, in batteries, and even in the most efficient valves the heater current was far greater than the weak signals a transistor could amplify.[11] A Bell engineer writing on military uses in 1958 put it in one sentence: "We are told, for example, that in World War II a certain type of communication company used more than ten tons of batteries in a single month for its communications equipment."[12] The suitcase sets used by British agents such as Noor Inayat Khan, in the previous chapter, weighed about thirty pounds.[13]

The transistor removed the heater. Bell's own house journal described the first ones as "not much larger than a shoelace tip", with "no vacuum, no glass envelope, no grid, no heated cathode". "More than a hundred Transistors can easily be held in the palm of the hand." At the June 1948 demonstration, Bown showed "that no time was required for warm-up as with vacuum tubes", and the journal reported that the power used by the device was "less than a tenth that used by an ordinary flashlight bulb".[14] Three years later, when Shockley's junction transistor was announced, Bell found an image for the old waste: amplifying a weak signal with vacuum tubes ordinarily used a full watt, "about like sending a 12-car freight train, locomotive and all, to carry a pound of butter."[15]

None of this happened at once. The first transistors were fragile and unpredictable. By 1951 Bell said it could make point-contact transistors "as uniform in performance as vacuum tubes", while two years earlier they had been "highly variable in their characteristics and of uncertain reliability".[16] Shockley had worked out the more robust junction transistor on paper in January 1948, published the theory in July 1949 and announced working devices in 1951.[17]



3.2 A replica of the first point-contact transistor of 1947 beside a 2N43 junction transistor of the 1950s.
PHOTO: MISTER RF, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS



3.3 From valve to chip. Each step on the upper line is dated by a source read for this chapter; later steps are only signposts to chapters still to come. Not to scale.

THE STATE SAW IT FIRST

The first large briefing on how to use the new device was organised with the American military.

In September 1951 Bell Labs held a five-day symposium on transistor electronics "in cooperation with the military services". Nearly 300 guests attended, more than a hundred of them from the armed services and government agencies. "The material presented was necessarily 'restricted' and consequently all participants in the sessions were either United States citizens or specifically cleared by the military services." Kelly, opening the sessions, expected "accelerated application of Transistor devices in the interests of national security".[18]

Power, voltage, size and life: the advantages were the ones Kelly listed. "Most military equipment must be movable and

often must operate while in motion," Bell's specialist on military applications wrote in 1958. "It may be carried on a man's back, in a tank, or more recently in an earth-circling satellite." From about 1951, he went on, "an increasing number of military projects have used transistors until at present there are hardly any new systems which will not use them extensively." He could not say much more. "Security regulations prevent publishing descriptions of many of these applications."[19]

So the transistor's first years repeat a pattern from the previous chapter: a capability is developed for a state's purposes, and only later reaches everyone else. This time the transfer was not by leakage or surplus but by sale. From 1951 and 1952 Western Electric, Bell's manufacturing arm, licensed the patents to other companies for a fee reported as $25,000, and taught their engineers at Bell Labs.[20] Among the licensees were Texas Instruments, of Dallas, and a small Tokyo company, Tokyo Tsushin Kogyo, later called Sony.[21]

INTO THE POCKET

The first transistor product on sale was for the ear. In 1952 the Sonotone company put a hearing aid on sale that combined one transistor with tubes; all-transistor hearing aids followed in 1953.[22] Bell's engineers had shown that their prototype transistor hearing aid ran ten times as long on its battery as a comparable valve model.[23]



3.4 A Philco portable radio of about 1946, with six vacuum tubes, for mains or batteries: what "portable" meant before the transistor.

PHOTO: JOE HAUPT, CC BY-SA 2.0, VIA WIKIMEDIA COMMONS

The radio came next. On 18 October 1954, in Dallas, Texas Instruments announced a pocket radio built with its transistors by a small Indianapolis firm, Industrial Development Engineering Associates, under the Regency name.[24] The Regency TR-1 contained four transistors, measured 12.7 by 8.7 by 3.5 centimetres and sold for $49.95. More than 100,000 were sold, though *IEEE Spectrum*, in an article by the historian Allison Marsh, notes that the set was never very profitable and that *Consumer Reports* found its reproduction of music unsatisfactory.[25]

Japanese makers followed within a year. Sony's first, the TR-55, went on sale in August 1955; in 1957 the company introduced the TR-63, at 112 by 71 by 32 millimetres smaller than the Regency.[26] Sony's own history tells how its co-founder Akio Morita, wanting to sell the TR-63 as a "pocketable" radio, "had shirts custom-made for his salesmen featuring a slightly larger pocket". It is a good story and the company's own; no document of 1957 that we have found records it.[27]

Production figures show the change better than any single model. In 1955 Japanese factories made 1.8 million radio sets. In 1960 they made 13.3 million, approaching the 16.4 million made that year in the United States, where output had grown much less.[28]

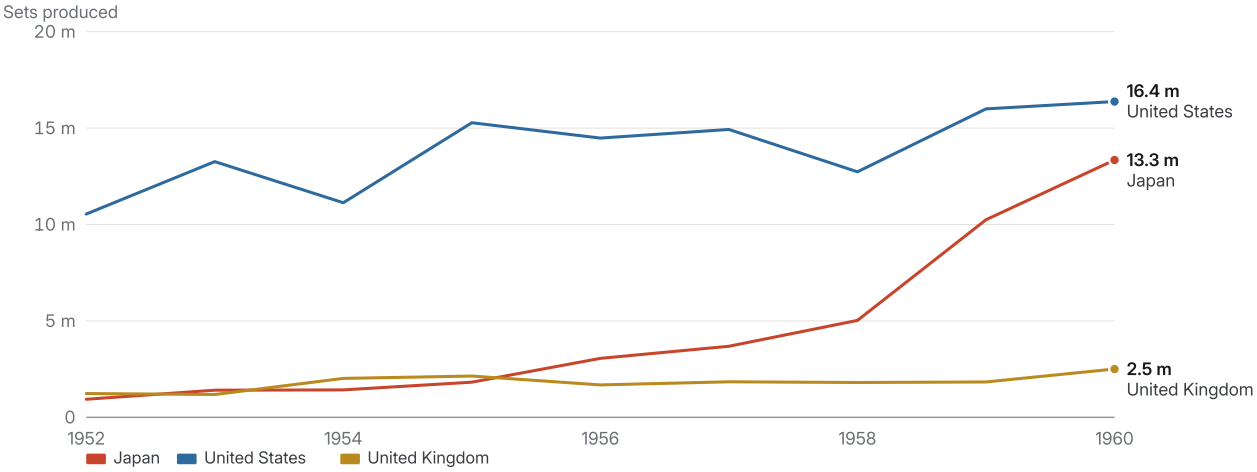


3.5 A Regency pocket transistor radio in its leather case, photographed for Tekniska museet, Stockholm, where it stood for the transistor in an exhibition of a hundred innovations.

PHOTO: ELLINOR ALGIN, TEKNISKA MUSEET (CC BY)

Japan's radio output rose from 1.8 million sets in 1955 to 13.3 million in 1960

Radio receivers produced, millions of sets a year, 1952–1960 (1960 provisional)



3.6 Complete receiving sets of all kinds, for home, car and general use, including battery sets. The figures do not separate transistor from valve sets; Japan's include sets made for export. The UN's figures for the United States differ from those of the American industry and are not combined with them here.

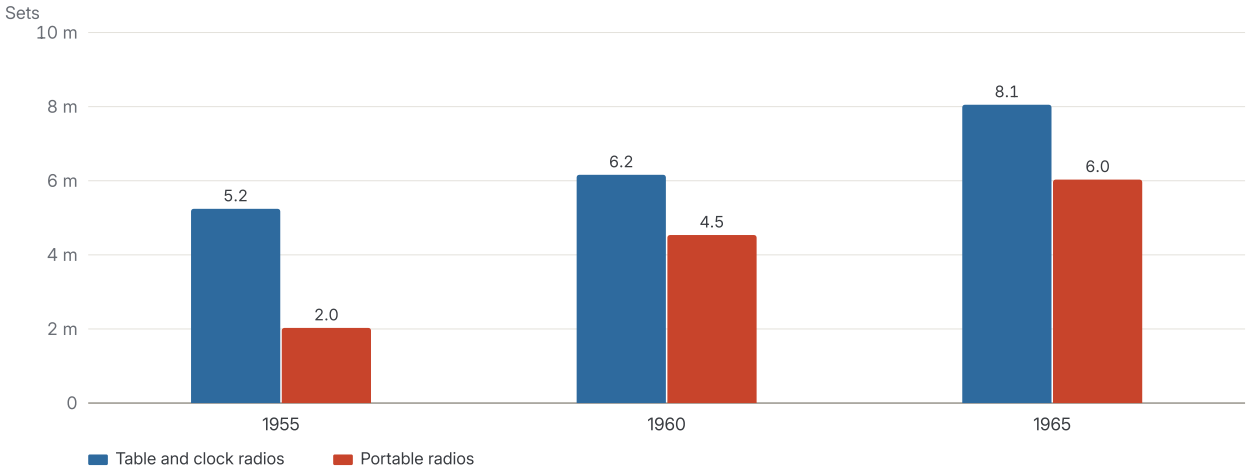
Source: United Nations, *Statistical Yearbook 1961* (1962), Table 114, p. 253; © United Nations, reproduced under the UN's terms for sales publications. Data: `data/processed/radio_production_un.csv`.

Those United Nations figures count all radios, including table sets and car radios, and do not separate transistor sets from valve sets. American trade figures do separate one thing: the portable. In 1955 American factories made 2.0 million

portable radios. In 1965 they made 6.0 million, while the retail value of all those portables was lower in 1965 than it had been in 1960.[29] The set was becoming small, common and cheap. A single transistor still cost about $10 in 1958, according to Jack Kilby, who at Texas Instruments that year is credited with building the first working circuit in which the transistors and the other components were all made of semiconductor material.[30]

American factories made 2.0 million portable radios in 1955 and 6.0 million in 1965

US manufacturers' production of home radios by type, millions of sets, 1955, 1960 and 1965 (car radios excluded)



3.7 Figures compiled by the trade journal *Merchandising Week* from associations and manufacturers; they include sets made for export. "Portable" is not the same as "transistor": the source does not say how many sets used transistors. 1950 is omitted because its portable figure appears to include clock radios (compare *Statistical Abstract 1962*, Table 1150).

Source: US Bureau of the Census, *Statistical Abstract of the United States 1967*, Table 1168, p. 776 (from *Merchandising Week*, Jan. 1967). Data: `data/processed/us_radio_sales_by_type.csv`.

A STATION THAT COULD MOVE

One of the first post-war contests over the air was fought in Palestine, and the clearest description of it comes from the British government's own evidence.

In July 1946 the Colonial Office presented to Parliament a White Paper, *Palestine: Statement of Information Relating to Acts of Violence*, to show that the Jewish Agency stood behind the armed underground. Part of its case was radio. A clandestine station, Kol Israel, which "claims to be 'the Voice of the Resistance Movement'", had broadcast between October 1945 and June 1946 about "specific acts of violence and sabotage". On 2 November 1945 it had lamented "the British, Arab and Jewish victims who fell in the attacks on the railways and

ports of Palestine."[31] The broadcasts were claims of responsibility, and the state collected them as evidence.

One sentence in the paper matters more for this book than its politics. Printing an intercepted telegram from Jerusalem that passed on an expert's assurance that there were "no grounds for anxiety from the technical point of view", the government added its own reading: the phrase "probably refers to apprehension that the station, which is a mobile one, might be located."[32] In the war, sets like Noor Inayat Khan's had carried one agent's messages to one headquarters. Now a transmitter that could be moved was speaking to a whole country, and the government that ruled it feared it could not be found.

It was written just before the worst attack of the period. On 22 July 1946 the Irgun, another underground organisation, blew up the wing of the King David Hotel in Jerusalem that housed the government's secretariat. Herbert Morrison told the Commons nine days later that 84 people, "Arabs, Jews, British", had been killed, 46 injured and 22 were still missing.[33] The Paper itself, Morrison noted, "was, of course, written before" the bombing.[34]

DISPUTED

Were the telephone warnings at the King David Hotel received in time?

The Irgun said it had telephoned warnings, and claimed windows of twenty to thirty minutes. British Army official histories, Hoffman writes, held that the warnings came "either a minute or even a second before the blast". The historian Bruce Hoffman, working from British and American archives and Israeli published accounts, concludes that calls did reach the hotel switchboard and an operator at the *Palestine Post*, probably about ten and five minutes before the explosion, but that "word was never passed" to anyone in authority in time, in a city used to hoax bomb threats. Neither side's timing, he writes, has been proven. In 2006 the British embassy protested against a commemorative plaque that described the warnings.[35]

B. Hoffman, *Small Wars & Insurgencies* 31 (2020), author's manuscript pp. 2, 9–13, citing CO 537/2290, KV 5/36, WO 261/562 and OSS reports. No British ministerial statement on the warnings was found in Hansard for July 1946 to December 1947. Begin's *The Revolt* was not read and is not quoted.

The dispute is about people, not machines. But it turns on a chain of ordinary civilian technology, a public telephone, a newspaper's switchboard, a hotel's, and on whether anyone at the end of that chain believed the voice on the line. The telephone warning would return, on a far larger scale, in later decades.

LISTENING, SUPPLIED BY THE STATE

In the decade after the war it was governments, not insurgents, that worked hardest to put cheap receivers into villages, and they did it with valves and batteries.

A minister told the Commons in 1949 that "some thousands of cheap receivers, specially designed by a British manufacturer" were being made available to African listeners in Northern Rhodesia.[36] There, "the cheap dry battery sets, now popularly known as the 'Saucepan Special'," the colony's report for that year recorded, "arrived in the Territory towards the end of September." They sold for £6 5s complete with battery, at about 425 a month, and "a number of these had been sold to Europeans."[37] In Kenya, during the Mau Mau emergency, the government abolished customs duty on sets costing 140 shillings or less. By 1954 an estimated 8,000 cheap sets had been bought by individual Africans, alongside the 1,500 supplied by the Department of Information.[38]

In Malaya the purpose was stated plainly. Colonial Development and Welfare grants of £58,639 paid for community listening receivers in rural Malaya, "to bridge the gap between Government and people and to counter subversive propaganda". Of all the sets allocated by the end of 1953, 987 ran on batteries and 59 on the mains: "Mains-operated sets cause little or no trouble; but unfortunately very few sites are electrified."[39] Two years later the main cause of breakdowns was "difficulties involved in conveying accumulators to and from charging stations. In some places the river was the only means of communication."[40]

On the other side of the war, in the jungle, messages still went on foot. In 1956 the security forces mounted an operation "to disrupt North-South courier routes and communications in the deep jungle".[41]

FIGHTING OVER THE AIR

Broadcasting across a border became a weapon of foreign policy in the same years, and the governments on the receiving end treated it as one.



3.8 Transistor radios on show at the Firato radio and television fair in Amsterdam, 31 August 1961. By then the portable set was an ordinary consumer product in Europe.
NATIONAAL ARCHIEF / ANEFO, WIM VAN ROSSEM, 912-8816 (CC0)

On 4 July 1953 Cairo Radio began a half-hour programme called the Voice of the Arabs. The historian Laura James writes that it had "strong links with Egyptian Intelligence", which had conceived the idea in the first place, and that it grew into a service broadcasting "for 18 hours each day across the Arab world".[42] By April 1956 Britain's ambassador in Cairo had protested to the Egyptian government "about offensive broadcasts by Cairo Radio".[43] In a Commons exchange in March 1956 on whether Cairo Radio should be jammed, the Foreign Secretary, Selwyn Lloyd, said that "the main governing factor in this matter is whether there is direct incitement to murder".[44]

Britain had already decided that Athens Radio crossed that line. When the EOKA campaign opened in Cyprus, in the early hours of 1 April 1955, the most serious attack of the first night, the Colonial Secretary, Alan Lennox-Boyd, reported, was on the Cyprus Broadcasting Station near Nicosia. Damage to government property that night was put at about £56,000, "most of which was to the broadcasting equipment". The station was back on the air with a limited service "less than 12 hours after the sabotage, using a low-power transmitter", and a new transmitter was flown out from Britain. On that first night EOKA spoke through paper: "Cyclostyled pamphlets by a body calling itself the National Organisation of Cyprus Struggle".[45]

Athens Radio's broadcasts to the island were monitored, transcribed and placed in the Library of the House of Commons. After more than twenty protests to the Greek government, in January 1956 Lennox-Boyd announced that Britain was prepared to take any necessary measure,

"including jamming".[46] The cost, ministers said, would be borne by the Cyprus government. By late March the jamming was in place, and ministers called it "generally effective".[47] Aneurin Bevan objected that "during the worst days of the war we never jammed the Nazis"; another member asked whether there had been "less violence since Athens radio was jammed?"[48] The answer was never established.

> ... the voice that gives the broadcast is as much an accessory to the murder as the hand that strikes the blow.
>
> ALAN LENNOX-BOYD, HOUSE OF COMMONS, 30 JANUARY 1956

Twenty months later, in the early hours of 12 December 1956, an explosion that a Northern Ireland member called an "Irish Republican Army outrage" hit the BBC's transmitting station at Londonderry. "The station building and equipment, including both transmitters, were damaged by the explosion."[49] In two islands, within two years, armed groups had chosen the state's transmitters as targets. Neither group, on the evidence read for this chapter, had a transmitter of its own worth the name.

A mountain station. In Cuba, on 24 February 1958, Fidel Castro's guerrillas began broadcasting from the Sierra Maestra as Radio Rebelde. Ernesto Guevara later recalled that at first "our only listeners were Palencho, a peasant who lived on the hill facing the station, and Fidel". By July the US State Department had noted the "anti-U.S. tone" of its broadcasts.[50] Cuba's war was an insurgency, not a terrorist campaign, but it showed what a small transmitter could give an armed group with a safe base.

A BATTERY IN THE DOUAR

Algeria shows why a technology's effect depends on where it lands.

Algeria's war of independence began in 1954. Two years later the National Liberation Front, the FLN, had its own clandestine station, the Voice of Fighting Algeria. According to a recent study by the Algerian historian Nadjat Lahdiri, it was founded on 16 December 1956 and began as a secret station "in a mobile truck containing a wireless set", transmitting from Tetouan, in Morocco; at the end of that year, the study says, the French detected it by radar at Nador, which forced it to keep moving.[51] The study rests mostly on Algerian official histories and participants' accounts, and it does not make clear exactly where the transmitter stood.

The transmitter had become mobile: it could be put on a truck and moved across a border. It had not become small. Nothing in the record read for this chapter suggests that anyone in the FLN carried a broadcasting station in a bag.

At the other end, the best-known description of what happened comes from the psychiatrist Frantz Fanon. His essay "This Is the Voice of Algeria", published in 1959, is an argument as much as a report. The historian Arthur Asseraf, as Robert Heinze reports, has questioned both its picture of colonial radio and its chronology.[52] Before 1945, he wrote, 95 per cent of the receivers in Algeria were in European hands; he gave no source.[53] At the end of 1956, when tracts announced the new station, Algerians, by his account, bought sets in large numbers.[54]

The detail that matters for this book is the kind of set. Fanon writes not of transistors but of "battery-operated receivers", which "from 1956 on, were in great demand", because the Algerian villages, the douars and mechtas, had no electric current; he describes sets bought by individuals, by families and by whole villages.[55] The word "transistor" does not appear in his chapter, in French or in English. The sentence often quoted as Fanon on the transistor ("The transistor radio has been transformed into a revolutionary implement as powerful as the gun") comes from Adolfo Gilly's introduction to the American edition of 1965, and is about Latin America.[56]

What freed the receiver from the wall in rural Algeria between 1956 and 1958, then, was the battery. The transistor would make battery sets lighter and cheaper in the years that followed, but the political effect Fanon describes did not wait for it.

TIMELINE 3

The receiver goes portable, 1945–1965

1945 VIOLENCE October–November: Kol Israel, a clandestine station the British government later called "a mobile one", broadcasts about attacks in Palestine.

1946 TECHNOLOGY June: the Moore School's report describes ENIAC, a machine of 18,000 vacuum tubes.

1946 VIOLENCE 22 July: the Irgun bombs the King David Hotel, Jerusalem. How much warning the telephone calls gave is still disputed.

1947 TECHNOLOGY 23 December: at Bell Labs, Murray Hill, a point-contact transistor amplifies a human voice.

1948 TECHNOLOGY 30 June: Bell announces the transistor and shows a portable receiver whose tubes have all been replaced.

1949 RESPONSE Late September: the first 'Saucepan Special' cheap battery sets reach Northern Rhodesia; they go on sale at the end of October.

1951 RESPONSE 17–21 September: a restricted transistor symposium for the US armed services at Murray Hill.

1953 RESPONSE 4 July: Cairo Radio's Voice of the Arabs goes on the air. Malaya buys community receivers, 987 of them for batteries.

1954 TECHNOLOGY 18 October: Texas Instruments announces the Regency TR-1 pocket radio, with four transistors.

1955 VIOLENCE 1 April: EOKA's campaign in Cyprus opens; the Cyprus Broadcasting Station is badly damaged.

1956 RESPONSE March: Britain jams Athens Radio's broadcasts to Cyprus.

1956 VIOLENCE 12 December: the BBC transmitting station at Londonderry is damaged. 16 December: the FLN's Voice of Fighting Algeria begins, from a truck in Morocco.

1958 TECHNOLOGY 12 September: Jack Kilby completes his first integrated circuits at Texas Instruments.

1960 TECHNOLOGY Japan makes 13.3 million radio sets in a year, up from 1.8 million in 1955.

1964 RESPONSE 17 July: the UN force in Cyprus is told that "transistorized and other batteries" are strategic materials Turkish Cypriots may not buy without authorisation.

1965 TECHNOLOGY American factories make 6.0 million portable radios.

Sources: Cmd. 6873 (1946); Moore School, *A Report on the ENIAC* (1946); FRUS 1946; B. Hoffman (2020); W. Brattain, notebook, 24 Dec. 1947; *Bell Laboratories Record* (1948, 1951, 1958); Northern Rhodesia, *Annual Report 1949*; L. James (2006); Federation of Malaya, *Annual Report 1953*; ETHW; Smithsonian NMAH; Hansard (1955–56); N. Lahdiri (2026); J. Kilby, Nobel Lecture (2000); UN, *Statistical Yearbook 1961*; UN S/5950 (1964); US Census, *Statistical Abstract 1967*.

The French response that is documented is jamming. "The programs were then systematically jammed," Fanon wrote, "and the Voice of Fighting Algeria soon became inaudible."[57] Lahdiri lists jamming stations, broadcasts in Arabic aimed at the same audience, and air attacks on the transmitter.[58] Fanon, for his part, reported that FLN time bombs had

damaged the technical installations of Radio-Alger, the official station, and that its broadcasts "were soon resumed".[59] Both sides, by these accounts, treated a transmitter as a target. Each account rests on one side's sources.

UNRESOLVED

Did the French authorities ban the sale of battery radios in Algeria?

Fanon wrote that after "a few months of hesitancy" the sale of radios was prohibited "except on presentation of a voucher issued by the military security or police services", that the sale of battery sets "was absolutely prohibited", and that spare batteries "were practically withdrawn from the market".[60] Lahdiri's study repeats the permit rule.[61] Neither cites an order, and no decree, prefectoral order or military instruction to this effect was found in the sources available for this book. The measure is plausible and may well have been local or military. Until a text is found, it is Fanon's account.

F. Fanon, *A Dying Colonialism* (1965), pp. 84–85; N. Lahdiri (2026), p. 166. French archives (ANOM, SHD series 1H) not consulted.

PLAUSIBLE INTERPRETATION

Listening as a political act

Fanon's most quoted claim is that when the jamming won, a listener would "sometimes leave the needle on a jammed wave-length or one that simply produced static, and would announce that the voice of the combatants was here."[62] He gives no place, date or witness, and on the page before he concedes that "claiming to have heard the Voice of Algeria was, in a certain sense, distorting the truth".[63] In our reading the scene is best taken as Fanon's interpretation of what listening meant, not as a documented practice. No second source read for this book confirms it.

F. Fanon, *A Dying Colonialism* (1965), pp. 87–88; R. Heinze, *African Studies Review* (2023), pp. 531–532.

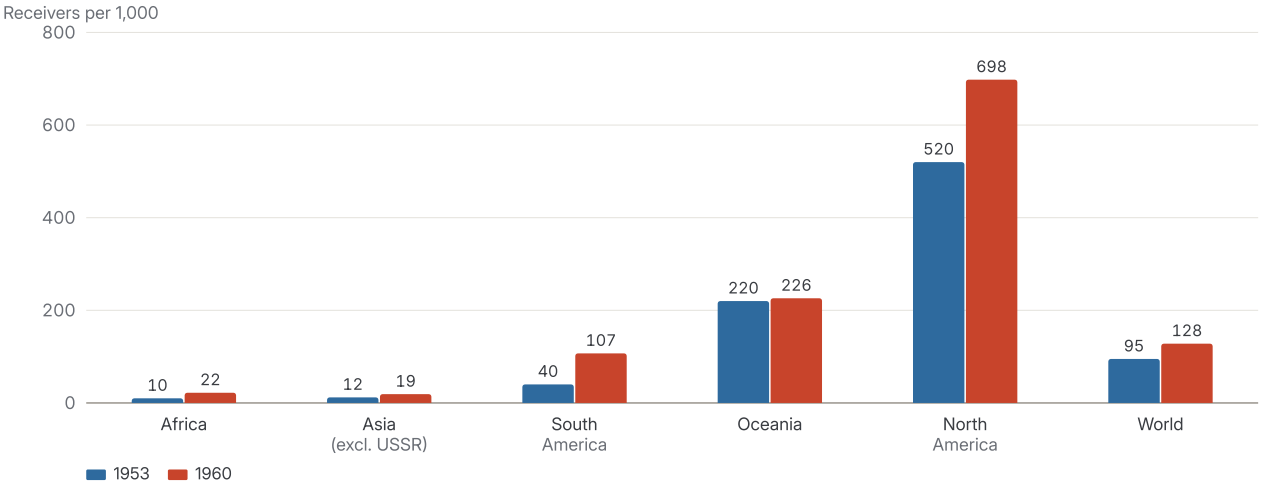
WHAT STILL HAD TO BE CARRIED

By 1960 there were, on UNESCO's estimates, 128 radio receivers for every 1,000 people in the world. In North America there were 698. In Africa there were 22, and in Asia outside the Soviet Union 19.[64] Averages for a continent hide a great deal, but they fit the scenes Fanon describes: peasants in Kabylia listening to Cairo's Voice of the Arabs "in groups of scores and sometimes hundreds around a receiver", or only the operator, "his ear glued to the receiver", able to hear at all.[65] A pocket radio was a mass product in the United States and Japan. In the countries where the wars of decolonisation

were fought, a receiver was still something a village or a family shared.

In 1960 Africa had 22 radio receivers for every 1,000 people; North America had 698

Radio receivers in use per 1,000 inhabitants, UNESCO estimates, by continent, 1953 and 1960



3.9 UNESCO's continental estimates of receivers in use, including loudspeakers on wired relay systems. Europe is omitted because the 1953 estimate excludes the USSR and the 1960 estimate includes it. National figures behind the estimates are often counts of licences, which understate the number of sets.

Sources: United Nations, *Statistical Yearbook 1953*, note to Table 182; *Statistical Yearbook 1961*, note to Table 185, p. 647 (UNESCO estimates); © United Nations, reproduced under the UN's terms for sales publications. Data: `data/processed/radio_receivers_un_continents.csv`.

In Cyprus in 1964, during the fighting between the island's Greek and Turkish communities, the government informed the United Nations force on 17 July that some twenty-five articles were now "strategic materials", which Turkish Cypriots could not buy without special authorisation. The list included "transistorized and other batteries". A revised list of 7 October named "Radio sets" and "Accumulators". President Makarios argued that batteries "can be used for military purposes" and had been used by Turkish armed groups, among other things, "for the maintenance of illegal portable radio telegraphy transmitters". The UN force recommended that batteries be taken off the list.[66] Twenty years after the war, the small battery made for a transistor set had become a strategic good.

Measured by the book's four questions, the twenty years after the war changed reach most. A movement without a state could now speak across a border, from a truck or from a friendly government's studio, to people who could listen almost anywhere. Labour changed little: the work of carrying messages inside a clandestine organisation was still done by couriers, and the work of broadcasting by a few technicians

with heavy equipment. Force, for small groups, barely changed.

The device's longer consequences were only beginning. In September 1958 Kilby built the first of his "solid circuits"; in July 1959 Robert Noyce, at Fairchild Semiconductor, applied for a patent on the planar integrated circuit, with working chips following in 1960.[67] In 1971 Intel put 2,300 transistors and a computer's central processor on a single chip.[68] The personal computer, the mobile telephone and the smartphone belong to later chapters. All of them are descended from the afternoon at Murray Hill when a voice passed through a piece of germanium and came out louder.

OBJECT 3 · 1947

The Transistor



PHOTO: NISSE CRONESTRAND, TEKNISKA MUSEET (CC BY)

FIRST SHOWN WORKING

Murray Hill, N.J., 23 Dec. 1947

REPLACED

A valve heater using 0.5–5 W before any signal

FIRST TRANSISTOR POCKET RADIO ON SALE

Regency TR-1, 1954: four transistors, $49.95

IN ONE PHONE CHIP

11.8 billion (Apple A14, 2020)

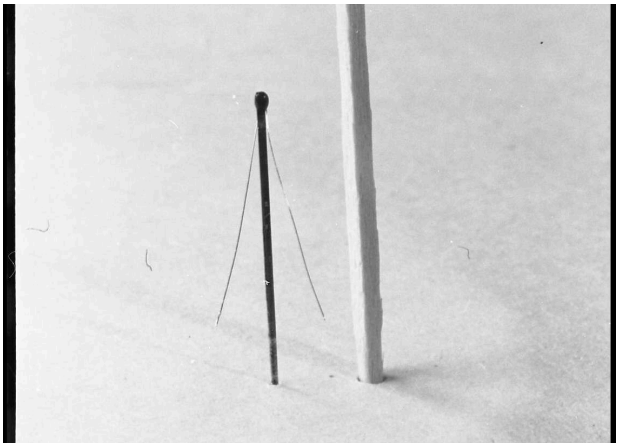
STRATEGIC MATERIAL · CYPRUS 1964

THE PROBLEM

Almost every amplifier of the 1940s was a valve, a glass tube with a filament that had to be heated before it worked. Kelly of Bell Labs put the heater power of common tubes at half a watt to five watts each.[1] A radio needed a wall socket or heavy batteries. ENIAC needed 18,000 tubes and fans to carry off their heat.[2]

WHAT CHANGED

A piece of germanium with metal contacts amplified a voice with nothing heated at all. Bell's journal said in 1948 that the device needed no warm-up and used less than a tenth of the power of a flashlight bulb. "More than a hundred Transistors can easily be held in the palm of the hand."[3]



O3.1 A transistor and a match at the Intermetall works in Freiburg, Germany, 4 April 1963. Photograph by Willy Pragher.
LANDESARCHIV BADEN-WÜRTTEMBERG, STAATSARCHIV FREIBURG W 134 NR. 072273B / WILLY PRAGHER (CC BY 4.0)

CIVIL USES

The telephone network, for which Bell Labs worked. Hearing aids: a Bell prototype ran ten times longer on its battery than a comparable valve model. More than 100,000 amplified telephones by 1958, most for people hard of hearing. And the pocket radio.[7]

HOW IT SPREAD

Bell briefed the armed services first, at a restricted symposium in 1951, then licensed the patents to other firms.[4] Hearing aids came in 1952–53, the Regency pocket radio in 1954, Sony's first set in 1955.[5] In 1958 one transistor still cost about $10.[6]

IN POLITICAL VIOLENCE

For armed groups the transistor's first effect was on listening, not on weapons. It made the receiver portable, and so it made the battery a political object. In Algeria in the late 1950s, Fanon reported, the French restricted the sale of battery sets.[8] In Cyprus in July 1964 the government put "transistorized and other batteries" on a list of strategic materials that Turkish Cypriots could not buy without permission.[9]

WHAT NOBODY EXPECTED

In 1936, Shockley recalled, M. J. Kelly of Bell Labs had told him of "his ideal of doing all telephone switching electronically instead of with metal contacts".[10] When Bell's journal wrote in 1948 that a hundred transistors would fit in a palm, it meant a hundred separate objects. In 2020 Apple said its A14 chip, used that year in the iPhone 12 Pro, held 11.8 billion of them.[11] Held in the same palm, that one object is a camera, a radio, a map, a printing press and a computer at once. None of these was on the list at Murray Hill in 1947.



Passengers walk across the apron at Zürich-Kloten to board a Swissair DC-8 jet, 8 September 1965. No checkpoint is visible between the terminal and the aircraft.

WERNER FRIEDLI, ETH-BIBLIOTHEK ZÜRICH, BILDARCHIV / STIFTUNG LUFTBILD SCHWEIZ / LBS_H1-026284 (CC BY-SA 4.0)

4

Terrorism Takes Flight

1960–1975

The jet airliner moved a hundred people across several borders in a matter of hours. For a few years it could also be taken, with everyone aboard, by one person who walked on with the other passengers.



ON 9 AUGUST 1961 A PAN AMERICAN DC-8, ONE OF THE new jet airliners, left Mexico City for Guatemala City with 72 passengers and a crew of seven. It was an American aircraft, registered in the United States, flying between two other countries. On the way it was seized by a gunman later identified as Albert Charles Cadon, a Frenchman, and flown to Havana. Cadon stayed in Cuba; the aircraft and its passengers were sent back the same day.[1]

Cadon was deported to Mexico. A Mexican court convicted him of robbery and illegal possession of firearms and sentenced him to eight years and nine months. In the Federal Aviation Administration's chronology of hijackings his entry ends with four words: "Fugitive from U.S. charges."[2]

In a single day one man had involved four states: the country that registered the aircraft, the two between which it was flying, and the one where it landed.

Six days earlier, a Continental Airlines Boeing 707 flying from Phoenix to El Paso with 67 passengers and six crew had been the target of an attempt to take it to Cuba. Federal agents and border patrol officers, the State Department's historians later recorded, captured the would-be hijacker "on the ground at El Paso, Texas, before he could force the pilot to fly a Continental Airlines 707 jet to Havana."[3] On 5 September 1961 the President signed a law that created a new federal crime, "aircraft piracy", punishable "by death if the verdict of the jury shall so recommend" or by at least twenty years in prison.[4]

The word chosen by Congress was old. The thing it described was not. This chapter is about what changed when a machine that carried a hundred strangers across borders at nearly five hundred miles an hour became, for a few years, something that one of them could take over, and what that machine did to the reach of political violence before television had finished doing the same to its audience.

A HUNDRED STRANGERS AT FIVE HUNDRED MILES AN HOUR

The jet airliner arrived in the United States in 1958. Its prototype, Boeing's Dash 80, had first flown four years earlier. At Pan American's insistence the production 707 was made four inches wider than the prototype "so that it could carry 160 passengers six-abreast." Pan American opened American international jet service in October 1958; flights between New York and San Francisco soon took "only 5 hours - 3 hours less than by the piston-engine DC-7."[5] According to ICAO's own news service, two British Comet 4 airliners had begun the

first scheduled transatlantic jet service earlier the same month, on 4 October 1958.[6]



4.1 A South African Airways Boeing 707 at Zürich-Kloten, 1 June 1967. The 707 was the aircraft of the hijacking years.

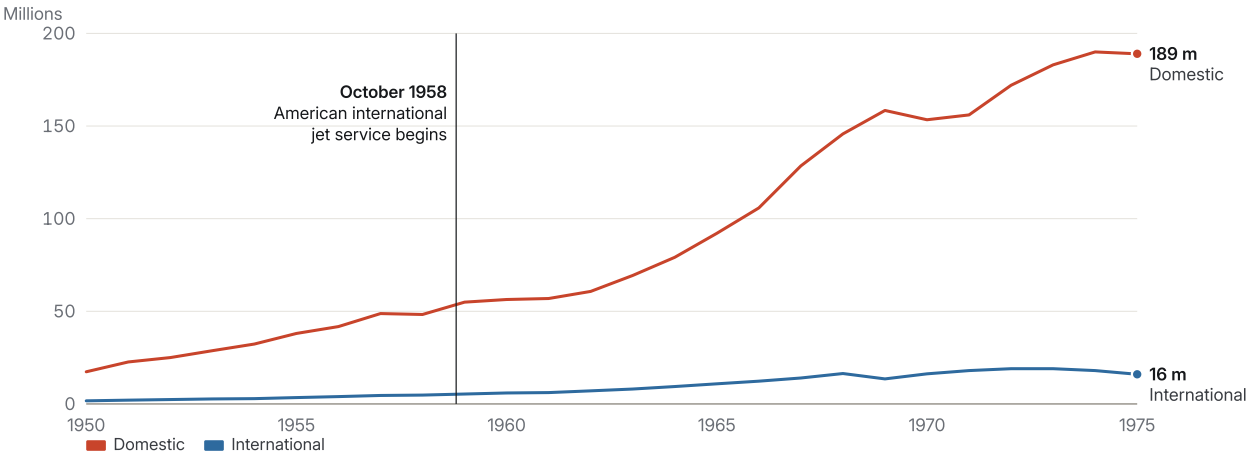
WERNER FRIEDLI, ETH-BIBLIOTHEK ZÜRICH, BILDARCHIV / STIFTUNG LUFTBILD SCHWEIZ / LBS_H1-026905 (CC BY-SA 4.0)

American airline statistics show what the new aircraft did to an ordinary journey. Between 1950 and 1975 the average speed of a domestic flight rose from 180 to 403 miles an hour, and of an international flight from 218 to 482. The average international aircraft offered 41 seats in 1950 and 225 in 1975. Consumption of aviation gasoline, the fuel of piston engines, fell from 1,195 million gallons in 1955 to 6 million in 1975.[7]

More people flew, and much further. American airlines carried 19 million passengers in 1950 and 205 million in 1975.[8] For the countries that belonged to ICAO, which excluded the Soviet Union and mainland China, scheduled airlines flew 21 billion passenger-kilometres in 1948 and some 97 billion in 1959.[9]

American airlines carried 17 million domestic passengers in 1950 and 189 million in 1975

Revenue passengers of US scheduled air carriers, millions, domestic and international services, 1950–1975



4.2 Scheduled services only. Passengers carried on more than one route of the same airline are counted once; those changing airlines are counted again. "International" includes flights to American overseas possessions, and to Hawaii and Alaska in earlier years; the boundary between the two series shifts slightly in the 1960s and 1970s. Values for 1950–1970 are given to the nearest thousand in *Historical Statistics*; those for 1971–1975 are printed in millions in the *Statistical Abstract*.

Sources: US Bureau of the Census, *Historical Statistics of the United States* (1975), series Q 584, pp. 769–770 (1950–1970); *Statistical Abstract of the United States* 1973, Table 941; 1976, Table 1031; 1977, Table 1102 (1971–1975). Data: `data/processed/us_air_passengers_chart.csv`; derivation `scripts/derive/ch04_series.py`.

The legal frame of all this had been set during the war. Under the Chicago Convention of 1944, every state had "complete and exclusive sovereignty over the airspace above its territory", and "Aircraft have the nationality of the State in which they are registered."[10] An airliner was therefore a small piece of one country moving through the sky of others, carrying citizens of many more.

THE OPEN GATE

Until 1969 airline passengers were not screened at all, and until January 1973 no rule required that every passenger be screened.[11]

In February 1969 the acting head of the FAA, David Thomas, explained the difficulty to a committee of the House of Representatives. "Hijacking presents us with our most frustrating safety problem," he said. Several measures had been tried since the first hijacking of an American airliner in 1961, and "Obviously, these steps have not been very effective." Screening every passenger was not yet practical: "you visit the airport now and there is a mass of people rushing toward

the gates." The detection methods his agency was studying were not "ready to be used in day-to-day airline operations".[12] The armed guards who flew on some flights were "a very small force, indeed. They do ride at random."[13]



4.3 Passengers wait in the new departure hall at Amsterdam's Schiphol airport on its opening day, 8 May 1967.
NATIONAAL ARCHIEF / ANEFO, RON KROON, 920-3094 (CC0)

Nor was it clear whose job it was. The head of the Justice Department's Criminal Division told the same committee that he did not think the FBI had "assumed the responsibility for screening passengers or anything like that."[14] There had been, the FAA admitted, "a reluctance to go in to search".[15]

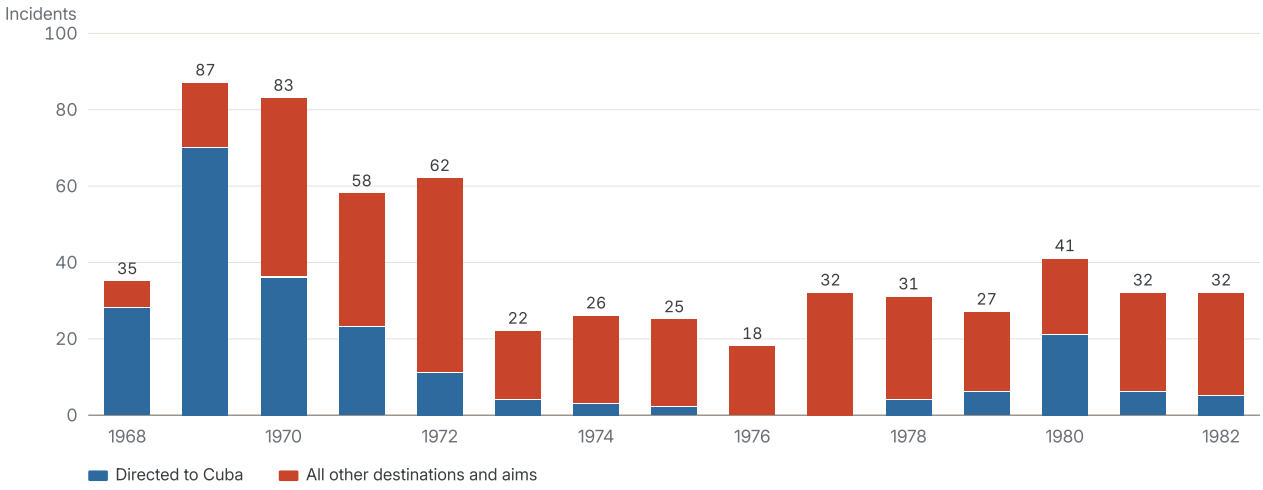
A FLIGHT TO HAVANA

Most of the hijackings that followed were not, as far as officials could tell, the work of political organisations.

Between 1968 and 1972 the FAA recorded 147 hijackings and attempted hijackings of American-registered aircraft. Ninety-two of them were attempts to reach Cuba. In 1969 alone there were 40, and 37 were attempts to reach Cuba.[16] Worldwide, counting aircraft of every registry, four hijackings in five in 1968 and 1969 were attempts to reach Cuba.[17]

In 1968 and 1969 four hijackings in five were attempts to reach Cuba; in the 1970s most were not

Hijackings and attempted hijackings of civil aircraft worldwide (all registries, air carrier and general aviation), per year, 1968–1982



4.4 The FAA counted the hijackings and attempts it recorded, successful or not, by the aircraft's country of registry. "Directed to Cuba" is the FAA's own sub-count of attempts with Cuba as the destination; the other bars are the remainder. The count records no motives: "all other" includes political, criminal and personal cases. Cuba-bound attempts rose again in 1980.

Source: Federal Aviation Administration, *Aircraft Hijackings and Other Criminal Acts Against Civil Aviation*, updated to 1 January 1983 (NCJRS 91941), Section E, "U.S. and Foreign Registered Aircraft Hijackings: Summarization", PDF p. 245 (page image). Data: `data/processed/hijackings_worldwide_cuba_other.csv`.

Who were these hijackers? The FAA's tables record destinations, not motives. American intelligence analysts, writing in December 1968, thought that "most of the perpetrators can be classified as mentally ill, criminal types, or simply homesick Cubans," with "a few" carried out by Puerto Rican nationalists and black militants.[18] The acting FAA chief described them in 1969 as fugitives, malcontents and people with personality disorders.[19] These were officials' impressions, not counts. No source read for this book classifies the Cuban hijackings of these years by motive.

The aircraft made these flights possible; the law made them hard to punish. The United States had an extradition treaty with Cuba, but, a State Department official told Congress, "Not for hijacking. I don't believe we have ever used it at all."[20] The Tokyo Convention of 1963 gave jurisdiction over offences on board to the state where an aircraft was registered and obliged the state where a seized aircraft landed to return it and let its passengers go on their way. It did not oblige any state to hand the hijacker back: "nothing in this

Convention shall be deemed to create an obligation to grant extradition."[21] It came into force only on 4 December 1969.[22]

DISPUTED

When did Cuba begin to punish hijackers, and when did it agree to return them?

A widely used statistical study of hijacking dates Cuba's law making hijacking a crime to October 1970, and a US-Cuban agreement to 3 February 1973, "Swedish-brokered".[23] American diplomatic records describe a Cuban law of 16 September 1969 (Law 1226) providing for hijackers to be prosecuted, or returned under reciprocal bilateral agreements.[24] The agreement itself, an exchange of notes through the Swiss and Czechoslovak embassies, is dated 15 February 1973 and came into force that day.[25] This book uses the treaty's date.

UNTS vol. 916, no. 13067; FRUS 1969–1976, vol. E-1; L. Dugan, G. LaFree and A. Piquero, *Criminology* 43 (2005).

A NEW KIND OF HOSTAGE

On the night of 22 to 23 July 1968 three Palestinian gunmen took over an El Al Boeing 707 flying from Rome to Lydda, with 38 passengers and 10 crew, and had it flown to Algiers. The Popular Front for the Liberation of Palestine, the PFLP, claimed the act in a statement issued in Beirut.[26] Algeria let most of the non-Israeli passengers leave. Twelve Israeli men, crew and passengers, were still held at the end of July.[27]

The aircraft was no longer a way of getting somewhere. It, and the people in it, had become the object of a bargain. Israel's chargé d'affaires in Washington, as the State Department recorded him, called it a "new dimension of trouble for Near East", and the department told its embassies to warn their host governments that the hijacking, "if not quickly redressed, might stimulate competitive hijacking attempts which could have disastrous impact on international civil aviation in Near East."[28] The historian Dan Porat describes it as the first case in which a plane was hijacked "not as a means of transportation but as an instigation of terror aimed at garnering public attention and causing a prisoner release".[29]

DISPUTED

An exchange of prisoners, or a gesture?

The aircraft and its remaining crew and passengers were released on 31 August or 1 September 1968 (the reports differ), after mediation through Italy.[30] Israel then announced that it would release sixteen Arab prisoners, all arrested before the war of June 1967, as a "humanitarian gesture". The same formula, "not as a quid pro quo but as a humanitarian gesture", had been put forward by Algeria's chargé d'affaires in Geneva in early August. Porat calls it an exchange.[31] Both descriptions are given here because both were used at the time and since.

FRUS 1964–1968, vol. XX, docs 223, 228; Jewish Telegraphic Agency, July–September 1968; D. Porat, *The Historical Journal* 67 (2024).

By early 1969, El Al carried armed security guards on its flights.[32]



4.5 An FAA notice at an airport check-in counter, 9 October 1969: hijacking was now a federal crime punishable by death.

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DAWSON'S FIELD

The bargaining space reached its largest size in September 1970.

On 6 September the PFLP seized three airliners bound for New York: a TWA Boeing 707 from Frankfurt, a Swissair DC-8 from Zurich and a Pan American Boeing 747 from Amsterdam. An attempt on a fourth, an El Al 707, failed: one hijacker was killed and his companion, Leila Khaled, was overpowered and detained when the aircraft landed in London. The TWA and Swissair aircraft were flown to a desert airstrip about 25 miles east of Zarqa in Jordan, which American records call Dawson Field. The 747 went to Beirut and then Cairo, where it was blown up after the 170 people aboard had been taken off. On 9 September a BOAC VC-10 was seized after a stop in the Gulf and flown, by way of Beirut, to the same airstrip.[33]

About three hundred passengers and crew were held, most of them on the airstrip and the rest in a hotel in Amman. Their governments, the United States, Britain, West Germany and Switzerland, joined later by Israel, coordinated through what White House memoranda called the Bern group, with the International Committee of the Red Cross as go-between. The hijackers demanded the release of prisoners held in Switzerland, West Germany, Britain and Israel.[34] On 9 September the United Nations Security Council, without a vote, appealed "for the immediate release of all passengers and crews without exception".[35]



Lambert azimuthal equal-area projection, centred 38°N 0°E. Present-day country boundaries (Natural Earth 1:50m, public domain).
Airport positions: GeoNames (geonames.org), CC BY 4.0. Routes: FAA, Aircraft Hijackings (1983), Section D; FRUS 1969–76, vols E-1 and XXIV.

4.6 The aircraft seized on 6 and 9 September 1970. Lines join the points of departure and landing recorded in the FAA chronology; they are not flight paths. The airstrip's position is approximate: an American report of 6 September put it about 25 miles east of Zarqa. The TWA, Swissair, Pan American and El Al flights were bound for New York.

On 12 September the three empty aircraft at Dawson's Field were blown up. Henry Kissinger reported to President Nixon that "all of the passengers were off the hijacked aircraft when they were blown up and that none were apparently injured by the explosions."[36] Several dozen people were held for two more weeks. By the end of September all had been released, Britain, West Germany and Switzerland had agreed to release seven prisoners, and Israel had agreed to release others.[37]

DISPUTED

How many people were held, and how many after 12 September?

The records do not agree. An American telegram of 6 September and a State Department situation report of 7 September give 142 and then 145 passengers on the TWA aircraft, and 150 and then 155 on the Swissair. After the aircraft were destroyed, the number still held was put at 40 by the PFLP, at "some 50-60" in a White House memorandum the next day, and at "between 39 and 54" by a news agency that called the reports "confused and contradictory". A telegram of 30 September relayed the hijackers' own figure of 56 hostages released.[38] This book gives approximate figures only.

FRUS 1969–1976, vols E-1 and XXIV; Jewish Telegraphic Agency, 14 Sept. 1970.

The journalist Gerald Seymour, interviewed for an American television documentary in 2006, remembered "all the television crews, all the newspapermen who had to file".[39] What audiences saw, and how quickly, belongs to the next chapter. In this one what matters is the machine: in four days a small organisation had moved several hundred citizens of half a dozen countries to a place of its choosing, and made five governments negotiate over them in public.

On 11 September Nixon announced that armed federal officers would fly on American airliners and that "electronic surveillance equipment and other surveillance techniques" would be extended to "all gateway airports and other appropriate airports" in the United States and, where possible, abroad. "The menace of air piracy," he began, "must be met—immediately and effectively."[40]

THE LAW FOLLOWS THE AIRCRAFT

September's hijackings hurried a legal process that had begun two years earlier, when the assembly of the International Civil Aviation Organization (ICAO) set a study in motion.[41]

The Hague Convention, signed on 16 December 1970, made it an offence to seize an aircraft "in flight", which it defined by the doors: from the moment they closed after boarding to the moment one opened again. It gave jurisdiction not only to the state of registration but to the state where the aircraft landed with the hijacker still aboard, and it closed the gap left by Tokyo, which had created no obligation to extradite.[42] A state holding a hijacker had to extradite him or, "without exception whatsoever", submit the case for prosecution.[43] The 77 states

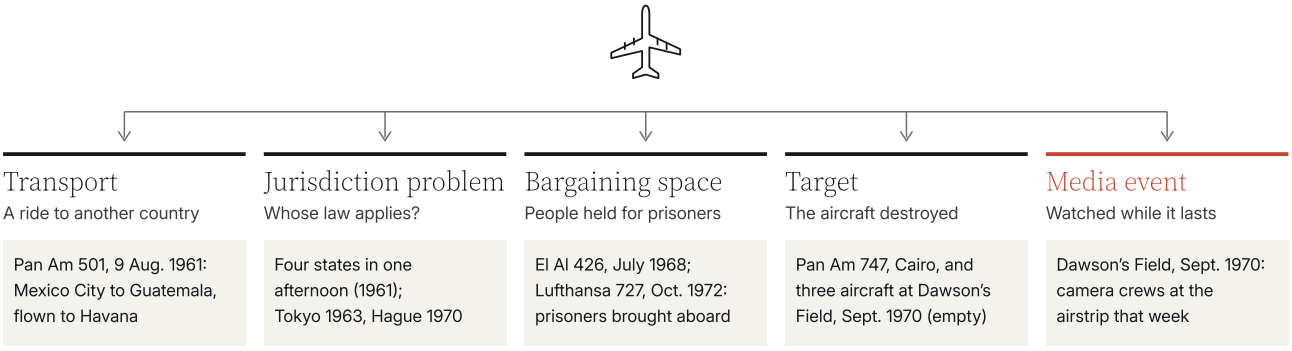
at the conference adopted it with no vote against and two abstentions.[44] The Montreal Convention of 1971 extended protection to aircraft "in service" on the ground and to air navigation facilities.[45]

In November 1970 the United Nations General Assembly condemned "without exception whatsoever, all acts of aerial hijacking" and declared that "the exploitation of unlawful seizure of aircraft for the purpose of taking hostages is to be condemned".[46] Neither the Tokyo nor the Hague text, nor the Assembly's resolution of 1969, used the word hostage.[47]



4.7 Queen Juliana receives the chairmen of delegations to the diplomatic conference on air piracy in The Hague, 7 December 1970. The conference produced the Hague Convention nine days later.

NATIONAAL ARCHIEF / ANEFO, ROB MIEREMET, 924-0744 (CC0)



The same machine in every column. What changed was who was aboard, who was watching, and what could be demanded.

4.8 What a hijacked airliner became between 1961 and 1972. The aircraft was the same machine in each role; what changed was who was watching it and what they could demand. Each role is illustrated by a case in this chapter.

SCREENING

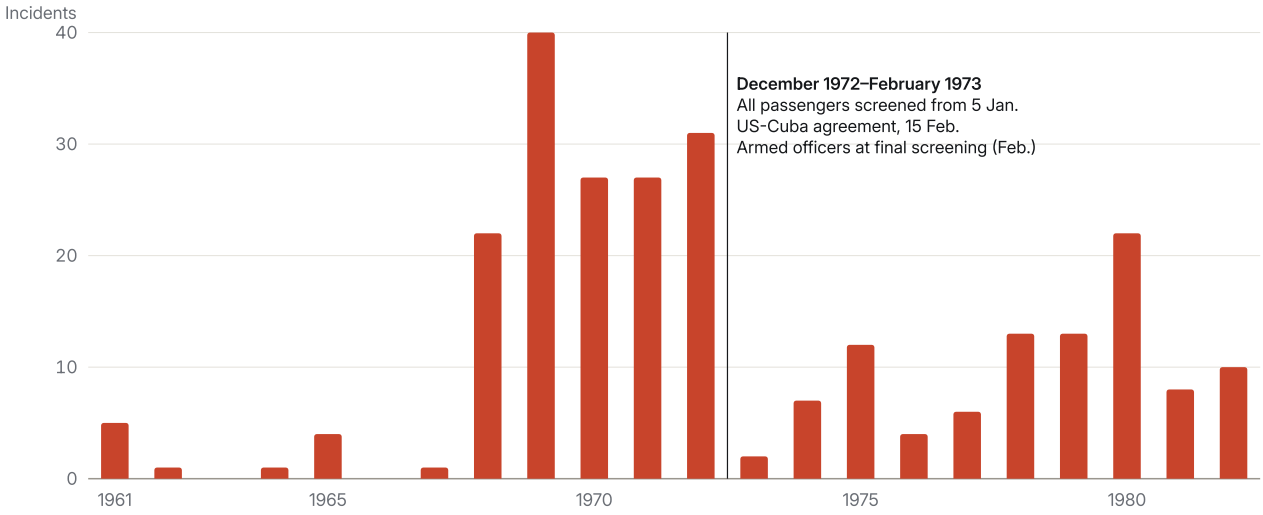
The American response came in stages, and the decisive one was administrative.

On 31 January 1972 the FAA gave the airlines until 6 February to put into use a passenger screening system acceptable to it.[48] Under these systems, except on some shuttle flights from July 1972, only passengers who matched a behavioural profile were checked, about one in a hundred by the FAA's own later account.[49] Then, in the autumn of 1972, came two violent hijackings to Cuba, twelve days apart. In the second, three men took a Southern Airways DC-9, demanded a ransom and shot and wounded the copilot before the aircraft landed in Havana.[50] The measures that followed, wrote the Transportation Department official responsible, "had been in

the planning stage so that we were ready when the occasion demanded." On 5 December 1972 the FAA ordered the airlines to amend their security programmes, and "Since January 5, 1973," he wrote, "air carriers have been required to electronically screen all enplaning passengers as a condition to boarding or reboarding."[51] A second rule required an armed law-enforcement officer at the final screening point by 6 February; after a court challenge by the airports it took effect, by the same official's account, on 16 February.[52] On 15 February the agreement with Cuba was signed.[53]

Hijackings of American aircraft: one in 1964, forty in 1969, two in 1973

Hijackings and attempted hijackings of US-registered aircraft (air carrier and general aviation), per year, 1961–1982



4.9 Counts include successful, unsuccessful and incomplete attempts, on airliners and private aircraft. The fall after 1972 coincides with several measures introduced within six weeks of each other; their separate effects cannot be distinguished (see the text).

Source: Federal Aviation Administration, *Aircraft Hijackings and Other Criminal Acts Against Civil Aviation*, updated to 1 January 1983 (NCJRS 91941), table "U.S. Registered Aircraft Hijacking Statistics 1961 to Present", p. 52. Dates of measures: B. O. Davis Jr. (1973); 37 Fed. Reg. 25934 (1972); UNTS vol. 916, no. 13067. Data: `data/processed/hijackings_faa_us.csv`.

The fall was immediate. American-registered aircraft were the object of 31 hijackings or attempts in 1972 and two in 1973.[54] In 1974, the FAA reported, 200.7 million passengers were screened at American airports.[55] The Air Transportation Security Act of August 1974 turned the emergency order into law: all passengers and their cabin baggage were to be "screened by weapon-detecting procedures or facilities".[56]



4.10 A passenger's bag is searched at Schiphol, 3 January 1974. The photograph belongs to a series on the airport's stricter checks of hand baggage.

NATIONAAL ARCHIEF / ANEFO, PHOTOGRAPHER UNKNOWN, 926-9139 (CC0)

OFFICIAL ASSESSMENT

How much did screening prevent?

In 1979, reporting on the second half of 1978, the FAA claimed that "at least 75 hijackings or related crimes may have been prevented" since 1973.[57] The economist William Landes, modelling the years before screening, estimated that without it, and with the chance of arrest held at its 1972 level, there would have been "between 41 and 67 additional hijackings compared to the 11 that actually occurred in the 1973 to 1976 period."[58] On another page of the same article he gives 41 to 60,[59] and Sandler and Enders, citing him, give 41 to 50;[60] the range depends on the model. All these figures are estimates of events that did not happen.

FAA, Ninth Semiannual Report to Congress (1979); W. Landes, *Journal of Law and Economics* 21 (1978), pp. 21, 29; T. Sandler and W. Enders, *European Journal of Political Economy* 20 (2004), manuscript pp. 12–13.

What screening did to political hijackings is a different question. Laura Dugan, Gary LaFree and Alex Piquero, who modelled 828 attempted hijackings worldwide before 1986, drawn mainly from the American aviation authority's records, found that the measures of early 1973, which they treated as a single intervention, "significantly decreased the likelihood of nonterrorist but not that of terrorist hijackings."[61] The authors were careful about how far this went. The difference between the two effects, they wrote, gave "only weak support" to the idea that terrorists

responded differently.[62] They also found that hijackings encouraged further attempts mainly when they succeeded.[63]

PLAUSIBLE INTERPRETATION

Did the attacks move elsewhere?

The economists Walter Enders and Todd Sandler, analysing transnational terrorist incidents from 1968, have argued that when screening made skyjackings harder, groups turned to other kinds of hostage-taking. In their own later summary of their studies of 1993 and 1995, "the number of other hostage-taking incidents and assassinations rose by almost 10 incidents per quarter. The measured trade-off between skyjacking and other logistically complex events was nearly one for one".[64] Elsewhere they put the trade-off at "about one for one".[65] Their data and those of Dugan and her colleagues count different events, so the two findings cannot be compared directly. The 1993 and 1995 articles themselves was not available for this book and is not quoted.

W. Enders and T. Sandler, in A. Silke (ed.), *Research on Terrorism* (2004), author's manuscript p. 14; T. Sandler and W. Enders, *European Journal of Political Economy* 20 (2004), manuscript p. 14.

Cases from these years show the targets widening beyond the aircraft in flight, though they cannot show that screening caused it: two came before universal screening began in the United States, and one was itself a hijacking. In May 1972 gunmen of the Japanese Red Army opened fire in the passenger terminal at Lod airport near Tel Aviv, killing passengers who had just left their aircraft.[66] In October 1972, after the killings at the Munich Olympics, hijackers of a Lufthansa Boeing 727 demanded the release of three men imprisoned in West Germany for their part in the killings; the prisoners were brought to the aircraft at Zagreb, and it flew on to Libya.[67] At Rome's airport in December 1973 an attack on a Pan American airliner and a Lufthansa aircraft seized on the ground left about thirty dead; a State Department memorandum gives 32, the FAA's chronology 30.[68] The airport, not only the aircraft, had become a place where violence could be staged.

WHAT THE JET CARRIED

By the four questions of this book, the jet changed reach in space most. A small group could now take a hundred people of several nationalities across three or four borders before any government had decided what to do, and hold them where the state whose territory they landed in could not enforce its authority. It changed force least: the hijackings in this chapter were done with weapons that one person could

carry, and the destruction at Dawson's Field was of empty aircraft. It changed labour in a curious way. The pilots, controllers and airport staff of an international system now did the hijackers' transport for them, under duress.

And it changed audience, though not yet fully. In September 1970 hundreds of foreigners had been held on a Jordanian airstrip for days, and camera crews came to see them. The aircraft had compressed distance. What compressed attention was the other machine on the airstrip that week, the television camera. Two years later, at the Olympic Games in Munich, its pictures went out by satellite to three continents.[69]

TIMELINE 4

The jet, the hijacker and the law, 1958–1974

1958 TECHNOLOGY October: Pan American opens American international jet service with the Boeing 707.

1961 VIOLENCE 1 May: first recorded hijacking of a US airliner, to Cuba. August: a 707 and a DC-8 are targeted within a week.

1961 RESPONSE 5 September: US law makes "aircraft piracy" a federal crime.

1963 RESPONSE 14 September: Tokyo Convention signed; in force only on 4 December 1969, with no duty to extradite.

1968 VIOLENCE 22–23 July: El Al 707 taken to Algiers; the aircraft and its passengers become the object of a bargain.

1969 VIOLENCE Hijackings of US-registered aircraft peak at 40; 37 are bound for Cuba.

1970 VIOLENCE 6–12 September: four airliners seized; three destroyed empty at Dawson's Field, one at Cairo.

1970 RESPONSE 11 September: Nixon announces armed guards on US airliners. 16 December: Hague Convention signed.

1971 RESPONSE 23 September: Montreal Convention extends protection to aircraft on the ground.

1972 RESPONSE January: FAA requires airlines to adopt screening systems.

1972 VIOLENCE 30 May: gunmen fire on passengers in the terminal at Lod airport. 29 October: a Lufthansa 727 is hijacked; three prisoners are brought to the aircraft at Zagreb.

1973 RESPONSE 5 January: every passenger and carry-on bag screened in the US. 15 February: US-Cuba agreement.

1974 RESPONSE 5 August: Air Transportation Security Act makes screening law; 200.7 million passengers screened that year.

Sources: NASM (Dash 80 record); FAA, *Aircraft Hijackings and Other Criminal Acts* (1983); House hearings 1969–70; Pub. L. 87-197 (1961); UNTS (Tokyo, Hague, Montreal conventions; US-Cuba exchange of notes, 1973); FRUS 1964–68 vol. XX, 1969–76 vols E-1 and XXVI; Nixon, statement of 11 Sept. 1970 (American Presidency Project); 37 Fed. Reg. 2500 (1972); B. O. Davis Jr. (1973); Pub. L. 93-366 (1974); FAA Third Semi-Annual Report (1976); JTA.

OBJECT 4 · 1958

The Boeing 707



WERNER FRIEDLI, ETH-BIBLIOTHEK ZÜRICH, BILDARCHIV / STIFTUNG LUFTBILD SCHWEIZ / LBS_H1-026899 (CC BY-SA 4.0)

PROTOTYPE FIRST FLEW
15 July 1954 (the Boeing 367-80, “Dash 80”)

SEATS
160, six abreast, at Pan American’s insistence

NEW YORK TO SAN FRANCISCO
5 hours, 3 fewer than a piston DC-7

IN SERVICE
Pan American international routes, October 1958

HIJACK ATTEMPT · 1961

THE PROBLEM

In the early 1950s almost every airliner was a piston aircraft. An American international flight averaged 218 miles an hour in 1950 and offered 41 seats.[1]

WHAT CHANGED

Jet engines and a bigger airframe. Boeing's prototype first flew in 1954; the production 707 was widened so that it "could carry 160 passengers six-abreast", and on domestic routes it cut three hours from a coast-to-coast flight.[2] The later 707-300 series "could fly nonstop across the Atlantic with full payload under any conditions."[3]

HOW IT SPREAD

Pan American opened American international jet service in October 1958.[4] By 1975 the average international flight of an American airline ran at 482 miles an hour and offered 225 seats.[5] The Smithsonian counts 855 707s built, 725 of them for airlines.[6]



O4.1 The Boeing 367-80, the prototype from which the 707 was developed, landing at Oakland, California. NASA Ames photograph, dated 12 December 1965.

NASA, A-36044 (PUBLIC DOMAIN)

CIVIL USES

Mass international travel. American airlines carried 2 million international passengers in 1950 and 16 million in 1975.[7]

IN POLITICAL VIOLENCE

The 707 was the aircraft of the hijacking years. In August 1961 an attempt was made on a Continental 707 at El Paso; in July 1968 an El Al 707 was taken to Algiers and its passengers held; in September 1970 a TWA 707 was destroyed at Dawson's Field.[8]

WHAT NOBODY EXPECTED

Pan American's first route, in 1927, had run from Key West to Havana.[9] Four decades later most successful hijackings of American aircraft ended in Havana.[10] The Chicago Convention of 1944 had foreseen both sides of the machine: civil aviation "can greatly help to create and preserve friendship", and yet "its abuse can become a threat to the general security".[11]



A monitor at the AT&T Telstar test, 11 July 1962, showing the caption “First pictures from England via Telstar”.

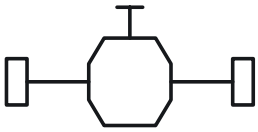
LIBRARY OF CONGRESS, PRINTS & PHOTOGRAPHS DIVISION, U.S. NEWS & WORLD REPORT MAGAZINE COLLECTION, LC-DIG-PPMSCA-39668 (PUBLIC DOMAIN)

5

Live to the World

1965–1985

For most of history the people who saw political violence were the people who were there. Television and the communications satellite changed who was watching, how many, and how soon.



THE BROADCASTING CENTRE IN MUNICH'S OLYMPIC PARK had a central control room with one wall of 48 television screens. It linked a videotape centre, 61 booths where commentators could speak over pictures, and eleven studios for individual broadcasters' own programmes. Six of them were reserved for ABC of the United States, the Australian Broadcasting Commission, the BBC, CBS, Japan's NHK and the West German networks.[1] In the stadiums and halls there were 89 electronic cameras, and transmission trucks at 25 of the 35 venues.[2]

None of this was run by the organising committee. It was run by a company founded on 21 May 1968 by the two West German public broadcasters, ARD and ZDF, whose task was to supply "a color signal with IT (international tone) that covered all essential events". "Inasmuch as scheduling and demand allowed," the official report records, "broadcasting was exclusively in color and live", from nine in the morning until eleven at night; live broadcasting filled about three-quarters of the transmission time.[3] The company accredited 1,198 journalists and 464 assistants from 112 radio organisations in 73 countries and 70 television organisations in 63 countries.[4]

The pictures left the park over the Post Office's network of cables and radio links. The West German Post Office connected 25 sites to the broadcasting centre, and the Olympic Tower served as the switching point for 14 television lines. Four of them ran to the Post Office's earth station at Raisting, south-west of Munich, where satellite channels had been reserved for Asia (one), North America (one), and Central and South America (two). There the European colour picture could be converted to the American standard. "TV signals," the official report explained, "need four-tenths of a second to travel to the 36,000 kilometers distant news satellites and back."[5] (At the speed of light the trip takes nearer a quarter of a second.)

The American network ABC had paid 7.5 million dollars for exclusive rights in the United States and 6 million more for technical services, "the highest that a television agency had ever negotiated for the transmission rights of the Olympic Games to date." In the negotiations the organisers counted some 85 million television sets in the United States and about 68 million in the Eurovision countries of western Europe.[6]

At about five in the morning of 5 September 1972, eight armed Palestinian members of the Black September organisation forced their way into the building at Connollystrasse 31 in the Olympic Village, where the Israeli team was lodged.[7] Before the night was over, eleven members of the Israeli Olympic team had been killed, two in the village that

morning and nine at the airfield of Fürstenfeldbruck, together with a West German police officer; five of the attackers also died.[8]

The attackers did not build any of the apparatus described above, and did not need to. It was already pointed at the Olympic Park. This chapter is about that apparatus: what had to be invented and agreed between 1962 and the early 1970s before a picture taken in one country could be seen, almost as it happened, in dozens of others, and what that did to the audience of political violence. The previous chapter followed a machine that compressed distance. This one follows the machines that compressed attention.

THE AUDIENCE USED TO BE THE CROWD

Political violence has always had an audience, but for most of history the audience that saw it was the one that was there. Everyone else read about it, later.

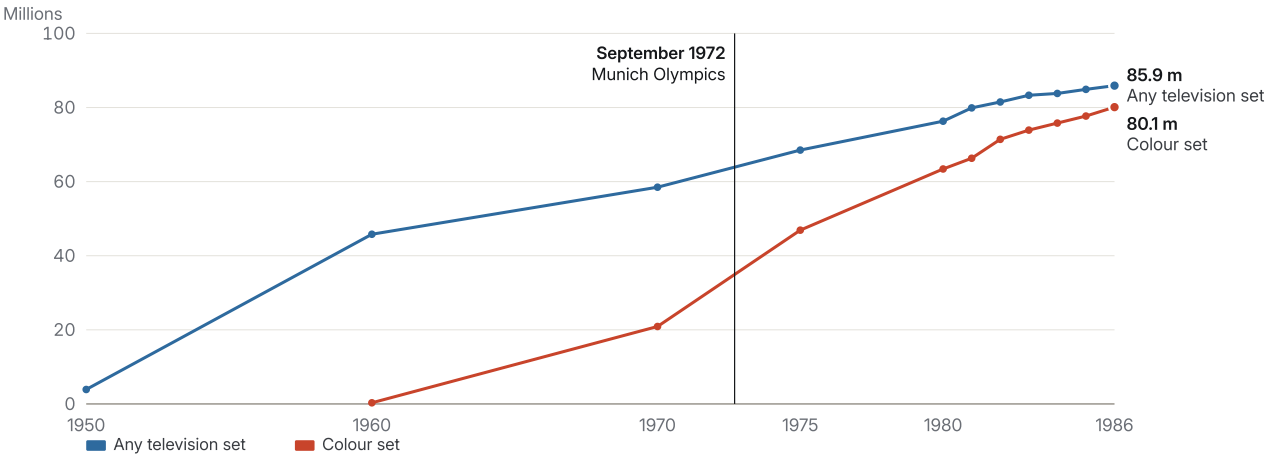
The historian David Rapoport dates the first international wave of terrorism, in the 1880s, partly to a revolution in communications: "The telegraph, daily mass newspapers, and railroads flourished in this period; and subsequently throughout the 20th century, technology continued to shrink time and space."[9] As chapter 1 showed, in Rapoport's own summary of that period, "Events in one country were known elsewhere in a day or so."[10] The news was international long before television.

What the telegraph carried, though, were words. Radio, the subject of chapters 2 and 3, added a voice and made news simultaneous for anyone within range of a transmitter. Television added the picture. According to the Census Bureau, 3.9 million American households had a set in January 1950; by January 1960 the figure was 45.8 million, 87 per cent of all households.[11]

These are counts of households, not of viewers, and they say nothing yet about borders. Until the early 1960s no broadcast television picture could cross an ocean while it was happening. Film of a distant event went by aircraft, and pictures could travel only as far as a chain of land relays reached. The next section is about how that changed.

American homes acquired television in the 1950s and colour television in the 1970s

US households with a television set and with a colour set, millions, 1950–1986 (years shown in the source only)



5.1 Households, not sets and not viewers: in 1986 a television household had on average 1.83 sets. Values exist only for the years marked; lines between them are drawn straight. Values for 1970 and 1975 refer to September of the previous year, all others to January. Ninety-five percent of American households had a set by 1970. The 1950–1965 figures come from NBC, later ones from A.C. Nielsen.

Source: US Bureau of the Census, *Statistical Abstract of the United States: 1987*, Table 906, p. 531 (from NBC and A.C. Nielsen, *Nielsen Report on Television*; sets per household from the Television Bureau of Advertising). Data: `data/processed/us_tv_households_1950_1986.csv`.

TWENTY MINUTES OVER THE ATLANTIC

The satellite that first carried television across the Atlantic was launched in the early morning of 10 July 1962.[12] Telstar was a project of the American telephone company AT&T, which paid NASA for the launch.[13] On its first pass within range of the company's new earth station at Andover, Maine, engineers sent speech and pictures up to it. On the other side of the ocean, according to A. C. Dickieson's account in the *Bell System Technical Journal*, "the French station at Pleumeur-Bodou was receiving picture and sound perfectly." The British station at Goonhilly Downs could see the signal but not use it, because of a fault in its aerial. The next day both European stations sent pictures back.[14] They had been built by the French and British telecommunications administrations, not by the Americans.[15]

It was a demonstration, not a service. Telstar flew in a medium-altitude, elongated orbit and was in sight of both continents only for short windows: at first three or four times a day, "each lasting 10-20 minutes", and seven weeks later four or five times a day for 20 to 40 minutes.[16] It could carry a single television channel.[17] On 23 July the American networks

and the European Broadcasting Union exchanged special programmes, and a presidential news conference was among them: the official transcript notes, in the middle of an answer about Berlin, "[At this point transmission to Europe via Telstar began.]"[18] Over the next several months, transatlantic television went by Telstar 47 times.[19]

DOCUMENTED

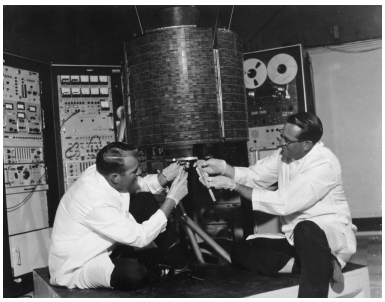
The first satellite television?

Telstar is often called the first communications satellite or the first to carry television. Neither is quite right. A NASA history records that in April 1962 the Massachusetts Institute of Technology and the US Air Force relayed "a live television transmission" off the passive Echo balloon satellite, three months before Telstar. The same history quotes an official's verdict on Telstar: "Although not the first communications satellite, Telstar is the best known". What Telstar did first, in the words of the US government's report for 1962, was give "the first demonstration of international television broadcasting".

Butrica (ed.), *Beyond the Ionosphere*, NASA SP-4217 (1997), pp. 39, 53; *US Aeronautics and Space Activities 1962*, PDF p. 13.

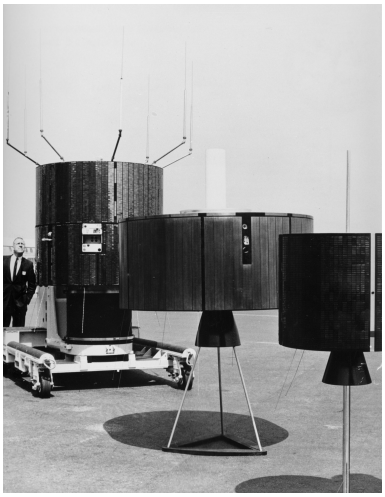
Satellites in lower orbits came and went. A satellite about 36,000 kilometres above the equator, turning with the Earth, stays in the same place in the sky, so that one dish can point at it all day.[20] Syncom 3, launched on 19 August 1964, was described by the US government as "the world's first geostationary satellite".[21] It carried the opening ceremony of the Tokyo Olympic Games live to North America that October. Most of what Americans saw of the Games, though, came on videotape flown from Japan. European viewers saw a 15-minute summary that travelled from Tokyo to Montreal, by microwave link to Andover and then by another satellite, Relay 1, to Europe, and otherwise depended on tapes carried across the Atlantic by jet.[22]

The first commercial communications satellite, Early Bird, was launched on 6 April 1965. It could carry 240 telephone circuits.[23] From 28 June[24] it gave "regular commercial service between North America and Western Europe".[25] That year it carried live the visit of Pope Paul VI to the United Nations in New York.[26] It belonged to an international consortium. In the summer of 1964 a group of governments that included the United States had agreed in Washington to set up "a single global commercial communications satellite system", with the aim of "basic global coverage in the latter part of 1967".[27] The system became known as Intelsat.



5.2 Engineers check Early Bird, built by Hughes Aircraft for the Communications Satellite Corporation. NASA photograph.

NASA (GRIN GPN-2003-00020, 66-H-150) (PUBLIC DOMAIN)



5.3 Replicas of the satellites used to televise the 1968 Olympic Games from Mexico City to Europe and Japan, at Hughes Aircraft, Culver City, California. Centre, Intelsat II; left, NASA's ATS-3; right, Early Bird.

NASA (GRIN GPN-2003-00018, 68-H-1024) (PUBLIC DOMAIN)

The target was missed by about eighteen months. Global coverage, by the US government's account, was achieved in July 1969, when service reached the Indian Ocean and an Intelsat satellite stood over each of the three oceans.[28] That was the month of the first landing on the Moon, relayed around the world by Intelsat satellites; the government estimated that "half a billion people" had watched.[29] Intelsat's television traffic had risen, by the same report's count, from about 40 hours in 1965 to about 760 hours in 1969.[30] In September 1970, while the hijacked airliners stood at Dawson's Field in Jordan, ABC in the United States "carried reports daily via satellite", and NBC had carried 17 satellite transmissions within the week.[31] Two years earlier, in 1968, the Olympic Games in Mexico City had been sent live by satellite to Europe and Asia.[32]

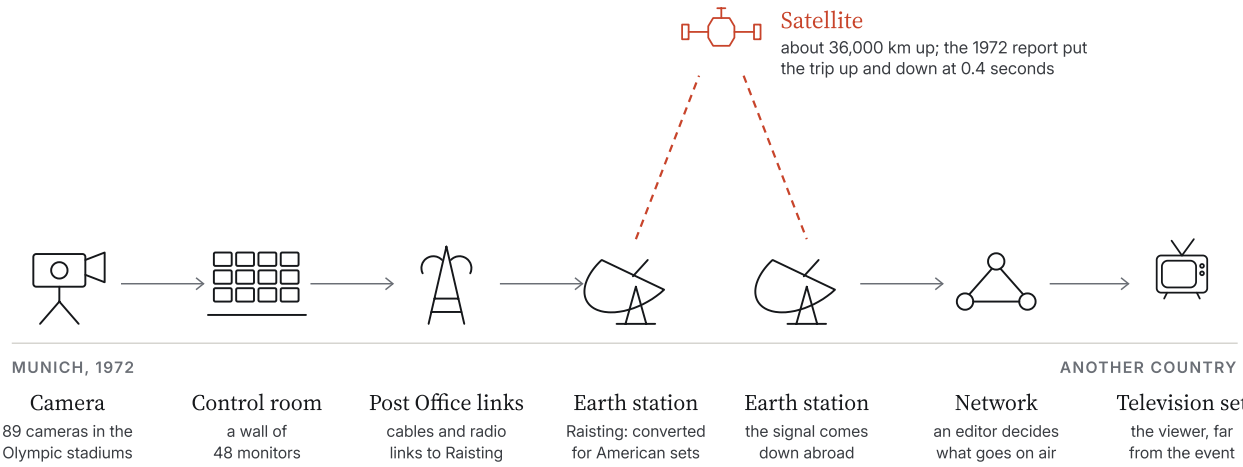
What spread fastest were the stations on the ground. A satellite was useless to a country without a large dish aerial to talk to it. In 1965 five countries had an earth station working in the Intelsat system. By the end of 1972 there were 49, and by the end of 1978, 96.[33]

A definitive agreement turned the consortium into an international organisation in 1973, with more than 80 member states.[34]

By the time of the Munich Games, then, the chain from a camera to a television set in another continent was in place, and it was routine. It ran through many hands.

WHAT THE CAMERAS SHOWED

In Munich the Games went on for most of the day. According to a telegram from the Israeli embassy in Bonn, as summarised by the Israel State Archives, the Olympic and West German authorities at first decided not to stop the Games, among other reasons because "German television has no alternative programming".[35] The Games were interrupted that afternoon and resumed on the afternoon of 6 September after a memorial ceremony in the Olympic Stadium.[36]

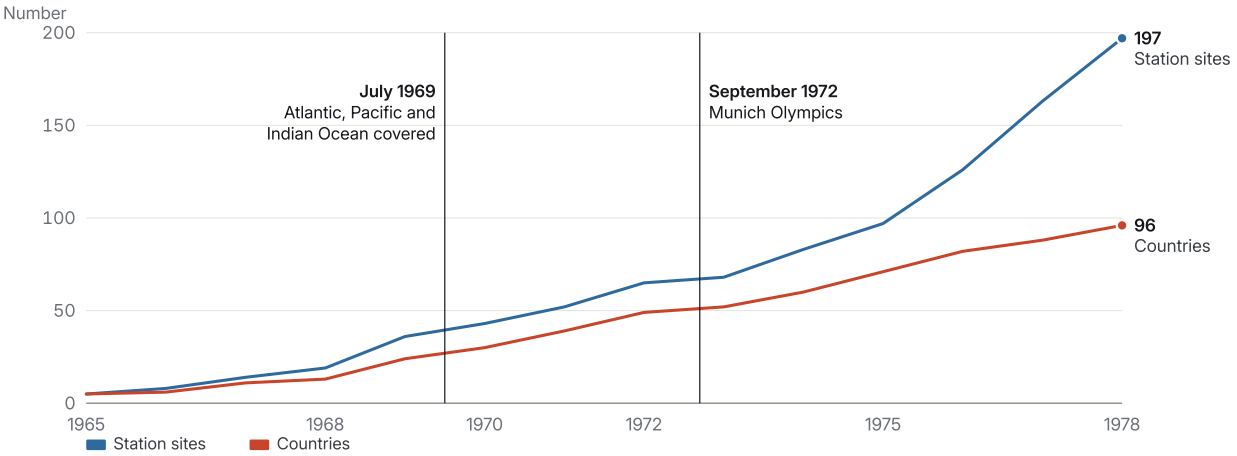


Every link belonged to an organisation: a broadcasting company, a post office, a satellite system, a network.

5.4 How a live picture left Munich in 1972, as described in the organisers' official report, and how it reached viewers elsewhere. The satellite system is not named in the report. Each link belonged to an organisation: the host broadcaster, the West German Post Office, the satellite system, a foreign network.

In 1965 five countries had an earth station in the Intelsat system; by 1978, 96 did

Countries and station sites with earth stations working in the Intelsat system, as of 31 December, 1965–1978



5.5 An earth station is the large dish aerial that sends signals to a satellite and receives them back. The totals include stations used only for domestic or specialised services on leased Intelsat capacity: of the 197 sites in 1978, 131 served international traffic. Counts of stations, not of television channels or viewers.

Source: Communications Satellite Corporation, *COMSAT Pathways* 4:1 (January–February 1979), p. 2, "Earth Stations in the INTELSAT System" (figures cited, page not reproduced). Global coverage: US President, *Communications Satellite Act of 1962: seventh annual report*, H. Doc. 91-264 (1970), pp. 2, 7. Data: `data/processed/intelsat_earth_stations_1965_1978.csv`; reshaped by `scripts/derive/ch05_series.py`.



5.6 Picture-check monitors and the main monitor in a Pye outside-broadcast van, Hungary, 1974.
FORTEPAN / RÁDIÓ ÉS TELEVÍZIÓ ÚJSÁG (CC BY-SA 3.0, CREATIVECOMMONS.ORG/LICENSES/BY-SA/3.0/)

By late morning cameras were trained on the building in Connollystrasse. ABC staff later described a camera moved onto an earth bank overlooking the building and another on the Olympic Tower that could be trained on its roof.[37] Live pictures showed armed police taking positions on the roofs nearby.[38]

Getting those pictures to America was a matter of bookings. According to the trade weekly *Broadcasting*, CBS was "first on the air with live TV pictures from Munich", though ABC "had much more extensive bookings on the transatlantic satellite". CBS had the satellite only from 1 p.m. to 3.40 p.m. (times as printed in the magazine), because "Israel had already booked 3:40 to 4:50". CBS and NBC both mounted coverage despite ABC's initial refusal to share its feed, and the Federal Communications Commission looked into the networks' quarrel over the satellite.[39]



5.7 The dish aerial of the new satellite earth station at Burum, in the Netherlands, on 12 September 1973, the day Queen Juliana opened it with a telephone call.
NATIONAAL ARCHIEF / ANEFO, BERT VERHOEFF, 926-6775 (CC0)

The police wanted the live pictures stopped. Historians working for the government-commissioned research project on the attack have read the police log for the day. Shortly after 11:00 the police command asked that the broadcasting company's director, Robert Lembke, ensure that television immediately stop broadcasting live pictures of "the objects in question".[40] The request was repeated over the following hours. The historians could not establish whether the broadcasters refused or whether the orders never reached them. At 17:15 a police officer again ordered transmissions stopped and went to the television studio himself.[41] Geoffrey Mason, an ABC producer, remembered German police with machine

guns in ABC's control room, waving their hands and saying "Kamera aus! Kamera aus!" [camera off]. The historians judge his account "quite credible".[42] The monitor the police pointed at was showing the picture from the Olympic Tower. What struck Mason at that moment, he recalled, was that if the hostages and their captors were "watching the Olympic broadcast cable system", on a channel that, he supposed, would have been listed as "ABC beauty shot Olympic Tower", "they would be seeing everything that we were seeing."[43]

Athletes watching in the village, the historians suggest, probably wondered the same thing; the West German sprinter Manfred Ommer recalled it in 2006. The historians think the story about the apartment probably grew from a coincidence: the police stood their rooftop teams down within minutes of their final order to stop the live pictures.[44] Later, *Broadcasting* reported, the police took over the host broadcaster's camera on the 800-foot tower and used it themselves for surveillance.[45]

The finding does not make television irrelevant. It moves its significance. What the cameras did on 5 September was to put the police, as well as the hostage-takers, in front of audiences in many countries. Whether the captors could see that audience is a separate question, and on the evidence now available the answer for the apartment is no. The director of the Institute for Contemporary History, which runs the project, thought it probably made no direct difference to the course of events either way.[46]

That night, television carried a report that was wrong. According to the organising committee, "a spokesman for the Federal Republic of Germany had reported on television the rescue of the hostages and the disarming of the assailants. The later investigation revealed that this report was due to an error in the transmission of the report."[47] The Israel State Archives describe West German radio and television presenting official spokesmen who said that all the hostages were safe.[48] The organising committee's president and the federal and Bavarian interior ministers briefed the international press at two in the morning.[49] In the United States, ABC's anchor Jim McKay told viewers: "They have now said that there were 11 hostages; two were killed in their rooms yesterday morning. Nine were killed at the airport tonight. They're all gone."[50]

OFFICIAL ASSESSMENT

Did the hostage-takers watch the police on television?

A widely repeated account says the hostage-takers saw the police preparations on a television set in the apartment, and that the operation on the roofs was called off as a result. Historians of the research project commissioned by the federal interior ministry examined the police inventory of the apartment, which lists every object, "every shaving brush, every apple", but no television; the scene photographs, which show no set; and the architects' plans, which show no aerial sockets in the apartments. They conclude that the assault was held back because ministers were negotiating at the door, and the police wanted to stop the hostage-takers seeing the police on the roofs as they did so; the teams were stood down once the hostage-takers demanded to be flown out. The findings are an interim result of a project that runs until the end of 2026.

A. Hänni, D. Aufleger and L. Kreller, "Der Fernseher, den es nie gab" (2025); research project press release, 14 May 2025 (quotations in our translation).

In the official report, the broadcasting company's summary of its work at the Games ends: "There were no unusual incidents."[51] It was describing its own technical operation, which had gone as planned.

"TERRORISM IS THEATER"

UNRESOLVED

How many people watched the crisis?

Figures of "900 million" and "about a billion" viewers are often given. None of the sources read for this book traces either to a measurement or to a contemporary estimate. A 2022 German-language scholarly article takes 900 million from a popular book of 2000; the historians' report of 2025 takes a billion from a journalistic book of 2021; one newspaper attributes 900 million to ABC alone, which held rights only for the United States and a few small bordering areas. The organising committee's report gives no global audience. What it does document is 70 television organisations from 63 countries, and satellite channels to three continents.

Olympic Official Report 1972, vol. 1, pp. 59–60, 193, 227; T. Riegler, *APuZ* 36/2022, p. 17; Hänni et al. (2025); *The Guardian*, 2024.

Less than two years later an American analyst put a name to what Munich had made visible. Brian Michael Jenkins, who directed research on international terrorism at the RAND Corporation from 1973,[52] submitted a statement to a

subcommittee of the House of Representatives on 24 June 1974. "Terrorist attacks are often carefully choreographed to attract the attention of the electronic media and the international press," he wrote. "Holding hostages increases the drama." And then: "Terrorism is aimed at the people watching, not at the actual victims. Terrorism is theater."[53]

The phrase was not a flourish. It came in the middle of an argument about fear and weakness. Terrorism, Jenkins wrote, aims at an atmosphere of fear and alarm that makes people exaggerate the terrorists' strength, so that their strength "is judged not by their actual numbers or violent accomplishments, but by the effect these have on their audience." And since most groups "are actually small and weak, the violence must be all the more dramatic".[54] He gave his own count: 486 incidents of international terrorism between January 1968 and April 1974, in which "351 people were killed, counting terrorists". It was less, he noted, than the weekly casualty rate in Indochina. "The effect produced by this small amount of actual terrorist violence is much greater. Look at the headlines captured, the amount of valuable television time devoted to the terrorists".[55]

He was explicit about the technology. "Recent developments in news broadcasting -- radio, television, communication satellites -- are also a boon to publicity-seeking terrorists," he wrote. "Terrorists may now be assured that their actions will receive immediate worldwide coverage on radio, on television, and in the press. The world is now their stage."[56] He had used nearly the same words two months earlier in a RAND paper of April 1974.[57] In January 1975 he added that radio "and especially television" had let an expanding audience "'participate' vicariously" in the struggle of guerrillas, an idea, he wrote, "that owes as much to Marshall McLuhan as it does to Mao Tse-tung."[58]

The best-known version came in November 1975, in testimony to a California State Assembly committee holding hearings on nuclear power. Its subject was whether terrorists would try to acquire nuclear material. Jenkins thought the main attraction would be fear rather than mass casualties, and explained why: "Terrorism is violence for effect. Terrorists choreograph violence to achieve maximum publicity. Terrorism is theater." Incidents designed to kill large numbers were rare: "Terrorists want a lot of people watching, not a lot of people dead".[59]

DOCUMENTED

Where "terrorism is theater" first appears in print

The earliest published text found for this book is Jenkins's statement for the House subcommittee of 24 June 1974 (RAND paper P-5261, p. 4). His RAND paper of April 1974 has the argument about media and satellites but not the phrase. The line about people "watching, not ... dead" is not in the 1974 statement; its earliest text found is the testimony of November 1975 (RAND P-5541, p. 4). A longer variant that adds "a lot of people listening" is in none of the five Jenkins papers read for this book (two of them only in part) and is not quoted here. His 1975 essay "International Terrorism: A New Mode of Conflict" was not available, and a scholar who interviewed Jenkins reports an earlier memorandum with the same idea, circulated at the State Department after Munich, which has not been seen.

RAND papers P-5217 (April 1974), P-5261 (June 1974), P-5339 (January 1975), P-5541 (November 1975), P-7139 (September 1985); A. Hobson (2023), n. 37.

Jenkins did not claim that television caused terrorism. His word was "may": the media's willingness to broadcast dramatic violence "enhances and even may encourage terrorism as an effective means of propaganda."[60] He also saw that the amplification was selective. Insurgents had been fighting in Angola, Mozambique and Portuguese Guinea for years, and "The world hardly notices", while a perhaps equal number of Palestinian terrorists had become "a primary concern to the world." In wartime, he observed, "incidents of terrorism elsewhere are not reported."[61] The camera did not go everywhere.

Other scholars were more cautious about how much the medium explained. In 1981 the political scientist Martha Crenshaw also held that "Terrorist violence communicates a political message", and that the most basic reason for terrorism is "to gain recognition or attention". She treated modern transport and communications as permissive causes: conditions that make terrorism possible, not reasons for it. Among explanations resting on assumptions "neither explicit nor factually demonstrable" she listed "the imitation of dramatic models encouraged by television."[62] Rapoport's account of the waves of modern terrorism, written after September 2001, gives the telegraph and the mass newspaper a part in the first wave and does not mention television at all.[63]

Whether coverage produced more attacks was hard to measure. A study of American hijackings from 1968 to 1972 found that successful hijackings were followed by more attempts of the same kind and unsuccessful ones were not.[64] A later study of hijackings over seven decades found that

"contagion seems to operate only through the rapid occurrence of successful hijackings".[65] Neither, as far as this book has read them, measured coverage directly. In 1986 a columnist for the *Christian Science Monitor*, reporting a review of the research by Robert G. Picard, concluded that there was "no sound evidence whatever" for any of the positions then argued.[66]

THE STATE ON THE SCREEN

By the mid-1970s governments had learned that the same channel could be used in both directions.

When the Movement 2 June, a West Berlin group, kidnapped Peter Lorenz, chairman of the Christian Democrats in Berlin, at the end of February 1975, the authorities had no way to reach his captors. On the night of 28 February to 1 March the police addressed the kidnappers over radio and television and promised to meet their first demand. The kidnappers' next message named a regional television programme in which any prisoner who did not want to be flown out was to say so. The historian Matthias Dahlke, who worked from the crisis staff's files, calls this "blind contact" through the media a characteristic of the case.[67] Lorenz was released unharmed on the night of 4 to 5 March, after five prisoners had been flown to South Yemen.[68]

The airwaves could also be the price of a hostage's life. On 21 December 1975 an armed group seized the conference of the oil-exporting countries, OPEC, in Vienna. Among its demands, Chancellor Bruno Kreisky told the Austrian parliament, was that its communiqué be broadcast by the national broadcaster, ORF, every two hours. It was read on the radio stations Ö1 and Ö3 for the first time at 18:22 and then every two hours until four in the morning. One opposition deputy said that three people had died "so that a group of criminals had eleven ministers in their custody for a day, so that a strange statement was read on Austrian radio, and so that a certain publicity thereby arose. Nothing else!"[69]

In the autumn of 1977 the West German government tried the opposite. Hanns Martin Schleyer, president of the two main federations of West German industry and employers, was held by his kidnappers for more than six weeks and then murdered.[70] In his statement to the Bundestag on 20 October 1977, Chancellor Helmut Schmidt thanked "many newspapers and other media at home and abroad" for having "helped extraordinarily" through their self-restraint, and stated the principle: "The course of terrorist crimes is made much more difficult if the perpetrators cannot make use of the means of

mass communication." He added that those media which had not restrained themselves, and had thereby caused danger, should ask themselves how far they had put success at risk.[71] He did not say which.

In London the state's response itself went out live. On the morning of 30 April 1980 armed men forced their way into the Iranian Embassy in Princes Gate and took 26 people hostage, two of them BBC employees.[72] On 5 May, when it became clear that the gunmen had begun to carry out their threats to kill hostages, the Home Secretary, at the request of the Metropolitan Police Commissioner, authorised the use of the Special Air Service. The gunmen killed two hostages; all 19 known to be alive when the soldiers went in were rescued.[73] Part of the assault was shown live on television.[74] The day after, the Opposition's home affairs spokesman, Merlyn Rees, spoke in the Commons of the decision "to act in the way that we saw last evening on television".[75]

Television had been part of the siege from the start. On 2 May, according to the National Army Museum, the gunmen insisted that their demands be televised; the police and the BBC agreed.[76] On the evening of 5 May BBC Two was showing the final of the world snooker championship live, and BBC One a western.[77] Who went live first is known mainly from one participant. Stewart Purvis, the duty editor that night at ITN, the news service of the commercial channel ITV, later quoted the BBC's internal review minutes of 7 May. In them one BBC executive was "surprised at how much later the BBC had come up with its coverage", and another said the BBC had shown the assault "simultaneously on both BBC One and BBC Two by halting the film and leaving the snooker for the time being at 7.31". Purvis concludes that ITN was first.[78] The minutes themselves have not been seen for this book.

Asked whether broadcasters had been told to be cautious, the Home Secretary, William Whitelaw, said that had restraint been thought necessary it would have been asked for, "but I must tell the hon. Gentleman that such an occasion did not, in the final event, arise." Such events, he said, were bound to be covered by television and radio.[79]

SEVENTEEN DAYS IN JUNE

A case in which the satellite appears plainly in the documents came in 1985. On 14 June gunmen hijacked TWA Flight 847, and its American passengers were held in Beirut.[80] The hijackers beat and shot dead Robert Dean Stethem, a US Navy diver among the passengers.[81] The last 39 hostages were freed

after what the *Christian Science Monitor* called a "17-day ordeal".[82]

American intelligence noticed the difference. Its open-source monitoring service, the Foreign Broadcast Information Service, reported in August that its work had stayed useful "even in the face of a massive international television blitz providing live relays of major events and interviews and commentary from participants". As the aircraft shuttled between Beirut and Algeria, a "relatively new" capability to monitor satellite-transmitted media let it follow Algerian television's reporting of the stops in Algiers.[83] A content analysis of NBC's evening news found that the hijacking took about 67 per cent of news time between 14 and 30 June.[84]

The networks were questioned by Congress. ABC told a House subcommittee that all its interviews and statements from Beirut, "with one exception, were pretaped and edited by us"; the exception was a live telephone interview. The interviews with hostages had taken place "with the captors nearby".[85] An internal NBC memorandum entered in the record said the network had withheld sensitive information on at least three occasions, and quoted a Navy letter praising its "sensitivity and restraint".[86] Kelly Cullins, whose husband was among the hostages, told the subcommittee: "It was terrifying to see my husband on television, but it allowed me to know that he was alive." She was also, she said, "appalled by the behavior of the media" at a press conference. Of the seven American hostages still held in Lebanon, out of sight, she said: "they are not a visual theatre. They do not exist on TV."[87]

Fred Friendly, a professor emeritus of journalism at Columbia University, gave the hearing the sentence closest to this book's subject. "Terrorism is a management crisis of miracles," he said. "Three miracles, perhaps four, if you add the first amendment—the jet airplane, the television, and the satellite—all in my lifetime, have made it possible for a few anarchists or murderers to take the law of civilization and the attention of the world into their own hands."[88]

Two weeks after the hostages were released Margaret Thatcher spoke to the American Bar Association in London. She recalled the hijacking of the TWA aircraft, and later in the speech said: "we must try to find ways to starve the terrorist and the hijacker of the oxygen of publicity on which they depend." She did not believe in constraining the media, she continued, but asked whether they might agree among themselves a voluntary code.[89]

TIMELINE 5

The satellite, the camera and the audience, 1962–1985

1962 TECHNOLOGY 10–11 July: television crosses the Atlantic by Telstar, in passes of minutes. 23 July: American and European networks exchange programmes.

1964 TECHNOLOGY August: agreement in Washington on "a single global commercial communications satellite system". October: Syncom 3 carries the Tokyo opening ceremony live to North America.

1965 TECHNOLOGY 28 June: Early Bird begins regular commercial service between North America and western Europe.

1969 TECHNOLOGY July: Intelsat covers the Atlantic, Pacific and Indian Oceans; the Moon landing is relayed by satellite.

1972 VIOLENCE 5–6 September: hostage-taking at the Munich Olympics, in front of cameras already in place; police ask for live pictures to be stopped.

1973 TECHNOLOGY 12 February: the definitive Intelsat agreement comes into force.

1974 ANALYSIS 24 June: Brian Jenkins tells a House subcommittee that "Terrorism is theater".

1975 RESPONSE February–March: in the Lorenz kidnapping, West Berlin police address the kidnappers over radio and television.

1977 RESPONSE 20 October: after the Schleyer kidnapping, Chancellor Schmidt thanks "many newspapers and other media" for their self-restraint.

1978 TECHNOLOGY 96 countries have an earth station in the Intelsat system, against five in 1965.

1980 VIOLENCE 5 May: part of the assault that ends the Iranian Embassy siege in London is shown live on television.

1985 VIOLENCE June: TWA Flight 847; US intelligence reports a "massive international television blitz". 15 July: Thatcher speaks of the "oxygen of publicity".

Sources: Bell System Technical Journal 42:4 (1963); NASA SP-4217 (1997); US Aeronautics and Space Reports 1962–1964; Communications Satellite Act annual report, H. Doc. 91-264 (1970); Interim Agreement (1964) and Intelsat Agreement (UNTS 1220); *COMSAT Pathways* (1979); Munich Official Report (1974); Hänni et al. (2025); RAND P-5261; M. Dahlke, *VfZ* (2007); Bundestag Plenarprotokoll 8/50; Hansard, 6 May 1980; S. Purvis, Royal Television Society (2025); FBIS memorandum (1985); Thatcher Archive.

A MULTIPLIER OF ATTENTION

The case for the interpretation rests on proportion. Jenkins counted 351 dead, attackers included, in six years of international terrorism, and set that figure beside the headlines and the "valuable television time" those incidents had taken.[90] What carried the Munich attack to the world was not the weapons used but the cameras, lines and satellite channels that were already there. The machines in this chapter did not make any weapon stronger. They made the same act visible to far more people, far sooner. By the book's four questions, in our reading, television and the satellite changed the audience most and the violence itself least; reach changed through the

jet of chapter 4 rather than the screen, and the labour of being seen passed, for a time, to the broadcasters.

☐ PLAUSIBLE INTERPRETATION

Television as a multiplier of audience, not of force

This book's interpretation is that television, carried abroad by satellite, was one of the largest multipliers in the history of terrorism, and that what it multiplied was the audience, not the destructive power. The evidence is circumstantial: the number of homes with a set, the spread of satellite links, the testimony of officials and broadcasters, and Jenkins's contrast between small violence and large attention. No study read in full for this book measures the effect of television on terrorism between 1965 and 1985. One study known here only from its abstract, which set RAND's chronology of international terrorism against coverage on the American television networks and in nine newspapers, reports "partial support" for contagion and a "significant contribution" of the media, "especially US television networks".[91] The research on hijacking finds contagion only after successful attempts.

Interpretation of this book, based on the sources cited in this chapter; H.-B. Brosius and G. Weimann (1991), abstract.

The case against it is as strong as the evidence for any effect is thin. Attention went to some causes and passed over others, as Jenkins himself observed of the wars in Portugal's African colonies: "The world hardly notices".[92] By 1985 he thought the public had become "to a degree desensitized", so that terrorists could "no longer obtain the same amount of publicity using the same tactics they used 10 years ago" and might feel compelled to escalate.[93] Crenshaw had made the same point in 1981: as the audience grows "more accustomed to terrorism, terrorists must go to extreme lengths to shock."[94] If that is right, the multiplier of attention did not stay separate from the multiplier of force. It may, over time, have pushed towards it.

THE CHANNEL BELONGED TO SOMEONE ELSE

There was a limit to all this, and it was built into the technology.

An organisation could create an event. It could not put it on the air. In Munich the pictures came from cameras and control rooms run by a company set up by the public broadcasters, whose operation was budgeted at 125 million marks and paid for, in the organisers' words, "entirely by the broadcasting agencies", and they left the park on lines run by the Post Office.[95] In the United States three networks competed

for time on the satellite, and the network that held the rights to the Games had booked the most of it.[96] When the news of the deaths came, ABC announced it only after Mason told the head of ABC Sports, Roone Arledge, "they're all dead", and Arledge asked, as Mason remembered it: "Can I go with it?"[97]

The same was true in London and in Beirut. On 5 May 1980 the broadcasters, not the government, decided when to break into their schedules: ITV at a natural break at the end of *Coronation Street*, the BBC on both its channels at once, some minutes later.[98] After the hijacking of 1985, NBC issued new rules: "Interruptions should be done rarely and only for the most important news developments. We should not go on the air just to be competitive."[99] In Beirut the satellite was again the bottleneck. *Broadcasting* reported that the city's own uplink facilities had been "knocked out of commission" by the fighting, and that rival networks used exclusive bookings at the nearest uplinks, in Damascus and Cyprus, to keep ABC's interview with the hijacked crew off the satellite for a time.[100] Thatcher's proposal was addressed to the media, not to the hijackers. In this book's reading, that was because the media held the switch.

Satellite time, moreover, was sold by the minute. In December 1966 the trade weekly *Broadcasting* reported that the Communications Satellite Corporation, the American partner in Intelsat, expected to charge 1,500 dollars for the first ten minutes of television to Hawaii and 1,200 dollars for the first ten minutes of a half circuit to Japan, with a surcharge of 25 per cent for colour.[101] When charges for Intelsat circuits were cut by a quarter in 1971, television was excluded.[102] In 1978 television still brought in less than two per cent of the corporation's revenue. That year prices fell: the corporation cut its rates for voice, data and video services by about 48 per cent overall, and its television traffic rose by two-thirds.[103] Even so, television by satellite was still bought by the occasion, not leased full time.[104]

The audience had become global. The channel had not. Between the act and the viewer stood editors who chose what went on air, companies that owned the cameras and the lines, and satellite circuits that had to be booked and paid for, and at moments of crisis could be hard to get. An organisation that wanted to be seen still had to be shown. The next technological shifts would begin, slowly, to take that decision away from the broadcaster.



5.8 The control room of a television studio in Amsterdam, 15 March 1965. Whatever the cameras saw, someone in a room like this chose what went out.
NATIONAAL ARCHIEF / ANEFO, JAC. DE NIJS, 917-5413 (CC0)

OBJECT 5 · 1962

The Satellite

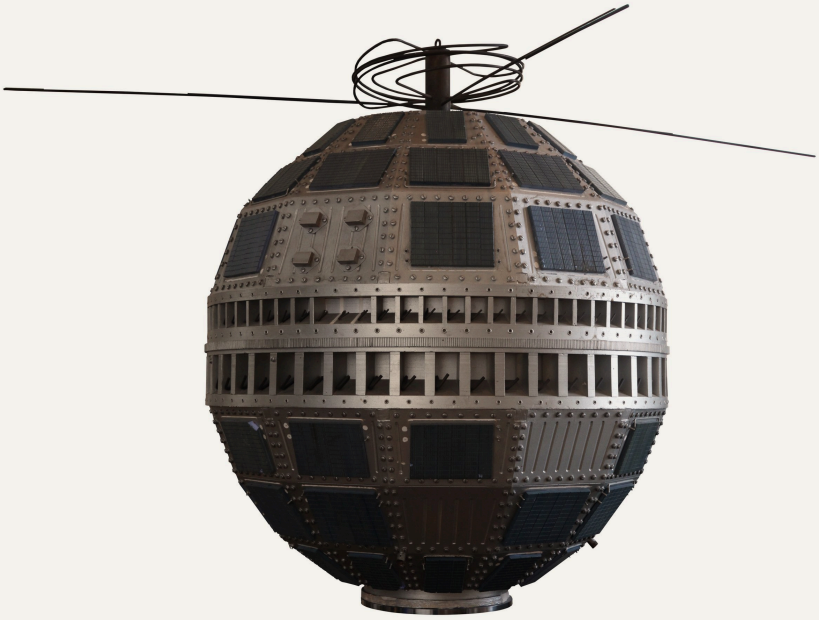


PHOTO: RAMA, WIKIMEDIA COMMONS (CC BY-SA 3.0 FR, CREATIVECOMMONS.ORG/LICENSES/BY-SA/3.0/FR/)

FIRST TRANSATLANTIC TELEVISION

10–11 July 1962 (Telstar, AT&T)

TELSTAR'S WINDOW

10–20 minutes a pass at first, a few passes a day

FIRST COMMERCIAL SATELLITE

Early Bird, launched 6 April 1965, 240 telephone circuits

GLOBAL COVERAGE

July 1969, over the Atlantic, Pacific and Indian Oceans

MUNICH · 1972

THE PROBLEM

Until the early 1960s no broadcast television picture could cross an ocean while it was happening. As late as the Tokyo Olympic Games of 1964, European broadcasters had most of their pictures recorded on tape and flown across the Atlantic by jet.[1]

WHAT CHANGED

A relay station in the sky. On the night of 10 to 11 July 1962 the French earth station at Pleumeur-Bodou received pictures sent from Maine by way of Telstar "perfectly".[2] Telstar was in view of both continents only for minutes at a time.[3] A satellite placed about 36,000 kilometres above the equator would stay in one place in the sky; Syncom 3, launched in August 1964, was the first in such an orbit, by the US government's account.[4] Early Bird, launched the next April, began regular commercial service between North America and western Europe on 28 June 1965.[5]

HOW IT SPREAD

Through an international consortium, Intelsat, set up in 1964.[6] US government reports counted 48 member countries at the end of 1965 and 109 in 1985.[7] The countries with an earth station in its system rose from five in 1965 to 96 at the end of 1978.[8]

CIVIL USES

Mostly telephone calls. Television was an occasional customer: less than two per cent of the American operator's revenue in 1978.[9] But the occasions were large: the visit of Pope Paul VI to the United Nations in 1965, and the Moon landing of July 1969, which, by a US government estimate, "half a billion people watched".[10]

IN POLITICAL VIOLENCE

At the Munich Olympics in September 1972 the earth station at Raisting had satellite channels reserved for Asia, North America, and Central and South America.[11] When members of the Israeli team were taken hostage on 5 September, the channels were already in place. ABC's anchor, Jim McKay, told American viewers: "I'm speaking to you live just outside the Olympic Village in Munich, West Germany."[12] In June 1985 American intelligence followed the hijacking of TWA Flight 847 partly by monitoring satellite-transmitted television.[13]

WHAT NOBODY EXPECTED

The Communications Satellite Act of 1962 declared that the new system would serve "the communication needs of the United States and other countries", and that it would "contribute to world peace and understanding".[14] Twelve years later Brian Jenkins listed "communication satellites" among the developments that were "a boon to publicity-seeking terrorists".[15]



Customers examine tape recorders at the BÁV technical goods store, Király utca, Budapest, 1976.

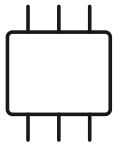
FORTEPAN / SZALAY ZOLTÁN (CC BY-SA 3.0, CREATIVECOMMONS.ORG/LICENSES/BY-SA/3.0/)

6

Electronics Enters the Underground

1970–1990

In 1960 a photocopier, a two-way radio or a calculator belonged to an office, an army or a laboratory. By 1990 each could be bought in a shop, second-hand or by mail order, and so, mostly, could the means of making a record, a picture or a copy.



IN DECEMBER 1969 THE ITALIAN MINISTRY OF TRANSPORT bought a photocopier. Four years later the machine was declared unserviceable and handed over to the supply depot of the State Railways, and on 19 June 1974 it was sold to a former railway employee, who installed it in his home. When he decided to sell it on, he placed an advertisement in the Rome daily *Il Messaggero* and asked a technician who had serviced the machine to help find a buyer. Two men came in the technician's name and bought it. Some time later a third man, Enrico Triaca, came to the firm where the technician worked and asked him to service the machine in the flat where it now stood.[1]

On 17 May 1978, eight days after the body of the former prime minister Aldo Moro had been found in via Caetani in central Rome, police raided a print shop in via Pio Foà run by Triaca.[2] The parliamentary commission that later investigated the kidnapping lists what they found: an IBM composing machine, proofs of four pamphlets distributed between April and December 1977, the typescript draft of a strategic resolution of November 1977 with its photographic plates, leaflets claiming attacks, and two machines for making copies. One was a printing machine that an army unit had declared unserviceable and sold as scrap. The other was the ministry's photocopier.[3]

On the majority report's account, the Red Brigades, who had kidnapped Moro on 16 March,[4] had not built either copying machine or seized it. Both were state equipment written off and sold on, through channels any small business used: an end-of-life sale, a classified advertisement, a service technician.[5]

DISPUTED

How the two machines reached the print shop was contested in the commission itself

The majority report of 1983 reconstructs the copier's route from its own inquiry: purchase by the ministry, write-off, sale in 1974, resale through an advertisement. In his minority report, the writer and deputy Leonardo Sciascia wrote that "no evidence could be obtained to understand how it went from the Ministry of Transport to the Red Brigades' print shop".[6] He also questioned the printing machine's route from the army unit, which he described as part of the military intelligence service, and called for an inquiry.[7] Neither report shows that any state agency supplied either machine knowingly.

Commissione parlamentare d'inchiesta sulla strage di via Fani e sul sequestro e l'assassinio di Aldo Moro, Doc. XXIII n. 5 (1983), vol. 1, p. 49; minority report of L. Sciascia, p. 407 (our translations).

A photocopier is not a weapon, and this chapter is not mainly about weapons. It is about a change in where capable equipment came from. In 1960 the machines that could copy a document in quantity, calculate, record a voice or speak over the air belonged mostly to offices, armies, broadcasters and laboratories. By 1990 all of them were sold in shops, in large numbers, at prices that kept falling. Small clandestine organisations bought them like everyone else. So did the states that pursued them, and the market that sold to both kept records of its own.

BOUGHT, NOT BUILT

In April 1965 Gordon Moore, then at Fairchild Semiconductor, wrote in the trade journal *Electronics* that integrated circuits "will lead to such wonders as home computers—or at least terminals connected to a central computer—automatic controls for automobiles, and personal portable communications equipment. The electronic wristwatch needs only a display to be feasible today."[8] It was a forecast. The first customers for the chips that chapter 3 described were not households. Jack Kilby, who at Texas Instruments in 1958 built the first of the "solid circuits" described in chapter 3,[9] said in his Nobel lecture that "The turning point came from two highly visible military programs in the 1960s – the Apollo moon mission and the Minuteman missile." Then, "To help popularize integrated circuits", his company built a handheld calculator.[10]

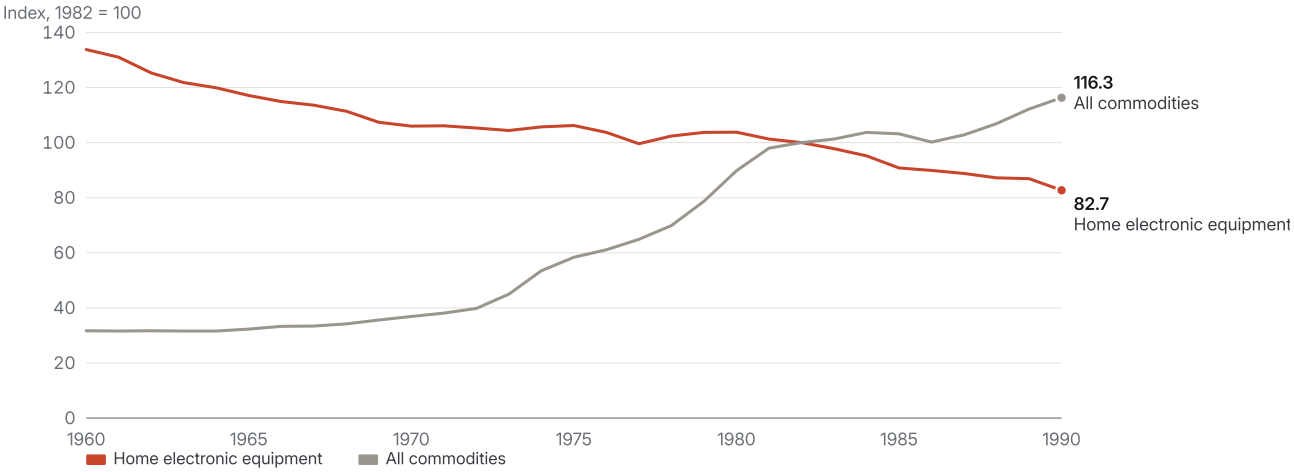
The calculator showed how fast a component first bought by the state could reach consumers. A prototype was built at Texas Instruments in 1967.[11] In 1971 the Bowmar Brain, which a museum of computing calls the first mass-market handheld, cost 245 dollars; Texas Instruments' own Datamath was introduced in 1972, at 149.99 according to one museum record and 119.95 according to another.[12] By December 1975 a newspaper advertisement in Chicago offered a Bowmar model for 29.99, below the original dealer's cost, and Bowmar, perhaps the largest maker of calculators in 1973, was bankrupt.[13] According to the US Congress's Office of Technology Assessment, the first commercial microprocessor, introduced by Intel in late 1971, had been made "to implement the arithmetic functions in an inexpensive calculator."[14]

Memory followed the same curve. In early 1980 samples of a new memory chip, the 64K RAM, sold for about 100 dollars each; by the end of 1981 the same chip could be bought "for $5 or less".[15] The next generation, the 256K chip, cost 100 dollars

in 1982 and 3.65 in 1985, according to industry figures that the Census Bureau reprinted.[16]

Between 1970 and 1990 producer prices in general more than tripled; those of home electronics fell

US Producer Price Index, annual averages, 1982 = 100: home electronic equipment and all commodities, 1960–1990



6.1 Prices American producers received for comparable goods: not retail prices, and not a measure of what electronics could do. Relative to all commodities, the home-electronics index in 1990 was about a quarter of its 1970 level (our calculation).

Source: US Bureau of Labor Statistics, Producer Price Index, series WPU125 (home electronic equipment) and WPU00000000 (all commodities), annual averages, 1982 = 100, accessed 9 Oct. 2026. Data: `data/processed/us_ppi_home_electronics_1960_1990.csv`; extraction `scripts/derive/ch06_series.py`.

What happened to chips happened, more slowly, to the things built from them. The index of prices that American producers received for home electronic equipment stood lower in 1990 than in 1970, and lower still than in 1960, while the index for all commodities more than tripled between 1970 and 1990.[17] By the early 1980s, the Office of Technology Assessment noted, “Not only home entertainment goods like VCRs, but pocket calculators, electronic watches, and CB radios are now produced mostly in the Far East.”[18]

The list of goods is long, and most of the capabilities on it had once belonged mainly to specialists. Philips dates its first compact cassette recorder to the Berlin radio exhibition of August 1963, and by Sony’s account Philips made the format available to other manufacturers free of charge in 1965.[19] The first quartz wristwatch sold to the public, the Seiko Astron, went on sale in Tokyo on 25 December 1969 at 1,250 dollars.[20] Polaroid’s SX-70, introduced in 1972, was described by the Smithsonian’s design museum as “the first camera to achieve one-step photography”: in the museum’s words, it “ejected pictures automatically, without the chemical residues of

previous models."[21] Sony puts the Japanese launch of its Betamax video recorder in May 1975, and JVC's VHS system followed in 1976.[22] Two-way radio, once a matter for professionals and radio amateurs, spread rapidly among consumers: in the six months to June 1975 the number of citizens band licences in the United States rose from 1.1 million to 1.5 million, and the Federal Communications Commission estimated that "almost 6 million CB transmitters were authorized for use".[23] Before 1977, a museum of computing notes, most home computers were kits that required technical knowledge; that year the TRS-80, the Commodore PET and the Apple II were sold as complete machines, at prices the museum gives as 495 to 1,298 dollars.[24]

c. 1960 · offices, armies, laboratories, broadcasters, radio amateurs

Copy a document	Calculate	Keep exact time	Record sound
Ministry copier sold off second-hand, Italy, 1974 Copy shop: 2.5 cents a page (1978)	Handheld calculator: $245 (1971) A Bowmar model cleared at $29.99 (1975)	Quartz wristwatch, Tokyo, 1969 $1,250 at launch	Compact cassette recorder, 1963 (Philips) Walkman, 1979 (Sony)
Get a print in one step	**Record moving pictures**	**Talk by radio**	**Program a computer**
Polaroid SX-70, 1972 Pictures ejected automatically	Betamax 1975, VHS 1976 (IEEE) 68.6% of US TV homes by 1990	Citizens band radio 1.5 million US licences (1975)	Personal computers sold ready to use, 1977 $495 to $1,298

c. 1990 · shops, mail order, the second-hand market

6.2 Capabilities that moved from institutions to shop counters between the 1960s and the 1980s. Dates and prices are those given in the sources cited in this chapter; they are examples, not averages.

None of these products was designed for clandestine work. That was the point. They were made in millions, for offices, families and hobbyists, and an organisation that wanted them needed money and nothing else: no factory, no state sponsor, and in most cases no specialist.

THE PRINT SHOP

For a clandestine group the oldest problem of communication was reproduction. A statement had to exist in many copies, in several places, at the same moment, and every printer who set it in type was a witness. The Moro commission's report suggests that by 1978 the Red Brigades had largely solved that problem. When a suspect communiqué turned up in a single copy in one city on 18 April, a senior police officer judged it false partly because it had been spread "in one city only and in a single copy instead of simultaneously in several places".[25] In our reading, simultaneous distribution was what a copier made easy.



6.3 A Xerox 914 office copier, the model marketed from 1959, on display at the Museum of Business History and Technology in Delaware in 2016.
PHOTO: MARCIN WICHARY, CC BY 2.0, VIA WIKIMEDIA COMMONS

The machines that multiplied a text also left traces in it. The police forensic service found that the suspect communiqué matched the earlier ones in "the typewriter typeface LIGHT ITALIC, the type pitch and anomalies in the spacing of some punctuation marks", although it was judged false on other grounds.[26] A typed page could link documents to one another; it did not by itself prove who had typed them.

In parts of eastern Europe the state acted on that fact in advance. A Romanian decree of March 1983 allowed only "socialist units and other organisations operating under the law" to hold copying machines, duplicators and similar equipment, and forbade private persons to own or use them. Private citizens could keep a typewriter, but only with a permit from the

militia, and in the first two months of every year, and within five days of any repair to the type, they had to hand in a sheet showing every letter, figure and punctuation mark the machine could type.[27] The decree replaced an older one of 1964 on duplicators: in Romania, control of copying predated the spread of the photocopier.[28] A Leningrad editor who had emigrated to the United States described Soviet copiers in 1978 as "inaccessible to the general public", kept in a separate room behind an iron door, and set them beside an American copy shop that charged 2.5 cents a page.[29] An American scholar of Soviet affairs, Albert Parry, had written in 1970 that Soviet samizdat had, with rare exceptions, no printing presses and depended on "the typewriter, each page produced with four to eight carbon copies".[30] In our reading, where the copier was licensed, the opposition typed. Where it was for sale, anyone could buy one.

In Northern Ireland the Provisional republican movement ran its own publishing alongside its armed campaign. An unsigned paper of 1983 in the Northern Ireland Office's files records that the Provisional IRA's major communiqués were issued to the media from Dublin under the name of the "Irish Republican Publicity Bureau", over the traditional signature "P O'Neill"; that the Belfast office had "telex facilities … to transmit communiques direct to the media"; and that in July 1973 police in Dublin had seized 10,000 copies of a single pamphlet.[31] It is the assessment of a government department in the conflict, and is cited as such. It shows a movement that could print and transmit for itself, and still depended on newspapers and broadcasters to be heard.

The British government thought that dependence was the important part. Announcing in October 1988 that broadcasters must not carry direct statements by representatives of proscribed organisations, of Sinn Féin, Republican Sinn Féin and the Ulster Defence Association, the Home Secretary, Douglas Hurd, told the Commons that "The terrorists themselves draw support and sustenance from access to radio and television—from addressing their views more directly to the population at large than is possible through the press."[32] The rules put broadcasters, he said, "on the same basis as representatives of the written press".[33] A copier could make a group its own publisher. It could not make it a broadcaster.

PROOF WITHOUT A LABORATORY

A photograph used to require a darkroom, and a darkroom meant either skill or a laboratory where someone else saw the pictures. In our reading, the instant camera removed both. When kidnappers in West Germany wanted to show that a hostage was alive, *Der Spiegel* reported in September 1977, they tried in 1977, as in 1975, to prove it "with an instant photograph"; investigators did not think that enough, and asked for answers to personal questions as well.[34] The print showed that the hostage had been alive at some moment. The questions were meant to supply what the photograph could not.

A week later the same magazine reported that the kidnappers of the industrialist Hanns Martin Schleyer used "at least four different typewriters" and seemed even to have "a copying machine for video films".[35] The second claim was hedged, and nothing read for this book confirms it. The same report states that the kidnappers telephoned an intermediary in Geneva, Denis Payot, from abroad for up to half an hour at a time without being traced. The West German government, as chapter 5 described, afterwards thanked many newspapers and other media for their self-restraint.[36]

States recorded too. When a man telephoned Moro's wife on 30 April 1978, the call was taped. Some listeners believed they recognised the voice of the university professor Antonio Negri; an investigating judge's order of 23 April 1980 cleared him of the charges relating to the Moro case, while other proceedings against him continued. A Red Brigades member who later collaborated with the authorities attributed the call, on the basis of the recording, to Mario Moretti.[37] A recorded voice was evidence, and evidence could mislead.



6.4 A Polaroid SX-70 instant camera, first model, 1972. Tekniska museet, Stockholm.

TEKNISKA MUSEET (PHOTOGRAPHER NOT RECORDED) (CC BY)

A CALL TO A STRANGER

In our reading, the public telephone, which nobody had to buy, made clandestine groups dependent on others. A warning or a claim went to whoever answered: in the two cases below, a news agency and a charity.

On 17 June 1974 a bomb exploded near the north end of Westminster Hall. The Leader of the House, Edward Short, told the Commons that six minutes' warning had been given by a telephone call to the Press Association, but that it had related to the House of Commons and "was quite unspecific."[38] On 17 December 1983 a call to the central London office of the Samaritans before the bomb at Harrods department store was prefaced, the Home Secretary, Leon Brittan, said, by "a code

word previously unknown to the police authorities". The police had already received "22 other similar messages earlier that day about suspicious devices, all of which turned out to be false alarms". Efforts "to establish the authenticity of the code word" had "no success".[39]

At Harrods the police could not authenticate a code word they had never heard. The telephone gave clandestine groups speed and distance from their messages, and left the meaning of those messages in the hands of strangers.



6.5 The Dutch bomb-disposal service leaves the offices of the newspaper *De Telegraaf* after a hoax bomb call, 22 March 1983.

NATIONAAL ARCHIEF / ANEFO, MARCEL ANTONISSE, 932-5398 (CC0)

PARTS FROM THE HOBBY SHOP

One long contest between a clandestine organisation and a state over consumer electronics took place in Northern Ireland. The British Army's own analysis of its campaign there, dated July 2006, says it plainly: "Early PIRA IEDs used commercially available model aircraft components."[40] Components made for a hobby had found their way into the bombing campaign.

What followed, in the Army's account, was "a continuous struggle between development and counter." Electronic countermeasures were issued to patrols "almost as soon as" the threat was understood, and then "rapidly and continuously developed to keep pace".[41] A scientific adviser (SCIAD) was attached to the Army's headquarters in Northern Ireland from 1969, and the development of the bomb as a major threat, the analysis says, "drew SCIAD's attention almost entirely away from OA [operational analysis] and into electronics."[42] A former member of the security forces, interviewed by RAND researchers in 2004, is reported as saying that the contest "was bounded by the availability of electronics components at the time."[43] It is one person's recollection, reported at second hand; the Army's account confirms only that the first parts were commercial.

Soldiers, too, relied on commercial equipment. The analysis records that the Army's combat radios did not work in urban areas, and that it fell back on commercial ones: "Pye, Westminster and Storno radios and pocket phones … These commercial, off-the-shelf systems were the everyday means of communications and none of them were truly satisfactory." Only from the mid-1980s did a purpose-built network give most units secure communications.[44] The airwaves were shared with everyone else. The Army found it had to coordinate its use of the spectrum with "fire brigades to air traffic controllers, doctors on call, hospitals and medical users".[45] And civilian broadcasting itself was contested: in the early 1970s loyalists were found to be jamming the BBC from a club

in Belfast, located by an Army electronic warfare team and raided.[46]



6.6 A shop selling citizens band radio transceivers in the Netherlands, 8 February 1980.

NATIONAAL ARCHIEF / ANEFO, FERNANDO PEREIRA, 930-6614 (CC0)

OFFICIAL ASSESSMENT

The Army judged its counter-loop a "war winner"

The Army's analysis claims that its loop of intelligence, forensics, research and procurement was a "war winner", and that the IRA's turn to sniper attacks in South Armagh in the 1990s "proved for a period to be an effective response to the success of the Army's border watchtowers and its electronic counter-measures." It supports these judgements only with examples that cannot be checked, such as an unnamed device made "effectively obsolete within three months", and calls itself "not intended as a history".[47] RAND's case study sets scholars who stress the IRA's "exceptional ability to adapt" against J. Bowyer Bell, who saw it as constrained by past assumptions, and concludes that its learning "varied" but "in most areas it was extremely successful".[48]

Ministry of Defence, *Operation Banner* (2006), foreword, paras. 824–826, p. 5-10; B. A. Jackson et al., *Aptitude for Destruction*, vol. 2 (RAND, 2005), pp. 93–94.

The analysis also records a cost of the contest to the Army itself. On one occasion a soldier lost a piece of patrol equipment, which "fell into the hands of PIRA, which analysed it and developed a counter which then killed at least one soldier"; the unit had not reported the loss until the end of its tour.[49]

THE TRAIL THE MARKET LEFT

Things bought on a market carry the market's paperwork with them. In the 1980s one investigation showed how far that paperwork could be run backwards.

The bomb that destroyed Pan Am Flight 103 over Lockerbie on 21 December 1988 killed all 259 people on board and 11 people on the ground.[50] The Scottish court that tried two Libyan men in the Netherlands described how investigators traced the debris. Fragments of a consumer electronic product were matched by comparison to a single make and model; fragments of clothing were traced to a shop in Malta.[51] A small fragment of a circuit board was the hardest. Inquiries "within the printed circuit board industry" to trace its origin "were fruitless" until, in about June 1990, it was matched to a type of timer shown to the investigators by the FBI. Enquiries in Switzerland then led to its maker, MEBO, a Zurich firm "engaged in the design and manufacture of various electronic items", whose principal customer in the mid-1980s, according to one of its owners, was the Libyan government.[52] The court reconstructed the firm's orders for circuit boards and its deliveries of sample timers to Libya.[53]

DISPUTED

The court relied on the timer fragment; the convicted man's side contested it to the end

The trial court convicted Abdelbaset al-Megrahi in January 2001 on the combination of evidence, including his association with MEBO's Edwin Bollier and with members of Libyan security and the military who had bought its timers. It could not call it impossible that the clothing had been "united somewhere with a timer from some source other than Libya", but found that the baggage evidence made the Libyan inference "irresistible"; it also found the firm's witnesses unreliable.[54] In 2007 the review commission "found nothing to support" an allegation that the fragment was fabricated.[55] In 2020 his representatives argued that the fragment pointed to a source other than the Libyan government; the commission had rejected that ground.[56] The appeal court in 2021 treated the timers' Libyan sourcing as not disputed in that appeal.[57] Independent critics have made similar arguments, not read for this book.

HM Advocate v Al Megrahi and Fhimah (2001), paras. 45, 47, 82, 89; SCCRC news release, 28 June 2007, p. 7; Al Megrahi v HM Advocate [2020] HCJAC 39, paras. 9–10, 23; [2021] HCJAC 3, para. 71.

Brighton, four years earlier, showed the same development from the other side. On 12 October 1984 a bomb exploded in

the Grand Hotel during the Conservative Party conference. Ten days later the Home Secretary named four people killed and counted 32 injured; later counts differ.[58] The police later established that a guest who had stayed at the hotel about three weeks before had given a false address, and the Home Secretary told the Commons that further inquiries "related to electronic devices recovered from the debris are continuing".[59] The chief constable of Sussex had asked a senior officer from Hampshire to examine the security arrangements; as the Home Secretary summarised his conclusions, no British police force would have searched the whole hotel, because a fully effective search "would have taken some weeks".[60] In our reading, the problem for security was no longer only the moment of an attack but the weeks before it. One member of Parliament asked whether "the technology of terror is now developing more rapidly than the capability of the security forces to deal with it".[61]

Police forces were computerising at the same time. In West Germany the conference of interior ministers decided on 28 January 1972 to build a common police information system, INPOL, and in the years that followed its terminals spread through police offices across the country.[62] The same decade that put calculators, recorders and copiers into private hands put terminals on police desks.

MACHINES THAT COPY

By the end of the 1980s the line this chapter began with, between equipment that belonged to institutions and equipment anyone could buy, ran through the home. Electronic equipment could now record, copy and process information, and it sat in ordinary living rooms.

In February 1980 about one American television household in a hundred owned a video recorder; in February 1990, more than two in three did, some 63 million homes.[63] In 1989, by trade estimates reprinted by the Census Bureau, manufacturers shipped about 12 million telephone answering machines, 4.7 million personal computers, 1.4 million fax machines and 1.1 million cellular telephones in the United States.[64] Answering machines and fax machines could hold or pass on a message with no one present, and a personal computer could store and process it: a tape that could be copied and posted, a page sent at the speed of a telephone call, a statement recorded once and played many times.



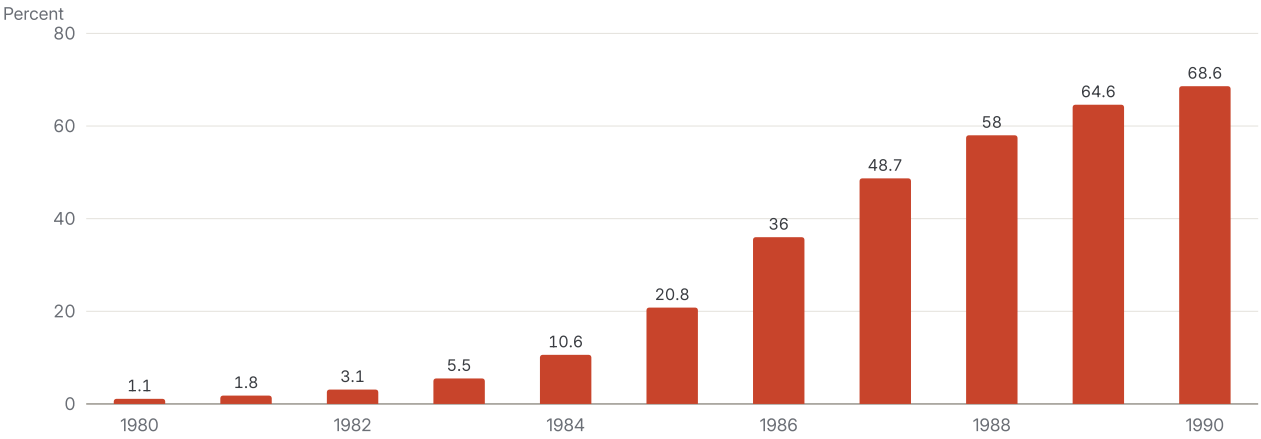
6.7 Crowds at Firato, the consumer-electronics fair in the RAI, Amsterdam, 1 September 1984.

NATIONAAL ARCHIEF / ANEFO, ROB BOGAERTS, 933-0619 (CC0)

In this book's reading, by its four questions, consumer electronics changed labour most. Work that had needed a printer, a typesetter or a photographic laboratory could be done by a member with a machine bought new or second-hand. It did not make violence more destructive. What it changed, at the scale of a street or a hotel, was the distance and time between the person and the act, and it gave the state the same parts to build countermeasures from, and a paper trail running back through the market. It changed the audience least: the groups in this chapter could now produce their own material, but to be heard they still depended on agencies, newspapers and broadcasters, and the British government's restrictions of 1988 assumed exactly that. Reach across borders changed little. On the evidence read for this book, it is not possible to say whether the organisations or the states gained more.

In ten years the share of American television homes with a video recorder rose more than sixtyfold, to over two in three

US households with a videocassette recorder, percent of television households, February of each year, 1980–1990



6.8 Households with at least one VCR, as a share of television households; Alaska and Hawaii excluded. Values for 1981–1982 are from the 1987 edition, which agrees with the 1991 edition where they overlap. In 1990: about 63 million homes.

Source: US Bureau of the Census, *Statistical Abstract of the United States 1991*, Table 919, p. 556 (from Television Bureau of Advertising, *Trends in Television*), and *1987*, Table 906, p. 531 (from A.C. Nielsen, *VCR Trends*; 1981–1982). Data: `data/processed/us_vcr_households_1980_1990.csv`.

What these machines did not yet do, in the cases of this chapter, was carry an organisation's material across the world. The next chapter follows the machines and networks that did: the video cassette, the fax, the international telephone line, satellite television and the personal computer.

TIMELINE 6

Electronics for sale, 1963–1990

1963 TECHNOLOGY August: Philips, by its own account, shows its first compact cassette recorder at the Berlin radio exhibition.

1965 ANALYSIS April: Gordon Moore forecasts that integrated circuits will lead to home computers and personal portable communications, and says an electronic wristwatch needs only a display.

1969 TECHNOLOGY December: the Seiko Astron, the first quartz wristwatch sold to the public, goes on sale in Tokyo; the Italian Ministry of Transport buys a photocopier.

1971 TECHNOLOGY The Bowmar Brain pocket calculator sells for 245 dollars. Late in the year Intel introduces the first commercial microprocessor, made for a calculator.

1972 RESPONSE January: West German interior ministers decide to build the police information system INPOL.

1974 VIOLENCE 17 June: a telephone warning of the bomb at Westminster Hall is "quite unspecific". 19 June: the ministry's photocopier is sold to a private buyer.

1975 TECHNOLOGY Citizens band licences in the US reach 1.5 million by June. May: Sony's Betamax video recorder goes on sale in Japan, by Sony's account. Bowmar is bankrupt.

1978 VIOLENCE 17 May: police find a former ministry photocopier and an army printing machine sold as scrap in a Red Brigades print shop in Rome.

1979 TECHNOLOGY 1 July: the Walkman goes on sale, by Sony's account.

1983 RESPONSE March: Romania forbids private copiers and duplicators and registers typewriters. December: the Harrods warning uses a code word unknown to police.

1984 VIOLENCE 12 October: bomb at the Grand Hotel, Brighton; inquiries follow "electronic devices recovered from the debris".

1988 RESPONSE October: UK broadcasters are barred from carrying direct statements by representatives of proscribed organisations and of Sinn Féin, Republican Sinn Féin and the UDA.

1988 VIOLENCE 21 December: Pan Am 103 destroyed over Lockerbie; a circuit-board fragment is later traced to a Swiss maker of timers.

1990 TECHNOLOGY February: 68.6 per cent of American television households own a video recorder.

Sources: Philips; G. Moore, *Electronics* (1965); IEEE Milestones; Computer History Museum; Office of Technology Assessment (1983); L. Hartung (2010); Hansard 1974, 1983, 1984, 1985, 1988; Commissione Moro, Doc. XXIII n. 5 (1983); GAO (1975); Sony; Decree 98/1983 (Romania); HM Advocate v Al Megrahi (2001); *Statistical Abstract* 1991.

OBJECT 6 · 1959

The Photocopier



PHOTO: PETER HÄLL, TEKNISKA MUSEET (CC BY)

PROCESS DEMONSTRATED
22 Oct. 1948, Detroit (Haloid, xerography)

OFFICE COPIER
Xerox 914, marketed 1959, on plain paper

COPY SHOP, ANN ARBOR, 1978
2.5 cents a page

ROMANIA, 1983
private copiers and duplicators forbidden

PRINT SHOP · ROME 1978

THE PROBLEM

A document existed in as many copies as someone could make by hand, by carbon paper or on a duplicator that needed a specially prepared master. An American scholar of Soviet affairs described Soviet samizdat in 1970 as typescripts, “each page produced with four to eight carbon copies”.[1]

WHAT CHANGED

A dry process that copied any printed page onto ordinary paper. In 1938 the patent attorney Chester Carlson dusted powder across an exposed plate and transferred the image to paper; the Haloid company demonstrated the process publicly in Detroit on 22 October 1948.[2] In 1959, according to the American Society of Mechanical Engineers, Haloid Xerox “risked all assets to market the first fast, low-cost, and convenient office copier, the 914.”[3] The Smithsonian calls the 914 “the world’s first plain-paper copier”.[4] The machine shown opposite is a later desktop model, the Rank Xerox 660-1 of 1966.



O6.1 A Gestetner 460 S stencil duplicator, used from 1975 to 1985 by Hässelby parish, Stockholm: the older way of making many copies.

PHOTO: PER IVAR LINDEKRANTZ, TEKNISKA MUSEET (CC BY)

HOW IT SPREAD

Through offices first, then the second-hand market. The Italian Ministry of Transport bought a copier in December 1969 and wrote it off four years later; in 1974 it was sold to a private buyer, who later advertised it in a newspaper.[5] By 1978 an American copy shop, a Soviet émigré editor noted, charged 2.5 cents a page.[6]

CIVIL USES

Offices, universities, lawyers, shops: any place where paper had to be duplicated quickly and in small numbers, without setting type or cutting a stencil.

IN POLITICAL VIOLENCE

In May 1978 police found a former ministry copier, an army printing machine sold as scrap and an IBM composing machine in a Red Brigades print shop in Rome.[7] A year later a document found in Cassino turned out to be a photocopy that faithfully reproduced one found in Rome.[8]

WHAT NOBODY EXPECTED

That some states would license the copier and register every typewriter. In the Soviet Union copiers stood in locked rooms, an émigré wrote.[9] A Romanian decree of 1983 forbade private persons to own copying machines or duplicators and required every private typewriter to be registered with the militia.[10]



A television camera at a press conference on satellite dishes held by Amstrad, Astra, Esselte and the broadcaster TV-10, 26 September 1989.

NATIONAAL ARCHIEF / ANEFO, ROB C. CROES, 934-5046 (CC0)

7

The Global Signal

1980–2000

In 1980 a statement meant for another continent usually went through a news agency, a telex office or a broadcaster. By the late 1990s, on the evidence of a New York trial, it could be dictated over a satellite telephone from Afghanistan to a newspaper in London, or faxed to a London shop that took faxes for the public. The people who sent it owned none of the networks that carried it.



THE GRAPEVINE STOOD AT 318 TO 320 KILBURN HIGH Road, in north-west London. A detective inspector of the Metropolitan Police's anti-terrorist branch who supervised a search of it in 1998 described it as "a small commercial business which was primarily responsible for providing a service of telecommunications and facsimile messages for members of the public to use at a cheap rate." Customers were served at a small counter. There were eight booths for private telephone calls and, further down on the right, one fax machine. The shop opened from about 08:00 until as late as midnight.[1]

The shop also received faxes for its customers and kept them in a binder, from which customers claimed their own pages at "a nominal fee of about 50 pence per sheet".[2] On Saturday 26 September 1998 the inspector seized the binder. One page in it bore a fax header dated 7 August 1998, 04:45.[3] At the trial in New York in 2001 of men accused of conspiring in the bombings of the American embassies in Nairobi and Dar es Salaam on that day, the prosecution told the jury that it was a claim of responsibility, "found at The Grapevine in London".[4] The bomb in Nairobi killed 12 Americans and 201 other people, almost all Kenyans, and injured about 5,000; the bomb in Dar es Salaam killed 11 more.[5]

No newspaper and no broadcast transmitter belonged to the organisation that, according to the prosecution, sent those claims.[6] Its statements reached the world through a high-street shop that let the public make calls from its booths and send or collect faxes for a fee,[7] through a newspaper published by others, and through the international telephone network that carried both. This chapter is about how that became possible. It follows the machines that made it so between 1980 and the late 1990s: the international telephone line, the fax, the video cassette, the satellite channel and the personal computer. Each was built for business, families or broadcasters. Each allowed a small group to do something that had once needed a broadcaster, a publisher, a studio, a printing press or an office abroad.

THE CHEAPER MINUTE

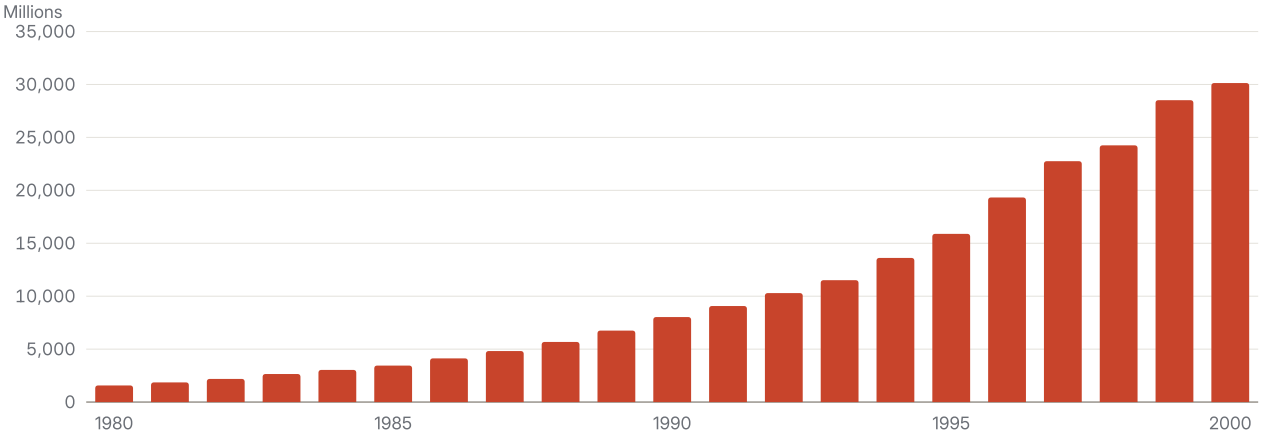
International communication had long meant the telegraph. In 1950, according to the Federal Communications Commission, telegraph service still accounted for 80 per cent of the international revenues of American carriers. The first commercial transatlantic telephone cable was installed only in 1956.[8]

The cable itself was a measure of what changed. The first transatlantic telephone cable had 40 usable circuits, at an

investment cost of 1.2 million dollars per circuit.[9] TAT-8, which entered service in 1988 and was the first cable in the commission's table to use optical fibre, had 6,048 usable circuits at about 59,500 dollars each.[10] Over the same years the call itself became ordinary. Customers of American carriers were billed for about 1.6 billion minutes of international telephone calls in 1980 and for about 30 billion in 2000. The average revenue for each minute fell from 1.34 dollars to 49 cents, and by more once inflation is counted.[11]

Between 1980 and 2000 the international telephone minutes billed by US carriers grew about nineteenfold

Minutes of international telephone calls billed by US carriers, millions, 1980–2000



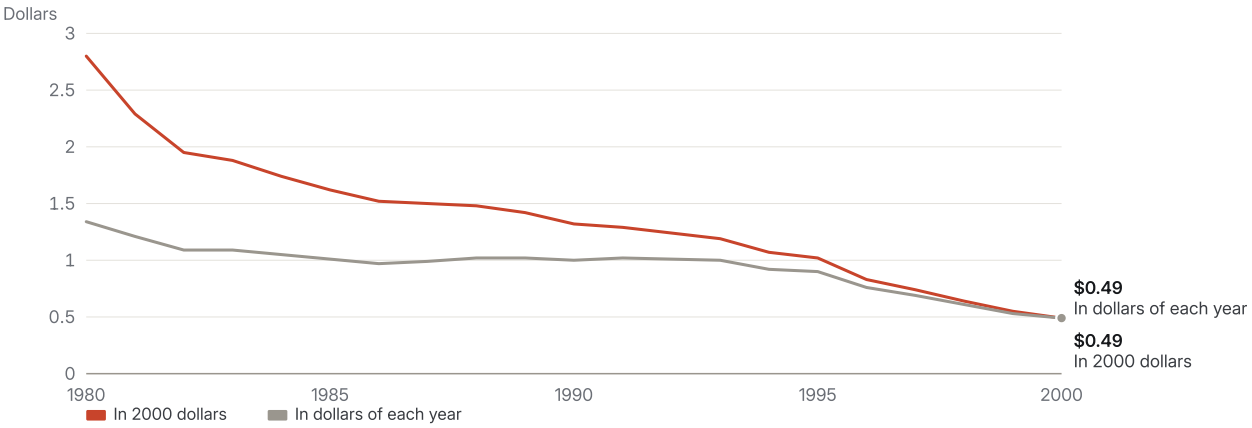
7.1 Calls billed in the United States to all foreign points (Canada and Mexico included from 1980; for carriers other than AT&T, estimated by the FCC for 1985–1990). From 1991 the data cover all US points. In 2000 about 11 per cent of the total were Country Direct, Country Beyond and re-originated calls; the FCC gives this breakdown only from 1993. Calls billed abroad are not included.

Source: Federal Communications Commission, International Bureau, *Trends in the International Telecommunications Industry* (September 2005), Table 2; Table 3 and Appendices A and C for coverage (public domain); 1980–2000; millions of minutes. Data: `data/processed/us_international_telephone_1980_2000.csv`.

These are American figures, and they measure what customers paid on average, not the tariff of any call. They show a direction that the rest of this chapter depends on. Every fax described below travelled as a telephone call, and so, through the 1980s and 1990s, did most connections from home computers to bulletin boards and, later, the Internet.

Allowing for inflation, US carriers billed about a sixth as much for the average international minute in 2000 as in 1980

Average revenue billed to US customers per minute of international telephone service, US dollars, 1980–2000



7.2 An average of what US carriers billed, not the tariff for any particular call. The two lines meet in 2000, the base year. Conversion to 2000 dollars with the consumer price index (CPI-U) is our calculation.

Source: Federal Communications Commission, International Bureau, *Trends in the International Telecommunications Industry* (September 2005), Table 2; US Bureau of Labor Statistics, CPI-U, series CUUR0000SA0, annual averages (public domain); 1980–2000; dollars per minute; 2000 dollars by CPI-U ratio. Data: `data/processed/us_international_telephone_1980_2000.csv`; derivation `scripts/derive/ch07_series.py`.

An early example of what an international line could do for a political movement came from outside terrorism. In October 1978 Ayatollah Ruhollah Khomeini, in exile, settled at Neauphle-le-Château outside Paris. An Associated Press report of 2019, drawing on interviews with people who had been there, says that "With telephones and cassette tape recorders, they turned the exiled cleric's cottage and garden into a media hub"; in the agency's paraphrase of Abolhassan Bani-Sadr, one of his closest aides at the time, recordings of his statements were sold in Europe and taken to Iran, and other messages were read down the telephone to supporters in Iranian towns.[12] The historian Martin Kramer wrote in 1990 that in France Khomeini and his followers "now had easy access to the international media and could direct-dial their supporters in Iran".[13] A Swedish study of 2016 cites earlier accounts in which Khomeini's statements, recorded in France, were played over an international telephone line, recorded again in Tehran and copied onto cassettes; those accounts have not been read for this chapter.[14] The revolution in Iran was not a terrorist campaign. It is here because it showed, at the start of the period, that a voice could leave a village in France and be heard across a country whose broadcaster belonged to the state it opposed.

A PAGE IN A MINUTE

A fax machine scans a page, turns it into a signal that travels over a telephone line, and prints a copy at the other end. The principle was old. What changed around 1980 was that machines of any make could exchange a page quickly.[15]

At first, according to the history published with the milestone that the Institute of Electrical and Electronics Engineers (IEEE) dedicated to the standard in 2012, few companies could afford fax machines, and "each company bought paired sets to communicate with themselves". A recommendation of 1976 for a "three minute facsimile" began to let machines of different makers connect.[16] In 1980 the CCITT, the International Telegraph and Telephone Consultative Committee of the International Telecommunication Union, adopted a further recommendation for "Group 3" machines, which would send a standard A4 page "over a telephone-type circuit in approximately one minute". They were designed for "the general switched telephone network", and could work "when either or both stations are not attended".[17] In our reading, a page could now arrive like a telephone call and wait like a letter.

The older networks declined as the new one grew. The international telex revenues of American carriers peaked at 415 million dollars in 1985 and fell to 33 million in 2000, in current dollars, while their international telephone revenues over the same years rose about fourfold.[18] The commission's own explanation was brief: telegraph and telex "began declining in the 1980s".[19] Its tables have no separate series for fax, which travelled as telephone calls, but it noted that "At one time, facsimile calls represented a large portion of traffic to some countries, particularly points whose time zones are offset from U.S. time zones by many hours."[20] In our reading the fax took over much of the work of telex: a page sent at night arrived on a desk on another continent before morning, and the sender needed only a fax machine and a telephone line.

In our reading, the state had foreseen part of this and missed the rest. In 1985 a report of the US Congress's Office of Technology Assessment noted that the Postal Service's INTELPOST, which "provides high-speed facsimile service by satellite between the United States and Europe", was "little used".[21] International facsimile was on offer as a public service, through the post office. It spread instead as a machine on a desk.

By 1993 Oswald Ganley, executive director of the Program on Information Resources Policy at Harvard, counted the fax



7.3 Part of the new digital telephone exchange of the Dutch state post and telephone company (PTT) in Amsterdam, December 1985. Exchanges like it carried the cheaper calls of the 1980s.

NATIONAAL ARCHIEF / ANEFO, ROLAND GERRITS, 933-5198 (CC0)

among the tools that had passed to small political groups during the previous decade: "Facsimile machines, personal laptop and desktop computers, cheaper satellite access within the price range of individuals, and public access to cable television joined forces with audio and videocassettes for underground uses."[22] It is a judgement made from inside the period, and Ganley gave no cases. The cases this chapter has found are few, and most of them were not violent.

In the 1980s, according to a RAND study for the US Army, "fax machines and e-mail systems enabled the NGOs [non-governmental organisations] to move news out of El Salvador and into the media, to inundate U.S. government inboxes with protests and petitions".[23] After the Zapatista rising in Chiapas in January 1994, and after Mexico's president "called a halt to combat operations",[24] the same networks ran "fax-writing campaigns", and the fax numbers of Mexican and American officials "were often posted in Internet newsgroups and mailing lists".[25] From the mountain town of San Cristóbal de las Casas the Internet links were slow and unreliable: "Faxes and telephone calls afford better communications."[26]

In the United States, armed groups that called themselves militias used the same channels. A report by the Anti-Defamation League, filed in the record of a congressional hearing in 1995, described how "some militia firebrands reach their audience through mail-order videotapes and through computer bulletin boards and the Internet", and "the pro-militia American Patriot Fax Network".[27] The league was a monitor and an advocate, and its report showed channels, not effects: it stated that an association between the men charged with the Oklahoma City bombing and one militia group "does not make the entire movement responsible for the crime."[28]

TAPE WITHOUT A NETWORK

The first video recorders were built for broadcasters. The VHS recorder that JVC announced on 9 September 1976 was, by the account in its IEEE milestone, "smaller and lighter than any other equivalent VTRs".[29] By about 1985 camera and recorder could be one battery-powered unit that a person could carry: a museum in Milan holds a Sony Video 8 camera of about that year, which recorded colour pictures on a cassette.[30] By February 1997, 84 per cent of American television households had a video recorder.[31]



7.4 László Pesty, cameraman of Fekete Doboz (Black Box), films Ferenc Kőszeg, one of the founders of the Alliance of Free Democrats (SZDSZ), at the party's headquarters in Mérleg utca, Budapest, 1989.
FORTEPAN / BÁTONYI CSABA (CC BY-SA 3.0)

What made the cassette a medium, though, was copying. In the United States, on the evidence of a congressional survey, copying turned out to be less common than the fight over it suggested. When an American company announced plans in 1984 to sell recorders with two decks, the Office of Technology Assessment recorded, the film industry's objections halted their introduction, and foreign manufacturers declined to make them. In a survey for the same report "only about one-fifth of the VCR owners had ever copied a prerecorded videotape."[32]

Where television belonged to the state, the same machine did something else. In 1987 two communications scholars, Joseph Straubhaar and Douglas Boyd, wrote that video recorders "circumvent both development use and political control of television by bringing de facto media decentralization. They put the control of programming in the hands of the audience."[33] Recorders cost around 400 dollars in 1984; many had been smuggled in (in Brazil, by an estimate of 1986, roughly two in three had been brought from abroad, mostly by smugglers); and most tapes, "75-80 percent in many countries", were pirated copies, "which can be easily carried in a coat pocket".[34] Their evidence for use by armed groups was thin. Central American guerrilla groups, they wrote, used video recorders "to spread alternative political and social

messages", but the claim rested on a single personal communication, and "The extent of such use is difficult to gauge".[35]

The cases on record in political violence are narrower. In January 1985 a 56-second videotape of William Buckley, a political officer at the American embassy in Beirut who had been kidnapped there in March 1984, was first shown to reporters by Visnews, a television news agency founded by Reuters, the British Broadcasting Corporation (BBC) and broadcasters of Australia, Canada and New Zealand, and then on the *Today* programme of the American network NBC. Visnews would not say how it had obtained the tape.[36] A magazine report preserved in the archive of the Central Intelligence Agency, and identified there as *Time*'s, said that it had "apparently" been filmed by the kidnappers "on a home videocassette".[37] It was not the first such tape. Another, showing three captives, had been sent secretly to the State Department in July 1984 and not made public.[38] In our reading, the new element in January 1985 was the route. A cassette that, by the newspaper's account, appeared to have been made by the captors reached an American network through a syndication agency, in a form the network could broadcast.

UNRESOLVED

Who first used videotape this way cannot be established from the record

A book of 1992 by Gladys Ganley, *The Exploding Political Power of Personal Media*, quoted in a Harvard paper of 1994, said that "The first hostage videotapes" were made by those who held the hostages at the American embassy in Tehran from 1979 to 1981.[39] The same paper quotes her saying that for "more than half a decade" videotapes of American hostages in Lebanon were "regularly passed by their terrorist captors to the mass media".[40] Ganley's own book has not been read for this chapter, and no source read here counts such tapes or dates the earliest. This book does not name a first.

A. T. Green, *New Personal Media* (Harvard PIRP, 1994), pp. 23–24, quoting G. D. Ganley (1992); *New York Times*, 29 January 1985.

A CHANNEL FOR RENT

Chapter 5 ended with a limit. An organisation could create an event; it could not put the event on the air. The cameras, the lines and the satellite circuits belonged to broadcasters and post offices, and the editors in their control rooms decided what went out. Between 1980 and the late 1990s three changes made that limit less absolute, without removing it.

First came continuous news. The Cable News Network (CNN), Ted Turner's 24-hour news service, was due to go on the air on 1 June 1980; the trade weekly *Broadcasting*, writing on the eve of the launch, expected it to reach between 2.5 and 3 million American homes through cable systems that picked its programmes off a satellite. Some of its bureaus were not yet linked to an uplink and sent their reports by carrying tapes to the nearest one.[41] By September 1985 it had foreign bureaus in London, Rome, Moscow, Cairo, Tokyo, Beirut, Jerusalem and, since April, Nairobi, and was opening another in Frankfurt.[42] News directors were interested in the technology: at their American convention that month, satellite news-gathering was expected to account for "the single biggest indoor booth".[43]

The second was reception. From February 1989 the Astra satellite broadcast channels to homes across western Europe; in the centre of its footprint, an encyclopedia of television notes, a dish for its analogue signals could be "as small as 60 centimeters in diameter".[44] A household could now receive programmes from a satellite without a cable company or a national broadcaster in between.

The third was rent. A channel whose programmes left from one country, which was licensed in a second because it was uplinked there, and which leased capacity on satellites owned by others, could be watched in many. The clearest case in the record is a Kurdish-language channel, MED TV, which, according to the members of the Bundestag who later asked about it, began broadcasting from London in the spring of 1995.[45] In September 1996 the German government told the Bundestag that the channel was licensed by the British authorities "because it used a satellite up-link in Great Britain". Its programmes, the government explained, had travelled from Brussels over a German satellite to London, on a transponder rented by a Belgian broadcaster and sublet to MED TV by the hour, and then onwards from a European satellite. The sublease had expired and was not renewed, and the French government, as owner of France Télécom, had terminated France Télécom's contract with the channel with effect from 31 March 1996.[46] In Germany it could be received "only via satellite".[47]



7.5 The satellite dish of Teleport, photographed at the opening of the Teleport Tower in Amsterdam, 15 April 1986.

NATIONAAL ARCHIEF / ANEFO, BART MOLENDIJK, 933-6248 (CC0)

DISPUTED

The German government called MED TV a mouthpiece of the Kurdistan Workers' Party (PKK); British MPs called it the only broadcast medium in Turkey for Kurdish culture, language and news

In 1996 the German government stated that "The PKK uses the station MED-TV as a mouthpiece for its propaganda", that senior PKK officials regularly appeared on it, and that spreading the party's propaganda in Germany broke the ban on its activities of 1993.[48] A Commons motion tabled in March 1999, eventually signed by 11 MPs, described the channel as "the only broadcast medium in Turkey for the expression of Kurdish culture, language and news" and accused Turkey of jamming its transmissions.[49] The two descriptions answer different questions, what the channel carried and whom it served; neither is a court finding.

Deutscher Bundestag, Drucksache 13/5483 (2 September 1996), answers 6 and 12 (our translation); Early Day Motion 469, 1998–99 session (23 March 1999).

By the late 1990s the gate had moved. It was no longer the studio or the national transmitter but the satellite lease, the uplink and the licence, and states used each of them. Britain's Independent Television Commission suspended MED TV's licence on 22 March 1999 and on 23 April decided to revoke it, having found that four broadcasts contained "inflammatory statements encouraging acts of violence in Turkey or elsewhere". According to a report for the European Audiovisual Observatory, it was the first time the commission had revoked a broadcaster's licence.[50]

The same British state had, in 1988, regulated something much smaller. Under the broadcasting restrictions described in chapter 6, broadcasters could show a representative of Sinn Féin speaking and report the words in full, but not in the speaker's own voice. Reviewing the restriction in 1991, Lord Bridge observed in the House of Lords that "The viewer may see the terrorist's face and hear his words provided only that they are not spoken in his own voice."[51] Within the national airwaves the state could still decide whose voice was heard. It had much less hold on a channel uplinked from another country, a fax from abroad or a cassette carried in a pocket.

In the Arab world, the decade brought satellite channels from the region itself. Al Jazeera was founded in Qatar in 1996, according to the Congressional Research Service, after the emir bought the rights to the BBC's Arabic television division; from 1998, the service noted, it aired taped interviews and footage of Osama bin Laden.[52] By then, a policy study

published in Washington in 2004 records, Hezbollah had a television station of its own, al-Manar, which went on satellite as the period ended.[53] That is the start of a different question, for a later chapter: what changed when an armed organisation owned the channel itself.

DISPUTED

Did global live television change policy? The scholars who studied the "CNN effect" did not agree

The "CNN effect" is the claim, in the words of Eytan Gilboa, that "compelling television images" force policymakers to adopt a policy. Gilboa recorded that some authors "strongly support this theory" while another called it a "myth". In 2002 he found that "no sufficient evidence has yet been presented to validate the CNN effect theory, that this effect has been highly exaggerated", and that "'Constraining' rather than 'controlling' policymakers is a more valid analytical concept".[54] Steven Livingston argued in 1997 that the term covered several distinct effects, which had to be separated before any could be measured.[55] In our reading, if the effect on policy is disputed, any effect of satellite news on terrorism needs stronger evidence still.

E. Gilboa, *The Global News Networks and U.S. Policymaking* (2002), pp. 6–7; S. Livingston, *Clarifying the CNN Effect* (1997), pp. 1–2.

A PRINT SHOP ON THE DESK

In 1978 the Red Brigades' print shop in Rome, described in chapter 6, held an IBM composing machine, a copier and a printing machine.[56] Ten years later, in our reading, much of the composing those machines did could be done on a desk.

IBM unveiled its Personal Computer in August 1981.[57] By the company's own account the team built it from "off-the-shelf parts" and published its technical reference, so that other companies could write programs for it.[58] In 1985 Aldus announced PageMaker for the Apple Macintosh. With Adobe's PostScript language and Apple's LaserWriter printer, the Computer History Museum notes, "All three were necessary to create a desktop publishing environment."[59] In 1990 the Office of Technology Assessment described the result for Congress: desktop publishing "eliminates the need for typesetting and mechanical page layout".[60]



7.6 Page layout with a computer at Infra-Expo, a trade fair of newspaper technology, RAI Amsterdam, 10 October 1983.
NATIONAAL ARCHIEF / ANEFO, ROB C. CROES, 932-7268 (CC0)

Paper produced in this way could look like anything, including the state. In 1995 the county attorney of Garfield County, Montana, told a congressional subcommittee about the summonses that a group calling itself the Freemen had sent to federal employees and to a lawyer: "These are very legal looking documents, generated on laser printers with computers, that even to the lawyer that received them thought they appeared that someone might take them seriously."[61]

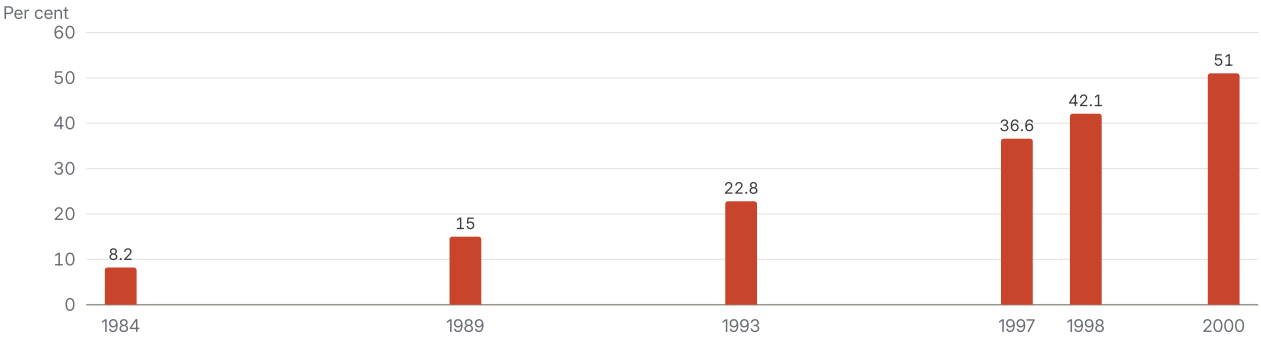
The personal computer could also answer the telephone. In November 1978 two hobbyists from the Chicago area, Ward Christensen and Randy Suess, described in *BYTE* a "personal computer based system for message communication among experimenters", which callers with "terminals or computers equipped with modems" could dial to leave and read messages. Such systems, they wrote, "could then become nodes in a communication network".[62] In 1990 the Office of Technology Assessment noted the political use: "With a personal computer and a modem, individuals can collect and store information related to their concerns; they can maintain lists of potential supporters and contributors and target specific messages to them".[63]

White supremacists in the United States had used such systems for several years by then. In January 1985 the Anti-Defamation League reported "two 'networks of hate' accessed through a home computer and a modem": one, the Aryan Nation Liberty Net, run by Louis Beam, and another operated from West Virginia by George Dietz of Liberty Bell Publications.[64] Callers reached Beam's system by dialling numbers in Idaho, Texas or North Carolina.[65] The league

reported that Beam claimed his system had been set up to get round Canada's embargo on importing hate literature.[66] A study published in 2026 reconstructs the equipment of Dietz's board: an Apple IIe, a 10-megabyte hard disk and a modem, which, its author estimates, would have cost the average consumer about 2,000 dollars in 1985 and "could be purchased at the nearest RadioShack".[67]

By 1997 more than a third of American households had a computer; by 2000, half

US households with a computer, per cent of all households, survey years 1984–2000



7.7 Bars only for the survey years shown in the Census Bureau's Figure 1 (a November 1994 survey is not shown); nothing is interpolated. Households with Internet access were first counted in 1997 (18 per cent) and reached 41.5 per cent in August 2000.

Source: US Census Bureau, E. C. Newburger, *Home Computers and Internet Use in the United States: August 2000*, P23-207 (2001), Figure 1 (public domain). Data: `data/processed/us_home_computers_1984_2000.csv`.

DISPUTED

Whether these were the "first" computer networks of hate, and whether they mattered

The study of 2026 calls Dietz's board, created in August 1983, "the first hate site ever put online", while noting that researchers and activists traditionally name three early boards, Beam's among them.[68] The monitor that reported them in January 1985 did not think them a turning point. The league saw "little evidence to suggest a great leap forward in the spread of anti-Semitic and racist propaganda", while noting that the new technology coincided with "serious talk" among some of the groups about committing acts of terror.[69] Whether Canadians used the board to read what could not be imported is not shown.

Anti-Defamation League, *Computerized Networks of Hate* (January 1985), news release pp. 1–3, report pp. 1–5; I. J. Glazman-Schillinger (2026), pp. 30, 36, 45.

Boards of this kind were small: Christensen and Suess's own went on the air through a single new telephone line in a

basement.[70] In October 1997, 36.6 per cent of American households had a computer. Adults who used one at home used it most often for word processing; "e-mail and communications" came third, after games. In the same month 22.2 per cent of Americans aged three and over used the Internet.[71]



7.8 A Nokia desktop modem of 1989, approved for connection to the Swedish public telephone network; maximum speed 9,600 bits a second.
PHOTO: HÄLL, PETER, TEKNISKA MUSEET (CC BY)

THE LONDON RELAY

The case with which this chapter opened shows several of these machines in one chain. It is documented in unusual detail, by the 9/11 Commission and by the record of the trial in New York in 2001.

In February 1998, the commission found, Osama bin Laden and Ayman al-Zawahiri "arranged from their Afghan headquarters for an Arabic newspaper in London to publish what they termed a fatwa".[72] The statement appeared in *al-Quds al-Arabi* on Monday 23 February 1998.[73] A summary chart admitted at the trial records a call of 30.7 minutes, at 17:49 GMT the day before, from a number registered to the newspaper to a satellite telephone; the prosecution argued that the statement was being dictated.[74] The telephone was a commercial product. An employee of the American company that sold it told the court that a satellite telephone "can be used in remote areas, particularly where there are no other means of communication", and that this model "is about the size of a laptop computer". It had been ordered by fax and paid for in advance, with an authorisation "for the $7,500".[75]

Between Afghanistan and the newspaper stood an office in London. In the summary of the trial evidence issued in 2015 by the federal prosecutor's office that announced his conviction, Khalid al-Fawwaz had been "bin Laden's media representative in London", "screening requests for interviews of Bin Laden and facilitating travel to Afghanistan by journalists", and had delivered the declaration of August 1996 "to a journalist for publication".[76] A disk seized at his home on 23 September 1998 held, in a directory listing read to the jury, an entry called "the message" with a creation date of 31 July 1996, about three weeks before that declaration was issued.[77]

HOW A STATEMENT TRAVELLED

Afghanistan	London office	London daily	Agencies, channels
Satellite telephone, ordered by fax from a company in the United States and paid for in advance	Telephone lines and a fax; at a home, a computer disk holding the 1996 declaration	An Arabic-language newspaper in London published the statement	Pages faxed on to a Paris radio station; a call to a news agency in Dubai; a satellite channel's fax number in an address book

Still owned by others: the newspaper, the agencies, the channels

Their editors decided what was printed and broadcast. Public fax services in London passed pages on for a fee.

7.9 How a statement could travel in 1998, on the evidence of the 9/11 Commission and the 2001 trial in New York. The telephone was bought from an American company; the newspaper, the fax services and the broadcasters belonged to others.

The office also passed on what others sent. On 7 May 1998, the commission records, al-Qaeda's Mohammed Atef "faxed to Bin Ladin's London office a new fatwa issued by a group of sheikhs located in Afghanistan. A week later, it appeared in Al Quds al Arabi".[78] The fax, as translated for the trial and read to the jury in the prosecution's summation, asked London to "send it to the Arab press, Al-Quds, Al Sharq Al-Awssat, Al-Moharer, Al-Hayat and the news agencies, satellite broadcasting agencies and others."[79] In August, around the time of the embassy bombings, claims of responsibility reached London by fax and went on from public fax services. A London police officer told the court that faxes had been sent from London to Radio France Internationale in Paris; a call log from a sub-post office that offered "a fax service to anyone that takes documents to them" showed calls on 8 August to numbers in Paris and Dubai that an address book listed for Radio France and the Associated Press, and the same address book held a fax number for Al Jazeera.[80]

DISPUTED

When the faxed claims reached London was contested

The prosecution told the jury that the claims "are sent as early as 4:45 in the morning" of 7 August, before the bombings.[81] In the London extradition proceedings the defence argued that the time on the faxes would not show this "if that time was not GMT"; the magistrate who committed the men had found only that a jury "could conclude" that the claims were sent before the bombings, and the House of Lords upheld the committal.[82] The 9/11 Commission states that "Shortly afterward", that is, after the bombings, a call was placed from Baku to London and the messages were then faxed there.[83] A machine's clock had become evidence, and its meaning was argued over.

United States v. bin Laden, trial transcript, 2 May 2001, p. 5440; In re Al-Fawwaz [2001] UKHL 69, paras. 91, 168–171; *The 9/11 Commission Report* (2004), p. 70.

International television also sought out the same organisation's leader. Representatives of CNN interviewed bin Laden in Afghanistan on 20 March 1997, and parts of the interview were broadcast in May.[84] Even so, the commission observed of the declaration faxed in February 1998 that "Few Americans had noticed it."[85] On the commission's evidence, publication in London did not make the statement heard in the United States. The equipment was in other people's hands, and so was the attention.

In 2015 the federal prosecutor in Manhattan, Preet Bharara, called al-Fawwaz "bin Laden's bridge to the West in the pre-Internet era".[86] It is a prosecutor's phrase; in our reading, the trial record bears out the function it describes. In this case an organisation in a remote place relied on people in a capital to receive its pages, take its calls and hand its words to editors.

TIMELINE 7

Small machines, long distances, 1976–1999

1976 TECHNOLOGY September: JVC announces the HR-3300, a VHS video recorder for the home (30 pounds, by the account in its IEEE milestone).

1978 TECHNOLOGY November: two hobbyists from the Chicago area describe in *BYTE* a bulletin board on a personal computer that people with modems can call to leave and retrieve messages.

1980 TECHNOLOGY The CCITT adopts its Group 3 recommendation for fax machines that send a page in about a minute over the telephone network. On 1 June CNN is due to begin 24-hour news, fed by satellite to cable systems.

1981 TECHNOLOGY August: IBM unveils its Personal Computer, built largely from off-the-shelf parts made by other companies, by IBM's own account.

1985 ANALYSIS January: the Anti-Defamation League reports two computer bulletin boards of the far right in the United States, reached with a home computer and a modem.

1985 VIOLENCE January: a videotape of the kidnapped American diplomat William Buckley is shown to reporters by a London-based news agency and then on NBC.

1985 TECHNOLOGY Aldus announces PageMaker; with PostScript and the LaserWriter it makes desktop publishing possible. US carriers' international telex revenue peaks in current dollars.

1988 TECHNOLOGY TAT-8, the first fibre-optic cable in the FCC's table of transatlantic systems, enters service.

1989 TECHNOLOGY February: the Astra satellite, launched in December 1988, becomes operational, broadcasting direct to home dishes.

1994 ANALYSIS January: after the Zapatista rising in Chiapas, non-governmental organisations in Mexico and abroad organise fax-writing campaigns; according to a RAND study, the spokesman's statements reportedly leave the jungle on diskettes.

1995 TECHNOLOGY Spring: MED TV, a Kurdish-language satellite channel later licensed in Britain, begins broadcasting, according to a parliamentary question in the Bundestag.

1995 RESPONSE September: the *Washington Post* prints the Unabomber's manuscript as an insert, on the advice of the Attorney General and the FBI.

1996 TECHNOLOGY Al Jazeera is founded in Qatar, according to the Congressional Research Service.

1997 TECHNOLOGY October: 36.6 per cent of American households have a computer, and 22.2 per cent of Americans aged three and over use the Internet.

1998 VIOLENCE February: a statement arranged from Afghanistan is published by an Arabic daily in London. August: after the embassy bombings, prepared claims of responsibility are faxed to London, according to the 9/11 Commission; police later seize a fax dated that morning at a public fax shop.

1999 RESPONSE April: Britain's Independent Television Commission decides to revoke MED TV's licence; according to the European Audiovisual Observatory, the first licence it has revoked.

Sources (see Bibliography): IEEE 2006; Christensen and Suess 1978; CCITT 1981; "CNN: the clock can never stop" 1980; IBM; Anti-Defamation League 1985; Gwertzman 1985; Computer History Museum; Federal Communications Commission 2005; Museum of Broadcast Communications; Ronfeldt et al. 1998; Deutscher Bundestag 1996; CNN 1995; Sharp 2003; US Census Bureau 1999; National Commission on Terrorist Attacks 2004; United States v. bin Laden 2001; Prosser 1999.

STILL ON PAPER

Even near the end of the period, mass distribution could still depend on a press someone else owned. In 1995 the man the Federal Bureau of Investigation (FBI) called the Unabomber demanded that the *Washington Post* or the *New York Times* print his 35,000-word manuscript, threatening to continue his bombings if they did not. Both newspapers agreed after the Attorney General, Janet Reno, and the director of the FBI, Louis Freeh, recommended publication "for public safety reasons". On 19 September the text appeared as an eight-page insert in the *Post*, chosen, the publishers said, for its "mechanical ability to distribute a separate section in all copies of its daily newspaper."[87] The FBI's own history says that the essay was published "in hopes that a reader could identify the author". The author's brother came forward with letters and documents; the bureau's analysts concluded that their author and the manifesto's "were almost certainly the same", and Theodore Kaczynski was arrested on 3 April 1996.[88]

The Zapatistas, a movement often said in the 1990s to have been organised online, worked in a similar way. "The notion that Marcos uploads his statements to the Internet is apocryphal," the RAND study noted of the movement's spokesman, Subcomandante Marcos. "He does reportedly have a laptop computer with him in the jungle, but uploading and downloading anything is accomplished by having diskettes taken to San Cristóbal."[89] In the mid-1990s, on RAND's account, a statement could be written on a computer and still have to leave the forest on a disk carried by hand.

A SIGNAL WITHOUT AN OWNER

In this book's reading, of its four questions, the machines of this chapter changed reach most. A page could cross an ocean in a minute, a voice on a satellite telephone could reach a newspaper in London, a cassette could cross a border in a coat pocket, and a channel uplinked in one country could be watched in many others. They changed labour as well. Work that had needed a correspondent, a telex office, a print shop or a studio could be done by a shop that rented telephones, a disk, a home camera or a rented hour on a satellite. They changed the violence itself not at all; the chapter has not needed to describe a single weapon. Audience changed little. Statements meant for a wide public still had to be printed by newspapers or aired by broadcasters, and the evidence read

for this book does not show that any of them was seen more widely because it travelled by fax or satellite. States adapted at the points where they still had a hold: the licence, the uplink, the satellite contract, the voice on a national channel, and the records that every call and every fax header left behind.

By the end of the decade the dependence on paper was beginning to give way. In October 1997 more than a fifth of Americans used the Internet, and by August 2000, 41.5 per cent of American households had access to it at home.[90] By 2005 the Federal Communications Commission could note that "Email and the use of web pages have greatly reduced the amount of facsimile traffic."[91] The statements in this chapter had travelled as pages, tapes and disks, or as calls that ended on paper. In our reading, three things that the next chapter depends on were in place by the late 1990s: statements were being written and stored as computer files, the computers that held them were being connected by telephone lines, and a copy no longer had to be carried, posted or faxed as an object. A statement no longer had to exist as a page, a tape or a disk before it could travel. The next chapter follows what happened when the network arrived.

OBJECT 7 · 1980

The Fax Machine



PHOTO: SUNDELL, PER, TEKNISKA MUSEET (CC BY)

GROUP 2 RECOMMENDATION
1976, about three minutes a page

GROUP 3 RECOMMENDATION
1980, about one minute a page

US SHIPMENTS, 1989
1.4 million machines

KILBURN HIGH ROAD, 1998
about 50 pence a sheet to collect a fax

FAX BUREAU · LONDON 1998

THE PROBLEM

A page could cross an ocean only if someone carried it, posted it or turned it into another kind of message. Facsimile machines existed, but for years, according to the history published with the IEEE milestone for the international standard, few companies could afford them, and each company "bought paired sets to communicate with themselves".[1] A public service did exist. In 1985 the US Postal Service offered international facsimile by satellite between the United States and Europe; Congress's Office of Technology Assessment noted that it was "little used".[2]

WHAT CHANGED

A common language for machines. An international recommendation of 1976 provided for Group 2 machines that sent a page in about three minutes; the Group 3 recommendation of 1980 brought it to "approximately one minute" over the switched telephone network, with or without anyone at either end.[3] The machine opposite, a Panafax UF-400, was made by Panasonic between 1984 and 1990.

HOW IT SPREAD

Through offices, then homes. In 1989 manufacturers shipped about 1.4 million fax machines in the United States.[4] International traffic followed. The Federal Communications Commission later recalled that "At one time, facsimile calls represented a large portion of traffic to some countries, particularly points whose time zones are offset from U.S. time zones by many hours."[5]

CIVIL USES

Offices first, and newspapers, which by the 1980s used computer composition and "fax transmission of whole newspapers over limitless distances", in the words of Oswald Ganley of Harvard's Program on Information Resources Policy.[6] In 1994 activist groups in North America that supported the Zapatistas ran "fax-writing campaigns" aimed at Mexican officials, whose fax numbers, and those of American officials, were posted in Internet newsgroups.[7]

IN POLITICAL VIOLENCE

On 7 May 1998, according to the 9/11 Commission, a senior al-Qaeda commander faxed bin Laden's London office a new statement issued by a group of sheikhs in Afghanistan; a week later it appeared in a London Arabic daily.[8] That September police seized the binder of received faxes at The Grapevine, a shop in Kilburn High Road with eight telephone booths and one fax machine, on which its owners sent and received faxes for the public.[9]

WHAT NOBODY EXPECTED

That the line of small type at the top of every page would become evidence. A fax header usually recorded the sender's name or number, the date and the time.[10] At the trial in New York in 2001 the prosecution argued from the times on the headers when claims of responsibility had been sent; in London, counsel for men facing extradition argued that the time on the faxes would not show they had been sent before the attacks "if that time was not GMT".[11] A machine bought to save time had begun to keep it.

OBJECT 8 · 1976

The VHS Cassette



PHOTO: LOMIT, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS

FIRST VHS RECORDER
JVC HR-3300, announced 9 Sept. 1976, 30 lb

RECORDING TIME
two hours

PRICE, 1984
about 400 dollars at world prices

US TV HOUSEHOLDS WITH A VCR, 1997
84 per cent

HOSTAGE TAPES · LEBANON 1984–85

THE PROBLEM

A recording of television belonged to the people who made television. In 1956, according to the IEEE's history of the format, the first commercial reel-to-reel videotape recorder, made by Ampex, had "the size of a jukebox".[1]

WHAT CHANGED

On 9 September 1976 JVC announced the HR-3300, a VHS recorder for the home. By the account in its IEEE milestone it weighed 30 pounds and could record for two hours.[2] By about 1985 camera and recorder could be one battery-powered unit, like the Sony Video 8 held by a museum in Milan.[3]



O8.1 A Ferguson Videostar portable video recorder in its shoulder bag, made to record from a video camera, 1979.
PHOTO: HÄLL, PETER, TEKNISKA MUSEET (CC BY)

HOW IT SPREAD

In February 1980 about one American television household in a hundred had a video recorder; by February 1997, 84 per cent did.[4] In 1984, two communications scholars wrote, the machines cost around 400 dollars at world prices, and their table put three television households in four in Saudi Arabia as owners of one that year (their text gives 80 to 90 per cent).[5]

CIVIL USES

Recording programmes to watch later, and playing prerecorded tapes. Few owners copied them. When an American company announced recorders with two decks in 1984, the film industry's protests halted their introduction, and in a survey for the US Congress "only about one-fifth of the VCR owners had ever copied a prerecorded videotape."[6]

IN POLITICAL VIOLENCE

In January 1985 a 56-second tape of the kidnapped American diplomat William Buckley was released to reporters by a London-based television news agency and then broadcast on NBC. A magazine report, attributed to *Time*, said it had "apparently" been filmed "on a home videocassette".[7]

WHAT NOBODY EXPECTED

That the cassette would matter most where television was controlled. In many countries, Straubhaar and Boyd wrote in 1987, most tapes were pirated copies, and even the Soviet Union and France had been unable to stop the illegal import of recorders, "much less tapes", which could be "easily carried in a coat pocket".[8] The machine sold as a convenience in American living rooms became, elsewhere, a way round the state broadcaster.



Server rooms in the basement of KTHNOC, photographed for the Tekniska museet, Stockholm, on 12 November 2003.

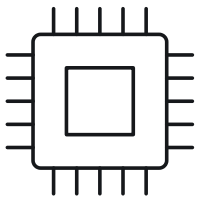
PHOTO: CRONESTRAND, NISSE, TEKNISKA MUSEET (CC BY)

8

The Network Arrives

1990–2005

Until the 1990s a small organisation that wanted to be read far away needed someone else's press, transmitter or newspaper. On the Web it could be its own publisher, and its own archive, from a rented server in another country.



FOR A PERIOD OF TIME, THE FEDERAL PROSECUTOR'S OFfice in Connecticut said in 2013, a set of websites run from London "were made possible through the unwitting services of a web-hosting company headquartered in Trumbull, Conn."[1] The sites went by the name of Azzam Publications. In a federal court in New Haven that December, a British man, Babar Ahmad, admitted that he had operated them, and that their purpose was "to 'Incite the believers' and also secondly to raise some money for the brothers". He and a second defendant, Syed Talha Ahsan, admitted that the sites had posted articles on supporting the jihad and the mujahideen and biographies of "martyrs", and had produced or sold audio and video recordings advertised on the websites. Ahsan admitted that in 2001 he had helped by processing video orders and passing on the correspondence sent to the operation's post office box in London.[2]

The indictment returned in Connecticut in 2006 alleged that "From in or about 1998 through at least 2002" accounts had been opened and maintained with Internet service providers and web-hosting companies in the United States, and that the sites had also been maintained in Britain, Ireland, Malaysia and elsewhere.[3] When the European Court of Human Rights later reviewed the men's extradition from Britain, it summarised the American case as alleging support "provided through a series of websites, one of whose servers was based in Connecticut".[4] Ahmad was arrested in 2004 and Ahsan in 2006; they were extradited in October 2012, and in July 2014 they were sentenced in Connecticut.[5] Announcing their pleas, a senior official of the Justice Department called the case "an early example of individuals using the internet not only to radicalize others and spread violent propaganda, but also to further the actions of terrorist groups".[6]

Chapter 7 opened in a London shop where the public could make calls from booths and send or collect faxes. In 1998, through such shops and offices, statements reached the world by way of a newspaper, agencies and telephone networks that others owned. Azzam Publications did not need a newspaper to be read. A few people in London published and sold their material and, for a period, kept it on the servers of a web-hosting company on another continent, where anyone with a connection could find it. This chapter follows how that became possible between 1990 and 2005, and asks what changed when a small organisation could publish to the world without a printing press, a television station or a satellite channel. The short answer, on the evidence of this chapter, is that publication, correspondence and the archive began to run on the same infrastructure.

ANYONE CAN PUBLISH

In our reading, the clearest description of the change came from the state. In June 1997 the Supreme Court of the United States struck down parts of a law that would have restricted "indecent" material on the Internet. In doing so it described the network, drawing on the findings of the federal trial court in Pennsylvania. The number of host computers, the Court said, had risen "from about 300 in 1981 to approximately 9,400,000 by the time of the trial in 1996", and "About 40 million people used the Internet at the time of trial". They reached it through universities, employers, libraries and "an increasing number of storefront 'computer coffee shops'".[7]



8.1 Cyberia, an internet café in London, photographed in June 1995.
PHOTO: ROGER GREEN, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS

The Court then explained what the World Wide Web meant for a publisher. "Any person or organization with a computer connected to the Internet can 'publish' information. Publishers include government agencies, educational institutions, commercial entities, advocacy groups, and individuals."[8] It quoted the trial court's finding that "thousands of individual users and small community organizations are using the Web to publish their own personal 'home pages,' the equivalent of individualized newsletters about that person or organization, which are available to everyone on the Web".[9] And it drew the contrast that matters for this book. Broadcasting had been regulated because the spectrum was scarce; "the Internet can hardly be considered a 'scarce' expressive commodity. It provides relatively unlimited,

low-cost capacity for communication of all kinds." Through web pages, mailing lists and newsgroups, the Court wrote, anyone with a phone line "can become a pamphleteer."[10]

Chapter 5 showed that television gave political violence a global audience while broadcasters kept the channel. Chapter 7 showed that faxes, cassettes and personal computers loosened that hold without breaking it. In 1997 the highest court of the largest market for the new medium described a channel that no one controlled and anyone could use. In our reading, it was describing the opposite of the conditions under which the satellite broadcasts of chapter 5 had been made.

FROM A TELEPHONE CALL TO A PAGE

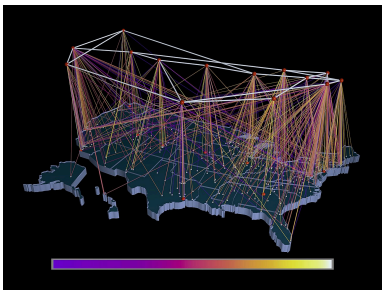
Most of the pieces were older than the Web. In 1999 the national chair of the Anti-Defamation League (ADL), Howard Berkowitz, told a Senate committee in a prepared statement that even before the white supremacist site Stormfront appeared on the Web, extremists had been using Internet Relay Chat, USENET newsgroups, which "have been compared to community bulletin boards", and "Electronic mailing lists".[11] Chapter 7 followed the bulletin boards of the 1980s, which were reached one telephone call at a time. What the 1990s added was a common way to put a document in one place and let anyone find it.

That had been the point from the beginning. In March 1989 Tim Berners-Lee, a British scientist working at CERN, the European laboratory for particle physics near Geneva, proposed "a universal linked information system". Its aim, he wrote, "would be to allow a place to be found for any information or reference which one felt was important, and a way of finding it afterwards."[12] By CERN's account, a browser and a server were running at the laboratory by December 1990; the National Center for Supercomputing Applications in Illinois issued the first official release of its Mosaic browser on 21 April 1993; and on 30 April 1993 "CERN put the World Wide Web software in the public domain".[13] In 1995 the National Science Foundation, which had paid for the American research backbone, shut its network down, because, in the Foundation's words, of the "Rapid expansion of commercial internet services".[14]

For most people the connection was still a telephone call. The modem, a device that turned a computer's data into sounds a telephone line could carry, set the speed. The recommendations of the International Telecommunication Union (ITU) show the ladder: 9,600 bits a second under the V.32 standard, 28,800 under V.34 in 1994, and from 1998, under V.90, "up to 56 000 bit/s downstream" over the ordinary public network.[15] In September 2001, by the Commerce Department's count, 80 per cent of Americans who went online from home did so by dial-up.[16] Mail came first among the uses of the network. In August 2000, 79.9 per cent of American Internet users said they used e-mail, which the department called "the Internet's most widely used application".[17]

Finding things became a technology of its own. In a paper presented in 1998, two graduate students at Stanford University, Sergey Brin and Lawrence Page, recorded that in 1994 "one of the first web search engines" had indexed 110,000 pages, and that by November 1997 the leading engines claimed to index "from 2 million (WebCrawler) to 100 million web documents".[18] In our reading, search changed what publication meant. A text placed on a server could be found by a stranger who did not know it existed, long after it was posted.

Pictures and sound followed text onto the same machines. A study of the world's production of information at the University of California, Berkeley, estimated that in 2002 "there were 27.5 million digital still cameras purchased worldwide, compared to 63 million analog (film- based) cameras", and that the visible Web held "about 170 terabytes of information", which "in volume" was "seventeen times the size of the Library of Congress print collections".[19] They are the study's estimates, not counts. In our reading, they show that by the end of the period images, recordings and video could be made and stored in the same form as a page of text.



8.2 Traffic entering NSFNET, the National Science Foundation's research backbone, in September 1991, visualised at the National Center for Supercomputing Applications, University of Illinois.

VISUALIZATION: DONNA COX AND ROBERT PATTERSON, NCSA, UNIVERSITY OF ILLINOIS; DATA MERIT NETWORK (CC BY-SA 3.0, VIA WIKIMEDIA COMMONS)



8.3 A U.S. Robotics Sportster Voice 56K external fax modem, of the kind that connected home computers to the Internet over a telephone line.

PHOTO: XIAOWEI; DERIVATIVE BY PITTIGRILLI, CC BY 3.0, VIA WIKIMEDIA COMMONS

WEB PAGES FOR THE PRESS

In our reading, the armed organisations that went online early used their sites mainly to reach people who already had audiences: journalists and editors. In June 1996 the Director of Central Intelligence, John Deutch, told a Senate subcommittee that terrorist groups "themselves have increasingly used the Internet and other modern means for their own communications. The groups concerned include such well-known, long-established organizations as the Lebanese Hizballah".[20] By the account of the political scientist Maura Conway, writing in 2002, Hezbollah then ran three sites, one of them for its Central Press Office, with statements, political declarations,

speeches, photographs and audio and video clips, and an e-mail address for contact.[21] One of them, the communication scholar Gabriel Weimann wrote in 2004, "specifically addresses journalists, inviting them to interact with the organization's press office via-email". Press releases were posted, he added, "in an effort to get the organization's point of view into the traditional media."[22]

Such a presence could cost nothing. In May 1997 the *San Francisco Chronicle* reported that the State University of New York at Binghamton had shut down a website of the Revolutionary Armed Forces of Colombia (FARC) on its server, while at the University of California, San Diego, a site supporting the Peruvian Túpac Amaru Revolutionary Movement (MRTA), put up and run by a group in Toronto, had operated "since shortly after the Peruvian rebel hostage crisis began in December". Such space, the newspaper said, "would cost several hundred dollars per year at a commercial server". Spokesmen for the State and Justice departments said there was little they could do "as long as the material posted does not directly incite violence".[23] In our reading, one of the gatekeepers was now the computing policy of a university.

The far right moved to the Web in the same years. Another witness at the Senate hearing of 1999 wrote in a prepared statement that in 1995 the Ku Klux Klan leader Don Black, as he described him, had established the site Stormfront.[24] Berkowitz called it "the first extremist hate site on the World Wide Web".[25] Chapter 7 recorded a scholar's claim that a bulletin board of 1983 was "the first hate site ever put online". The two claims answer different questions, and neither is adopted here.

DISPUTED

How many armed organisations had websites by the end of the 1990s? Researchers disagreed

Weimann wrote in 2004 that "In 1998, around half of the thirty organizations designated as 'Foreign Terrorist Organizations'" by the United States maintained websites, and that by 2000 "virtually all terrorist groups had established their presence on the Internet".[26] Conway wrote in 2002 that in 1999 it had been reported that "12 of the 30" had their own sites.[27] Weimann described his search method only in general terms; Conway repeated a press report. Neither published the lists behind the numbers. What the sources agree on is the direction, not the numbers.

G. Weimann, *www.terror.net* (US Institute of Peace, 2004), p. 2; M. Conway, "Reality Bytes", *First Monday* (2002).

A SHOP WINDOW IN LONDON

Azzam Publications showed how much more a website could carry than a press release. The prosecutors' summary of the pleas of 2013 describes one operation that was at the same time a publisher of texts, a mail-order business for videos and a fundraiser.[28] The indictment alleged that e-mail accounts "associated with the websites" were used "to administer the websites", to correspond with readers and donors, and to deal with "those who sought to purchase items advertised on the websites. These items included videotapes".[29] In our reading the cassette of chapter 7, and the London post office box, were still there. The Web was the shop window and the catalogue; the goods still travelled by post.

The sites were known in New York before September 2001. On 31 May 2001, at the penalty phase of the trial over the embassy bombings of 1998 described in chapter 7, counsel for one convicted defendant offered material "off a Web site called jihad in Chechnya, by Hazzam Publications", which he described as "a group of jihad Web sites". It was, he told the court, his "understanding he has never seen them".[30] In our reading, the two forms of publication had by then met in the same trial record: the operation that had arranged the statements of 1998 by fax and satellite telephone, and a publisher that needed neither.

	BEFORE THE WEB	ON THE WEB · c. 2005
Write and lay out	Typewriter, composing machine	Personal computer
Make copies	Print shop or copier	The server, a copy for each reader
Distribute	Post, couriers, fax, newspapers	The Web and e-mail
Reach a mass audience	Broadcasters and their editors	Still, mostly, broadcasters
Sell and collect money	Post office box, mail order	Site as shop window; goods by post
Keep and find later	Files, libraries, archives	The site itself, search engines, others' copies

8.4 Who did the work of publication for a small organisation, before and after the Web. The roles are those described in chapters 5 to 8; the diagram simplifies, and both forms coexisted throughout the period.

ONE MORNING, SEVERAL NETWORKS

On 11 September 2001 the attacks took place in three places, and were followed through every network of the period at once. The aircraft belonged to the system of commercial aviation that chapter 4 described. News of them went out over broadcast and cable television, by telephone and the mobile network, and onto the Web.[31]

Television came first. "Most federal agencies learned about the crash in New York from CNN," found the National Commission on Terrorist Attacks Upon the United States, known as the 9/11 Commission.[32] One fire chief in the lobby of the North Tower said afterwards, in words the Commission quoted, that "People watching on TV certainly had more knowledge of what was happening a hundred floors above us than we did in the lobby."[33] In New York the event also struck the broadcasters themselves: according to a report of the National Research Council, the transmitters of nine of the 14 local television stations were lost when the North Tower fell.[34]

EASTERN DAYLIGHT TIME, 11 SEPTEMBER 2001

Aviation	Aircraft strike the North Tower 08:46, the South Tower 09:03, the Pentagon 09:37; a fourth aircraft crashes in Pennsylvania 10:03
Television	The second impact is seen on television as it happens; most federal agencies learn of the crash in New York from CNN; nine of 14 New York stations lose their transmitters with the North Tower
Telephone	Parts of national toll-free calling impaired right after the 09:03 impact; in New York 75% of mobile calls blocked, 92% at the morning peak
Internet	Connectivity dips but recovers quickly; news sites strain under demand; CNN reports 132 million page views on its site that day, 14 million the day before; e-mail and instant messaging used instead of the phone
Archive	Afterwards: websites about the attacks archived daily until 1 December 2001; television news recorded live and put online from 11 October 2001

At 09:03 in New York it was 14:03 in London, 15:03 in Paris, 17:03 in Moscow, 21:03 in Beijing and 22:03 in Tokyo

Local clock times are our calculation.

8.5 11 September 2001: one morning, several networks. Times and the CNN detail are from the 9/11 Commission, in Eastern Daylight Time; telephone, Internet and transmitter facts from the National Research Council's report of 2003; archive facts from the Pew Internet and American Life Project and the Internet Archive. Local clock times abroad are our calculation.

In New York the telephone networks could not carry the load. There, the council reported, "75 percent of calls were blocked (92 percent at the morning peak)" on the mobile networks, and parts of the national toll-free system were impaired after the second impact.[35] The Internet as a whole held up better. Its loss of connectivity "was actually less than has been seen in other incidents affecting the Internet", and people used e-mail and instant messaging as "substitutes for telephone service"; but news websites were "straining under unprecedented levels of demand".[36] CNN (Cable News Network) told the council that its website recorded 132 million page views on 11 September, against 14 million the day before, and that it stripped its home page down so that its servers could deliver more pages.[37]

The audience still chose television. In a survey taken between 20 September and 1 October by the Pew Internet and American Life Project, whose results the council reproduced, 79 per cent of Americans named television as their main source of information about the attacks, and 2 per cent the Internet.[38] The project's own researchers concluded that "this was not a breakthrough moment for use of the Internet compared to other technologies, as some have argued".[39] What was new came afterwards. Two researchers, by their own account working with the Library of Congress, the Internet Archive and volunteers, collected websites about the attacks and archived each of them every day until 1 December 2001.[40] A non-profit Television Archive recorded television news live from around 11 September and put it online from 11 October 2001; in 2011 the Internet Archive published 3,000 hours of it, from 20 channels over seven days, among them stations in Japan, China, Russia, Iraq and Mexico.[41] The record of the event was being kept, as the Web and the world's television showed it, while it was still news.

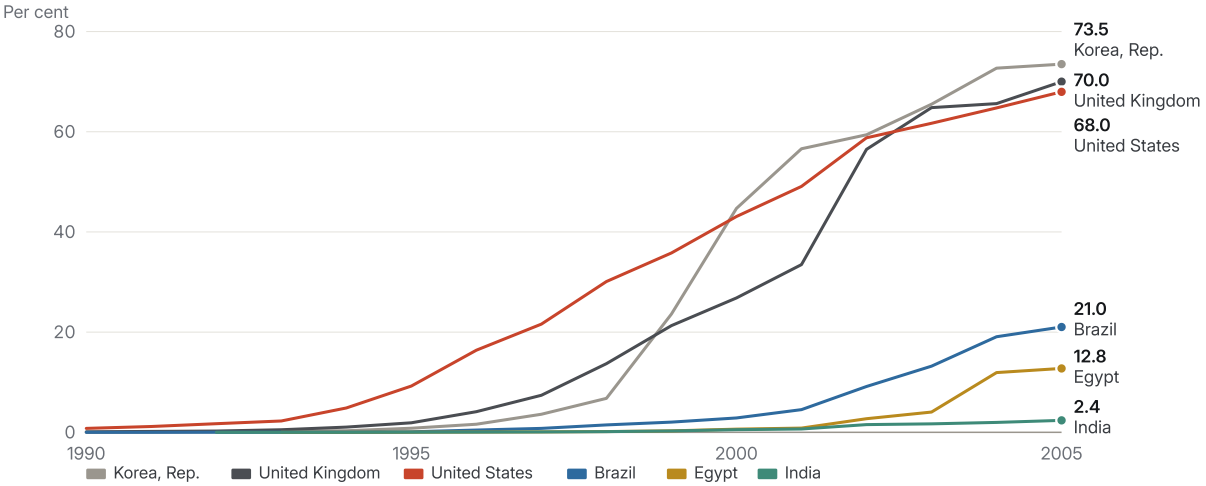
THE BROADCASTER'S LAST MONOPOLY

In our reading, al-Qaeda, the organisation the Commission held responsible, was not, before 2001, an organisation of the Web, though others' sites carried its material. As late as 10 September 2001, Thomas Hegghammer of the Norwegian Defence Research Establishment (FFI) later noted, many of the videos that were the cornerstone of its recruitment could be bought online, from azzam.com among others, or downloaded.[42] The Commission's report, in the passages read for this chapter, describes the plot's organisers keeping in touch by e-mail and instant messaging, and describes no al-Qaeda website before the attacks.[43] It recorded in 2004, from a

United States government working paper, that in the broader Middle East "Less than 2 percent of the population has access to the Internet".[44] The International Telecommunication Union's estimates, revised since, are higher for Egypt and Saudi Arabia by 2003 (4.0 and 8.0 per cent; Egypt is shown in the chart below).[45] Al-Qaeda's own statements went where chapter 7 found them: to newspapers and to satellite television. Portions of a propaganda video made after the attack on the USS *Cole* in October 2000, the Commission noted, "were aired on Al Jazeera, CNN, and other television outlets".[46]

In 2000 a quarter or more of people used the Internet in the rich countries shown, under 3 per cent in the others

Individuals using the Internet, per cent of population, selected countries, 1990–2005



8.6 Estimates of the International Telecommunication Union, under its current definition (use in the previous three months). National series contain breaks (United Kingdom 2001–02, Korea 1998–99, Egypt 2003–04). In 2000: Saudi Arabia 2.2, Egypt 0.6, India 0.5 per cent. No world total is published before 2005 (15.6 per cent).

Source: World Bank, World Development Indicators, IT.NET.USER.ZS, from ITU World Telecommunication/ICT Indicators Database (CC BY 4.0); 1990–2005; per cent of population. Data: `data/processed/wdi_internet_users_selected_1990_2005.csv`.

Hegghammer's catalogue of al-Qaeda's statements, published by the FFI in 2003, shows when that changed. Up to the end of 2001 the statements and interviews it lists were released mainly through Al Jazeera, newspapers and Western television and news magazines. The first it dates to a website appeared in April 2002.[47] Since January 2002, he wrote, there had been a flowering of short-lived websites apparently run by al-Qaeda members or strong sympathisers.[48] In our reading, the move followed the loss of the organisation's base in Afghanistan at the end of 2001: an organisation that could no longer count on its old routes to a broadcaster began to publish for itself. Even then the two worked together. In 2002 the

news agency Agence France-Presse reported an audio warning issued "on the drasat.com site which was aired by Qatar's Al-Jazeera satellite channel".[49]

DISPUTED

Whether al-Qaeda had a website before September 2001

In 2006 the terrorism scholar Bruce Hoffman told a congressional committee that "before 9/11, al-Qa'ida had only one website: www.alneda.com", citing a book by Weimann that has not been read for this chapter.[50] Conway wrote in November 2002 that the same site "is thought to have first appeared on the Net in early February 2002", and the Norwegian catalogue first lists statements on it in April 2002.[51] A wire report of 2002, whose exact date is uncertain, said the site had carried statements "for about five months".[52] Whether any al-Qaeda website existed before the attacks is unresolved on the sources read.

B. Hoffman, testimony, CT-262-1 (RAND, 2006), p. 6; M. Conway, "Reality Bytes" (2002); T. Hegghammer, Norwegian Defence Research Establishment (FFI) report (2003), pp. 6–8; Sapa-AFP, *Mail & Guardian* (2002).

The question of who controlled a statement's route also reached back to chapter 7's satellite telephone. The 9/11 Commission found that al-Qaeda's leaders "had stopped using a particular means of communication almost immediately after a leak to the Washington Times" in August 1998; press accounts identified it as the satellite telephone.[53]

DISPUTED

Whether a newspaper report in 1998 made bin Laden stop using his satellite telephone

The Commission based its finding on the *Washington Times* of 21 August 1998 and on interviews with intelligence officials.[54] In 2005 Glenn Kessler of the *Washington Post* traced the story. He found that *Time* had reported bin Laden's use of satellite telephones in December 1996, that the *Washington Times* had mentioned the telephone in its 21st paragraph without saying that the United States was listening, that television networks had mentioned it too, and that American cruise missiles had struck his camps the day before. "Causal effects are hard to prove," he wrote.[55]

The 9/11 Commission Report (2004), p. 127 and n. 105; G. Kessler, *Washington Post*, 22 December 2005.

PUBLICATION THAT STAYS

A printed pamphlet could be pulped and a broadcast ended when it ended. A web page could stay up, be copied and be found again. That made the Web an archive as well as a press, and it made the archive a problem.

In November 1996 Brewster Kahle, a founder of the Internet Archive, wrote that while the Web was "unprecedented in spreading the popular voice of millions that would never have been published before, no one recorded these documents and images from 1 year ago."[56] In 2003 the United Nations Educational, Scientific and Cultural Organization (UNESCO) adopted a charter on digital heritage that described web pages among materials that "are frequently ephemeral, and require purposeful production, maintenance and management to be retained".[57] The volatile sites of 2002 were the same problem from the other side. Hegghammer warned his readers that some of the links given in his report would not necessarily still be there in six months.[58]

For history this cuts both ways. In our reading, archived copies are now the record of many sites that their owners took down or lost, and they are also the reason the record is hard to date. In this book's method, a capture shows that a page existed on the day it was captured, not when it was first published; and a claim to be the "first" site of its kind, made from such captures or from memory, is not printed unless a dated primary source supports it.

WHAT THE WEB HAD NOT SOLVED

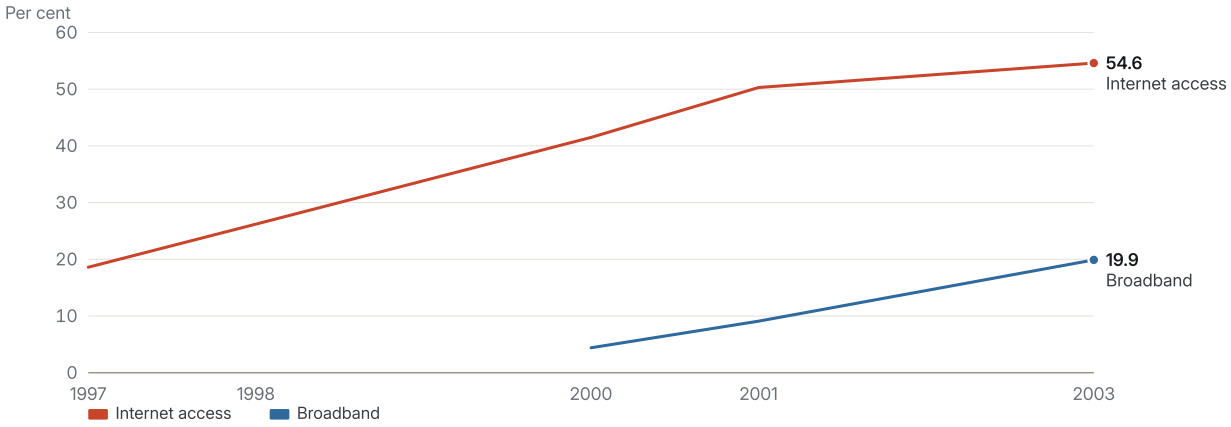
By 2003, 55 per cent of American households had Internet access at home, about three times the share of 1997, according to the Census Bureau.[59] Most of them were still connected by a dial-up telephone call: 38.6 million of the 61.5 million households online in 2003.[60]

In this book's reading, of its four questions, the Web changed reach most. A small organisation could put its statements, its archive and its shop before anyone with a connection, from servers in another country. It changed labour almost as much: the work of the printer, the distributor, the bookseller and the librarian could be done by a few people with rented machines. It changed the violence not at all. The audience changed less than the reach suggests. In 2000, on International Telecommunication Union estimates, fewer than one person in 40 used the Internet in Egypt, Saudi Arabia or India,[61] and on 11 September 2001 Americans still

turned to television. States acted where they could still reach: the server and the court in the country where the machine stood.

By 2003 more than half of American homes were online, but only one in five had broadband

US households with Internet access at home and with a broadband connection, per cent of all households, survey dates 1997–2003



8.7 Survey dates: October 1997, December 1998, August 2000, September 2001, October 2003; the lines join survey points and imply nothing between them. The source shows broadband from 2000; for 2001 it counts digital subscriber line (DSL) and cable modem connections only. 2001 and 2003 use 2000 Census weights, earlier years 1990 Census weights.

Source: US Department of Commerce, Economics and Statistics Administration and National Telecommunications and Information Administration, *A Nation Online: Entering the Broadband Age* (September 2004), Figure 1 and Data Note (public domain); per cent of households. Data: `data/processed/us_households_internet_ntia_1997_2003.csv`.

In our reading, by 2005 the Web had solved publication. It had not yet solved several other things. In 2003 only one American household in five had a high-speed broadband connection.[62] The telephone that people carried was still mainly a telephone, and the camera, the map and the identity a person presented to others online belonged to separate devices and services. Those capabilities were about to converge in one object that people would carry everywhere, connected all the time. That is the subject of a later chapter.



8.8 A Zyxel ADSL2+ broadband modem and wireless router of the 2000s, in the Tekniska museet, Stockholm. In the United States, broadband connections were taking over from dial-up in many homes by 2003.

PHOTO: HÄLL, PETER, TEKNISKA MUSEET (CC BY)

TIMELINE 8

Publisher, post office and archive, 1989–2004

1989 TECHNOLOGY March: Tim Berners-Lee proposes a linked information system at CERN, to allow a place to be found for any information and a way of finding it afterwards.

1990 TECHNOLOGY December: by CERN's account, a web browser and a server are running at the laboratory, the server on a NeXT computer.

1993 TECHNOLOGY April: the first official release of the Mosaic browser (21 April), and CERN puts the Web's software in the public domain (30 April).

1994 TECHNOLOGY The International Telecommunication Union's V.34 recommendation provides for modems of up to 28,800 bits a second over the telephone network.

1995 TECHNOLOGY The National Science Foundation shuts down its research backbone as commercial Internet services expand. Stormfront is set up, according to a statement submitted to the Senate in 1999.

1996 RESPONSE June: the Director of Central Intelligence tells the Senate that terrorist groups, Hezbollah among them, increasingly use the Internet.

1997 ANALYSIS May: a newspaper reports websites of the FARC and the MRTA on American university servers.

1997 RESPONSE June: in Reno v. American Civil Liberties Union the Supreme Court finds that any person or organisation with a connected computer can publish.

1998 TECHNOLOGY The International Telecommunication Union's V.90 recommendation provides for 56,000 bits a second downstream; a paper from Stanford describes a new search engine.

1998 VIOLENCE From about this year, according to a later indictment, the websites of Azzam Publications are hosted in the United States.

2001 VIOLENCE 11 September: the attacks are followed on television, by telephone and on news websites; in a survey taken from 20 September to 1 October, 79 per cent of Americans name television as their main source.

2002 VIOLENCE April: the first al-Qaeda statements that a Norwegian catalogue dates to a website.

2003 TECHNOLOGY October: 54.6 per cent of American households have Internet access at home, and 19.9 per cent a broadband connection. UNESCO adopts a charter on digital heritage (15 October).

2004 RESPONSE August: Babar Ahmad, who later admitted running Azzam Publications, is arrested.

Sources (see Bibliography): Berners-Lee 1989; CERN 2019; ITU-T 2026; National Science Foundation 2024; Senate Committee on the Judiciary 2001; Deutch 1996; Collier 1997; Reno v. American Civil Liberties Union 1997; Brin and Page 1998; United States v. Ahsan 2006; National Research Council 2003; Hegghammer 2003; Economics and Statistics Administration and NTIA 2004; UNESCO 2003; US Attorney's Office 2013.

OBJECT 9 · 1993

The Website



PHOTO: GENI, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS

PROPOSAL
CERN, March 1989

WEB SOFTWARE IN THE PUBLIC DOMAIN
30 April 1993

INTERNET HOSTS, 1996
about 9.4 million

AZZAM PUBLICATIONS
US hosting, c. 1998–2002 (alleged)

WEB PUBLISHER · LONDON, C. 1998–2002

THE PROBLEM

A document was easy to keep and hard to find. Proposing a new system at CERN in March 1989, Tim Berners-Lee described the laboratory's own difficulty: with people staying about two years, "information is constantly being lost". "Often," he wrote, "the information has been recorded, it just cannot be found."[1]

WHAT CHANGED

A page that could sit in one place, link to any other, and be read from anywhere. The aim of the proposal was "to allow a place to be found for any information or reference which one felt was important, and a way of finding it afterwards."[2] By CERN's account, a browser and a server were running at the laboratory by December 1990, the server on a NeXT computer like the one shown opposite, and on 30 April 1993 CERN put the Web's software in the public domain.[3]

HOW IT SPREAD

Through universities, employers and, after the American research network shut down in 1995, commercial providers.[4] By the time of a federal trial in 1996, about 40 million people used the Internet, by the government's estimate quoted by the Supreme Court.[5]

CIVIL USES

Anything a press, a notice board or a catalogue had done. The trial court found in 1996 that "small community organizations are using the Web to publish their own personal 'home pages,' the equivalent of individualized newsletters".[6]

IN POLITICAL VIOLENCE

From about 1998, according to a later American indictment, a family of websites run from London under the name Azzam Publications posted texts and biographies and advertised videos for sale, from accounts with web-hosting companies in the United States, and was also maintained elsewhere; its operators admitted their role in 2013.[7]

WHAT NOBODY EXPECTED

That the publication would become the archive, and the record. A page meant for readers stayed on a server, could be copied by others and could be found by anyone. In 2003 the United Nations Educational, Scientific and Cultural Organization (UNESCO) warned that digital materials, web pages among them, "are frequently ephemeral";[8] in our reading, the copies that others kept are now much of the record of the sites their owners took down.



The train shed of King's Cross station, London, on 23 July 2005, 16 days after the attacks.

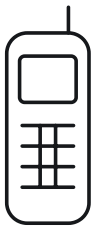
PHOTO: CGP GREY (CGPGREY.COM), CC BY 2.0, VIA WIKIMEDIA COMMONS

9

A Small Battery in London

2005

On 7 July 2005 four men set off bombs in London, and the city's cameras, ticket barriers and telephone networks later allowed investigators to rebuild their morning almost minute by minute. At the centre of the reconstruction stands a purchase at a station newsagent that the record can place to the minute and still cannot explain.



AT 08:54, BY THE CLOCK OF A CLOSED-CIRCUIT TELEVISION (CCTV) camera that investigators believed to be accurate, Hasib Hussain walked out of King's Cross Underground station onto Euston Road.[1] A few minutes earlier the three men he had travelled to London with had set off their bombs on Underground trains near Aldgate, at Edgware Road and between King's Cross and Russell Square.[2] His own had not gone off.

Over the next 20 minutes his phone tried to reach each of them. The call records show attempts from 08:58:53 until 09:19:27, to three men who were already dead.[3] Cameras followed him back into the station through a branch of Boots and onto the concourse. At the entrance to W H Smith a segment of footage about two and a half minutes long shows him taking off his rucksack and looking into it. Then he went in and paid at the counter, with a £5 note, according to the detective who took the inquests through the footage.[4] The shop's till recorded the sale at 08:59: a 9-volt battery at £4.49, paid with £5, and 51 pence given in change.[5]

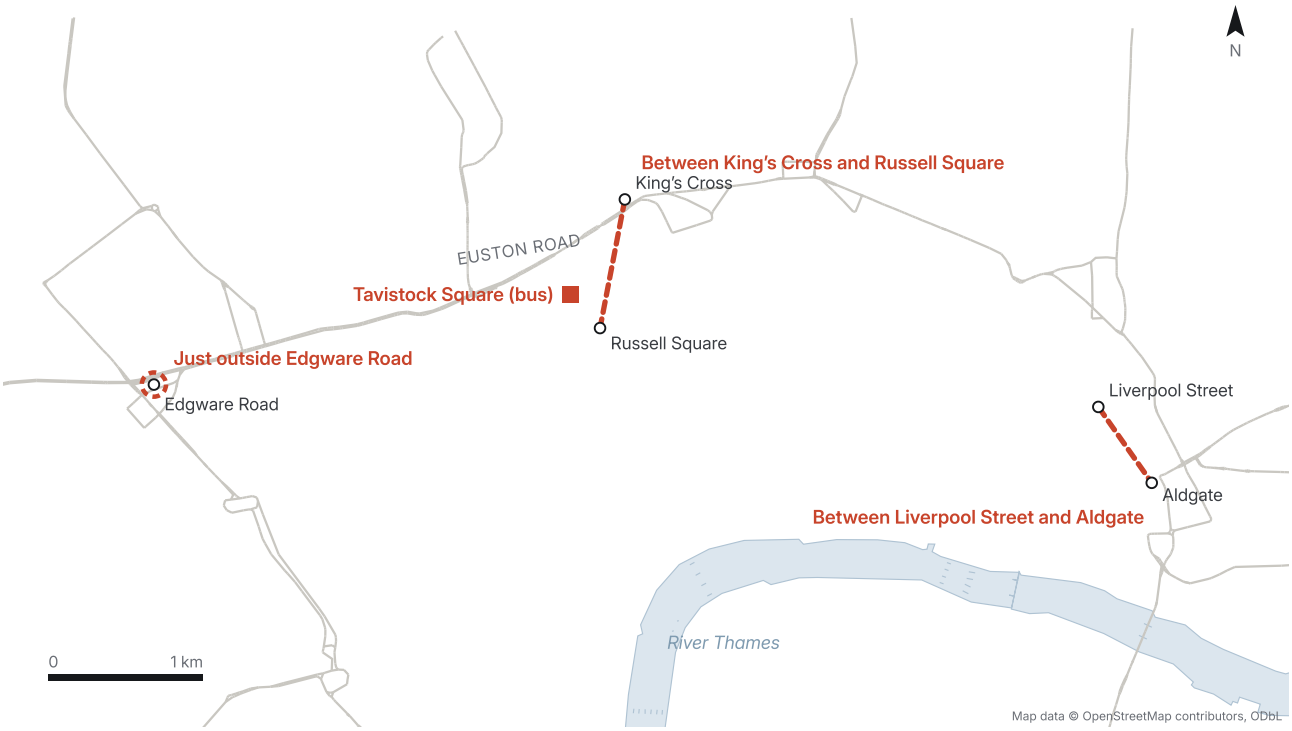
At 09:47 the bomb he carried exploded on a No. 30 bus in Tavistock Square. The explosion killed 13 people as well as Hussain.[6] In all, the four bombs killed 52 people and injured more than 700.[7] The inquests held in 2010 and 2011 heard evidence about each of the 52 who were killed, and recorded for every one of them a verdict of unlawful killing.[8]

In our reading, what Hussain bought on the concourse is a detail of that morning that has been retold in firmer words than the record allows, as a BBC News timeline of 2006 shows.[9] It also shows how much the record of a modern city could tell investigators, and how much it could not. This chapter follows both. The machines of chapters 7 and 8 had given small organisations reach; by 2005, in our reading, the same kinds of machine, in the hands of companies, transport operators and the police, were also recording a great deal of what everyone in a city did.

A CITY THAT KEPT RECORDS

Within days the police had collected thousands of recordings. On 12 July 2005 the Metropolitan Police said that it had "seized and started to view more than 2,500 CCTV tapes".[10] On 14 July the head of the Metropolitan Police Anti-Terrorist Branch, Deputy Assistant Commissioner Peter Clarke, gave the figure as "more than 5,000", with more than 500 witness statements, and added: "This number will grow dramatically."[11] By May 2006 the Home Office's Official Account recorded "over 12,500 statements", "over 26,000

exhibits" and "more than 6,000 hours of CCTV footage".[12] At the inquests in 2010 their counsel, Hugo Keith QC, put the total at "over 20,000 CCTV video tapes" and "some 1600 or so hard drives".[13] The figures are in different units and were given at different dates, so they cannot be added up; in our reading, together they give a sense of how large a record one city produced around that morning.



9.1 London, 7 July 2005: the four sites. Three of the bombs exploded in tunnels between or just outside stations, and are shown as sections or a zone, not as points. Site descriptions from the Official Account (2006); no routes are shown. Map data © OpenStreetMap contributors, ODbL; local equirectangular projection.

That record was not a single system watched from one room. The detective inspector who coordinated the analysis of CCTV for the investigation, Ewan Kindness, told the inquests that his team began with the footage closest to the scenes and worked backwards from there, with more than 100 officers recovering footage.[14] At King's Cross a temporary system was in place, with "76 cameras that were effectively working on one-second movements between each camera".[15] The four men were first seen together on the footage on 11 July.[16] The cameras belonged to many owners and kept their recordings for different lengths of time, from a day to a month; the Underground's station footage was kept for 14 days.[17] Asked whether the police had been "already losing potential CCTV material", Kindness answered: "Yes, we were."[18] Clocks



9.2 A CCTV camera on a building in London, July 2010. The cameras that recorded 7 July 2005 belonged to stations, shops and transport companies, among others.

PHOTO: GAMMEW, CC0, VIA WIKIMEDIA COMMONS

disagreed too, and some images carried two different times until the trawl established which was right.[19]

Some of the most obvious sources failed. The hard drive of the CCTV system on the No. 30 bus, Kindness told the inquests, "had corrupted on a date prior to the bomb attack. It showed a date earlier in the year, so it was of no evidential value to the enquiry."[20] Others came from systems built for quite different purposes. At Luton station, where the four had boarded a train for London, the automatic ticket barriers kept electronic records of every ticket used. By matching those records to the times on the station cameras, counsel told the inquests in 2010, the police were confident they had found the men's tickets: three-day returns to London Thameslink. In 2006 the Official Account had said that it was not known what sort of tickets they held.[21] The telephone companies kept a record of the cell mast that carried each call, and investigators combined call data, subscribers' details, text messages and the handsets recovered at the scenes into a single schedule.[22]

The public's own records were sought as well. The police had appealed on 10 July for the public's photographs and video of the incidents; on 14 July they renewed the appeal, saying that pictures and footage could be submitted online, and released a CCTV image of Hussain at Luton station at about 07:20, with his passport photograph.[23] In our reading, photographs sent in by the public, ticket barriers and a shop till had become sources for a criminal investigation.

DISPUTED

How many cameras watched London? The best-known figures are estimates, one of them a self-described guess

The figure of 4.2 million cameras in the United Kingdom, often repeated in the press, was traced by Channel 4 News to a working paper of 2002 by the criminologists Michael McCahill and Clive Norris.[24] From a sample of premises on one London high street they suggested it would not be unreasonable to "'guesstimate'" at least 500,000 cameras in London, and "at least 4,285,000" in the country.[25] Later estimates for the United Kingdom ranged, by the accounts of Channel 4 News in 2013 and the Police Foundation in 2014, from just under 2 million to nearly 6 million.[26] No count of the cameras in London in July 2005 was found.

M. McCahill and C. Norris, *CCTV in London*, Urban Eye working paper 6 (2002), p. 20; Channel 4 News FactCheck, "Is Big Brother watching you?" (2013); Police Foundation, CCTV briefing paper (2014), p. 2.

THE NETWORKS THAT FAILED

RECORD	HELD BY	COULD SHOW	COULD NOT SHOW
Station and street cameras	Underground, rail, shops, councils	Where and when people were seen	Off-camera moments; kept days to a month; clocks could disagree
Bus camera (No. 30)	Bus operator	Nothing: the hard drive had corrupted earlier in the year	Nothing further
Ticket barriers (Luton)	Railway at Luton	Each ticket and the time it was used	Who held each ticket
Telephone records	Mobile networks	Calls, times and the mast that carried them	What was said
Till and receipt	The newsagent and its till-systems provider	Item, price, payment and the minute of sale	Why it was bought
Public photographs and witnesses	Members of the public	What people saw and filmed	Only what they happened to see
Exhibits from the scenes	Police and the Forensic Explosives Laboratory	What was recovered	Whether a battery was the one bought ("believed")

9.3 How the morning was reconstructed: the kinds of record investigators used, who held them, and what each could and could not show. Based on the inquests' evidence and the Official Account; no movement or route is shown.

The same morning showed the opposite side of a wired city. The networks that let investigators reconstruct events afterwards did not serve the people caught up in them. According to the London Assembly's 7 July Review Committee, Vodafone saw a 250 per cent increase in calls, and O2, which would normally expect to handle 7 million calls a day, connected 11 million.[27] At the request of the City of London Police, the O2 network in a 1 km area around Aldgate station was closed to the public, from about noon until 16:45. The committee found that this had happened outside the agreed command structure, and O2 estimated that "Several hundred thousand, possibly maybe even more than a million" attempted calls by the public were lost.[28]

Below ground, communication largely failed. The committee reported that London Underground's radio systems "did not work, for various reasons, on any of the three affected trains", and that the British Transport Police was the only emergency service with radios that could function underground.[29] In her report of 2011 the coroner, Lady Justice (Heather) Hallett, wrote that there had been "considerable

failings in radio and mobile communications", of "both capacity and coverage". At Aldgate the train driver raised the alarm by mobile phone; at King's Cross a train driver made his way on foot to Russell Square. "While ultimately the paucity of communications did not cost lives," she wrote, "it did impede effective management of the scenes".[30]

In our reading, the city had two relationships with its networks that day. During the morning they were overloaded, shut or out of reach. Afterwards their records became the most detailed account of what had happened.

THE 20 MINUTES AT KING'S CROSS

At the centre of that account sits the purchase on the concourse. It is also a small lesson in how a detail changes as it is retold. Here is what the record supports, and what it does not.

DOCUMENTED

He bought a single 9-volt battery for £4.49.

At the inquests in October 2010, counsel asked Detective Inspector Kindness whether investigations had shown "a purchase of a single … 9-volt battery for £4.49". He answered: "That's correct, sir."[31] In his opening, counsel to the inquests said that a 9-volt battery "showing possible explosive damage" had been found at Tavistock Square.[32] The shop's till recorded the sale at 08:59.[33]

Coroner's Inquests into the London Bombings of 7 July 2005, transcripts of 11, 14 and 18 October 2010.

OFFICIAL ASSESSMENT

The battery may have been needed for his device. Officials called this "only speculation".

The Home Office's Official Account of May 2006 says that Hussain, "it appears, buys a 9v battery", and adds: "It is possible that a new battery was needed to detonate the device, but this is only speculation at this stage."[34] The Intelligence and Security Committee, the same month, wrote that he "stopped to buy batteries", in the plural, and that "it is possible that this indicates he had difficulty setting off his device."[35] In 2010 counsel to the inquests listed possibilities, including that the battery "was not working" or that "he had left it behind".[36] An opening statement is not a finding, and the coroner made none on this point.[37]

Official Account, HC 1087 (2006); ISC, Cm 6785 (2006); inquest transcripts (2010); Rule 43 report (2011), which does not mention the battery.

PLAUSIBLE INTERPRETATION

That the device failed at 08:50 and the battery was the remedy.

In his opening in 2010, counsel to the inquests spoke of Hussain's "failure to detonate his bomb" and said that he "then went searching, it would seem, for a battery".[38] On the cause, the official sources go no further than "possible", "probably" and "it would seem".[39] A BBC News timeline of 2006, four years before the inquests heard evidence of the purchase, turned the Official Account's "it appears, buys" into "buys".[40] And the idea that the battery was for the bomb, and that he dealt with it during his 8 to 10 minutes in a McDonald's on Euston Road, was a supposition put by counsel and agreed by a police witness: the restaurant's cameras had stopped recording before he arrived.[41]

inquest transcripts of 11 and 14 October 2010; Official Account (2006); ISC (2006); BBC News (2006).

UNRESOLVED

Why his bomb did not explode with the others.

"It remains unclear why the bomb did not go off at 08.50am alongside the others," the Official Account said in 2006.[42] The other explanation it offered, delays on the Northern Line, was weakened at the inquests, where counsel reported that the suspension of service had "apparently had little impact" on the frequency of trains.[43] Whether the battery found at Tavistock Square is the one bought at King's Cross is, in the words of the evidence, "believed".[44]

Official Account (2006); inquest transcripts of 11 October 2010 and 1 February 2011.

The record of those minutes is unusually full. It has the time he left the station, the times of his calls, the shops he walked through, how long he stood at the shop entrance with his rucksack and the note he paid with. It has the minute the till recorded the sale.[45] It does not have the reason for the purchase. The camera inside the restaurant where he spent the next minutes was not recording.[46]



9.4 The memorial to the victims of the 7 July 2005 bombings in Tavistock Square, photographed in 2018.
PHOTO: ETHAN DOYLE WHITE, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS

WHAT THE RECORD CANNOT SAY

In this book's reading, the technologies of this chapter changed none of the four questions as much as they changed the response. The violence of 7 July used nothing that chapter 1 would not have recognised: men, explosives and public transport. Its reach, in our reading, came from the audience that chapters 5 and 8 described. What was new was the record. The older labour of an investigation, finding witnesses and asking them what they saw, had been joined by the labour of collecting what machines had already seen: thousands of tapes and hard drives, ticket records, call data, a till. The investigators' sources were mostly systems built for commerce, transport and safety, owned by others and set to overwrite themselves within days or weeks.

That record answered questions about time and place with a precision that none of the earlier cases in this book shows. It did not answer questions about intention. The most precise record of the morning cannot say why a man bought a battery.

The city of 2005 still kept its records in separate places, belonging to separate owners: the station's cameras, the shop's till, the network's call records, the photographs the public were asked to send in. Within a few years many of those functions would be carried by one object that most people had with them, which could photograph, film, locate and transmit at once. That is the subject of the next chapter.



9.5 The 7 July memorial in Hyde Park, July 2009.
PHOTO: HAHNCHEN, CC BY-SA 3.0, VIA WIKIMEDIA COMMONS

TIMELINE 9

The morning and the record, 7–14 July 2005 (times on 7 July)

07:21	TECHNOLOGY At Luton the four are recorded together by CCTV heading for the platform (Official Account).
07:40	TECHNOLOGY The train for London King's Cross leaves Luton.
08:26	TECHNOLOGY CCTV records the four on the concourse at King's Cross, heading towards the Underground.
08:50	VIOLENCE About this time, three bombs explode on Underground trains near Aldgate, at Edgware Road and between King's Cross and Russell Square.
08:54	TECHNOLOGY A station camera, its clock believed accurate, shows Hussain leaving King's Cross Underground (08:55 in the Official Account).
08:58	TECHNOLOGY His telephone begins a series of call attempts to the other three, the last at 09:19:27.
08:59	TECHNOLOGY Through Boots to W H Smith on the concourse, where the till records the sale of a single 9-volt battery (09:00 in the Official Account).
09:06	TECHNOLOGY He enters a McDonald's on Euston Road; its cameras were not recording.
09:47	VIOLENCE A bomb explodes on a No. 30 bus in Tavistock Square.
Noon	RESPONSE Access to one mobile network (O2) within 1 km of Aldgate is restricted to the emergency services until about 16:45.
23:40	RESPONSE Personal items found at Aldgate start the inquiry into the bombers' identities.
11 July	RESPONSE Officers viewing station footage first see the four together.
12 July	RESPONSE Police say they have seized more than 2,500 CCTV tapes.
14 July	RESPONSE Police release an image of Hussain at Luton and renew their appeal for the public's pictures.

Sources (see Bibliography): Home Office 2006; 7/7 Inquests 2010; 7/7 Inquests 2011; London Assembly 2006; Metropolitan Police Service 2005.

OBJECT 10 · 1959

The 9-Volt Battery



PHOTO: NEVIT DILMEN, CC BY-SA 3.0, VIA WIKIMEDIA COMMONS

NOMINAL VOLTAGE	AMERICAN STANDARD	IEC DESIGNATIONS	KING'S CROSS, 7 JULY 2005
9 volts	transistor batteries listed from 1959	6F22, 6LR61, 6LP3146	one, £4.49

STATION NEWSAGENT · LONDON 2005

THE PROBLEM

A portable radio of the valve age needed two kinds of power and carried them in a heavy box. The Science Museum Group's collection includes an Ever Ready battery of this kind, "Combined 1.5 volt and 90 volt", weighing 2.5 kilograms.[1] Chapter 3 described how the transistor removed the valves; it also removed the need for such a battery.

WHAT CHANGED

A small battery with a standard shape and snap terminals. The American standard for dry cells and batteries, revised in 1959, "includes for the first time specifications on cells and batteries for use with transistors", among them several 9-volt types; its table does not yet include the 6F22, one of the designations under which the 9-volt battery is grouped today.[2] The International Electrotechnical Commission's other designations for it are 6LR61 and 6LP3146.[3] In the evidence to the 7 July inquests it is called the PP3.[4]

HOW IT SPREAD

Through shops that sold radios, toys and household goods; no figures for its sales were found for this book. Who made the first one, and when, is told mainly in company histories; no museum or standards record found for this book dates it.

CIVIL USES

Radios, toys and smoke alarms. "9-volt batteries power most of our home smoke detectors, as well as many other household items and toys," the United States National Park Service advises.[5] In 2005 the US Consumer Product Safety Commission recommended "changing smoke alarm batteries at least once a year".[6]

IN POLITICAL VIOLENCE

On 7 July 2005 Hasib Hussain bought a single 9-volt battery at a newsagent on the King's Cross concourse, about three-quarters of an hour before the bomb he carried exploded. The Official Account called the idea that it was needed for his device "only speculation".[7]

WHAT NOBODY EXPECTED

In our reading, that a product made to be bought anywhere without a second thought would leave a record because it was bought. The concourse cameras and the shop's till, which recorded the sale at 08:59, placed the purchase in time.[8] Neither could say why it was made.



A first-generation iPhone in a hand at an Apple shop, July 2007, a month after it went on sale in the United States.

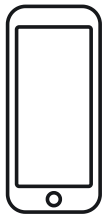
PHOTO: MARCUS QUIGMIRE, CC BY 2.0, VIA WIKIMEDIA COMMONS

10

Everything in One Pocket

2005–2015

Between 2007 and 2015 the camera, the map, satellite positioning and the connection to an audience came to be carried in one object. At Mumbai in 2008, before that object was common, live television and ordinary mobile phones let the men directing an attack follow it as it happened; in 2013 the witnesses' own phones put them and their pictures inside the investigation at Boston and at the front of the news at Woolwich.



ON 9 JANUARY 2007, AT THE MACWORLD CONFERENCE IN San Francisco, Apple introduced a telephone. Its press release that day described the iPhone as "combining three products", "a revolutionary mobile phone, a widescreen iPod® with touch controls, and a breakthrough Internet communications device with desktop-class email, web browsing, searching and maps", "into one small and lightweight handheld device". It also had a camera of two megapixels.[1] The words were the company's, written to sell a product. Smartphones already existed: Apple's own release compared its touch keyboard with "the small plastic keyboards on many smartphones".[2] The phone went on sale in the United States on the evening of 29 June 2007; Apple said that it combined a phone, an iPod and "the Internet in your pocket".[3]

Apple's release of 2007 lists no receiver for satellite positioning among the first iPhone's features.[4] The next model, the iPhone 3G, had what Apple called "built-in GPS for expanded location-based mobile services"; it went on sale on 11 July 2008, when Apple's App Store, opened the day before through its iTunes software, reached iPhones with what Apple called "native applications".[5] In September 2008 T-Mobile announced that from 22 October it would sell in the United States the G1, a phone running Google's Android software, with a "3-megapixel camera with photo-sharing capabilities", maps and access to an application shop, "Android Market".[6]

None of these devices is the subject of this chapter for its own sake. Chapter 9 ended in a city whose records sat with many owners: cameras, tills, call records, the public's photographs. This chapter is about what happened as several of those functions came to be carried in one object, held above all by everyone at the scene. At Mumbai, just before, the men who directed an attack from far away already used two of those functions, separately.

ONE OBJECT INSTEAD OF SEVERAL

The parts of the smartphone were older than the smartphone. For this book, the most important had been released by a government. On 1 May 2000 the White House announced that from midnight that night the United States would stop degrading on purpose the Global Positioning System (GPS) signals available to civilians. The White House said that this would allow "civilian users of GPS" to "pinpoint locations up to ten times more accurately than they do now", and that the service would remain "free of charge". "Originally developed by the Department of Defense as a military system," the statement said, "GPS has become a global utility."[7] The example of

a civil benefit it chose was that "emergency teams responding to a cry for help can now determine what side of the highway they must respond to".[8]

The networks were older too. In 2012 the International Telecommunication Union (ITU), the United Nations agency that sets standards for telecommunications, described the mobile systems "widely deployed since 2000" as the ones "referred to as 3G". It had designated the next generation, "true 4G technologies" in its words, in October 2010, and agreed their specifications in January 2012.[9] A standard is not a service. In the United Kingdom, Ofcom, the communications regulator, found in 2015 that "nearly a third (30%)" of adults said they had access to 4G.[10]



10.1 A handheld GPS receiver, 2005. Within a few years the same function was built into telephones.

PHOTO: THMS.NL, CC BY 2.0, VIA WIKIMEDIA COMMONS

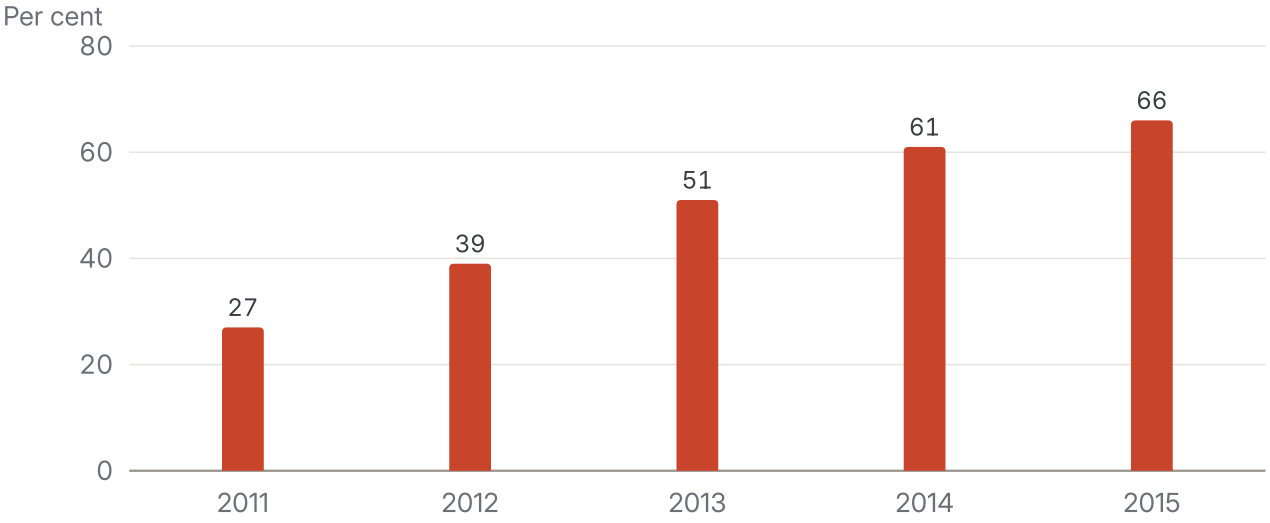
Mobile telephones themselves had already spread widely. In 2005 the world had about 34 mobile telephone subscriptions for every 100 people; in 2015, about 96. The count is of subscriptions, not of people: one person may hold several, which is why the figure for the United Kingdom was already above 100 in 2005.[11] In India, Nigeria and Pakistan the figure rose in ten years from under 13 to between about 58 and 79.[12] The series does not distinguish smartphones from other phones, and in its early years almost none were. What the numbers show is how many people already carried a handset connected to a network, and so how many could later replace it with one that also had a camera and a browser.

Smartphones came later. Ofcom's surveys give a series for the United Kingdom: in early 2011, 27 per cent of adults used a smartphone; in early 2015, 66 per cent.[13] In the United States, the Federal Communications Commission (FCC), citing Nielsen, reported that 55 per cent of mobile subscribers owned a smartphone in the second quarter of 2012, and, citing a survey by the Pew Research Center, that 46 per cent of adults did in February 2012.[14] The two American figures count different things, subscribers and adults, and cannot be compared directly.

By 2015 the phone had become, for many, the main way of going online. That year, Ofcom reported, the Internet users it surveyed named the smartphone, at 33 per cent, ahead of the laptop, at 30 per cent, as "the most important" device for connecting; in 2014 the order had been the other way round, 40 per cent for the laptop and 22 per cent for the smartphone.[15]

In four years the share of British adults using a smartphone rose from about a quarter to two-thirds

Adults in the United Kingdom who personally use a smartphone, per cent, first quarter of each year, 2011–2015



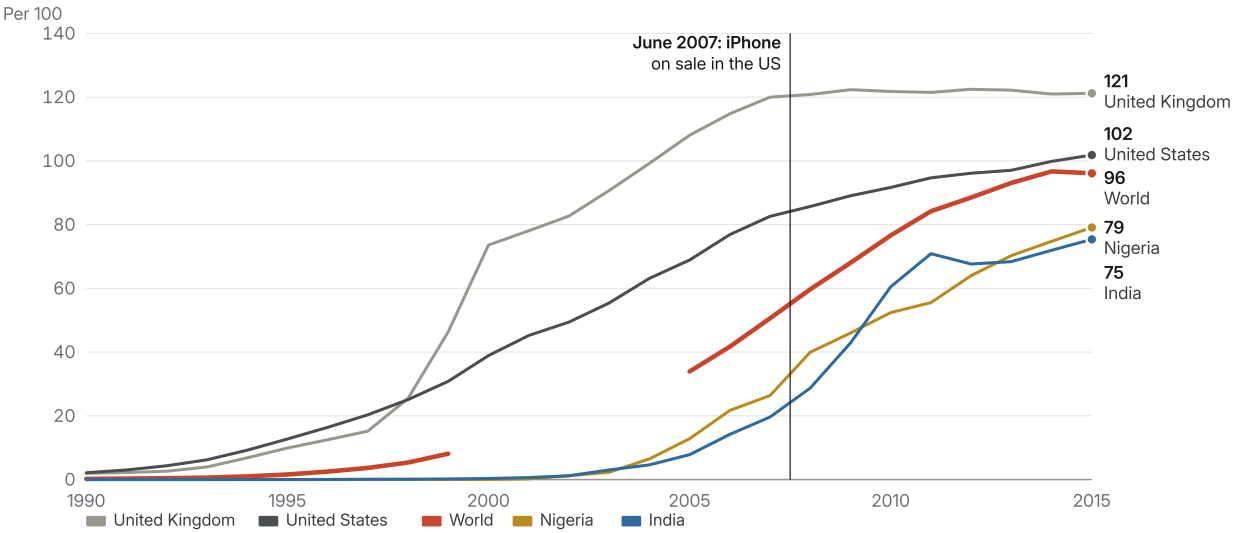
10.2 Ofcom Technology Tracker, adults 16 and over, first quarter of each year. The 2011 figure comes from the 2011 report and may not be strictly comparable with 2012–2015 (2015 report, Figure 1.43). Redrawn for this book.

Sources: Ofcom, *Communications Market Report: UK* (2011), p. 47; Ofcom, *The Communications Market Report* (2015), Figure 1.43, p. 65 (data © Ofcom, redrawn with acknowledgement). Data: `data/processed/uk_smartphone_ofcom_2011_2015.csv`.

Ofcom had also asked, in March 2011, what smartphone users did less since they had one. More than half, 55 per cent, said they did something less. The answers named other devices: 16 per cent took fewer photographs with a camera, 15 per cent used a computer less to go online, 13 per cent read a printed newspaper less and 13 per cent used a paper map less. Among teenagers aged 12 to 15 who had a smartphone, 30 per cent said they used a camera less.[16] These were answers to a survey, and they measure what people said, not what they bought or threw away. In our reading, they describe the change this chapter follows: functions that had belonged to separate objects, and often to separate trades, had moved into the telephone.

In 2005 the world had about 34 mobile subscriptions for every 100 people; by 2015, about 96

Mobile cellular telephone subscriptions per 100 people, world and selected countries, 1990–2015



10.3 Subscriptions, not people: one person may hold several, so values can exceed 100. The series does not distinguish smartphones. Pakistan, cited in the text, is omitted for legibility; the world series has no values for 2000–2004.

Source: World Bank, World Development Indicators, IT.CEL.SETS.P2, from the International Telecommunication Union (CC BY 4.0), data as of October 2026. Data: `data/processed/wdi_mobile_subs_selected_1990_2015.csv`.

WHAT APPLE SAID IT COMBINED · 2007

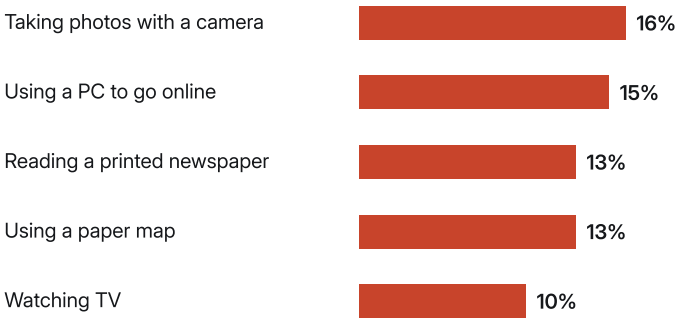
A mobile phone

A widescreen iPod
with touch controls

An Internet communications device
email, web browsing, searching, maps

"into one small and lightweight handheld device"; also a 2-megapixel camera

WHAT GB USERS SAID THEY DID LESS · 2011



Per cent of adult smartphone users; 55% said they did at least one activity less. Teenagers 12–15: a camera 30%, a paper map 14%.

10.4 What the smartphone took over. Left: the three products Apple said it combined, January 2007. Right: what smartphone users in Great Britain told Ofcom in March 2011 they did less (per cent of 474 adult users; self-reported). Sources: Apple, 9 January 2007; Ofcom, *CMR 2011*, p. 58.

For the subject of this book, three of those functions mattered more than the others: knowing where one was,

recording what one saw, and sending it to others at once. Ofcom's survey of 2011 suggests that, for some users, they had still been done with separate objects until then: users named the camera, the computer and the paper map among the things they used less since they had a smartphone.[17] By early 2013 about half of the adults in the United Kingdom said that they used a smartphone, a device that could usually do all three.[18] The cases that follow show what that meant, first for the people who directed an attack, then for the people who witnessed one.

MUMBAI, NOVEMBER 2008: THE ATTACK ON TELEVISION

On the evening of 26 November 2008, 10 men who had landed on the city's shore from the Arabian Sea began a series of attacks in Mumbai, in furtherance, according to the prosecution case summarised by the Supreme Court of India, of a conspiracy "hatched in Pakistan". The attacks lasted until about 09:00 on 29 November, when the last of the attackers was killed at the Taj Mahal Palace hotel. By the court's count, they killed 166 people and injured 238.[19] At the city's main railway terminus, Chhatrapati Shivaji Terminus (CST), the court found that 52 people were killed and 109 injured.[20] The nine other attackers died; the one taken alive, a Pakistani national, was convicted at trial in 2010, and his appeal reached the Supreme Court, which gave its judgment on 29 August 2012.[21]



10.5 Chhatrapati Shivaji Terminus (CST), Mumbai, January 2011, one of the sites of the attacks of November 2008.

PHOTO: JOE RAVI, CC BY-SA 3.0, VIA WIKIMEDIA COMMONS

The judgment, a final appeal decision that reviewed the trial evidence, records how the attackers used their telephones, and this book follows it at the level of capability. The attackers at the Taj, at the Oberoi hotel and at Nariman House "were in regular contact with their collaborators and were constantly receiving moral support, tactical advice and guidance from them by means of mobile phones."[22] Investigators recovered a satellite telephone and a GPS receiver from the fishing boat the attackers had seized, and further GPS devices from the sites of the attack.[23] One of the attackers at Nariman House "also engaged in dialogues with India TV, a popular news channel in the country".[24]

For this book, what sets Mumbai apart from the earlier cases is the part played by television. In a passage of its judgment that it headed as an obiter, a remark not needed for its decision, on the role of the media, the court wrote that the attacks on the hotels and Nariman House were "shown live on the TV screen", and from the transcripts of the calls "it is evident that the terrorists ... and more than them, their collaborators across the border were watching the full show on

TV".[25] The channels, it said, showed the attacks "from beginning to end almost non-stop", competing "in showing the latest developments on a minute to minute basis", and that the operations of the security forces shown on screen "were being watched by the collaborators across the border on TV screens and being communicated to the terrorists."[26]

OFFICIAL ASSESSMENT

Men outside India spoke to the attackers by mobile phone repeatedly while the attacks went on, and, the court observed, followed them on live Indian television.

The Supreme Court of India found that the attackers at three of the sites were "in regular contact with their collaborators" by mobile phone.[27] In a passage it marked as an obiter, it observed from the transcripts of the calls that the collaborators "were watching the full show on TV" and that what they saw was passed on.[28] The book records the matter at that level. What was said in the calls, and what was passed on, is in the judgment and is not reproduced here.

Supreme Court of India, *Kasab v. State of Maharashtra*, judgment of 29 August 2012, paras 360, 402–403.

The court did not find that the coverage had cost lives, and said that it could not. "In these appeals," the judges wrote, "it is not possible to find out whether the security forces actually suffered any casualty or injuries on account of the way their operations were being displayed on the TV screen." It was "beyond doubt", the judges added, that the coverage had made the work of the security forces "not only exceedingly difficult but also dangerous and risky".[29] In their opinion the channels had acted "in their own commercial interests putting the national security in jeopardy".[30]

UNRESOLVED

Whether the live coverage caused casualties among the security forces.

The Supreme Court, which had the intercepted calls before it, wrote that "it is not possible to find out" whether the security forces suffered casualties or injuries because of the way their operations were shown.[31] No source read for this book settles the question, and the book does not say that the coverage cost lives.

Supreme Court of India, *Kasab v. State of Maharashtra* (2012), para. 404.

Those telephones carried evidence out as well as guidance in. An inspector of the Maharashtra Anti-Terrorism Squad

noticed the calls; with emergency permission the service providers diverted them to a police line, where they were recorded. The recordings ran to "twelve (12) hours and thirty-three (33) minutes", and at the trial they were played in court, where the inspector confirmed the transcripts against them.[32] In our reading, the connection that let the men directing the attack take part in it from far away also let the police listen to them while it was happening.

In January 2009, six to nine weeks after the attacks, witnesses before a committee of the United States Senate were drawing lessons from them. The New York police commissioner, Raymond Kelly, spoke of media coverage that "could disclose law enforcement tactics in real time". In the past, he said, police had been able to keep hostage-takers from following the coverage, but "the proliferation of hand-held devices would appear to trump that solution."[33] Brian Jenkins of the RAND Corporation described 10 men with "little more than the arsenal of a 1940s infantryman, except they had with them 21st Century communications technology".[34]

UNRESOLVED

That the attackers used Google Earth to survey their targets and watched the coverage on phones taken from hostages.

Both claims were made at the Senate hearings of January 2009. The committee's chairman, Senator Joseph Lieberman, said that the attackers had "apparently" used Google Earth; a Department of Homeland Security official said that they had monitored the coverage "through wireless communication devices they had taken from hostages".[35] The Supreme Court judgment read for this book places the watching of television mainly with the collaborators abroad and neither confirms nor contradicts either claim.[36] Both remain unconfirmed official statements.

US Senate Committee on Homeland Security and Governmental Affairs, *Lessons from the Mumbai Terrorist Attacks* (2009), pp. 2, 6; Supreme Court of India (2012), paras 402–403.

At Munich in 1972, as chapter 5 described, an American television producer recalled realising that the hostage-takers might be watching the broadcast and "seeing everything that we were seeing".[37] At Mumbai, the court observed, the men directing the attack were watching. They needed no special device to see it. They used the most public one there was, the television, and the telephone connected what they saw to the men in the buildings. In our reading, that combination was what the smartphone would soon put in one object.

BOSTON, APRIL 2013: THE CROWD'S CAMERAS

On the afternoon of 15 April 2013 two bombs exploded on Boylston Street near the finish line of the Boston Marathon. The state's after-action report counts three people killed and 264 spectators injured, many of them critically.[38] Spectators were lining the street to cheer the runners as they reached the finish.[39]

That evening, at the last of four press conferences, officials asked the public "to provide photographs or videos they may have taken before, during or after the bombings". "The response from the public was overwhelming", the state's after-action report said later, "and ultimately proved to be invaluable in identifying the two suspects."[40] The assessment is the report's. The next day the Federal Bureau of Investigation (FBI) also asked businesses to "review and preserve surveillance video".[41] By 17 April the FBI had received "a large number of photos and videos".[42]



10.6 Paper bibs printed "One Boston" and signed with messages, at a memorial in Boston, June 2013.
PHOTO: TRAVIS WISE, CC BY 2.0, VIA WIKIMEDIA COMMONS

The phones held more than the police could easily take in. Officers also collected the phones of witnesses, relatives and survivors, and the Boston Police had a web portal to which investigators could upload their contents before returning them, "but the website was soon overloaded from thousands of megabytes of pictures, and data from some cell phone brands could not be downloaded with the available software"; one technician was in charge of the work.[43] The report refers elsewhere to "the thousands of photographs and video feeds provided to and obtained by law enforcement", among the tasks of the investigation that the federal emergency agency would not pay for.[44] No official source read for this book gives a more precise count. The networks strained as well: mobile telephone service "became saturated and inaccessible in the moments following the bombings. However, texting remained available", as did calls on a priority service for officials.[45]

On 18 April, at a press conference late in the afternoon, the FBI released photographs of two suspects. "For clarity," the agent in charge said, "these images should be the only ones—the only ones—that the public should view to assist us. Other photos should not be deemed credible and unnecessarily divert the public's attention in the wrong direction". And: "With the media's help, in an instant, these images will be delivered directly into the hands of millions around the world."[46] According to the after-action report, officials had deliberated about whether to release them, and the images came from "surveillance cameras".[47] The day before, the FBI had issued a

statement that "contrary to widespread reporting, no arrest has been made", and said that "a number of press reports based on information from unofficial sources" had been inaccurate.[48]

Some members of the public did not wait for the FBI. Kate Starbird and colleagues, in a study of messages on Twitter, wrote that people online "were already working to identify the bombers from photos of the scene", and that after the FBI released pictures of the damaged backpacks found at the scene, users of sites such as 4chan and Reddit "began to collect and analyze images of suspicious individuals wearing backpacks at the scene".[49] On the night of 18 to 19 April a false identification spread: a student who had been reported missing, and who had no connection with the bombing, was named online as one of the suspects. In the messages about it that the study collected, false claims outnumbered corrections by about 5 to 1; for another false rumour of the week the ratio was more than 44 to 1. Corrections, the authors concluded, "emerge but are muted compared with the propagation of the misinformation"; in the case of the student, corrections grew steadily and had begun to overtake the false claims even before the suspects were officially named.[50] The study measured one platform with one set of messages. The book does not name the people wrongly accused.

OFFICIAL ASSESSMENT

The public's photographs were "invaluable" to the investigation, but the images released of the suspects came from surveillance cameras.

The Massachusetts after-action report of 2014 calls the public's response to the appeal "invaluable in identifying the two suspects", and says that the photographs released on 18 April came from "surveillance cameras".[51] The book therefore does not say that photographs taken by the public identified the suspects. The report does not say how the two kinds of image were used together, and no source read for this book does. The report itself says that its review did not assess the criminal investigation.[52]

Massachusetts Emergency Management Agency et al., *After Action Report for the Response to the 2013 Boston Marathon Bombings* (2014), pp. 16, 47, 53.

On 22 April Reddit published an apology on its company blog. "We hoped that the crowdsourced search for new information would not spark exactly this type of witch hunt," it said. "We were wrong."[53]

In our reading, the five days in Boston show what had changed since the reconstruction of 7 July 2005. In London the

investigators had collected the records of machines owned by businesses and public bodies, and asked the public to send in its photographs and video. In Boston the public held cameras in such numbers that the police could not process all of their pictures quickly, and the FBI had to ask millions of people to look only at its own. Some of those people also did the work of investigators, and got it wrong in public.

WOOLWICH, MAY 2013: THE PASSER-BY'S PHONE

On the afternoon of 22 May 2013, in a street in Woolwich in south-east London, two men killed Fusilier Lee Rigby, a soldier who had finished his shift and was returning to his barracks.[54] According to the chronology in a later report by Ofcom, "at least two members of the public are known to have filmed" on their mobile telephones, among other things "both the suspects; the victim", and "one suspect speaking directly to camera".[55] Sentencing the two men in 2014, the judge said to one of them that, "knowing that you were being filmed, you made a political statement. Images of that filmed statement were broadcast around the world."[56] This book does not reproduce it.

The order in which the footage reached the public is set out in Ofcom's account. The attack took place at about 14:20. "The mobile telephone footage was widely disseminated via social media very soon after the incident"; the Press Association sent out an alert at about 15:51.[57] ITV told Ofcom that its news desk had contacted a witness who had filmed the aftermath on his phone, had checked that he was "genuinely a member of the public who happened to be there at the time", and first broadcast his footage in its London bulletin, *London Tonight*, at about 18:20.[58] One channel showed other footage under a caption crediting YouTube.[59] Other broadcasters edited what they showed in various ways, among them blurring images, shortening the clips and removing the sound of the man speaking to the camera.[60]

Ofcom received almost 680 complaints, among them that the coverage "gave one of the alleged attackers a platform to justify and explain his actions".[61] The regulator found that none of the nine programmes it examined had breached the rules it investigated, on scheduling and on offensive material, and accepted that, "in the exceptional circumstances of this particular case", there had been "a strong public interest in showing the mobile telephone footage in some form before the watershed", provided that it was "edited and broadcast in an appropriate manner".[62] One of its reasons was that "many in the audience would probably already have had an

awareness of the incident and its seriousness from other news outlets and social media".[63]

OFFICIAL ASSESSMENT

The regulator took into account that many viewers probably already knew of the attack from other outlets and social media before the television news.

In deciding that the Woolwich broadcasts were acceptable, Ofcom took into account that "many in the audience would probably already have had an awareness of the incident and its seriousness from other news outlets and social media".[64] Its own chronology has the footage circulating on social media "very soon after" the attack and first broadcast on television at about 18:20.[65] The time order is Ofcom's; the book adds no figures on who saw what first.

Ofcom, *Broadcast Bulletin* 245 (2014), pp. 22–23, 44, 46, 49.

In our reading, Woolwich completed a change that chapter 5 anticipated and chapters 6 to 8 followed. At Munich in 1972, as chapter 5 described, the pictures the world saw came from broadcasters' cameras, and broadcasters chose what to show. At Woolwich in 2013 the first pictures came from passers-by and reached the public through social media.[66] A broadcaster then had to decide whether to show footage of an attack that, in Ofcom's judgement, many of its viewers probably already knew about from other outlets and social media, and a regulator had to decide whether it had been right to.[67]

Parliament's Intelligence and Security Committee later examined what the intelligence agencies had known about the two men. Its overall conclusion was that the agencies, given what they knew at the time, had not been in a position to prevent the murder.[68] Looking at material that came to light only afterwards, it found "only one issue which could have been decisive": an online exchange in December 2012, not seen until after the attack, in which one of the two men had told an individual overseas that he intended to murder a soldier. The exchange took place on the platform of an overseas company, which the committee did not name, and which "does not appear to regard itself as under any obligation to ensure that its systems identify such exchanges".[69] In our reading, services of the same broad kind that carried the bystanders' video had carried that exchange.

DISTANCE AND RECORD

TIMELINE 10

Everything in one pocket, 2000–2015

2000 TECHNOLOGY 1 May: the White House announces that from midnight the United States will stop degrading civilian GPS signals, so that users can fix positions "up to ten times more accurately".

2007 TECHNOLOGY 9 January: Apple introduces the iPhone in San Francisco, describing it as three products in one. 29 June: on sale in the United States.

2008 TECHNOLOGY 10–11 July: Apple's App Store opens; the iPhone 3G, with built-in GPS, goes on sale. 22 October: T-Mobile's announced US sale date for the G1, an Android phone.

2008 VIOLENCE 26–29 November: attacks in Mumbai kill 166 people. Attackers at three of the sites are in regular contact with men across the border by mobile phone; the Supreme Court later observes that those men watched live television.

2009 RESPONSE January: a US Senate committee hears from New York's police commissioner that "the proliferation of hand-held devices" would appear to defeat an old police remedy against hostage-takers.

2010 TECHNOLOGY October: the ITU announces that two technologies qualify as "true 4G"; their specifications are agreed in January 2012.

2011 TECHNOLOGY Ofcom: 27 per cent of UK adults use a smartphone; about one in six adult users says they take fewer photographs with a camera, one in eight that they use paper maps less.

2012 TECHNOLOGY Second quarter: 55 per cent of US mobile subscribers own a smartphone, the FCC reports, citing Nielsen.

2012 RESPONSE 29 August: the Supreme Court of India gives judgment in the Mumbai case; it cannot find whether the live coverage cost the security forces casualties.

2013 VIOLENCE 15 April: two bombs at the Boston Marathon kill three people and injure 264.

2013 RESPONSE 15 April: officials ask the public for photographs and videos. 18 April: the FBI releases images of two suspects and asks the public to view only those. 22 April: Reddit apologises for an online "witch hunt".

2013 VIOLENCE 22 May: Fusilier Lee Rigby is killed in Woolwich; passers-by film on mobile phones, and the footage spreads on social media before television shows it.

2014 RESPONSE 6 January: Ofcom finds that the broadcasters' use of the footage breached none of the rules it investigated. 25 November: the Intelligence and Security Committee reports on the intelligence before the murder, and criticises an unnamed overseas company on whose platform one of the attackers had stated his intention.

2015 TECHNOLOGY Ofcom: 66 per cent of UK adults use a smartphone, and Internet users name it ahead of the laptop as their most important device for going online.

Sources (see Bibliography): The White House 2000; Apple 2007; Apple 2008; T-Mobile USA 2008; Supreme Court of India 2012; US Senate 2009; ITU 2010; ITU 2012; Ofcom 2011; FCC 2013; MEMA et al. 2014; FBI Boston 2013; Reddit 2013; Ofcom 2014; Intelligence and Security Committee 2014; Ofcom 2015.

Between about 2007 and 2015, in our reading, the smartphone shortened, almost to nothing, the distance between an

act and its audience, and it did the same for the people who investigate and witness it.

Its first half is the better known. Mumbai came just before the smartphone was common: the men directing the attack needed a television and ordinary mobile phones, two objects that within a few years many people would carry as one. At Mumbai the men directing the attack watched it as it was broadcast, and passed on what they saw; the court observed that much and could not establish more.[70] At Woolwich a man spoke to the cameras of people who happened to be in the street, and the pictures were circulating before the television news had them.[71]

The second half, in our reading, has drawn less attention. The connection that carried guidance to the attackers in Mumbai also carried 12 hours and 33 minutes of their calls to a police line.[72] At Boston the phones of witnesses held more pictures than a police website could take in.[73] And people online, working partly from the crowd's pictures, produced a false identification, on Twitter and Reddit, for which Reddit later apologised.[74] The record of chapter 9 was made mostly by machines that belonged to others. By 2013, in our reading, witnesses made a growing share of it, in their own hands, and sent it from there.

☐ PLAUSIBLE INTERPRETATION

The smartphone put the roles of witness, photographer, publisher and investigator into the same hands.

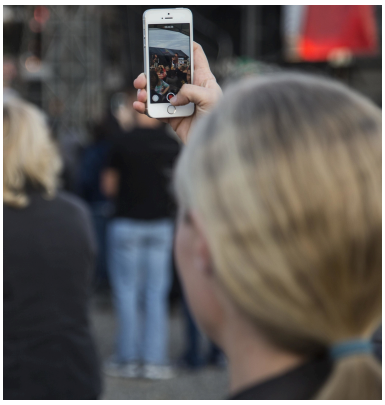
The interpretation is this book's. It rests on the cases in this chapter: the Boston appeal for the public's pictures and the overloaded police portal, the FBI's request that the public look only at its images, the crowd's false identification, and the order of publication at Woolwich.[75] The surveys show that the devices were widely held in the United Kingdom and the United States by then, not that every crowd had them.[76]

Massachusetts after-action report (2014); FBI, 18 April 2013; Starbird et al. (2014); Ofcom, *Broadcast Bulletin* 245 (2014); Ofcom (2015); FCC 13-34 (2013).

In this book's reading, by its four questions, the smartphone changed audience most, and with it the response. The audience could now be reached by the people at the scene before any broadcaster chose what to show; the response had to deal with more pictures than its systems could hold, and with a public that investigated on its own. It changed the violence itself hardly at all: none of the three attacks in this chapter is shown by the sources read here to have depended on a smartphone.

The introduction followed a second thread through this book: who does the work? In the 1990s, as chapter 8 showed, a person with a computer and a modem could publish, while a host stored the pages and a reader had to come and find them. By 2013 the person at the scene could locate, record and publish at once, and the networks and the platforms did the storing and the carrying. Locating, recording and broadcasting, in our reading, now sat with the same person, in one hand.

In our reading, it also moved a good deal of power to a few companies. The footage from Woolwich reached the public through social media, services that, in our reading, no newsroom and no regulator controlled; the exchange that the intelligence committee examined sat on a service whose owner, in the committee's words, did "not appear to regard itself as under any obligation" to identify such exchanges.[77] By 2015 the question was no longer whether people at the scene could publish what they saw. It was what the platforms that carried it would do: what they would keep, what they would take down, and what they would show to whom. That is the subject of the next part of this book.



10.7 A spectator films a concert on a smartphone, Okinawa, December 2014.
PHOTO: CPL. HENRY ANTENOR, US MARINE CORPS (PUBLIC DOMAIN), VIA WIKIMEDIA COMMONS

OBJECT 11 · 2007

The Smartphone



PHOTO: K2025, CC0, VIA WIKIMEDIA COMMONS

INTRODUCED

Apple iPhone, San Francisco, 9 January 2007

BUILT-IN GPS

iPhone 3G, July 2008

APP STORE OPENS

July 2008

UK ADULTS USING A SMARTPHONE

27% (2011), 66% (2015)

US MOBILE SUBSCRIBERS, 2012

55% with a smartphone (Nielsen, via FCC)

PUBLIC APPEAL FOR PICTURES · BOSTON 2013

THE PROBLEM

Before the smartphone was common, taking a photograph, finding the way and reading e-mail away from a desk could need separate objects: a camera, a map or a satellite receiver, a computer. When Ofcom asked smartphone users in Great Britain in 2011 what they did less since they had one, the answers named some of them: 16 per cent took fewer photographs with a camera, 15 per cent used a computer less to go online and 13 per cent used a paper map less.[1]

WHAT CHANGED

Two things, one decided by a government and one sold by companies. On 1 May 2000 the United States announced that from midnight it would stop degrading the civilian GPS signal, so that users could fix their positions "up to ten times more accurately", "free of charge".[2] Then telephones took in the receiver and the rest. Apple's iPhone, introduced in January 2007, combined, in the company's words, a phone, a music player and "a breakthrough Internet communications device" with "a 2 megapixel camera".[3] Its successor of July 2008 added "built-in GPS", and that month Apple opened a shop for applications written by others; T-Mobile announced that a phone running Google's Android software, with access to "Android Market", would go on sale in the United States in October 2008.[4] Apple's release itself mentions "many smartphones".[5]

HOW IT SPREAD

In the United Kingdom 27 per cent of adults used a smartphone in early 2011 and 66 per cent in early 2015.[6] In 2015, Ofcom reported, British Internet users named the smartphone "for the first time" ahead of the laptop as their most important device for going online.[7]

CIVIL USES

Calls, messages, e-mail, maps and photographs, and help in an emergency. Announcing the end of the degraded GPS signal, the White House gave as its example that "emergency teams responding to a cry for help can now determine what side of the highway they must respond to".[8] At Boston in April 2013, when the mobile network was saturated in the moments after the bombings, "texting remained available".[9]

IN POLITICAL VIOLENCE

Telephones of several kinds appear in the cases of chapter 10, not only smartphones. At Mumbai in 2008 men abroad spoke to the attackers by mobile phone and, the Supreme Court observed, followed the attacks on live television.[10] At Boston in 2013 officials asked the public for its photographs and videos, and the investigation gathered "thousands" of photographs and video feeds, from the public and other sources.[11] At Woolwich passers-by filmed the attackers on their mobile telephones, and the footage reached social media before it reached television.[12]

WHAT NOBODY EXPECTED

In our reading, that the camera most people carried would become a source that investigators asked for and then struggled to control. Within three days of officials' appeal for the public's pictures, the FBI was asking the public to view "the only ones" it had released.[13]



Facebook’s data centre at Luleå, northern Sweden, September 2016.

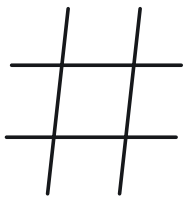
PHOTO: CHRISTOPHER DOWN, CC BY 4.0, VIA WIKIMEDIA COMMONS

11

Propaganda at Platform Scale

2010–2020

In the 2010s a few companies came to decide, with ranking systems, what billions of people saw first. A militant organisation filled their services with its output and was then removed from Twitter, account by account; its supporters moved to smaller services. After an attack in Christchurch was streamed live in 2019, governments and companies turned removal into shared databases and law. Whether the platforms' algorithms radicalised anyone the record does not settle.



ON TUESDAY 14 MARCH 2017 THREE MEN FROM GOOGLE, Facebook and Twitter sat before the Home Affairs Committee of the House of Commons in London. The committee was holding an inquiry into hate crime, and that session asked the companies, among other things, what they did about extremist and terrorist material on their services.[1] Its report, published on 1 May, set down the answers. The three companies had said that their approach to moderation rested on "a 'report and take down' model under which their staff do not proactively search for illegal content but instead rely on their user base to report offensive material for later review and possible removal".[2] The committee asked how many people did the reviewing. All three companies "refused to tell us". Twitter's witness, Nick Pickles, said: "We do not give out numbers for the simple reason that someone, somewhere would say that it is not enough." Facebook's, Simon Milner, told it that the number was in the thousands but would not be more specific; Google's, Peter Barron, also said "thousands".[3]

The committee drew its own conclusion. The companies, it wrote, relied on their users to report material for review and were "in effect, outsourcing the vast bulk of their safeguarding responsibilities at zero expense"; in the United Kingdom the Metropolitan Police had a unit, the Counter Terrorism Internet Referral Unit, that monitored the platforms for terrorist material.[4] The view was a committee's, not a finding of fact. The companies told it that they were looking for "algorithmic solutions"; the committee also noted that YouTube, Facebook, Microsoft and Twitter had announced a partnership to share "hashes", digital fingerprints of known terrorist images and videos, so that each could scan for them.[5]

This chapter is about the decade in which that hearing took place. In 2010 the large platforms were already the places where many people met, read and watched. By 2020 they ranked what each user saw, by rules that their engineers had written and that few outsiders could read, and they were removing material by the million with the help of machines. In between, the Islamic State, the organisation that seized territory in Syria and Iraq in 2014, filled those services with its output on a scale that researchers set out to count, and was pushed off Twitter, the one they studied most. The chapter follows the mechanisms first, then the organisation, then the removals, and asks at the end what can and cannot be said about the algorithms.

WHO DECIDES WHAT APPEARS

In 2006 Facebook added to its users' home pages a feature called News Feed, which, the company wrote, "updates a personalized list of news stories throughout the day".[6] A list has to be put in an order. In August 2013 Lars Backstrom, writing for Facebook, explained how the company did it. Each visit, he wrote, offered more "potential stories from friends, people they follow and Pages" than anyone would read, and the system allowed the company to "prioritize" some of them. Among the signals he named were how often a user interacted with whoever had posted, and "the number of likes, shares and comments a post receives from the world at large and from your friends in particular".[7] The company also gave its reason: when it had stopped ranking and shown posts in time order instead, people read fewer stories and made fewer likes and comments.[8]

These are the company's descriptions of its own system, published to explain it to users and to the businesses that posted there. They are the most direct evidence read for this book of how the system worked, and they show one thing plainly. What a crowd of other users had done with a post, by liking, sharing and commenting on it, helped decide whether a given user saw it at all.

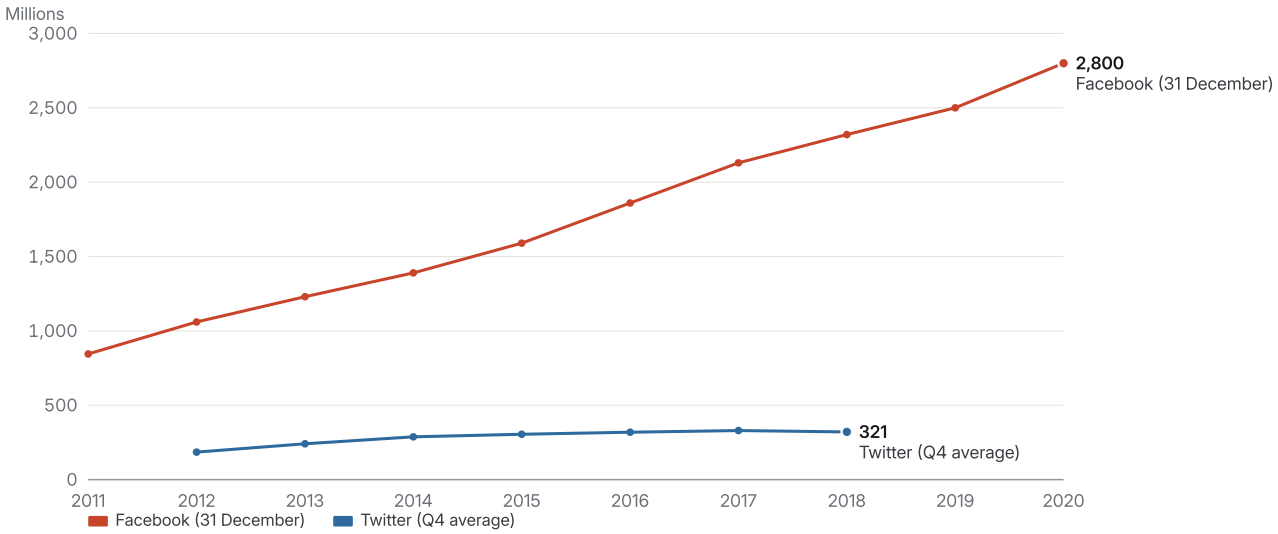
YouTube's engineers described their recommender in a paper presented at a computing conference in 2016. Its recommendations, they wrote, were "responsible for helping more than a billion users discover personalized content". A first stage picked a few hundred candidate videos from millions; a second ranked them. "Our final ranking objective is constantly being tuned based on live A/B testing results but is generally a simple function of expected watch time per impression." They preferred watch time to the rate at which users clicked, because ranking by clicks "often promotes deceptive videos that the user does not complete ('clickbait')".[9] The paper says what the system was rewarded for. It says nothing about what kind of video that favoured, and this book does not add anything.

Twitter came to ranking late and partially. Its home timeline showed the newest messages first. In February 2016 it offered a setting, "Show me the best Tweets first", that put the messages "you're most likely to care about" at the top; "the rest of the Tweets will be displayed right underneath, also in reverse chronological order". The company said it would soon switch the setting on for everyone, and that users could turn it off.[10] Twitter had already had, since 2008 by its own

account, a list of "Trends" chosen by an algorithm that, in its words, "favors novelty over popularity": it looked for topics whose volume "dramatically increases" at a given moment.[11] The interlude that follows this chapter, on the hashtag, takes up the story of these lists.

By the end of 2017 Facebook counted more than two billion monthly users; Twitter, about a third of a billion

Monthly active users reported by the companies in their annual filings, millions, 2011–2020



11.1 Defined differently: Facebook counts users active in the 30 days to 31 December; Twitter averages its monthly figure over October–December, excluding users it called 'SMS Fast Followers' (2015: 305 million; 320 million with them). Twitter stopped reporting the measure after 2018.

Sources: Facebook, Inc., Form 10-K, fiscal years 2012–2020; Twitter, Inc., Form 10-K, fiscal years 2013–2018 (US Securities and Exchange Commission, EDGAR). Data: `data/processed/ch11_platform_mau.csv`.

Two more features of the decade matter here. By April 2016 Facebook had made live video available "to everyone in the US", so that a user could "use your phone to share a moment instantly".[12] And in September 2015 Telegram, a messaging service, introduced "channels", which could "have an unlimited number of members", could be "public with a permanent URL" and showed a view counter on each post.[13] By the companies' own filings, Facebook had 845 million monthly active users at the end of 2011 and 2.8 billion at the end of 2020; Twitter, which measured differently, an average of about 185 million in the last quarter of 2012 and 330 million in that of 2017.[14]

THE ISLAMIC STATE ON TWITTER, 2014–2015

In September 2014 two researchers, J. M. Berger and Jonathon Morgan, set out to count the Twitter accounts of the Islamic State's supporters. Their report, commissioned by Google Ideas and published by the Brookings Institution in March 2015, is the source of a figure still widely repeated.[15] From data gathered between 4 October and 27 November 2014, they estimated that there were "no fewer than 46,000" Twitter accounts supporting the organisation in that period;[16] the summary adds, "although not all of them were active at the same time". The figure was, they wrote, "our most conservative estimate for this time frame". Their maximum, in the report's summary, was "in the neighborhood of 70,000", and they believed "the truth is closer to the low end of the range".[17] Further on, the same report gives a "hard ceiling" in the vicinity of 90,000 accounts and says the authors suspected the real number did not approach it.[18]

The 46,000 was a count of accounts, not of people: one person could hold several.[19] On average these accounts had "about 1,000 followers each", "considerably higher than an ordinary Twitter user" but far from the millions sometimes imagined. What mattered more, the authors found, was "a relatively small group of hyperactive users, numbering between 500 and 2,000 accounts, which tweet in concentrated bursts of high volume".[20] They described what those bursts did. "Short, prolonged bursts of activity cause hashtags to trend, resulting in third-party aggregation and insertion of tweeted content into search results."[21] In our reading, the platform's own counting machinery, built to show users what was new, could carry the material of a small core of accounts in front of people who had never looked for it.

DOCUMENTED

The "46,000 ISIS Twitter accounts" were supporters' accounts over two months of 2014, a minimum estimate, and not 46,000 people.

Berger and Morgan estimated that "no fewer than 46,000" Twitter accounts were used by supporters of the Islamic State between October and November 2014, not all of them active at once, and that one person could run several.[22] Their maximum was about 70,000 in the summary and a "hard ceiling" of about 90,000 later in the report; they thought the truth "closer to the low end".[23] It is a count of accounts in one period, not of people, and not of the organisation's members.

Berger and Morgan, *The ISIS Twitter Census* (Brookings, 2015), pp. 2, 7.

What the supporters redistributed, the organisation produced centrally. Three studies counted it, each in its own way. Aaron Zelin collected 123 official releases in one week of April 2015, an average of 18 a day, most of them visual.[24] Charlie Winter, for the Quilliam Foundation, recorded 1,146 separate "events", batches of propaganda, from the organisation's official outlets between mid-July and mid-August 2015, an average of 38.2 a day.[25] Daniel Milton, at the Combating Terrorism Center at West Point, coded "just over 9,000 videos, picture reports, and photographs" posted on Twitter between January 2015 and August 2016, with "no fewer than 52,000 photographs" and "approximately 140 hours" of video.[26] The three counts measure different things over different periods and cannot be joined into one series. Only Milton's covers long enough to show a shape. Releases rose to more than 700 in August 2015 and fell to fewer than 200 in August 2016.[27]

It was multilingual. All 123 releases in Zelin's week were in Arabic, a few also in English, Russian, Kurdish, French or Urdu;[28] Milton found products in 28 languages.[29] Berger and Morgan found that three-quarters of the supporters they could classify had chosen Arabic as the language of their Twitter interface, and almost one in five English.[30]

None of these studies describes a hidden capability. What they describe is volume, a small number of very active redistributors, and a platform whose public lists and search results responded to sudden volume, from whatever source. The researchers had the same access as anyone else: they collected what was public. The Census was commissioned by Google Ideas, a division of Google, the company that owned YouTube.[31]



11.2 Twitter's headquarters on Market Street, San Francisco, June 2014.
PHOTO: MATTHEWKEYS, CC BY 3.0, VIA WIKIMEDIA COMMONS

RECRUITMENT: WHAT THE NUMBERS DO NOT SAY

Fighters went abroad to join it and other groups in numbers the United Nations called new: "from a few thousand foreign terrorist fighters a decade ago to more than 25,000 today".[32] In May 2015 the United Nations team that monitors sanctions against al-Qaeda reported that "more than 25,000 foreign terrorist fighters" from "more than 100 Member States" were involved with groups associated with al-Qaeda, a category in which it included the Islamic State.[33] In December 2015 the Soufan Group, a private consultancy, compiling official and other estimates, put the number who had gone to Syria and Iraq to join the Islamic State "and other violent extremist groups" at between 27,000 and 31,000.[34] Neither figure is a count of the Islamic State's recruits alone, and neither says how many people were recruited online.

No source read for this book gives such a number. The UN team wrote that radicalisation "continues to rely largely on direct social contact. Increasingly, however, the Internet and social media strengthen and shorten the process", and that "most Member States indicate that direct personal contact remains a core ingredient", although "the Internet and social media play a crucial role"; some had reported cases of radicalisation online alone.[35] Lorenzo Vidino and Seamus Hughes, who studied the Americans charged with offences linked to the Islamic State in 2014 and 2015, wrote that "in most cases online and offline dynamics complement one another".[36] A review of the research literature for the VOX-Pol network in 2017 found the consensus to be that the Internet alone was "not a cause of radicalisation, but a facilitator and catalyser", and the empirical evidence still scarce.[37]

UNRESOLVED

How many foreign fighters were recruited through social media.

The UN monitoring team counted "more than 25,000" foreign fighters with al-Qaeda-associated groups including the Islamic State by 2015; the Soufan Group 27,000 to 31,000 who went to Iraq and Syria to join it and other groups.[38] Neither gives, and no source read for this book gives, a number recruited online. The UN reported that member states saw direct personal contact as "a core ingredient" in most cases.[39] The question would need case files, not counts of accounts or posts.

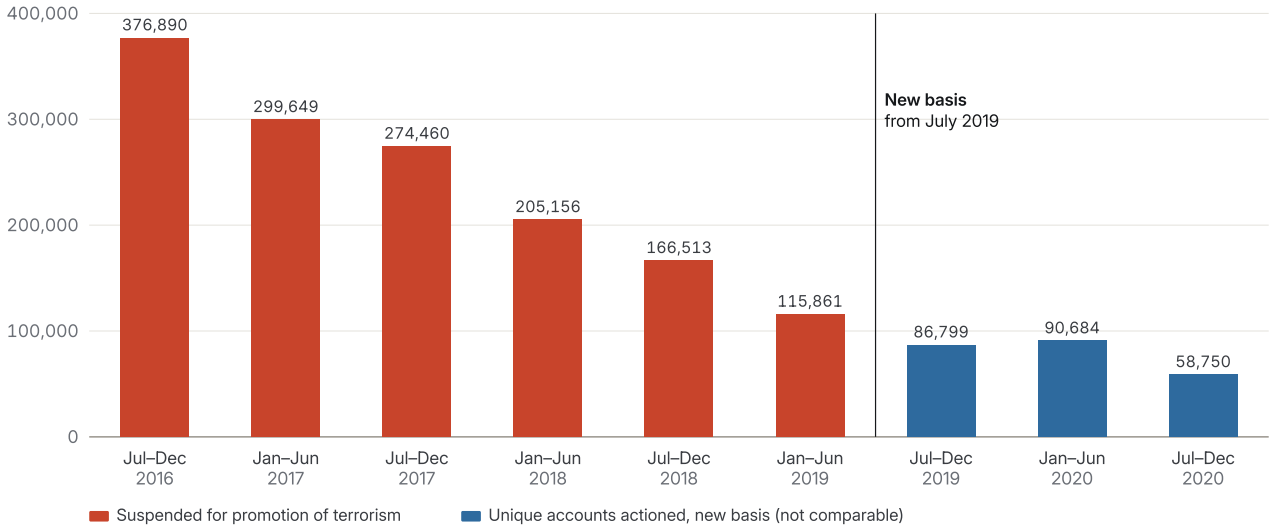
UN Analytical Support and Sanctions Monitoring Team, S/2015/358 (2015), pp. 3, 18; Soufan Group (2015), pp. 4–5.

SUSPENSION AND THE MOVE TO SMALLER SERVICES

From late 2014 Twitter began to remove the supporters, and to count what it removed. Berger and Morgan saw at least 1,000 supporters' accounts suspended between September and December 2014.[40] In February 2016 Twitter announced that "since the middle of 2015 alone, we've suspended over 125,000 accounts for threatening or promoting terrorist acts, primarily related to ISIS"; in August, "an additional 235,000", which brought the total to 360,000.[41] From then on it reported a figure for each half-year: 376,890 accounts suspended "for violations related to promotion of terrorism" between July and December 2016, falling to 115,861 in the first half of 2019.[42] By the company's account, its own "internal, proprietary" tools had surfaced or flagged most of them: 74 per cent in late 2016, 95 per cent in the first half of 2017.[43]

Twitter said the number of accounts it suspended for terrorism fell by more than two-thirds between late 2016 and mid-2019

Accounts suspended for promotion of terrorism (to mid-2019) and unique accounts actioned under the terrorism and violent extremism policy (from mid-2019), per half-year, as reported by Twitter



11.3 Twitter's own counts, not independently checked; one person may hold several accounts. From July 2019 Twitter counted 'unique accounts actioned' under a new policy: the two colours are not one series. Twitter said its own tools surfaced 74–95% of suspended accounts (2016–2019).

Sources: Twitter, Government TOS reports (July–December 2016; January–June 2017); Twitter blog, 18 August 2016 (360,000 suspensions from mid-2015), 5 April 2018, 12 December 2018, 9 May 2019, 31 October 2019; Twitter Transparency Center, Rules Enforcement, July 2019–December 2020. No half-year figure exists for January–June 2016. Data: `data/processed/ch11_twitter_suspensions_chart.csv`.

These are Twitter's numbers. They count suspensions, not people, and an account created again after a suspension could be counted again. Nobody outside the company could check them. They do show what the company chose to count and publish. They also sit uneasily beside the London hearing. In the six months that ended ten weeks before it, by Twitter's own account, its tools had surfaced most of the accounts it suspended for terrorism; in the committee room, the companies described a system that waited for users' reports.

Researchers measured what the suspensions did to the supporters who stayed. In a network of English-speaking supporters followed from June to October 2015, Berger and Heather Perez found that suspensions "held the size and reach of the overall network flat, while devastating the reach of specific users who have been repeatedly targeted"; the readily discoverable ones were "usually fewer than 1,000 accounts" and the wider network "fewer than 3,000 accounts at any given time", and their networks "extremely insular",

following and talking mostly to each other.[44] By early 2017 the pressure was heavier. Maura Conway and colleagues, for VOX-Pol, followed 722 pro-Islamic State accounts and 451 accounts of other jihadist groups from February to April 2017. "The majority – around 65% – of the Pro-IS accounts in our dataset were suspended within 70 days of their establishment", and more than a quarter within five days; fewer than 1 per cent of the other jihadist accounts were removed that fast. They called this "differential disruption". Accounts of the other groups could gain "13 times as many followers".[45]

Berger and Morgan had already noticed what changed when the large accounts went. "We did not see images of beheaded hostages flooding unrelated hashtags or turning up in unrelated search results. We also did not see ISIS hashtags trend or aggregate widely." The organisation's main hashtag, its name in Arabic, had gone from "routinely registering in 40,000 tweets per day or more" when the suspensions began in September 2014 "to less than 5,000 on a typical day in February" 2015, and many of the remaining tweets were hostile to it.[46] The report does not say how these counts were made; they are the authors' observations. The effect they describe is on what outsiders could stumble on: the overflow into lists and searches that had carried the material beyond the supporters' own circle.

The supporters did not disappear. Conway and her colleagues concluded, drawing on other researchers' work, that they had "re-located their social media community-building activity elsewhere, primarily to Telegram".[47] Their own sample contained almost no links to Telegram.[48] Audrey Alexander, at George Washington University, who followed 1,782 English-language accounts from February 2016 to May 2017, found that most "lasted fewer than 50 days" and gave two causes for the decline: Twitter's suspensions and the organisation's own move to messaging services offering encryption.[49] Bennett Clifford and Helen Powell, from the same programme, studied 636 English-language pro-Islamic State channels and groups on Telegram between June 2017 and October 2018, which they called "a sliver" of the whole.[50]

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Telegram's channels, the tool its users had for broadcasting, were not end-to-end encrypted.

Telegram's own answers in 2016 said that "server-client encryption is used in Cloud Chats (private and group chats)", and that only its optional "secret chats" used end-to-end encryption.[51] Cryptographers who studied the protocol, in work published in 2022 and 2023, described the same arrangement: messages are by default "encrypted and authenticated between a client and a server, but not end-to-end encrypted".[52] A public channel was readable by anyone who joined it; Telegram said it blocked channels related to the Islamic State, and Europol and researchers later recorded it doing so.[53] Encryption, in this sense, did not hide the channels: they were made to be found.

Telegram FAQ (Wayback capture, 20 December 2016); Albrecht et al. (2023), p. 4; Telegram, 22 September 2015; Europol, 22 November 2019; Amarasingam et al. (2021), p. 4.

Telegram said in 2016 that it did not process requests about private chats and groups, and that "while we do block terrorist (e.g. ISIS-related) bots and channels, we will not block anybody who peacefully expresses alternative opinions".[54] In November 2019 the European Union's police agency, Europol, coordinated a "Referral Action Day" with nine companies, Telegram among them; Telegram received most of the requests, and, Europol said, "a significant portion of key actors within the IS network on Telegram was pushed away from the platform".[55] A study for the Centre for Research and Evidence on Security Threats, covering 7.8 million posts from 1,911 jihadist channels and groups, found that this action had "a profound impact" on jihadist posting on Telegram that "was not short-term or temporary". Channels created in the month after it lasted on average 14 days; after a similar action in 2018, 302 days.[56] Where the users went next, the study names, and this book does not.

The disruption had costs for the people trying to watch. Berger and Morgan warned in 2015 that suspensions might isolate supporters and "increase the speed and intensity of radicalization for those who do manage to enter the network";[57] Alexander, in 2017, that "silencing IS adherents on Twitter may produce unwanted side effects", among them for investigators trying to see the network.[58] These were warnings, not findings.

CHRISTCHURCH, MARCH 2019

On 15 March 2019 a gunman attacked two mosques in Christchurch, New Zealand, and killed 51 people.[59] He broadcast the attack live on Facebook. Five days later Facebook published its account of what had happened to the video. By its account few people watched the broadcast as it happened, and "No users reported the video during the live broadcast"; the first report from a user came after the broadcast had ended. Before the company was alerted, a user of another site, 8chan, "posted a link to a copy of the video on a file-sharing site".[60]

Then the copies came. "In the first 24 hours, we removed more than 1.2 million videos of the attack at upload, which were therefore prevented from being seen on our services. Approximately 300,000 additional copies were removed after they were posted."[61] These figures are Facebook's; no independent check of them was found for this book. Added together, they are sometimes quoted as 1.5 million removals; the company gave two numbers, for two different things. Facebook's account says that a link to a copy was posted on another site before it was alerted, and that people uploaded copies again and again; it does not discuss the ranking of its feed.

Facebook used the same statement to say why its machines had not caught the broadcast. Its detection systems, it said, needed "many thousands of examples" to learn from, and "this particular video did not trigger our automatic detection systems". It also gave a figure of the kind its witness had declined to give in London two years earlier: in 2018, it said, it had "more than doubled the number of people working on safety and security".[62]

New Zealand's Chief Censor classified the recording as objectionable, banning it in New Zealand, in a decision dated 18 March 2019 and announced on 20 March.[63] The Royal Commission of Inquiry that reported in November 2020 examined what the attacker had read and watched. It had "no doubt" that he visited right-wing forums and "subscribed to right-wing channels on YouTube", and found the evidence "indicative of more substantial use of YouTube" than of the discussion boards.[64]



11.4 Flowers and messages left in Christchurch after the attacks on two mosques on 15 March 2019, photographed six days later.

PHOTO: ALAN TENNYSON, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS

OFFICIAL ASSESSMENT

The Royal Commission judged it plausible that online content contributed to the Christchurch attack, but found no evidence of "personalised encouragement".

The Royal Commission wrote of the attacker that "his exposure to such content may have contributed to his actions on 15 March 2019 – indeed, it is plausible to conclude that it did. We have, however, seen no evidence to suggest anything along the lines of personalised encouragement or the like."[65] It described his use of YouTube; in these passages it did not examine YouTube's recommendation system, and its judgement is about content, not about an algorithm.

Royal Commission of Inquiry into the Terrorist Attack on Christchurch Masjidain, *Ko tō tātou kāinga tēnei* (2020), vol. 2, Part 4.

Two months after the attack, on 15 May 2019 in Paris, the prime minister of New Zealand, Jacinda Ardern, and the president of France, Emmanuel Macron, brought governments and technology companies together to adopt what they called the Christchurch Call.[66] Its text said that the attacks "were designed to go viral". It described its commitments as "collective, voluntary". The companies undertook to act against the spread of such material "through livestreaming" and to "review the operation of algorithms and other processes that may drive users towards and/or amplify terrorist and violent extremist content".[67]

REMOVAL BECOMES INFRASTRUCTURE

By 2019 the responses had become standing machinery. In the European Union it began with the police. On 1 July 2015 Europol opened an Internet Referral Unit, under a mandate given by the Union's Justice and Home Affairs Council in March, to "identify and refer relevant online content towards concerned internet service providers".[68] Referral meant asking: in Europol's words, a referral was "a request for voluntary deletion", which companies assessed against their own terms.[69] By the end of 2017, Europol said, it had assessed 51,805 items, which produced 49,969 decisions to refer, and 84.8 per cent of the referred material had been removed; by the end of 2020, 123,551 decisions to refer, concerning material found on 370 platforms.[70]

NUMBER	WHAT WAS COUNTED	WHO COUNTED	WHEN	NOT A COUNT OF
46,000	Twitter accounts used by supporters (a minimum; one person could run several)	Berger and Morgan, Brookings	Oct.–Nov. 2014	People, or members
1,146	Batches ("events") of official propaganda, 38.2 a day	Winter, Quilliam	17 July–15 Aug. 2015	Videos; supporters' posts
9,000+	Official visual products posted on Twitter: videos, picture reports, photographs	Milton, Combating Terrorism Center	Jan. 2015–Aug. 2016	9,000 videos
360,000	Accounts Twitter said it had suspended for promoting terrorism	Twitter (company figure)	Mid-2015–Aug. 2016	Distinct people
25,000+	Foreign terrorist fighters with groups associated with al-Qaeda, the Islamic State included	UN monitoring team	To May 2015	Islamic State recruits alone; online recruits
>1.2 m + c. 0.3 m	Copies of the Christchurch video Facebook said it removed: blocked at upload, and removed after posting	Facebook (company figure)	First 24 hours, March 2019	Views; one total of 1.5 million

11.5 Six numbers about terrorism online, 2014–2019, and what each counted; none can be added to another. Sources: Berger and Morgan (2015), p. 7; Winter (2015), p. 5; Milton (2016), p. 21; Twitter, 18 August 2016; UN S/2015/358, p. 3; Facebook, 20 March 2019.

The companies built their own. On 5 December 2016 Facebook, Microsoft, Twitter and YouTube announced "a shared industry database of 'hashes' — unique digital 'fingerprints' — for violent terrorist imagery or terrorist recruitment videos or images that we have removed from our services". A match would not mean automatic removal: "matching content will not be automatically removed", and each company would apply its own rules.[71] On 26 June 2017 the four announced the Global Internet Forum to Counter Terrorism (GIFCT) to run such work together.[72] The size of the database is known only from what its members said: "more than 40,000 hashes" in December 2017, "more than 200,000 unique hashes" in July 2019, and 300,000 "unique hashes" by July 2020.[73] GIFCT later explained that a "unique hash" stood for a cluster of items that looked identical or nearly so; the 2017 figure did not say whether its hashes were unique.[74] These counts measure what the companies chose to add, not how much terrorist material existed or how much was removed.

Then the law. In April 2021 the European Parliament and the Council adopted Regulation (EU) 2021/784 "on addressing the dissemination of terrorist content online". Its Article 3 obliges a hosting company that receives a removal order from



11.6 Europol's headquarters in The Hague, 2015, the year its Internet Referral Unit began work.

PHOTO: OSEVENO, CC BY-SA 3.0, VIA WIKIMEDIA COMMONS

a national authority to remove the material "as soon as possible and in any event within one hour". It applied from 7 June 2022.[75] What Europol had asked for in 2015, an authority could now order.



11.7 The European Parliament's chamber in Brussels, October 2011. Parliament approved the regulation on terrorist content online on 28 April 2021.

PHOTO: MICHALPL, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS

DOCUMENTED

After six years of voluntary arrangements, an EU regulation adopted in 2021 made removing terrorist material on an authority's order a legal duty from June 2022.

Europol's unit, from 2015, referred material to companies, which Europol described as a request for "voluntary deletion".[76] The companies' shared database of 2016 did not remove matches automatically.[77] Twitter said its own tools flagged most of the accounts it suspended for terrorism from late 2016, while in March 2017 three companies told Parliament that they relied on users' reports.[78] The Christchurch Call of 2019 was "voluntary".[79] The EU regulation of 2021 made removal within one hour of an order a legal duty.[80]

HC 609 (2017); Europol (2015); Twitter Government TOS reports (2016–2017); joint statement, 5 December 2016; Christchurch Call (2019); Regulation (EU) 2021/784.

THE ALGORITHM QUESTION

A question often asked about this decade is whether the platforms' recommendation systems pushed people towards extremism. The evidence read for this book does not answer it, for two reasons.

One is what has been studied. The research read for this book on recommendation and extremist content concerns the far right and YouTube, with some work on Reddit and Gab, mostly in the United States between 2016 and 2020. No study read for this book measured what recommendation systems did with jihadist material or with the Islamic State's supporters. In 2017 the Home Affairs Committee repeated its earlier description of YouTube as a "vehicle of choice" for spreading terrorist propaganda;[81] that was a view, not a measurement.

Another is what the studies found: they disagree. Manoel Horta Ribeiro and colleagues, auditing 349 channels and using commenters as a stand-in for viewers, found that users "consistently migrate from milder to more extreme content", and that the recommender let far-right channels "be discovered, even in a scenario without personalization"; they said they did not account for personalisation.[82] Joe Whittaker and colleagues, with three test accounts on each platform for two weeks in early 2019, found that a YouTube account that interacted with far-right content was "twice as likely to be shown Extreme content".[83] Mark Ledwich and Anna Zaitsev, in a paper not peer-reviewed in the version read, looking at recommendations shown to users who were not logged in, found the opposite.[84] Two studies of what real users watched found little sign of a push. Homa Hosseinmardi and colleagues, testing the causal claim with the desktop browsing records of more than 300,000 Americans from 2016 to 2019, found "no evidence that engagement with far-right content is caused by YouTube recommendations systematically".[85] Annie Chen and colleagues, with 1,181 volunteers in 2020, from a panel that oversampled people with high resentment and heavy viewers, after YouTube had changed its system, found exposure "heavily concentrated among a small group of people with high prior levels of gender and racial resentment", and said that they could not make causal claims.[86]

UNRESOLVED

Whether platform recommendation systems radicalised people.

The companies' own descriptions show that ranking used engagement and expected watch time.[87] Two audits found that YouTube's recommendations could lead to far-right content; a third, of recommendations shown to logged-out users, found the opposite.[88] The study designed to test cause, on American desktop users from 2016 to 2019, found no systematic effect; another, in 2020, found exposure concentrated among people who already sought such content.[89] None concerns jihadist content. Settling the question would need data on what individual users were shown, which the companies hold.

Covington et al. (2016); Backstrom (Facebook, 2013); Ribeiro et al. (2020); Whittaker et al. (2021); Ledwich and Zaitsev (2019); Hosseinmardi et al. (2021); Chen et al. (2023).

What can be said is narrower. The companies ranked material by what users and crowds of users did with it, and said so. In our reading, that was enough to make the order of a list something a small group could push, as Berger and Morgan saw with Twitter's trends in 2014; whether the same held for

feeds, they did not study. Whether ranking changed what anyone came to believe is a different question.

WHAT CHANGED, AND WHAT DID NOT

In the European Union, at least, the violence remained for the most part low in technology. Europol reported in 2018 that "improvised explosive devices, firearms and improvised weapon, such as knives and vehicles, are the weapons of choice with which recent attacks were carried out", and that the rise in the number of jihadist attacks in the Union in 2017 "ran in parallel to a decrease in sophistication in their preparation and execution". Most of the jihadists who attacked in the Union in 2017 had been "home-grown, meaning that they were radicalised in their country of residence".[90] The platforms changed how the acts were announced and seen, and who could find whom. They did not change what the attackers did with their hands.

In this book's reading, by its four questions, the platforms changed audience most. An armed organisation could, for a year or two, put its own material in front of people who had not looked for it, by the platforms' own machinery of trends and search; an attacker could stream his act, and others could copy and upload it again and again. Response changed almost as much, and in a new way: the decisions that mattered were made by companies, under pressure from parliaments and police units, about accounts, hashes and copies. Reach, once the organisation was removed from Twitter, shrank to smaller services. Labour changed in both directions, as the next paragraph describes. The violence itself changed least.

The introduction followed a second thread through this book: who does the work? Chapter 10 left the person at the scene able to record and publish, with the networks and the platforms doing the storing and the carrying. In this decade the work of putting a message in front of a reader passed to systems that the group did not own: the platform's ranking chose what came first, and its lists showed what was rising. The work of taking material down passed, in part, to machines as well, matching copies against databases of known images. In both directions the decision about what an audience saw had moved, in our reading, from editors and broadcasters to companies, and inside the companies, partly to software.

In the same years another kind of machine began to move in the physical world. It is the subject of the next chapter.

TIMELINE 11

Platforms, propaganda and removal, 2006–2021

2006 TECHNOLOGY 5 September: Facebook introduces News Feed, a "personalized list of news stories" on each user's home page.

2007 TECHNOLOGY 23 August: Chris Messina proposes on Twitter using "# (pound) for groups"; he credits IRC and Jaiku for the idea.

2010 TECHNOLOGY 8 December: Twitter explains that its Trends, introduced in 2008, are chosen by an algorithm that "favors novelty over popularity".

2013 TECHNOLOGY 6 August: Facebook explains that it ranks the stories in News Feed, using signals that include likes, shares and comments.

2014 RESPONSE September–December: at least 1,000 accounts of Islamic State supporters suspended; researchers estimate no fewer than 46,000 supporters' accounts on Twitter in October–November.

2015 RESPONSE 1 July: Europol opens its EU Internet Referral Unit. 22 September: Telegram introduces channels with unlimited members.

2016 TECHNOLOGY YouTube's engineers describe a recommender ranked by "expected watch time per impression".

2016 RESPONSE 5 February: Twitter reports more than 125,000 suspensions since mid-2015. 6 April: Facebook, which has already opened Live video to everyone in the US, adds new features. 5 December: four companies announce a shared database of hashes.

2017 RESPONSE February–April: about 65% of pro-Islamic State accounts in one study are suspended within 70 days of creation.

2017 RESPONSE 14 March: Google, Facebook and Twitter decline to give a House of Commons committee exact numbers of staff who review content. 26 June: the Global Internet Forum to Counter Terrorism is announced.

2018 TECHNOLOGY 11 January: Facebook says it will rank for "meaningful interactions" and show "less public content".

2019 VIOLENCE 15 March: 51 people are killed at two mosques in Christchurch; the attack is streamed live on Facebook, which reports removing more than 1.2 million copies at upload in the first 24 hours.

2019 RESPONSE 15 May: the Christchurch Call, "collective, voluntary commitments", is adopted in Paris. 21–22 November: a Europol action day with nine companies; Europol says key Islamic State actors were "pushed away" from Telegram.

2020 RESPONSE 26 November: New Zealand's Royal Commission reports; it judges it plausible that online content contributed to the attack, but finds no evidence of "personalised encouragement".

2021 RESPONSE 29 April: Regulation (EU) 2021/784 requires removal within one hour of a removal order; it applies from 7 June 2022.

Sources (see Bibliography): Sanghvi 2006; Messina 2007; Twitter 2010; Backstrom 2013; Berger and Morgan 2015; Europol 2015; Telegram 2015; Covington 2016; Twitter 2016; Simo 2016; Facebook 2016; Conway et al. 2017; House of Commons Home Affairs Committee 2017; Facebook 2017; Mosseri 2018; Royal Commission of Inquiry 2020; Rosen 2019; The Christchurch Call to Action (2019); New Zealand MFAT 2019; Europol 2019; Regulation 2021/784.

OBJECT 12 · 2007

The Hashtag

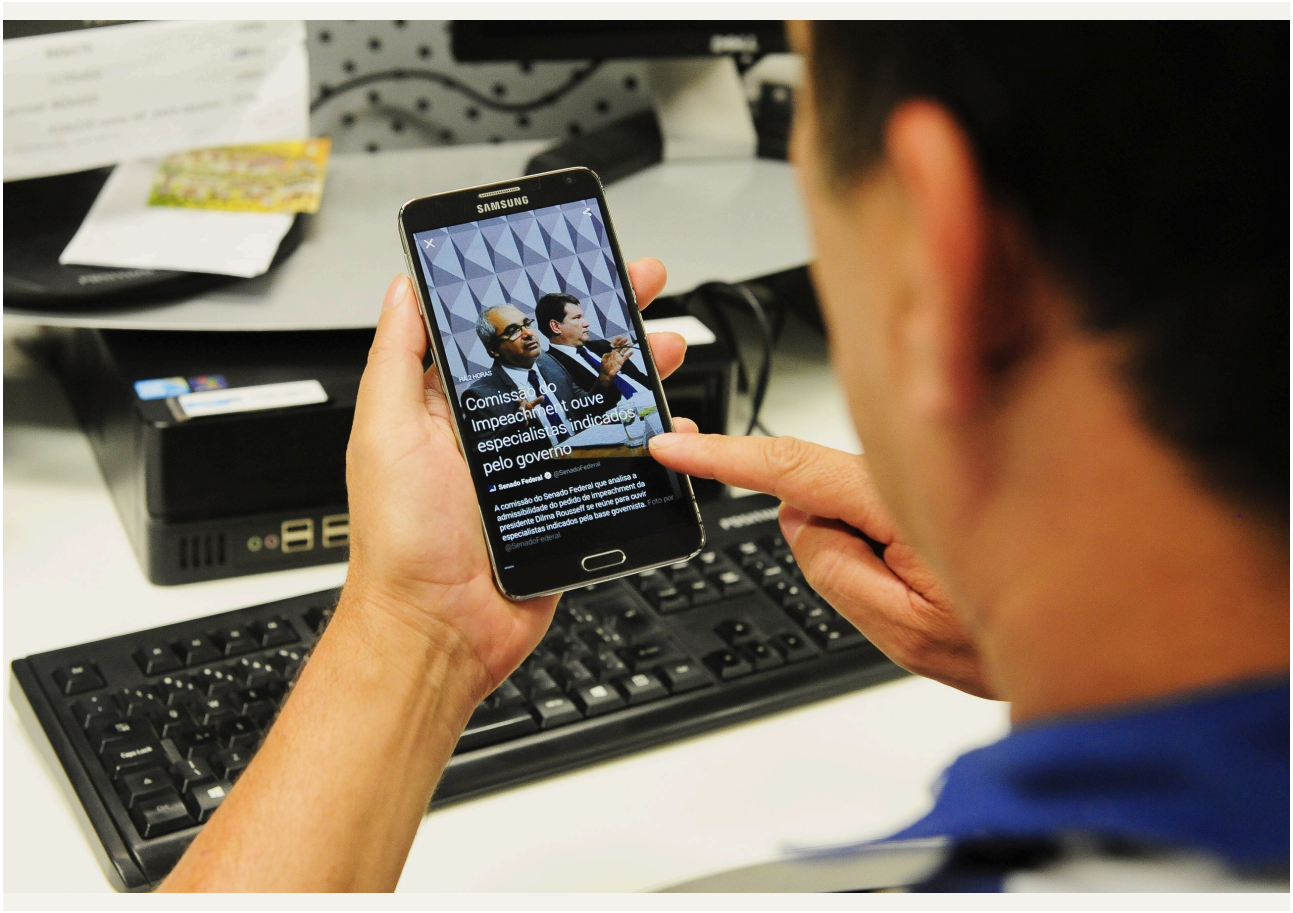


PHOTO: SENADO FEDERAL, CC BY 2.0, VIA WIKIMEDIA COMMONS

PROPOSED FOR TWITTER
Chris Messina, 23 August 2007

BORROWED FROM
IRC channels and Jaiku, by his account

TRENDS ON TWITTER'S HOME PAGE
April 2009 (Trends from 2008, per Twitter)

#QLDFLOODS, 10–16 JANUARY 2011
more than 35,000 tweets

MAIN ISLAMIC STATE HASHTAG, A DAY
40,000+ (Sept. 2014), under 5,000 (Feb. 2015)

SHOWN
Twitter Moments on a smartphone, May 2016

TRENDS AND SEARCH RESULTS · TWITTER 2014

THE PROBLEM

In 2007 Twitter let people reply to one another and send private messages, but not gather messages by subject. Chris Messina, a user, wanted something lighter than groups: "a better eavesdropping experience on Twitter", with "contextualization, content filtering and exploratory serendipity".[1]

WHAT CHANGED

On 23 August 2007 he asked on Twitter: "how do you feel about using # (pound) for groups. As in #barcamp [msg]?"[2] Two days later he set out the idea: tags "simply used by prefixing one or more words with the hash (#) character". He did not claim to have invented it. He took the model from the channels of IRC, an older chat system, and from Jaiku, a rival service where a channel was made by posting "a message that begins with a hash (#)".[3] The platform later began to count it. In April 2009 Twitter opened its search to everyone and said that it analysed public messages "to detect when certain words or phrases occur with higher frequency", showing these "trending phrases" on its home page.[4] Its Trends, it explained in 2010, were "automatically generated by an algorithm", which "favors novelty over popularity": a topic entered the list when its volume "at a given moment dramatically increases".[5]

HOW IT SPREAD

Among users: by the end of 2009 Twitter's own list of the year's top trends had a category for hashtags.[6] The company dated its Trends feature to the summer of 2008.[7]

CIVIL USES

Finding others talking about the same thing, and, in emergencies, finding help. During the floods in Queensland in January 2011 the tag #qldfloods "quickly became the central coordinating mechanism" for flood-related activity on Twitter: more than 35,000 messages carried it between 10 and 16 January, from more than 15,500 users.[8]

IN POLITICAL VIOLENCE

In 2014, by the account of J. M. Berger and Jonathon Morgan, bursts of activity by a small number of very active accounts supporting the Islamic State made its hashtags trend, "resulting in third-party aggregation and insertion of tweeted content into search results".[9] After Twitter began suspending such accounts in September 2014, they observed, the organisation's main hashtag fell from "40,000 tweets per day or more" to "less than 5,000 on a typical day" by February 2015.[10]

WHAT NOBODY EXPECTED

In our reading, that a mark proposed for eavesdropping, in a scheme where "anyone can choose to leave or remove topics that don't interest them",[11] would, once a machine counted it and pushed what was rising onto a public list, let a small, organised group put material in front of people who had chosen nothing. The tag that carried the material also left a trace: Berger and Morgan could report its fall.



The Astoria-Megler Bridge over the Columbia River, seen from a drone during an inspection by the Oregon Department of Transportation, May 2020.

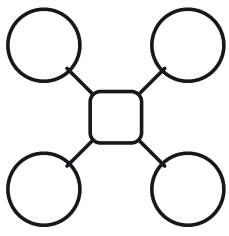
PHOTO: OREGON DEPARTMENT OF TRANSPORTATION, CC BY 2.0, VIA WIKIMEDIA COMMONS

12

The Machine Becomes Mobile

2015–2025

In the 2010s the sensors of the smartphone, satellite positioning and a camera were joined to four small rotors and sold for the price of a phone. The result could hold its place in the air, film what it saw and fly itself home. Farmers, engineers and rescuers used it. The Islamic State flew it over Mosul, and reports of one closed Gatwick Airport. Almost every decision it took was still taken by a person.



ON 9 DECEMBER 2021, IN SWEDEN, A 71-YEAR-OLD MAN had a cardiac arrest while shovelling snow outside his home. His wife found him; an emergency physician who happened to be passing began chest compressions; the dispatch centre alerted an ambulance, and at 10:05:28 a drone was dispatched with a defibrillator. It "flew autonomously out of sight for 673 m and, at 3 minutes 19 seconds after dispatch, safely delivered an AED in the snow 10 m from the patient before EMS had arrived". A neighbour fetched it from the snow. The defibrillator was attached at 10:10:18, after the first ambulance had reached the address at 10:09:53, and a first shock was given at 10:10:58. Thirty days later the man had made a full neurological recovery.[1]

The researchers who reported the case did not claim that the drone saved him. "It is uncertain", they wrote, "whether the earlier delivery of the AED by the drone … affected the patient's outcome", and the compressions begun by the passing physician were probably important.[2] The flight was part of a programme. In October 2016, in a trial of 18 flights from a fire station at Norrtälje, north of Stockholm, the same group had found that a drone reached simulated cardiac arrests in a median of 5 minutes 21 seconds after dispatch; the ambulances they compared it with, from earlier records, had taken a median of 22 minutes.[3] In a study of the service from April 2021 to May 2022, a drone was sent to about a third of suspected cardiac arrests, since it could not fly in darkness, in bad weather, in some zones or without clearance from air traffic control; where both times were known it arrived before an ambulance in 37 of 55 cases, not all of which proved to be cardiac arrests.[4]

In the snow, the machine had done several things that for most of history only a person could do. It carried an object to a place it had not been before, found the place, kept itself in the air and set the object down. Nobody was on board. A drone pilot had first to ask air traffic control for permission to fly.[5] The researchers called the flight autonomous; in the terms set out later in this chapter, it was an automated flight with a pilot responsible for it. This chapter is about how that became ordinary.

WHAT A PERSON HAD TO DO

The introduction to this book began with a list of jobs that, for most of history, only a person could do: carry, watch, find the way, decide. To watch a place from above, someone had to go up. Photographs of Boston taken by James Wallace Black in the 1860s survive in the Metropolitan Museum of Art, one of them catalogued as taken from a hot-air balloon.[6] A century and a half later, police forces in England and Wales still sent crews up in helicopters. In 2016/17 the National Police Air Service cost, on one of the inspectorate's measures, £2,820 for each hour in the air, against an estimate of £1,335 made in 2009.[7] The figure is an all-in cost of running a service, not of one flight, but it shows the order of magnitude. Watching from above needed an aircraft, a pilot and an organisation.

There was a cheaper way, and it was old. Hobbyists had flown radio-controlled model aircraft for decades. Aviation law treated them as a category of their own: the International Civil Aviation Organization (ICAO) left them outside its framework, and a United States statute of 2012 forbade the Federal Aviation Administration (FAA) to make new rules for model aircraft flown "within visual line of sight" by hobbyists.[8] A model aeroplane could go up without a pilot on board. What it could not easily do was hold its position, carry a camera steadily, find its way or come back by itself. All of that depended on the skill of the person holding the controls.

This chapter is about the decade in which some of those skills moved into the machine. It is not a history of drones, which armed forces had flown for much longer, and it is not about the military aircraft of later wars. It is about a consumer product, the small multirotor drone, and what changed when a machine that could move through physical space, steady itself, record what it saw and fly back could be bought in a shop.

ONE MACHINE FROM MANY PARTS

The parts came from the telephone. Dario Floreano and Robert Wood, reviewing the field in *Nature* in 2015, put it plainly: small drones had benefited from the "miniaturization and cost reduction of electronic components (microprocessors, sensors, batteries and wireless communication units), largely driven by the portable electronic device industry", which put drones weighing less than a kilogram on sale "at smartphone prices".[9] The sensors that let a phone know which way up it was held, accelerometers and gyroscopes

made as tiny chips, were also what a small aircraft needed to keep itself level. By Apple's own announcements, it put an accelerometer in the first iPhone in 2007, satellite positioning in the iPhone 3G in 2008 and a "3-axis gyro" in the iPhone 4 in 2010.[10] Floreano and Wood pointed to "the IMUs used in cell phones and video game controllers", the inertial measurement units of phones and consoles, as parts that small aircraft could use.[11] One open-source flight-control program of the period was, by a later description in an engineering survey, "based on sensors from Nintendo Wii".[12] Researchers at ETH Zurich published in 2012 the design of an autopilot system that "is an open source and open hardware design".[13]

Chapter 10 described what satellite positioning made possible once it was released for full civilian accuracy in 2000 and built into phones. In the drone it did a further job. Combined with the inertial sensors, it let a small aircraft hold a point in the sky when the person at the controls let go. Floreano and Wood noted that this fusion of sensors "is now also available in small drones for recreational or professional use".[14]

The companies that assembled these parts described the result in their own words. In January 2010 Parrot, a French maker of wireless accessories, announced the AR.Drone, a quadcopter flown by tilting an iPhone, listing among its parts "MEMS (Micro Electro Mechanicals Systems), 3 axes accelerometer, 3 axes gyro, ultrasound sensor"; its stabilisation technologies, the company said, were "usually used for professional and military applications".[15] In January 2013 DJI announced the Phantom, with a "GPS-based autopilot system" and a failsafe that "will bring the PHANTOM back to its take-off point and land itself if it loses signal from the remote control unit". DJI said that before it, building and flying such aircraft had been "a complex task only performed by professionals and extreme hobbyists".[16] Later that year the company added a built-in camera; in 2016 it announced a model that could sense obstacles ahead and, if it could not go round one, "slow to a stop and hover until the user redirects it".[17] These are companies' descriptions of their products, and the claims of being first that run through them are not repeated here.

How many were sold, no independent source says. The FAA estimated, when it introduced registration in December 2015, that 1.6 million small unmanned aircraft intended as model aircraft were expected to be sold in the United States that year.[18] It then counted registrations. Within 30 days of the registry opening, "nearly 300,000 owners" had done so.[19] By the end of 2018, by the FAA's count, more than 900,000 hobbyists had registered, each registration covering any number of drones; by the end of 2025 more than 1.6 million had registered at some time, of whom about 323,000 held a registration that was still active. Commercial operators, who registered each aircraft separately, had registered about 42,000 by the end of 2016 and 1,074,451 by the end of 2025, of which 424,516 were still active.[20] The FAA put the hobbyist growth down to "falling prices, improved technology such as built-in camera and ease of use".[21]

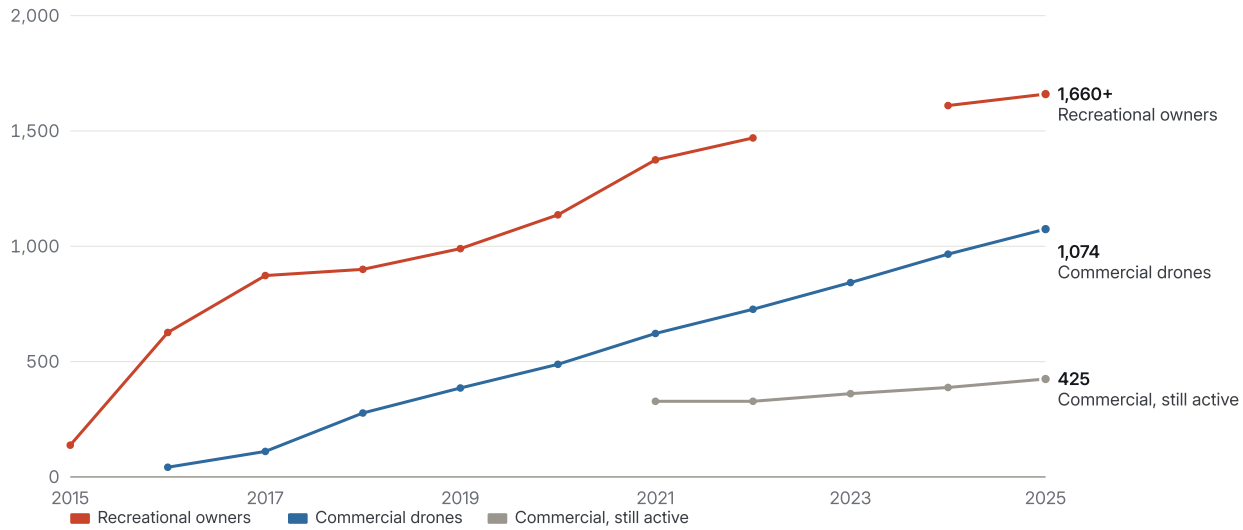


12.1 A farmer in the United States flies a consumer quadcopter, a DJI Phantom 4, over a soybean field, September 2018.

PHOTO: UNITED SOYBEAN BOARD, CC BY 2.0, VIA WIKIMEDIA COMMONS

Hobbyists registered first and fastest; commercial registrations kept growing for a decade

United States, cumulative new FAA drone registrations at year end, 2015–2025, thousands. Recreational: one per owner, covering any number of drones. Commercial (Part 107): one per drone. Grey: commercial registrations still active, 2021–2025



12.2 Registrations, not drones in use; owners and aircraft are different units. Several values are FAA lower bounds; 2017 recreational extrapolated by the FAA; no recreational figure for 2023.

Sources: FAA Aerospace Forecast, fiscal years 2017–2037 to 2026–2046 editions (actual registration counts reported in each); recreational registry opened 21 December 2015. Data: `data/processed/ch12_faa_registrations_2015_2025.csv`.

REMOTE CONTROL, AUTOMATION, AUTONOMY

Three words are often used as if they meant the same thing. The people who wrote the rules and built the machines did not use them consistently either, so this book sets out how it will use them.

Remote control: a person at the controls flies the aircraft from outside it. *Automation*: the machine performs set functions by itself, such as keeping level, holding its position, following a route of waypoints that a person has set, or returning to where it took off when the signal is lost. *Autonomy*: the machine makes some decisions of its own without continuous human control. The line between the last two is where the next chapter begins.

The sources draw the lines in different places. A glossary in a circular of the International Civil Aviation Organization (ICAO) of 2011, which it says has "no official status within ICAO", defines an "autonomous operation" as one "during which a remotely-piloted aircraft is operating without pilot intervention in the management of the flight"; the same circular says that a remotely piloted aircraft "may possess various types of auto-pilot technology but at any time the remote pilot can intervene".[22] The European Union's rules of 2019 define an autonomous operation as one in which the aircraft operates "without the remote pilot being able to intervene".[23] The FAA, in its operating rule of 2016, called a flight "autonomous" when the pilot entered a flight plan for the aircraft to follow, and allowed it on condition that "the remote pilot in command must retain the ability to direct the small unmanned aircraft".[24] Engineers used the word more widely still. Floreano and Wood distinguished three levels: "sensorymotor autonomy", which covered keeping attitude and position and following pre-programmed waypoints and was already deployed in 2015; "reactive autonomy", which included holding position against wind and avoiding obstacles and was partly deployed; and a cognitive level, not yet deployed.[25] In this book's terms, the first two are automation.

PLAUSIBLE INTERPRETATION

In this book's terms, consumer drones of the mid-2010s were remotely piloted machines with automated functions; the choice of where to go stayed with a person.

The classification is this book's. Floreano and Wood wrote in 2015 that "none of today's commercial drones has sufficient control autonomy" to complete the missions they described "without skilled human supervision".[26] The makers described stabilisation, position holding and a return home on loss of signal; in 2016 DJI said its obstacle sensing would steer round an obstacle "when possible" and otherwise stop and wait for the user.[27] The FAA required a pilot able to take over.[28]

Floreano and Wood, *Nature* 521 (2015), p. 460; DJI releases of 7 January 2013 and 1 March 2016; FAA, 81 FR 42064 (2016).

THE USES THAT CAME FIRST

Drones were bought for photography, for work and for play. Some of the uses took over jobs that had needed aircraft with pilots, or people on foot.

Agriculture had led the way with larger machines. In Japan, by the account of its Ministry of Agriculture, Forestry and Fisheries (our translation), unmanned helicopters sprayed about 10,000 hectares of rice in 1991; by 2003 the area they sprayed was larger than that sprayed by helicopters with pilots, and by 2017 about 890,000 hectares against 30,000. In February 2018 about 2,800 unmanned helicopters and about 700 small drones were registered for the work. The ministry gave as reasons that it was cheaper per hectare than spraying from the ground, and that spraying from aircraft with pilots had become difficult as farmland and houses came to mix.[29]

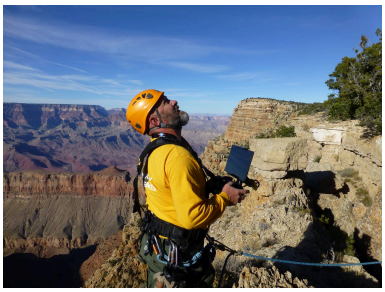
Engineers used drones to look at structures that were costly to reach. Inspecting the approach spans of the Blatnik Bridge in Duluth, Minnesota, the state's transport department estimated a minimum cost of about $59,000 with the usual under-bridge inspection trucks against a quoted $20,000 with drones, but its first report was clear that "tactile functions", the touching and sounding of steel and concrete, "cannot be replicated using UAVs".[30] After Hurricane Harvey in Texas in 2017, the FAA's administrator said that his agency had issued "more than 70 authorizations" for drone flights, some "within minutes", to emergency services and others, and called the response "a landmark in the evolution of drone usage".[31] Four years earlier, after Typhoon Haiyan in the Philippines, a policy paper published by the United Nations' humanitarian

office noted that checking whether roads were passable "could take days when done on foot or by helicopter".[32] In Rwanda, a peer-reviewed study found that drones flying blood to hospitals between 2017 and 2019 delivered in a mean of 49.6 minutes and estimated that expired blood units fell by 67 per cent, with no control group, though delivery by drone was "at present more expensive than road delivery".[33]

FUNCTION	BEFORE: DONE BY	CONSUMER DRONE, c. 2016	LEVEL
Get a camera into the air	Pilot in an aircraft, balloon or helicopter	Rotors, battery and built-in camera, flown from the ground	REMOTE CONTROL
Keep level and steady	Pilot	Inertial sensors and flight controller	AUTOMATION
Hold a position	Pilot	Satellite positioning with inertial sensors	AUTOMATION
Come back	Pilot or navigator	Return to take-off point on lost signal	AUTOMATION
Avoid an obstacle	Pilot	Steer round it, or stop and wait (some models, 2016)	AUTOMATION
Fly a set route	Pilot	Waypoints a person sets in advance	AUTOMATION
Choose where to go	Person	Person at the controls	REMOTE CONTROL
Decide what to look at, and when to stop	Person	Person	PERSON

Autonomy, in this book's sense (the machine making its own decisions without continuous human control), appears in no row. Engineers and the FAA called some automated functions "autonomous"; the FAA required that the pilot could always take over.

12.3 What the consumer drone took over, c. 2016, and at what level. Classification by this book from ICAO (2011), EU (2019) and FAA (2016) definitions and the makers' descriptions.



12.4 A drone operator on the park's search and rescue team, roped in at the rim of the Grand Canyon, March 2021.

PHOTO: GRAND CANYON NATIONAL PARK, CC BY 2.0, VIA WIKIMEDIA COMMONS

What these users needed, in our reading, was an aircraft that would hold its position, carry a camera or a small load and come back, flown by an operator on the ground rather than a crew in the air. That is what the consumer drone sold. In our reading, its civil uses matter to this book for a simple reason: the technology was made and bought for them, and the uses that follow came after, from the same shops.

THE ISLAMIC STATE'S DRONES, 2014–2017

Among armed groups outside the state, the one whose use of consumer drones is best documented is the Islamic State, in Iraq and Syria; Don Rassler, of the Combating Terrorism Center at West Point, called its use "pioneering".[34] In January 2017 a monitoring team of the United Nations Security

Council reported, on information from member states, that the group "continues to use drones for reconnaissance and to film propaganda".[35] In August it added that the drones on the battlefield were "mainly commercially available models", which member states put at "$100 to $1,000" each.[36] An American officer in Iraq, Colonel Brett Sylvia, described them in a Pentagon briefing in January 2017 as "commercial off-the-shelf, you know, just UAVs that – that they purchase".[37]

Their first uses were the ones their makers had advertised: seeing and filming. Aerial footage appeared in the group's media releases; Europol, the European Union's police agency, reported that from late January 2017 its propaganda began "showing attacks allegedly carried out with unmanned aerial vehicles".[38] Rassler, who has written detailed studies of the subject, warned that such videos were "carefully edited pieces of propaganda" and "should certainly be taken with a grain of salt".[39]

It did more than film. On 2 October 2016, near Erbil in northern Iraq, according to the UN team, "a drone carrying explosives killed two Peshmerga fighters and injured two French soldiers"; Conflict Armament Research, a body that traces weapons in conflict zones, recorded the same date and added that "the exact circumstances of the incident are still unknown".[40] In the battle for Mosul, Colonel Sylvia said in January 2017, the role of the drones had "transitioned in the beginning of the Mosul campaign from – from just reconnaissance" to dropping munitions on Iraqi forces, "in a somewhat imprecise manner, in a somewhat crude manner"; the coalition had helped bring down "almost a dozen", and use had since fallen off.[41] This book records these events at that level and no further.

OFFICIAL ASSESSMENT

The Islamic State used commercially available drones for observation, filming and, from 2016, small attacks in Iraq and Syria.

The UN monitoring team reported reconnaissance and filming in January 2017 and, in August, that the group's drones were "mainly commercially available models".[42] It dated a deadly attack near Erbil to 2 October 2016, and a US officer described attacks on Iraqi forces in Mosul from late 2016.[43] No official count of attacks or casualties exists in the sources read. An open-source estimate of 60 to more than 100 attacks a month is not an official figure, and this book does not adopt it.[44]

UN S/2017/35 and S/2017/573; US Department of Defense briefing, 11 January 2017; Conflict Armament Research (2016); Rassler (2018), p. 4.

Its drones were organised as well as bought. Documents recovered in Mosul and studied by Rassler, Muhammad al-'Ubaydi and Vera Mironova placed the drone unit under a brigade subordinate to the group's "Committee of Military Manufacturing and Development"; in October 2015 a provincial governor asked that committee to give the "Aviation Brigade" of his province "whatever they need". The authors warned that the 21 documents were probably "a very small fraction" of what had existed.[45] Rassler found purchases "from at least 16 different companies that were based in at least seven different countries".[46] In Denmark, according to Europol's summary, an appeal court upheld in September 2020 the convictions of three men who had bought "hobby aircraft, unmanned aerial vehicle (UAV or 'drone') parts" and other items for the group's drone programme; a further appeal was pending.[47]

How much did it matter? Rassler's judgement in 2018 was measured: the impact of the group's drones "was not that long-lasting and did not result in a large number of deaths", yet it was able "to challenge the United States' air superiority tactically in a major combat zone for a defined period of time".[48] By his account, drawing on officials quoted in the press, the threat peaked in the spring of 2017, during the fight for Mosul, and had since been "significantly degraded".[49] Colonel Sylvia had already said in January 2017 that use had dropped off as Iraqi forces took more ground.[50] And on the question that the next chapter takes up: "There have been no demonstrated cases thus far of the Islamic State using autonomous or pre-programmed drones that take the human controller out of the loop."[51]

UNRESOLVED

How many drone attacks the Islamic State carried out, and how many people they killed.

No official series exists in the sources read. Military officials, as reported in the press, believed that the group's drone attacks had killed "more than a dozen people across time"; open-source tallies of attacks per month are estimates of uncertain method.[52] The UN, the US briefing read for this book and the West Point studies describe the kind of use; none gives a count of attacks or casualties.[53]

Rassler (2018), pp. iv, 4–5; US Department of Defense briefing, 11 January 2017.

Other armed groups with drones belong to a different story. Hezbollah and Hamas flew drones that Rassler described as "usually modified versions of Iranian machines",

and scholars place the Houthis in Yemen in the same category of military drones supplied by a state, not consumer products.[54] At Caracas on 4 August 2018, two explosions interrupted a speech by President Nicolás Maduro. Venezuelan ministers gave different numbers of drones, two and three; the president blamed plotters in Bogotá and Miami and named Colombia's president, accusations that Colombia called absurd; an open-source analysis of the video found it not possible to attribute the act. In the sources read, the number of drones, how they were stopped and who sent them all remain disputed.[55] In the European Union, none of Europol's annual reports for 2015 to 2026 read for this book[56] describes a completed terrorist attack using a drone; Europol records what member states report to it.[57] Its reports moved from noting unexplained drone flights over French nuclear sites in 2014, of unclear motive, and warning that the use of drones in Iraq and Syria "might also inspire other jihadist supporters", to noting in 2026 that "terrorist and violent extremist actors regularly featured unmanned aerial vehicles (UAV) systems in their propaganda".[58]

GATWICK, DECEMBER 2018

At about 21:00 on Wednesday 19 December 2018, an airport security officer at Gatwick who was finishing work reported seeing two drones.[59] The runway was closed and did not reopen until Friday 21 December, about 30 hours in all by the account of Sussex Police; flights were suspended again for a time that evening.[60] The government spoke of "over 100,000 passengers" affected; the police, the following September, of "disrupting 1,000 flights and more than 140,000 passengers".[61] The Ministry of Defence provided help at the request of the police on 20 December.[62] "No aircraft was damaged or passenger injured", the police said.[63]

What flew is less clear than what happened on the ground. Sussex Police said in September 2019 that it had recorded "129 separate sightings of drone activity, 109 of these from credible witnesses", among them police officers, and that "at least two drones were in operation".[64] Two local people were arrested on 21 December and released without charge two days later;[65] the force later paid them £55,000 "in a joint settlement … on a no liability basis" and apologised.[66] Two damaged drones found nearby were "ruled out of the enquiry".[67] The police operation and investigation cost, by the force's account, £790,000; the investigation found no further "realistic lines of enquiry".[68] The incident, the police said, "was not deemed terror-related".[69]



12.5 Gatwick Airport's North Terminal from the air, July 2012. In December 2018 reported drone sightings closed the airport's runway for about 30 hours, by police account.

PHOTO: CHRIS SAMPSON, CC BY 2.0, VIA WIKIMEDIA COMMONS

In our reading, Gatwick showed something that the Islamic State's drones had not. A small object in the air, or reports of one that could not be disproved, could stop a large airport for about 30 hours without any act of violence at all. The chief constable of Sussex told a parliamentary committee in 2019 that what could cause such disruption was "not necessarily the catastrophic, mind-stretching uses of a drone"; "it is the mere presence of a drone itself in the first instance".[70] On 8 January 2019, less than three weeks after Gatwick, a sighting stopped departures at Heathrow for about an hour.[71]

UNRESOLVED

Who flew drones at Gatwick, how many, and why.

Sussex Police concluded, from witness statements, that "at least two drones were in operation"; the transport secretary had told Parliament in January 2019 that "nobody is quite sure whether it was one, two or three" and that it was "probably only one".[72] No drone was linked to the incident, and two damaged drones found nearby were ruled out; no one was charged, and the police found no evidence of state, campaign or interest-group involvement and did not deem it terror-related.[73] The record allows the disruption to be measured, not its cause to be named.

Sussex Police, statements of 23 and 29 December 2018 and 27 September 2019; HC Deb 7 January 2019, vol. 652, col. 112.

AVAILABILITY FIRST, RULES AFTER

TIMELINE 12

The machine becomes mobile, 2007–2024

2007 TECHNOLOGY 9 January: Apple announces the iPhone with a built-in accelerometer; satellite positioning follows in the iPhone 3G (2008) and a three-axis gyroscope in the iPhone 4 (2010).

2010 TECHNOLOGY 5 January: Parrot announces the AR.Drone, a quadcopter flown by tilting an iPhone (company release).

2012 RESPONSE 14 February: a US statute requires the FAA to plan for civil drones to be integrated into the national airspace by 30 September 2015.

2013 TECHNOLOGY 7 January: DJI announces the Phantom, with a GPS autopilot and automatic return to its take-off point; a model with a built-in camera follows in October (company releases).

2015 RESPONSE 17 November: DJI announces GEO geofencing, a manufacturer's policy. 21 December: US registration of small drones takes effect; nearly 300,000 owners register in 30 days.

2016 RESPONSE 29 August: the FAA's operating rule for small drones (Part 107) takes effect.

2016 VIOLENCE 2 October: near Erbil, Iraq, a drone carrying explosives kills two Peshmerga fighters and injures two French soldiers, according to the UN.

2017 VIOLENCE January: a US officer describes the Islamic State dropping munitions from commercially bought drones in Mosul; officials later tell the press that the threat peaked in spring 2017.

2018 VIOLENCE 4 August: explosions interrupt a speech by President Maduro in Caracas; ministers give different numbers of drones, and responsibility remains disputed.

2018 RESPONSE 5 October: the US Preventing Emerging Threats Act gives federal agencies powers against drones.

2018 RESPONSE 19–21 December: reported drone sightings close Gatwick's runway for about 30 hours; no one is charged, and police find it was not terror-related.

2019 RESPONSE 13 March: extended flight restriction zones around UK airports. 30 November: UK registration for drones of 250 g and over.

2020 RESPONSE 31 December: the EU's common drone rules apply.

2021 TECHNOLOGY 9 December: in Sweden a drone delivers a defibrillator to a man in cardiac arrest before the ambulance arrives.

2024 RESPONSE 16 March: the FAA ends its leniency on Remote ID, the requirement that drones broadcast an identification.

Sources (see Bibliography): Apple 2007; Apple 2008; Apple 2010; Parrot 2010; United States Congress 2012; DJI 2013; DJI 2015; FAA 2015; FAA 2016; UN Monitoring Team 2017; US Department of Defense 2017; Rassler 2018; Waters et al. 2018; Associated Press 2018; Semana 2018; United States Congress 2018; Sussex Police 2019; UK Government 2019; UK Government 2018; European Commission 2020; Schierbeck et al. 2022; FAA 2023; FAA 2024.

In our reading, the rules arrived after the machines. In the United States, Congress had required the FAA in 2012 to produce a plan providing for civil drones to be integrated into the national airspace by 30 September 2015.[74] Registration of

small drones began on 21 December 2015, more than two years after DJI announced a quadcopter with satellite positioning and a built-in camera; the general rule for commercial operation took effect on 29 August 2016.[75] The European Union's common rules applied from 31 December 2020.[76] The United Kingdom required operators of drones of 250 grams and more to register from 30 November 2019, a requirement legislated before Gatwick, and extended the restricted zones around airports from 13 March 2019, after it.[77] The American requirement that drones broadcast an identification, announced in December 2020, was enforced from March 2024.[78]

Some limits came from the manufacturers themselves. DJI announced in November 2015 a system that would by default prevent its drones from flying into or taking off in places "that raise safety or security concerns", while saying that "in most instances, strict geofencing is the wrong approach".[79] States also gave themselves powers to act against drones: in the United States the Preventing Emerging Threats Act of 2018, and in the United Kingdom a counter-drone strategy in October 2019 and police powers in an act of 2021.[80] The British transport secretary had told Parliament, less than three weeks after Gatwick, that "any restriction zone would not have prevented a deliberate incident such as that at Gatwick".[81]



12.6 A sign on Forest Service land near Sedona, Arizona, January 2017, banning unauthorised drone flights within five miles of the local airport and citing the FAA's rules.

PHOTO: COCONINO NATIONAL FOREST, USDA FOREST SERVICE (PUBLIC DOMAIN)



12.7 A drone in flight during NASA tests of traffic management for emergency drone operations, near Redding, California, May 2021.

PHOTO: NASA/JOEL KOWSKY (PUBLIC DOMAIN)

AUTOMATION, NOT YET AUTONOMY

In this book's reading, by its four questions, the small drone changed the violence itself, which few technologies in the second half of this book had done, though not by much. The Islamic State could watch, film and drop small munitions from the air, an ability that until then had belonged mostly to states; by Rassler's account the effect was tactical, for "a defined period of time", and "not that long-lasting".[82] Outside the four questions, the response changed most visibly: armies fielded counter-drone measures, and states that had let a consumer product spread for years wrote registration, zones and police powers after the fact. Reach and audience changed least, except through the pictures that drones made for the group's propaganda. And at Gatwick the drone changed something this book has met before, in the hijackings of chapter 4: the cost that a single act, or the fear of one, could impose on a transport system.

The introduction followed a second thread: who does the work? A person once had to go up to watch from above, carry what was to be carried, and keep the aircraft level and on course. The consumer drone took over the steadying, the holding of position and the return home, and put the camera where the person used to be. It did not take over the decisions: where to go, what to look at, when to stop. In 2018 Rassler found no case of the Islamic State using drones that "take the human controller out of the loop".[83]

By the end of the 2010s the consumer drone could move, stabilise, navigate, record and return. The decisions about where it went and what it did still came from a person. The next question is what happens when software, having learned to steady and steer, begins to recognise, classify, generate and decide. That is the subject of the last chapter.

OBJECT 13 · 2013

The Commercial Drone



PHOTO: CLEMENSPOOL, CC0, VIA WIKIMEDIA COMMONS

TYPICAL FORM
four rotors, camera, satellite positioning, return home

ANNOUNCED BY DJI
Phantom, 7 January 2013

US REGISTRATION OPENS
21 December 2015

US HOBBYIST OWNERS REGISTERED
626,245 (end 2016); over 1.6 million ever, about 323,000 active (2025)

BATTLEFIELD PRICE, 2017
$100 to $1,000 (member states, via the UN)

SHOWN
DJI Phantom 3 Standard in flight, 2016

RECONNAISSANCE AND FILMING · IRAQ 2016–17

THE PROBLEM

To see a place from above, or to bring something to it over rough ground, someone had to go up or go there: in an aircraft, a helicopter, on foot. A radio-controlled model could fly without a pilot on board, but keeping it level, in place and on course depended on the skill of the person at the controls.

WHAT CHANGED

The parts of the smartphone made the skill cheap. Small drones, wrote Dario Floreano and Robert Wood in 2015, benefited from the falling cost of microprocessors, sensors, batteries and radios, "largely driven by the portable electronic device industry".[1] In January 2013 DJI announced the Phantom, with a "GPS-based autopilot system" that would bring it back to its take-off point and land it if it lost the signal from its controller.[2] Within the year, the company added a built-in camera.[3]

HOW IT SPREAD

Through shops. When the United States opened a registry for small drones on 21 December 2015, "nearly 300,000 owners" registered in 30 days; 626,245 hobbyists had registered by the end of 2016, each registration covering any number of aircraft.[4] The FAA credited "falling prices, improved technology such as built-in camera and ease of use".[5]

CIVIL USES

Photography, inspection, mapping, farming, rescue and the delivery of small, urgent things. In Sweden in December 2021 a drone flew a defibrillator 673 metres to a man in cardiac arrest and set it down before the ambulance arrived; the researchers who reported the case did not claim it changed the outcome.[6]

IN POLITICAL VIOLENCE

In Iraq and Syria the Islamic State bought commercially available drones and used them, the United Nations reported, "for reconnaissance and to film propaganda", and from 2016 to drop small explosives; a US officer described the aircraft as "commercial off-the-shelf".[7] At Gatwick in December 2018, in an incident that police found was not terror-related, reported sightings closed the runway for about 30 hours; no drone linked to the incident was ever recovered and no one was charged.[8]

WHAT NOBODY EXPECTED

In our reading, that the most disruptive thing about a toy-sized aircraft would be the possibility of it. After Gatwick, the chief constable of Sussex told a parliamentary committee that it was "the mere presence of a drone itself in the first instance" that could cause such disruption.[9] The machine could steady itself, hold its place and fly home. The decisions were still a person's.



The Summit supercomputer at Oak Ridge National Laboratory, Tennessee, in May 2018, a week before its unveiling.

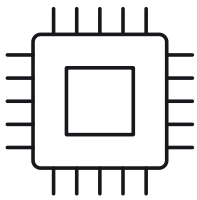
PHOTO: CARLOS JONES/ORNL, CC BY 2.0, VIA WIKIMEDIA COMMONS

13

The Algorithmic Age

2020–

From 2022 software that could write, draw, speak and translate was offered to anyone with a browser. By 2025 one adult in three in the European Union had used it in the previous three months. Extremists experimented with it, and by 2026 the United Nations reported terrorist groups using it for propaganda and translation, without "a step change in capability". What a tool can do, what researchers have shown, what supporters and groups have done and what officials fear are different questions, and this chapter keeps them apart.



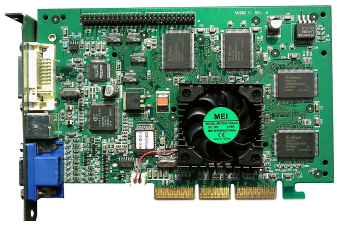
ON 30 NOVEMBER 2022 OPENAI, A COMPANY IN SAN Francisco, put on its website a program called ChatGPT. It was a "research preview", and "during the research preview, usage of ChatGPT is free". A user typed a question or an instruction in ordinary language, and the program answered in ordinary language: an explanation, a letter, a poem, a piece of computer code.[1] Within two and a half years, in the European Union, about one person in three between the ages of 16 and 74 said that in the previous three months they had used a tool of this kind, which statisticians called "generative AI"; among those aged 16 to 24, almost two in three.[2]

Two years earlier, the company's researchers had considered how their model GPT-3 might be misused. Readers in a test could tell its short news articles from real ones only "barely above chance at ~ 52%"; and for harmful uses such as "misinformation, spam, phishing", they wrote, "many of these applications bottleneck on human beings to write sufficiently high quality text".[3] The bottleneck was a person. This chapter is about what happened when, for some kinds of work, it stopped being one.

Most earlier chapters of this book described technologies that carried, copied or sent something a person had made. The telegraph carried words, the press and the photocopier copied them, radio and the satellite broadcast them, the Web stored them and the platforms of chapter 11 sorted and recommended them. Even the drone of chapter 12 carried a camera that a person pointed. The systems of the 2020s did something else as well. They produced text, images, speech and translations, and they recognised and classified what was put in front of them. The question for this chapter is what changed for political violence when software began to make and to interpret, as well as to carry. It is a question about evidence, and the evidence is thinner than the attention it has received.

CHIPS MADE FOR GAMES

The machines behind this change were not designed for it. In August 1999 NVIDIA, a Californian maker of graphics chips, announced the GeForce 256, which it called "the world's first graphics processing unit (GPU)", a chip to draw three-dimensional scenes for computer games; its chief executive hoped to "broaden the appeal of 3D far beyond the game enthusiasts".[4] The claim of being first is the company's. What mattered later was how such chips worked: they performed very many simple calculations at the same time, which is what drawing millions of points on a screen requires.



13.1 A GeForce 256 graphics card, c. 1999–2000. NVIDIA called the chip a "graphics processing unit".
PHOTO: HYINS (PUBLIC DOMAIN), VIA WIKIMEDIA COMMONS

Researchers soon saw a use their makers had not advertised. A survey of 2007 described commodity graphics processors as "probably today's most powerful computational hardware for the dollar", though a programmer then had to "recast" a problem "into graphics terms" to use them; the "vital step", the authors wrote, was "the introduction of fully programmable hardware".[5] In November 2006 NVIDIA announced CUDA, "a fundamentally new architecture for computing on NVIDIA graphics processing units".[6] In 2009 three researchers at Stanford reported that a graphics processor made the training of one kind of neural network "up to 70 times faster than a dual-core CPU", cutting the time "from several weeks to around a single day".[7]

Three years later a network called AlexNet, trained by Alex Krizhevsky, Ilya Sutskever and Geoffrey Hinton in Toronto, won an image-recognition competition with a top-5 error of 15.3 per cent against 26.2 per cent for the next entry. It took "between five and six days to train on two GTX 580 3GB GPUs", consumer graphics cards, and the authors added that their results could be "improved simply by waiting for faster GPUs and bigger datasets to become available".[8] Both arrived. The authors of GPT-3 in 2020 trained it on "V100 GPU's on part of a high-bandwidth cluster provided by Microsoft"; Meta's researchers trained their LLaMA models in 2023, by their account, on large clusters of data-centre graphics processors.[9] Epoch AI, a research group that compiles such figures, estimated, from the developers' own published numbers, the computation used to train GPT-3 at about 3×10^{23} operations and that for Meta's largest model of 2024 at about 4×10^{25}, more than a hundred times as much.[10]

In our reading, a chip made to draw games had become the engine of a new industry. By its own annual reports, NVIDIA's revenue from graphics for gaming was $6.2 billion in the year to January 2019, and from data centres $2.9 billion; in the year to January 2026, gaming brought in $16.0 billion and data centres, including networking equipment, $193.7 billion.[11] In October 2022 the United States restricted exports of advanced computing chips, including "graphical processing units (GPUs)", to China, citing among other things "military modernization, including the development of weapons of mass destruction (WMD), and human rights abuses".[12] A games component had become a matter of state security.

MAKING INSTEAD OF CARRYING

The software that ran on these chips also came from somewhere else. The architecture on which the language models of this chapter were built, the "transformer", was described by researchers at Google in 2017 in a paper on machine translation; it was "based solely on attention mechanisms, dispensing with recurrence and convolutions entirely", which in plain terms meant a model that weighs every word of a passage against every other at once, rather than reading one word after another.[13] Within five years models built on it were writing text.

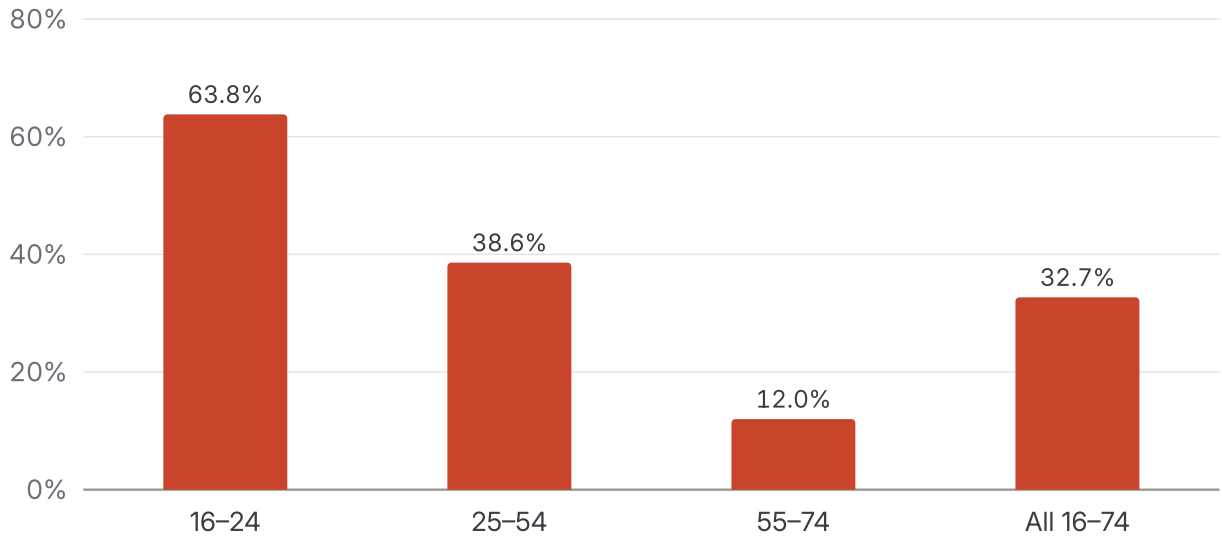
The products reached the public in a few months. OpenAI showed its image generator DALL·E 2 as a research preview in April 2022 and said in September that it was available without a waiting list.[14] Midjourney, another image service, announced its open beta in July.[15] On 22 August 2022 Stability AI released Stable Diffusion with its model weights, the numbers that make up a trained model, for anyone to download under a licence; the company said it could run on consumer graphics cards.[16] ChatGPT followed in November. In February 2023 Meta released its LLaMA models to researchers, "case-by-case"; in July, Llama 2, "free of charge for research and commercial use".[17] In February 2024 OpenAI announced a video generator, Sora, which it opened to paying users in some countries in December.[18] All of these dates and descriptions are the companies' own.

What became cheap, in our reading, was a kind of labour: the first draft of a text, an illustration, a voice reading a script, a translation, a transcript. Shakked Noy and Whitney Zhang, in an experiment with 453 professionals published in *Science* in 2023, found that with ChatGPT the "time taken decreased by 40% and output quality rose by 18%" on writing tasks.[19] Erik Brynjolfsson and colleagues, studying 5,172 customer-support agents in one company, found that an AI assistant raised the number of issues resolved per hour by 15 per cent on average and by 30 per cent for less skilled and less experienced agents, while the most skilled saw "small declines in quality".[20] Neither study measured what such tools did for anyone writing propaganda, and the second warned that it described "a single firm". Firms adopted AI quickly. By Eurostat's count, the share of enterprises in the European Union with 10 or more employees that used at least one AI technology rose from under 8 per cent in 2021 to about 20 per cent in 2025, a year in which Eurostat also widened the list of

technologies; the share using AI to generate written or spoken language or code rose from 1.3 to 8.8 per cent.[21]

In 2025 nearly two in three young Europeans had recently used generative AI, against one in eight aged 55–74

Individuals in the EU27 who used a generative AI tool in the last three months, by age, per cent, 2025



13.2 First year in which Eurostat asked the question; self-reported use for any purpose.

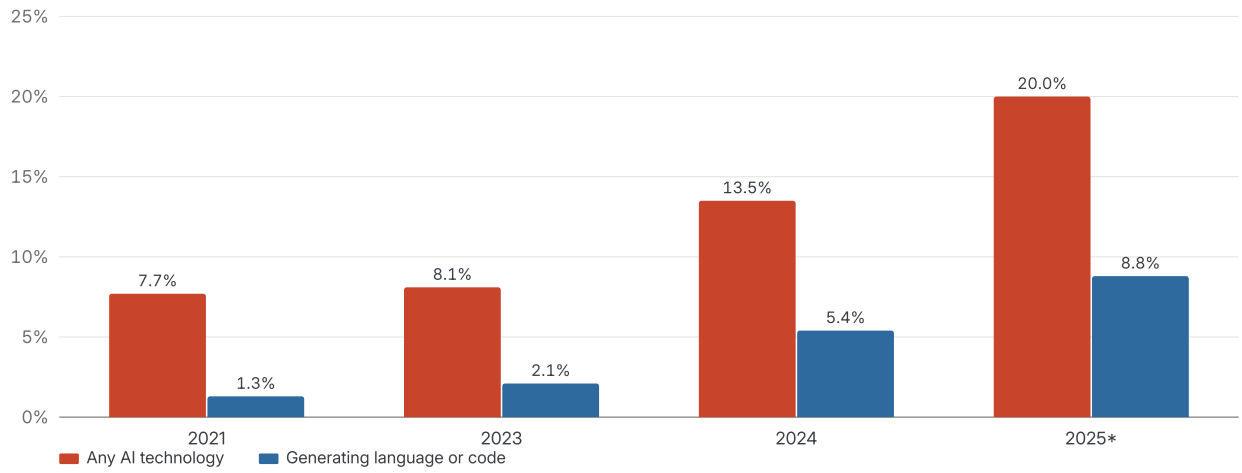
Source: Eurostat, ICT usage in households and by individuals (isoc_ai_iaiu), 2025, CC BY 4.0. Data: `data/processed/ch13_chart_eu_genai_age.csv`.

FIVE SYSTEMS, NOT ONE

Discussions of "the algorithm" often treat as one thing several systems that do different jobs. Chapter 11 described ranking and recommendation: software that chose the order in which existing posts were shown. *Classification* sorts material into categories: spam or not, a weapon in a picture or not, terrorist content or not. *Matching* compares an item with a list of items already known, as the shared database of "hashes" in chapter 11 did. *Moderation* is the decision to remove, label or keep something, taken by people, by machines or by both. *Generation* makes new material. Robert Gorwa, Reuben Binns and Christian Katzenbach, writing in 2020, separated matching from classification and observed of the platforms' systems that "it remains unknown if or how these systems are audited, and what kind of false positive rates are considered typical or acceptable".[22]

The share of EU firms using AI rose from about one in thirteen in 2021 to one in five in 2025

Enterprises in the EU27 with 10 or more persons employed using at least one AI technology, and using AI to generate written or spoken language or code, per cent, 2021–2025 (AI use not collected in 2022)



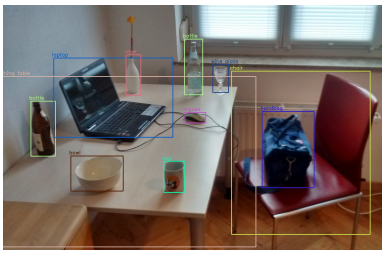
13.3 *In 2025 Eurostat added a category for generating pictures, video and sound, so part of the last rise is definitional. Excludes agriculture, mining and finance.

Source: Eurostat, Artificial intelligence by size class of enterprise (isoc_eb_ai), data updated 15 June 2026, CC BY 4.0. Data: `data/processed/ch13_chart_eu_enterprise_ai.csv`.

Classification rested on the progress of computer vision, and its history shows both how fast the change was and how carefully its claims must be read. ImageNet, a collection of millions of photographs gathered from the Web and checked by people working through Amazon Mechanical Turk, was presented in 2009.[23] In its annual competition, error in classifying images fell from 28.2 per cent in 2010 to 6.7 per cent in 2014. The organisers estimated human error on the same task at 5.1 per cent, for one annotator who had trained on 500 images and was tested on 1,500; a second annotator scored about 12 per cent. Humans, they thought, could still win, but "only by use of significant effort, expertise, and time".[24] When researchers at Microsoft reported in 2015 a top-5 error of 4.94 per cent, "surpassing human-level performance", they added that this "does not indicate that machine vision outperforms human vision on object recognition in general".[25] In 2019 a group that rebuilt the test from new photographs found accuracy falling by "11% – 14%".[26]

Facial recognition followed the same path. The United States National Institute of Standards and Technology (NIST) reported "massive gains in accuracy" between 2013 and 2018, with "almost a twenty-fold reduction in false negatives", while noting that for the tenth or more of images that were aged or of poor quality, "human adjudication becomes necessary".[27] In 2019 it reported that, for many algorithms, false positive rates "often vary by factors of 10 to beyond 100 times" between demographic groups.[28] In our reading, recognition had become good enough to be used widely and remained unequal enough to be contested.

The platforms of chapter 11 put these methods to work. Facebook said in April 2018 that in the first quarter of that year "99% of the ISIS and al-Qaeda content we took action on" was found before a user reported it, a figure that covered its human reviewers as well as its machines; in November it said that it removed some posts automatically when its tools had "very high confidence", but "we still rely on specialized reviewers to evaluate most posts".[29] These are the company's descriptions of its own actions. The European Union's regulation of 2021 on terrorist content online, described in chapter 11, did not oblige companies to use automated tools, and required that a company found exposed to terrorist content, if it took specific measures with such tools, provide safeguards "in particular through human oversight and verification".[30] By 2025 Meta, for one, described "input and output classifiers" around its own assistant, checking both what users asked and what the system produced.[31] Generation, classification and moderation had begun to sit in one product.



13.4 An object-detection program labels the things on a desk, 2019. Such systems recognise categories they have been trained on, not meanings.
PHOTO: MTHEILER, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS

	A PERSON PUBLISHES c. 1900–2005	A PLATFORM RANKS c. 2006–2020	A SYSTEM GENERATES from 2022
MAKES THE MESSAGE	A person	A person	A person with a generative system
CHOOSES WHO SEES IT	Editors, broadcasters, readers	Ranking and recommendation	Ranking and recommendation
CARRIES IT	Press, radio, television, the Web	The platform	The platform

13.5 From carrying to making. Who produced, chose and delivered a message in three periods: the human publisher, the platform that ranks, and the generative system. A schematic drawn for this book; most real cases mix all three.

WHAT EXTREMISTS DID WITH IT

The evidence about extremist use of these tools has to be sorted before it can be read, because it is often quoted as if every kind of statement were the same kind. Five kinds of statement appear in the sources. Some describe what the technology *can* do. Some describe what researchers have *demonstrated* in tests. Some describe what *individual extremists and supporters* have done. A few describe what *organised groups* have documentedly done. And many describe what officials and commentators *fear*. A finding in one category is not evidence for another.

Until 2023 there was little to sort. A report by two United Nations bodies in 2021 found that "no clear evidence of the actual use of AI by terrorist organizations has been identified to date".[32] In November 2023 Tech Against Terrorism, an organisation that monitors terrorist use of the Internet, reported "little evidence that generative artificial intelligence (AI) services are being systematically exploited" by terrorist groups, and judged the use "likely to be in its experimental phase".[33] Its examples were small: a supporter group of the Islamic State that published a guide to using an AI chatbot privately, a supporter who claimed to have used an AI tool to transcribe an audio message of the group's leadership, and posters for a pro-al-Qaeda outlet that were "highly likely" made with an image generator.[34] Its one example from an organisation's own channels was a set of posters of Hamas's armed wing in October 2023 that it judged "likely" to be AI-generated or enhanced, adding that such imagery was "negligible compared to authentic content".[35] These were supporters, not the organisations. Later official reports sometimes attributed the chatbot guide to the Islamic State itself.[36]

A later case studied closely was of the same kind. After the attack on the Crocus City Hall near Moscow in March 2024, researchers monitoring supporters' channels found a single supporter of the Islamic State posting a short series of videos over a few weeks in which a synthetic presenter read the group's official claims in the style of a news bulletin.[37] They found a positive reception among supporters and objections on religious grounds to the presenter's face. It was one person and a few weeks.

KIND OF STATEMENT	EXAMPLE	SOURCE	STATUS
What the tools can do	Write fluent, authentic-sounding text at speed and scale	Europol, 2023	Official assessment (capability)
What researchers have shown	Chatbots tested with harmful questions answered some of them	Weimann et al., 2024	Documented (experiment only)
What individuals and supporters did	A chatbot privacy guide; posters highly likely AI-made; synthetic news videos by one supporter	Tech Against Terrorism, 2023; GNET, 2024	Reported by monitors
What organised groups did	Propaganda and translation with AI tools; experiments with fake documents	UN monitoring team, 2025–2026	Official assessment
What officials fear	Help with planning attacks; radicalising content; live deepfakes	UK CONTEST 2023; US DHS 2024; Europol 2024	Official forecast

13.6 Five kinds of statement about terrorism and generative AI, 2023–2026, with examples cited in this section. The status column describes the kind of evidence; one kind of statement is not evidence for another.

Official assessments followed. In 2023 Europol, the European Union's police agency, described what the tools could do: ChatGPT "excels at producing authentic sounding text at speed and scale".[38] The forecasts were broader. The British government expected terrorists to be "likely to exploit the technology to create and amplify radicalising content, propaganda and instructional materials, and to plan and commit attacks"; in 2024 the United States expected terrorist groups and their supporters to "continue to experiment with generative AI", and reported that some had "used or explored" it.[39] The findings were narrower. Europol reported in 2025 that the use of generative AI to make propaganda and hate speech "has reached unprecedented levels, especially in the right-wing scene", without giving numbers.[40] In 2026 it added that "much of the AI-generated material consisted of hate speech and 'awful but lawful' content rather than explicit terrorist content", and that "AI-driven applications were used to conduct preliminary research to prepare attacks".[41] The United Nations monitoring team on the Islamic State and al-Qaeda reported in 2025 that the Islamic State was "experimenting with artificial intelligence (AI)-created fake documentation" to get round the identity checks of financial services, and that al-Shabaab, in Somalia, had "released a series of messages that were translated into various languages using AI tools".[42] In early 2026 it summed up: groups had "demonstrated greater proficiency in the use of artificial intelligence,

primarily in propaganda", although "this did not represent a step change in capability".[43]

OFFICIAL ASSESSMENT

By 2025–2026 the UN monitoring team reported terrorist groups using generative AI, mainly for propaganda and translation, without a step change in capability.

The UN monitoring team reported in 2025 that al-Shabaab had released messages "translated into various languages using AI tools" and that the Islamic State was "experimenting" with AI-made documents; in 2026 that groups showed "greater proficiency … primarily in propaganda", which "did not represent a step change in capability".[44] Europol, describing users rather than organisations, found much AI-generated material to be hate speech and "'awful but lawful'" content.[45] These reports rest on information from member states and give few individual cases.

UN Monitoring Team S/2025/482 and S/2026/44; Europol, TE-SAT 2026, p. 12.

The strongest claim of organisational adoption is also the least verifiable. A study of Boko Haram based on interviews with 27 former members reported that both of its factions ran units for artificial intelligence "directly under the leadership"; its author cautioned that the findings "do not conclusively establish whether AI provided uplift", and that "documented use remains conventional".[46]

Officials have also described individuals who used chatbots before acts of violence, at the level of looking things up. After a vehicle exploded outside a hotel in Las Vegas on 1 January 2025, its driver having shot himself inside it, the city's police said, as reported by the Associated Press, that he had used generative AI, including ChatGPT, to look up information beforehand; the sheriff called it "a game-changer" and "a concerning moment".[47] In June 2025 the Department of Justice, announcing a charge against a man accused of helping the bomber of a fertility clinic in Palm Springs, said that "records from an AI chat application" showed what the bomber had researched.[48] Neither official statement said whether the chatbot had given the men anything they could not have found elsewhere, and this book records no more of either case. In Britain a man who entered the grounds of Windsor Castle with a crossbow on Christmas Day 2021, later convicted of an offence under the Treason Act 1842, had for weeks discussed his plan with a companion chatbot; experts told the court that it "may have served to bolster and reinforce" his intentions, and the judge called his belief that he

was speaking through it to an angel "a delusional belief".[49] The Independent Reviewer of Terrorism Legislation wrote, in a report published in July 2025, that at the time of writing the case was "the only one in the UK (or as far as I am aware, anywhere in the world) where a chatbot appears to have conversed about attack-planning".[50]

THE QUIET CHANGE: TRANSLATION

UNRESOLVED

Whether generative AI has changed what terrorist groups are able to do.

Official and research sources agree that extremists have experimented with generative tools since 2023 and that some groups use them for propaganda and translation.[51] They do not show a change in the violence. A study published in 2026 found "limited evidence that they fundamentally alter the nature of terrorism or significantly enhance operational capability".[52] Experiments in which researchers asked chatbots for harmful help show what the tools would answer, not what anyone did with the answers.[53]

Tech Against Terrorism (2023), p. 2; UN S/2026/44; Glazzard et al. (2026), p. 25; Weimann et al. (2024).

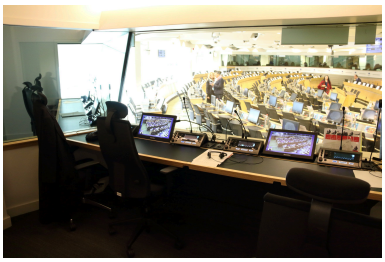
Chapter 11 described an organisation whose output appeared in 28 languages.[54] Each version needed a person who knew the language. Translation had been human work for the whole history this book covers. In 2018 the European Commission's own translation service translated "some 2 255 000 pages".[55] The same report recorded that its machine-translation service had handled "more than 41 million pages", including requests from other computer systems as well as from people.[56]

The machines had improved quickly. Google said in 2016 that its new neural system made markedly fewer errors, and added that "machine translation is by no means solved".[57] In 2024 a team at Meta and its partners described in *Nature* a model covering 200 languages, many of them with little written material online.[58] The organisers of the main annual competition in machine translation headed their report of 2024 "The LLM Era is Here but MT is Not Solved Yet": the previous year's report had found large language models strong, on the evidence of only two such systems, and weaker when translating into less widely written languages.[59]

Armed groups had used machine translation before generative AI, and not always well. In 2017, according to an affidavit

filed in an American court, a member of a pro-Islamic State media group complained that a designer had used Google's translation and produced a phrase that said the opposite of what was meant; the group relied on a translation department staffed by several of its members.[60] Human translator networks persisted after the machines arrived.[61] By the mid-2020s official reports described a change. The United Nations monitoring team reported that al-Shabaab had issued messages "translated into various languages using AI tools", that the Islamic State's Khorasan province (ISIL-K) "appeared to be using AI tools to translate and rapidly circulate propaganda", and that "using translation services enhanced by artificial intelligence, terrorist groups quickly reached audiences in multiple languages".[62] The reports give no volumes or dates.

In our reading, translation may matter more than the spectacular uses that drew attention. A deepfake is a single object that can be exposed. Translation multiplies what already exists, cheaply and quietly, into languages its authors did not speak. The evidence for its use is official but general; how much difference it made, the sources do not say.



13.7 An interpreting booth overlooking a meeting room in Brussels, December 2023. For most of the history in this book, translation was the work of people.

PHOTO: FRDR, CC BY 4.0, VIA WIKIMEDIA COMMONS

SYNTHETIC FACES AND VOICES

Synthetic media drew much of the fear. The documented incidents of the period were real, and few of them concerned terrorism. On 16 March 2022, three weeks after Russia's invasion, hackers made a Ukrainian television channel display, in the words of Ukraine's Centre for Strategic Communications, President Volodymyr Zelensky's fake "capitulation" address; Meta said it had removed "a deepfake video claiming to show President Zelensky issuing a statement he never did".[63] A peer-reviewed study later judged that "the quality of the deepfake was poor".[64] On 22 May 2023 a fabricated picture of an explosion near the Pentagon spread online until the local fire department said that "there is NO explosion or incident taking place at or near the Pentagon reservation".[65] In January 2024 voters in New Hampshire received telephone calls in a voice that the state's attorney general said "appears to be artificially generated" and that imitated President Joe Biden; the Federal Communications Commission ruled the next month that voices made with "voice cloning" fell within an existing ban on artificial voices in calls, and later found that the message had been made in a day for "$150" and sent in "9,581 calls".[66]

People were poor at telling such material apart from the real thing. In a laboratory study published in 2022, participants identified faces generated by a model with an accuracy

of “48.2%”, close to chance; in another, listeners “correctly spotted the deepfakes 73% of the time”.[67] Yet the measured effects outside the laboratory were smaller than feared. A study of the British and European elections of 2024 found “just 16 confirmed viral cases” of AI-enabled disinformation in the United Kingdom and 11 in the European Union and France combined, and “no evidence” that they had changed any result.[68]

DOCUMENTED

No documented case was found of a terrorist group using a deepfake of a real person in an operation.

Europol wrote in 2024 that “some supporters of terrorism and violent extremism” had “integrated the use of generative AI and LLMs into their propaganda toolbox”, and that “livestreaming deepfakes could be used for terrorist purposes in the future”.[69] The synthetic-media incidents of 2022–2024 documented in official sources read for this book were political, state-linked or of unknown origin.[70] The supporters’ synthetic news videos of 2024 used an invented presenter, not a real person.[71] Absence in the sources read is a finding about the record, not a guarantee about the future.

Europol, TE-SAT 2024, p. 10; Ukraine Centre for Strategic Communications, 16 March 2022; New Hampshire Department of Justice, 22 January 2024; GNET (2024).

WHERE THE BOUNDARY STANDS

Chapter 12 ended at the line between automation and autonomy. The words used in this chapter add a fourth term, and it is worth placing it. *Artificial intelligence* names a family of techniques; it says nothing by itself about how independently a system acts. The Organisation for Economic Co-operation and Development (OECD), in a definition revised in 2023, describes an AI system as one that “infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions”; the European Union’s AI Act of 2024 excludes systems based on “rules defined solely by natural persons to automatically execute operations”.[72] The distinction is between how a system works, by rules people wrote or by inference from data, and how much it does without a person, which is what chapter 12 measured: a system that uses AI can still be remotely controlled, automated or autonomous. A chatbot that writes a paragraph when asked does not decide anything outside the conversation.

The debate about autonomy in weapons is a debate among states. The International Committee of the Red Cross defined

autonomous weapon systems in 2021 as systems that "select and apply force to targets without human intervention"; the United States Department of Defense defines one as a weapon that, "once activated, can select and engage targets without further intervention by an operator".[73] In 2024 the UN Secretary-General wrote that "machines that have the power and discretion to take human lives are politically unacceptable and morally repugnant", and states told him of their concern that such weapons could spread to "terrorist and criminal groups".[74] A much-discussed case of a weapon that may have attacked on its own was in a civil war. A UN panel on Libya wrote in 2021 that retreating forces had been "hunted down and remotely engaged by the unmanned combat aerial vehicles or the lethal autonomous weapons systems such as the STM Kargu-2", which "were programmed to attack targets without requiring data connectivity between the operator and the munition"; the paragraph does not say that the system killed anyone on its own, and what happened remains disputed among analysts.[75]

DOCUMENTED

No documented case of terrorists using autonomous drones was found up to 2025.

UN monitoring reports of 2023–2025, Europol's annual reports of 2024–2026 and three articles in the West Point centre's *CTC Sentinel* of 2024–2026, searched for this book, describe no such case.[76] The UN reported that al-Qaeda in the Arabian Peninsula was "reported to be pursuing … drones or autonomous vessels", which is a report of intent.[77] Researchers at West Point expected terrorist use of drones to rely on "human-machine teaming instead of autonomous swarms, at least over the near term".[78] The Libyan case concerned a weapon supplied by a state.

UN Monitoring Team reports 2023–2025; Europol, TE-SAT 2024–2026; Rassler and Veilleux-Lepage, CTC Sentinel (2025); UN S/2021/229.

OPEN WEIGHTS AND CLOSED DOORS

Two ways of offering these systems developed side by side. Some companies kept their models on their own servers and let users reach them through a website or a paid interface, which allowed the company to watch for misuse and refuse requests. Others released the weights so that anyone could run the model on their own computer. "Open" did not mean unrestricted. Meta called Llama 2 "open source"; the Open Source Initiative, which maintains the definition of the term for software, replied that "it is not", because the licence

limited who could use it and for what.[79] In 2024 the same initiative published a definition for AI requiring use "for any purpose and without having to ask for permission".[80]

The United States government examined the question in 2024. Its report on models with "widely available weights" concluded that "current evidence is not sufficient to definitively determine either that restrictions on such open-weight models are warranted, or that restrictions will never be appropriate in the future". On the gravest fear, it found that "no current models, proprietary or widely available, offer uplift" on chemical, biological, radiological or nuclear weapons "relative to open source information resources on the Internet"; on propaganda, it recorded a disagreement, in which "some researchers argue that the bottleneck for successful disinformation operations is not the cost of creating it". It also noted that running a model on one's own machine "limits the capacity to monitor model use and misuse".[81] The report was an assessment at a moment in time, and the order that commissioned it was revoked in January 2025.[82]

WHO DECIDES

In this book's reading, by its four questions, generative systems had by 2026 changed labour most. Work that had needed a writer, a designer, a voice or a translator could be done in seconds by one person with a computer, and the official reports of 2025 and 2026 describe groups using such tools for propaganda and translation. Audience and reach may have changed with it, through translation above all, though the sources do not measure how much. Response changed too: companies placed classifiers around their own generators, and states studied whether open models should be restricted. The violence itself, on the evidence read here, changed least. No source read for this book documents an attack that was possible only because of generative AI; the cases in official records read here are of individuals looking up information, and no official cited here said whether the chatbot gave them anything they could not have found elsewhere.

TIMELINE 13

The algorithmic age, 1999–2026

1999 TECHNOLOGY 31 August: NVIDIA announces the GeForce 256, which it calls a "graphics processing unit" (company claim).

2009 TECHNOLOGY Researchers at Stanford report that a graphics processor trains one kind of neural network up to 70 times faster than a dual-core processor.

2012 TECHNOLOGY AlexNet, trained on two consumer graphics cards, wins the ImageNet image-recognition competition.

2017 TECHNOLOGY Researchers at Google describe the transformer, an architecture for machine translation.

2019 RESPONSE NIST reports that for many face-recognition algorithms false positive rates "often vary by factors of 10 to beyond 100 times" between demographic groups.

2021 RESPONSE A UN report finds "no clear evidence of the actual use of AI by terrorist organizations". A UN panel on Libya reports a loitering munition that may have attacked without a data link; what happened remains disputed.

2022 TECHNOLOGY 22 August: Stable Diffusion released with downloadable weights. 30 November: ChatGPT opened as a free research preview.

2023 RESPONSE November: Tech Against Terrorism finds "little evidence" of systematic terrorist use of generative AI; use is "likely to be in its experimental phase".

2024 RESPONSE March–May: after the Crocus City Hall attack, researchers find one supporter of the Islamic State posting a short series of AI-generated news-style videos.

2024 RESPONSE July: a US government report finds the evidence "not sufficient" to decide whether open-weight models should be restricted.

2025 RESPONSE The UN monitoring team reports al-Shabaab messages "translated into various languages using AI tools".

2025 TECHNOLOGY Eurostat: 32.7% of people aged 16–74 in the EU used a generative AI tool in the previous three months.

2026 RESPONSE The UN monitoring team reports greater proficiency "primarily in propaganda", not "a step change in capability"; Europol finds that much AI-generated material was hate speech and "awful but lawful" content rather than explicit terrorist content.

Sources (see Bibliography): NVIDIA 1999; Raina et al. 2009; Krizhevsky et al. 2012; Vaswani et al. 2017; Grother et al. 2019; UNCCT and UNICRI 2021; United Nations Security Council 2021; Stability AI 2022; OpenAI 2022; Tech Against Terrorism 2023; Borgonovo et al. 2024; NTIA 2024; UN Monitoring Team 2025; Eurostat 2026; UN Monitoring Team 2026; Europol 2026.

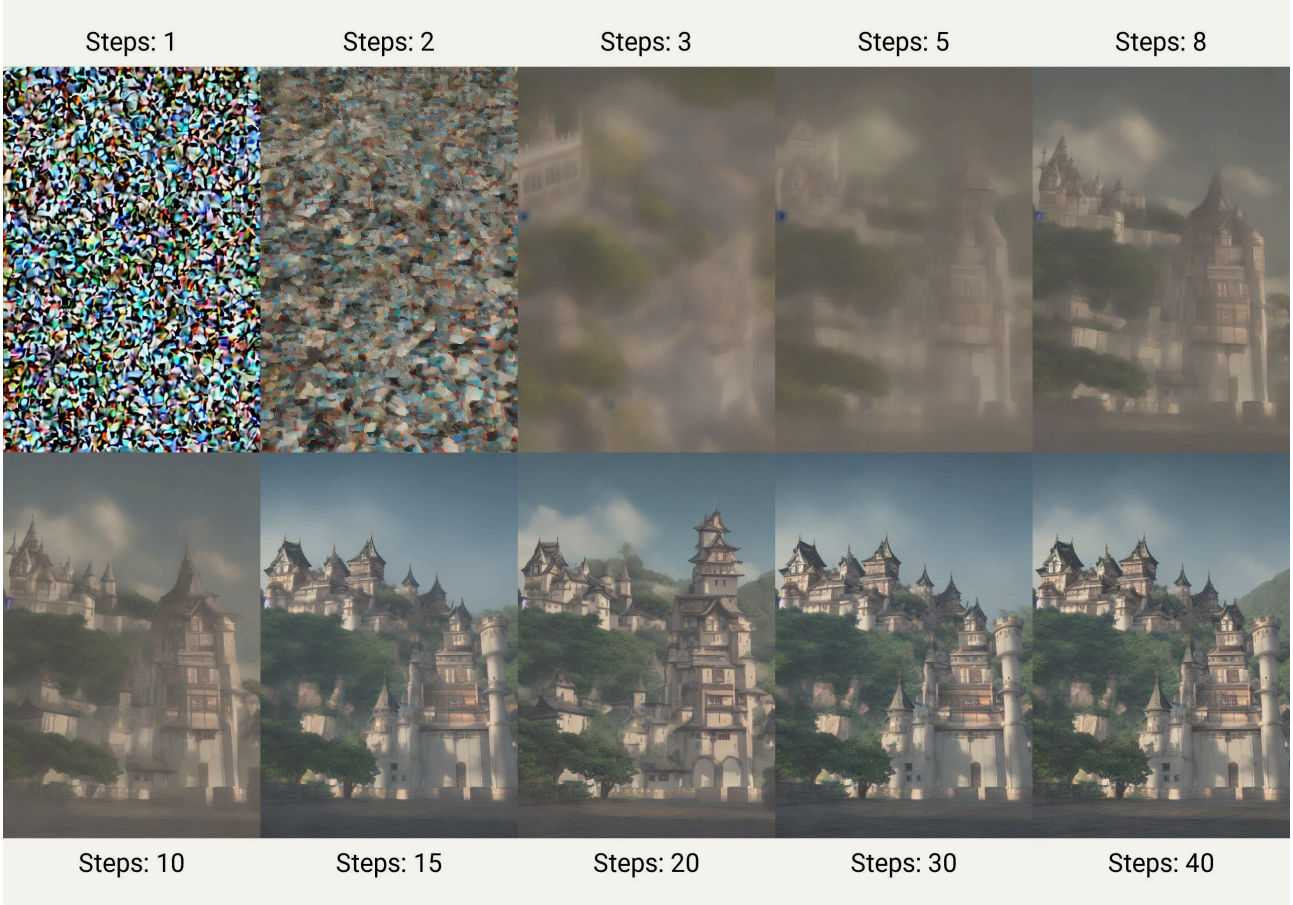
The introduction followed a thread through every chapter: who does the work? Over a century and a half, machines took over parts of carrying, talking, watching, finding the way and publishing. In the 2020s software began to help with writing, translating, recognising and classifying. The last row of the introduction's diagram is the decision, and the introduction said that the decision to kill had stayed with people throughout this history, a statement it promised to test against the

evidence of the 2020s. In the cases of political violence read for this book, it still had. The machines in those cases helped people look things up, write and translate. In the Windsor case, which was not treated as terrorism, the judge who sentenced the man found that he had "conceived of killing the Queen earlier in 2021", before he joined the chatbot service in December.[83] The one case in this chapter in which a weapon may have attacked without a person choosing the target, in Libya, concerned a state's weapon in a war, and what happened there is disputed. The systems of this chapter generate, rank and classify; the sources read here show people deciding what to ask them, what to keep and what to do. Whether that remains so is not a question the record can answer.

Some technologies in this book were made for war. Most were not made for violence of any kind. Dynamite was made for blasting rock and the transistor for the telephone network; satellites were launched to carry telephone calls and television across oceans; the smartphone combined a telephone with things people already owned; the consumer drone put a camera in the air for anyone who could fly one. The graphics chip was made for games, and the architecture of the language models was first described for translation. Generative AI was not created for terrorism either. The pattern, in this book's reading, is not that technology causes terrorism. It is that technologies acquire uses that their makers did not design, predict or control.

OBJECT 14 · 2022

The Generative Model



AI-GENERATED. IMAGE: BENLISQUARE, MADE WITH STABLE DIFFUSION V1.5, CC BY-SA 4.0, VIA WIKIMEDIA COMMONS

LANGUAGE MODELS BUILT ON
the transformer, described in 2017

OPENED TO THE PUBLIC
ChatGPT, 30 November 2022 (free research preview)

RELEASED WITH WEIGHTS
Stable Diffusion, 22 August 2022

TRAINED ON
graphics processors, first made for games

EU ADULTS WHO HAD USED ONE, 2025
32.7% (16–74; last three months)

SHOWN
an AI-generated image, made step by step from noise with Stable Diffusion, 2022

AI-TRANSLATED MESSAGES · AL-SHABAAB, REPORTED 2025

THE PROBLEM

Text, pictures, voices and translations had to be made by people: writers, designers, speakers, translators. Software could store, find, sort and send what they made. Considering in 2020 how their model might be misused, the authors of one language model observed that such harmful applications "bottleneck on human beings to write sufficiently high quality text".[1]

WHAT CHANGED

Two things that began elsewhere. Graphics chips built for games turned out, by 2009, to make the training of one kind of neural network "up to 70 times faster" than an ordinary processor; in 2012 a network trained on two consumer graphics cards won an image-recognition contest.[2] In 2017 researchers at Google described the transformer, in a paper on machine translation.[3] Together, in our reading, they made it possible to train models that produce text, images and speech, and to offer them to anyone through an ordinary website.

HOW IT SPREAD

In a few months. Stability AI released Stable Diffusion with its weights, under a licence, on 22 August 2022; OpenAI opened ChatGPT as a free research preview on 30 November.[4] By 2025, 32.7 per cent of people aged 16 to 74 in the European Union, and 63.8 per cent of those aged 16 to 24, said they had used a generative AI tool in the previous three months.[5]

CIVIL USES

Drafting, summarising, translating, transcribing, illustrating, writing code, answering questions. In one experiment with 453 professionals, writing tasks took 40 per cent less time with ChatGPT.[6]

IN POLITICAL VIOLENCE

At first, experiment, mostly by supporters rather than organisations: in 2023 a monitoring group found "little evidence" of systematic use.[7] The United Nations monitoring team reported in 2025 that al-Shabaab had "released a series of messages that were translated into various languages using AI tools", and in 2026 that groups had grown more proficient, "primarily in propaganda", without "a step change in capability".[8]

WHAT NOBODY EXPECTED

In our reading, that the official record would be so undramatic. Commentators feared fake videos and machines that plan attacks; a few, in 2023, pointed to translation instead.[9] By 2026 the reports of the UN monitoring team named propaganda and translation with "AI tools": an old human job, done faster.[10]

Uses Nobody Ordered

The technologies in this book were made to blast rock, carry voices, move passengers, copy pages, record television, publish documents, take photographs and answer questions. None was made for terrorism. Each changed what a few people could do.

THIS BOOK BEGAN WITH A MAN WHO RECEIVED HIS MESsages by hand. In 2011, in the account American officials gave on the night of the raid, the house in Abbottabad had "no telephone or Internet service connected to it", and what linked the man inside to the world was "one of the few al Qaeda couriers trusted by bin Laden".[1] A person carrying words was the oldest arrangement there was. It was also, in the same account, the thread that led to the house.

Between that courier and the first chapter lie about a century and a half and 14 objects: a stick of dynamite, a radio set, a transistor, a jet airliner, a satellite, a photocopier, a fax machine, a video cassette, a website, a battery, a smartphone, a hashtag, a drone and a generative model. This conclusion does not retell the chapters. It asks what they show together, and what they do not.

WHAT THEY WERE MADE FOR

Almost none of these things was made for violence of any kind, and none was made for terrorism. Dynamite was an industrial product that cut the cost of "blasting rock, drilling tunnels, building canals".[2] The transistor came out of research at Bell Laboratories aimed at doing the switching of the telephone network electronically.[3] Broadcasting was organised by states and licensed companies to reach households, and by 1945 an estimated 33 million American households had a radio set.[4] The Boeing 707 was built to carry passengers, "160 passengers six-abreast", and later to fly the Atlantic without stopping.[5] Communications satellites were put into orbit to carry telephone calls and television between continents; Early Bird began regular commercial service between North America and western Europe on 28 June 1965.[6] In 1959 Haloid Xerox put on the market what the American Society of Mechanical Engineers later called "the first fast, low-cost, and convenient office copier".[7] The home video recorder was announced in 1976 to record television.[8] The proposal that became the Web aimed "to allow a place to be found for any information or reference which one felt was important, and a way of finding it afterwards".[9] Apple described its telephone of 2007 as "combining three products" in one handheld device.[10] The consumer drone was sold as an easy way to film from the air, with an autopilot that would fly it home.[11] ChatGPT was offered in 2022, free, as a "research preview" on a public website.[12]

There are exceptions, and the book has not hidden them. Chapter 2 is about weapons that were made for war, and about what happened when wars ended and their weapons,

skills and surplus stayed behind. There, in this book's reading, force changed most, and the skills that war had taught to millions changed labour with it.

In our reading, the pattern across these chapters is not that technology causes terrorism. None of the technologies created a grievance, chose a target or recruited a member. The pattern is that new technologies redistribute capability. Each made something cheaper, faster, smaller or more widely available, and in doing so it moved a little power away from those who had controlled that capability, towards anyone who could now buy, rent or borrow it. Most of the people who gained were not violent. A few were.

USES NOBODY ORDERED

The title of this conclusion is meant precisely. It does not say that inventors were naive. By Bertha von Suttner's account, Nobel knew that explosives could serve war, and hoped that his factories would end war sooner than her peace congresses.[13] It says something narrower: that a complex technology, once it is cheap and widespread, acquires uses that nobody in particular ordered, not the inventor, nor the manufacturer, nor the government that licensed it, nor the regulator, nor most of its users.

The chapters show this far beyond terrorism. A sign proposed in 2007 so that people could follow a conversation on Twitter, in its proposer's words for "a better eavesdropping experience", became the raw material of a list that Twitter's algorithm compiled to favour "novelty over popularity".[14] Graphics chips made to draw games were also bought to mine cryptocurrency: the United States Securities and Exchange Commission found in 2022 that "NVIDIA customers increasingly used its gaming GPUs for cryptomining".[15] The same kind of chip became the engine of the language models of chapter 13. Radio sets in Algeria were long shunned as the voice of the colonial power, until an insurgent station began to broadcast and, by Frantz Fanon's account, Algerians bought sets in large numbers.[16] None of these uses was violent. All of them were unplanned.

Terrorism makes such uses unusually visible, for a simple reason. It is investigated. Its uses of technology end up in court records, inquests, official inquiries and parliamentary reports, which describe in detail what a machine was used for, by whom and when. In our reading, most unplanned uses of technology are never examined so closely, and the cases in this book are therefore not a measure of how often

technology is misused. They are a measure of how carefully some misuses are recorded.

☐ PLAUSIBLE INTERPRETATION

New technologies redistribute capability; they do not, on the evidence of this book, cause terrorism.

The interpretation is this book's. It rests on the chapters taken together: technologies made for industry, commerce, communication or entertainment changed what small groups could do, while the grievances, choices and organisations behind political violence came from elsewhere. It would be weakened by evidence that a technology produced political violence that would not otherwise have occurred; no chapter found such evidence. Chapter 2, on weapons made for war, is the main exception to the claim that these technologies were made for other purposes.

chapters 1–13 and the sources cited there.

FORCE, REACH, AUDIENCE AND LABOUR

The chapters asked four questions of their technologies, set out in the introduction: did a technology change the force of the violence, the reach of a small group, the audience for its acts, or the labour it had to do itself? The answers were never the same twice, and the book has presented them as interpretation. Taken together, in our reading, they suggest a shape.

Force changed less than the popular story suggests. Dynamite gave small groups the means to attempt what had needed an army, but, as chapter 1 found, most of the famous killings of its age were still done with a knife or a pistol. More than a century later, the most common methods of the attacks Europol recorded in the European Union in 2025, where the method was known, were stabbing, bombing, arson and shooting: knives, explosives, fire and guns.[17] The large changes in force came from war, not from consumer technology, as chapter 2 described, and the small drone of chapter 12 was the rare later case in which a consumer product changed the violence itself, briefly and tactically.

Reach expanded enormously. The telegraph, the cable and the mass newspaper of chapter 1 made an act in one city an event in many the same night. The jet airliner of chapter 4 let a few people move a hundred hostages across several borders before any government had decided what to do. The satellite telephone, the fax and the Web let organisations without a state speak across continents, on networks they did not own.

Audience, over the whole period, expanded more. In 1974 Brian Jenkins of the RAND Corporation wrote that recent developments in "radio, television, communication satellites" meant that terrorists could "be assured that their actions will receive immediate worldwide coverage". "The world is now their stage," he wrote.[18] Television made the audience global; the smartphone and the platforms of chapters 10 and 11 let the people at the scene, and the perpetrators themselves, reach that audience without waiting for a broadcaster. The growth was not steady. In the decades of the fax and the early Web, as chapters 7 and 8 found, reach ran ahead of audience.

Labour, the least visible of the four, changed most steadily. Work that had needed a courier, a printer, a typist, a signaller, a photographer, a broadcaster or a translator was taken over, in part, by machines that anyone could buy: the copier and the cassette, the mobile telephone, the website, the smartphone, and at the end the generative model. A small group needed fewer people, and fewer specialists, to do the supporting work around an act.

These are this book's readings, not measurements, and each chapter shows where they fail. Every chapter also recorded the response, and in chapters 9 and 10 it changed more than any of the four. States, companies and publics answered each new capability, usually after it had spread: with a law against explosives in Britain in 1883, airport screening in the 1970s, suspension of accounts in the 2010s and registration of drones after they were already in the shops. And as the introduction noted, each time a human function moved into a machine, the machine kept a record. The telephone logs, ticket records and camera footage that investigators used to rebuild a morning in London in 2005, as chapter 9 described, were part of the same history as the tools that made the attacks easier.[19]

WHO DOES THE WORK

The introduction drew a chart of seven human functions and the technologies that took over parts of them. It can now be read to the end.

To *carry*, a person once walked or rode; the railway, the post, the jet and, at the edge of this history, the drone carried instead. To *talk* at a distance, a messenger once went in person; the telegraph, the telephone, radio, the mobile network and the messaging app spoke instead. To *watch*, a lookout once stood in the street; by the 2010s cameras were in every pocket, and could be flown. To *find the way*, a person once needed local knowledge; satellite positioning, after the

United States stopped degrading the civilian signal in 2000, found it instead.[20] To *publish*, a group once needed a printer, a newspaper or a broadcaster; the copier, the cassette, the website and the platform let it publish itself. To *write and translate*, it needed an author, a printer and someone who knew the language; in the 2020s software began to draft, to translate, and to generate images and voices.

Each of these transfers was partial. Couriers did not vanish: the man in Abbottabad still relied on one.[21] Human translators did not vanish either. Europol described the Islamic State's translation outlets at work in 2022, years after machine translation had arrived, and when the United Nations reported in 2026 that terrorist groups had grown more proficient with artificial intelligence, "primarily in propaganda", it added that their capability had not changed in kind.[22]

The last row of the chart did not move. In the cases of political violence read for this book, a person decided. The Islamic State's drones, Rassler judged, were most likely flown by its members; in 2018 he found no case of "autonomous or preprogrammed drones that take the human controller out of the loop".[23] The chatbots of the 2020s answered questions that people chose to ask. The book does not say that this will remain so. It says that the record so far shows people deciding, and that the record is all that a history can report.

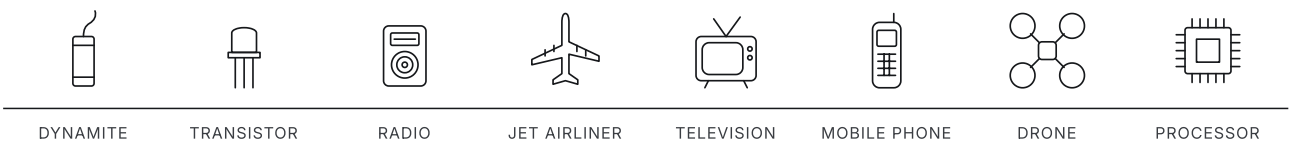
WHAT A HISTORY CAN SAY

It is tempting to end a book like this with a warning about the next technology. This one will not. The evidence of 14 objects does not support predictions, and it argues against confident ones. In 2023 the British government expected terrorists to be "likely to exploit the technology to create and amplify radicalising content, propaganda and instructional materials, and to plan and commit attacks".[24] By 2026 the uses that the United Nations monitoring team recorded were, in its words, "primarily in propaganda", together with translation services that let groups reach "audiences in multiple languages".[25] The forecast was not foolish, and it may yet prove right. In this book's reading, those who feared each new technology were often right that it would be misused, and less often right about how.

What a history can say is narrower and, in its way, more useful. In our reading, technologies are made to solve ordinary problems: to blast rock, to carry a voice, to fly passengers, to copy a page, to find a document, to take a photograph, to answer a question. Once they are cheap and widespread, they are used for things their makers did not design, did not

predict and do not control. Some of those uses are violent, and they are recorded with unusual care. The people who decide how a technology will be used are rarely those who made it. They are its users, including a few who want to frighten the rest.

The courier in Abbottabad carried words by hand. In our reading, the head of an organisation known to the world through satellite television, websites and video relied on the oldest technology in this book because it kept no record of its own. In 2011 it was still the technology a hunted man trusted, and still the one that could be followed home.



C.1 Some of the objects of this book, as drawn on its title page: dynamite, the transistor, the radio set, the jet airliner, the television set, the mobile telephone, the drone and the processor. None was made for terrorism.

Notes

Notes are numbered afresh in each chapter and interlude. Short titles refer to the Bibliography.

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1.3 Le journal le mieux informé, c'est le Petit Journal. Quatre millions de lecteurs. Petit Palais, musée des Beaux-Arts de la Ville de Paris / Paris Musées (CC0). Licence: CC0 (Paris Musées Open Content). https://commons.wikimedia.org/wiki/File:Le_journal_le_mieux_inform%C3%A9,_c%27est_le_Petit_Journal._Quatre_millions_de_lecteurs_-_Exposition_Universelle_de_1900.-_Le_P,_PPAF5.jpg

1.4 Attempt on the life of Alexander II, 1 March 1881 — explosion of the second bomb. Vsemirnaya illyustratsiya, 14 March 1881, public domain, via Wikimedia Commons. Licence: Public domain (PD-old). https://commons.wikimedia.org/wiki/File:The_assassination_of_Alexander_II_of_Russia_on_March_1_1881.jpg

1.5 The Dynamite Explosions in London, at the Houses of Parliament. The Graphic, 31 January 1885, public domain, via Wikimedia Commons. Licence: Public domain (PD-Art / PD-old-100-expired). https://commons.wikimedia.org/wiki/File:The_Dynamite_Explosions_in_London,_at_the_Houses_of_Parliament_-_The_Graphic_1885.jpg

1.6 The Anarchist Riot in Chicago — A Dynamite Bomb Exploding Among the Police. Library of Congress, Prints & Photographs Division, cph.3a04704 (public domain). Licence: Public domain (PD-old-100-1923); LoC: no known restrictions. https://commons.wikimedia.org/wiki/File:The_Anarchist_Riot_in_Chicago_-_A_Dynamite_Bomb_exploding_among_the_police_(McCormick_Strike,_Haymarket_Square)_LCCN99614182.jpg

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2 (opener) Type 3 Mk II ("B2") clandestine suitcase transceiver. Photo: Avron / Wikimedia Commons, CC BY 3.0. Licence: CC BY 3.0 (also GFDL). https://commons.wikimedia.org/wiki/File%3AType_3_Mk_II.jpg

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2.2 Mr. Babcock tuning in for war news, Rochester, New York. Library of Congress, Prints & Photographs Division, FSA/OWI Collection, LC-DIG-fsa-8d27674 (public domain). Licence: Public domain (US government work, OWI). https://commons.wikimedia.org/wiki/File%3AAnd_Now%2C_the_News_Mr._Babcock%2C_an_American_war_worker%2C_tuning_in_for_war_news_on_his_radio._Rochester%2C_New_York%2C_1943._%2846987287375%29.jpg

2.4 Construction of the Palais des Nations, Geneva, 14 May 1934. Bibliothèque nationale de France / Agence Rol (public domain). Licence: Public domain (BnF Gallica: anonymous agency photograph >70 years). https://commons.wikimedia.org/wiki/File%3A14-5-34%2C_travaux_au_palais_SDN%2C_future_cour_d%27honneur%2C_au_fond_%C3%A0_g._palais_d%27honneur_pour_assembl%C3%A9e_pl%C3%A9ni%C3%A8re_-_btv1b53302203t.jpg

2.5 Women workers install fixtures and assemblies to a tail fuselage section of a B-17F bomber. Library of Congress, Prints & Photographs Division, FSA/OWI Collection, LC-DIG-fsac-1a35356 (public domain). Licence: Public domain (US government work, OWI). https://commons.wikimedia.org/wiki/File%3AWomen_workers_install_fixtures_and_assemblies_to_a_tail_fuselage_section_of_a_B-17F_bomber_at_the_Douglas_Aircraft_Company%2C_Long_Beach%2C_Calif._Better_known_as_the_%22Flying_Fortress%2C%22_the_LCCN2017878924.jpg

2.7 Demobilisation of the British Army: selecting a demob suit, Olympia, London (IWM BU 8063). IWM BU 8063 (Crown copyright expired; public domain). Licence: Public domain (Crown copyright expired: UK government photograph taken before 1957). https://commons.wikimedia.org/wiki/File%3ADemobilisation_of_the_British_Army_BU8063.jpg

2.8 Dump van legervoertuigen (dump of army vehicles). Nationaal Archief / Anefo, CC0. Licence: CC0 1.0 (Nationaal Archief). https://commons.wikimedia.org/wiki/File%3ADump_van_legervoertuigen%2C_Bestanddeelnr_900-6257.jpg

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O2.1 Atwater Kent Model 40 receiver and Model L horn speaker on radio table. Photo: Joe Haupt, CC BY-SA 2.0. Licence: CC BY-SA 2.0. https://commons.wikimedia.org/wiki/File%3AVintage_Atwater_Kent_Model_40_Radio_Receiver_and_Model_L_Horn_Speaker%2C_Circa_1920s_%2832974715560%29.jpg

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3.1 SC 195637 – Pfc. Ragnel Lundgren with a handie-talkie radio, Aachen. U.S. Army Signal Corps photo SC 195637 (public domain). Licence: Public domain (US Army work). https://commons.wikimedia.org/wiki/File:SC_195637_-_In_Aachen,_Germany,_Pfc._Ragnel_Lundgren,_Jamestown,_New_York,_maintains_continuous_communications_with_his_headquarters_with_a_handie-talkie_radio._15_October,_1944._(52598916203).jpg

3.2 Replica of the first working transistor compared with a 2N43 transistor. Photo: Mister rf, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:A_replica_of_the_first_working_transistor_02.jpg

3.4 Vintage Philco portable radio, model 46-350, 6 tubes, circa 1946. Photo: Joe Haupt, CC BY-SA 2.0, via Wikimedia Commons. Licence: CC BY-SA 2.0. https://commons.wikimedia.org/wiki/File:Vintage_Philco_Portable_Radio,_Model_46-350,_Broadcast_Band_Only_(MW),_6_Tubes,_Line_%26_Battery_Powered,_Made_In_USA,_Circa_1946_(14722094670).jpg

3.5 Bild till utställningen 100 innovationer föreställande innovationen ‘transistorn’. Photo: Ellinor Algin, Tekniska museet (CC BY). Licence: CC BY (DigitaltMuseum record; version unstated there). https://digitaltmuseum.se/021016847892

3.8 Transistorradios op Firato. Nationaal Archief / Anefo, Wim van Rossem, 912-8816 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Transistorradios_op_Firato,_Bestanddeelnr_912-8816.jpg

Object 3 · 1947 Transistor. Photo: Nisse Cronestrand, Tekniska museet (CC BY). Licence: CC BY (DigitaltMuseum record; version unstated there). https://digitaltmuseum.se/021017129020

O3.1 Freiburg: Intermetall, Transistor und Streichholz. Landesarchiv Baden-Württemberg, Staatsarchiv Freiburg W 134 Nr. 072273b / Willy Pragher (CC BY 4.0). Licence: CC BY 4.0. https://www.landesarchiv-bw.de/plink/?f=5-2489172

4 (opener) Passagiereinstieg in eine Dougals [sic] DC-8 der Swissair in Zürich-Kloten. Werner Friedli, ETH-Bibliothek Zürich, Bildarchiv / Stiftung Luftbild Schweiz / LBS_H1-026284 (CC BY-SA 4.0). Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:ETH-BIB-Passagiereinstieg_in_eine_Dougals_DC-8_der_Swissair_in_Z%C3%BCrich-Kloten-LBS_H1-026284.tif

4.1 Boeing B707-344, ZS-CKD “Cape Town” der South African Airways am Boden in Zürich-Kloten. Werner Friedli, ETH-Bibliothek Zürich, Bildarchiv / Stiftung Luftbild Schweiz / LBS_H1-026905 (CC BY-SA 4.0). Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:ETH-BIB-Boeing_B707-344,_ZS-CKD_%22Cape_Town%22_der_South_African_Airways_am_Boden_in_Z%C3%BCrich-Kloten-LBS_H1-026905.tif

4.3 Schiphol centre geopend, passagiers wachten in de vertrekhal. Nationaal Archief / Anefo, Ron Kroon, 920-3094 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Schiphol_centre_geopend,_passagiers_wachten_in_de_vertrekhal,_Bestanddeelnr_920-3094.jpg

4.5 Hijacking Sign at National Airport. Library of Congress, Prints & Photographs Division, U.S. News & World Report Magazine Collection, LC-DIG-ppmsca-56774 (public domain). Licence: Public domain (U.S. News & World Report deed of gift; LoC: no known restrictions on publication). https://commons.wikimedia.org/wiki/File:Hijacking_Sign_at_National_Airport.jpg

4.7 H.M ontvangt delegatie van voorzitters diplomatieke conferentie m.b.t. luchtpiraterij, op Huis ten Bosch ; koningin Juliana met delegatie. Nationaal Archief / Anefo, Rob Mieremet, 924-0744 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:H.M._ontvangt_delegatie_van_voorzitters_diplomatieke_conferentie_m.b.t._luchtpira,_Bestanddeelnr_924-0744.jpg

4.10 De bagage van een passagier wordt gecontroleerd. Nationaal Archief / Anefo, photographer unknown, 926-9139 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:De_bagage_van_een_passagier_wordt_gecontroleerd,_Bestanddeelnr_926-9139.jpg

Object 4 · 1958 Boeing 707-320C, OO-SJJ der Sabena am Boden in Zürich-Kloten. Werner Friedli, ETH-Bibliothek Zürich, Bildarchiv / Stiftung Luftbild Schweiz / LBS_H1-026899 (CC BY-SA 4.0). Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:ETH-BIB-Boeing_707-320C,_OO-SJJ_der_Sabena_am_Boden_in_Z%C3%BCrich-Kloten-LBS_H1-026899.tif

O4.1 Boeing 367-80. NASA, A-36044 (public domain). Licence: Public domain (PD-USGov-NASA). https://commons.wikimedia.org/wiki/File:NASA_A-36044_a.jpg

5 (opener) AT+T Telstar test (first sattelite t.v. broadcast). Library of Congress, Prints & Photographs Division, U.S. News & World Report Magazine Collection, LC-DIG-ppmsca-39668 (public domain). Licence: Public domain (U.S. News & World Report deed of gift; LoC: no known restrictions on publication). https://www.loc.gov/pictures/item/2015650987/

5.2 Engineers checkout Early Bird-Communication Satellite. NASA (GRIN GPN-2003-00020, 66-H-150) (public domain). Licence: Public domain (NASA; GRIN: ‘Photographs are not protected by copyright unless noted’). https://commons.wikimedia.org/wiki/File:INTELSAT_I_(Early_Bird).jpg

5.3 Olympic Game Communication Satellite “Birds”. NASA (GRIN GPN-2003-00018, 68-H-1024) (public domain). Licence: Public domain (NASA; GRIN: ‘Photographs are not protected by copyright unless noted’). https://commons.wikimedia.org/wiki/File:Olympic_Game_Communication_Satellite_Birds_-_GPN-2003-00018.jpg

5.6 PYE típusú közvetítőkocsi képellenőrző monitorai és a főmonitor.. FORTEPAN / Rádió és Televízió Újság (CC BY-SA 3.0, creativecommons.org/licenses/by-sa/3.0/). Licence: CC BY-SA 3.0. https://fortepan.hu/en/photos/?id=56308

5.7 Koningin Juliana opent met telefoongesprek grondstation voor satellietenverkeer in Burum (Fr.), parabool. Nationaal Archief / Anefo, Bert Verhoeff, 926-6775 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Koningin_Juliana_opent_met_telefoongesprek_grondstation_voor_satellietenverkeer_,_Bestanddeelnr_926-6775.jpg

5.8 Televisiestudio Amsterdam (oude Bellevue), de regelkamer. Nationaal Archief / Anefo, Jac. de Nijs, 917-5413 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Televisiestudio_Amsterdam_(oude_Bellevue),_de_regelkamer,_Bestanddeelnr_917-5413.jpg

Object 5 · 1962 Telstar satellite-CnAM 35181-IMG 5408-white. Photo: Rama, Wikimedia Commons (CC BY-SA 3.0 FR, creativecommons.org/licenses/by-sa/3.0/fr/). Licence: CC BY-SA 3.0 FR (also offered under CC BY-SA 2.0 FR and CeCILL). https://commons.wikimedia.org/wiki/File:Telstar_satellite-CnAM_35181-IMG_5408-white.jpg

6 (opener) Király (Majakovszkij) utca 35-37., BÁV Műszaki Áruház.. FORTEPAN / Szalay Zoltán (CC BY-SA 3.0, creativecommons.org/licenses/by-sa/3.0/). Licence: CC BY-SA 3.0. https://fortepan.hu/en/photos/?id=139258

6.3 Museum of Business History and Technology in Delaware: Xerox 914 copier. Photo: Marcin Wichary, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Museumofbusinesshistoryandtechnology_(32000833342).jpg

6.4 Kamera, Polaroid SX-70. Tekniska museet (photographer not recorded) (CC BY). Licence: CC BY (DigitaltMuseum record; version unstated there). https://digitaltmuseum.se/021026360489

6.5 Explosieven Opruimingsdienst vertrekt na een nep-bommelding bij de Telegraaf. Nationaal Archief / Anefo, Marcel Antonisse, 932-5398 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Explosieven_Opruimingsdienst_vertrekt_na_een_nep-bommelding_bij_de_Telegraaf,_Bestanddeelnr_932-5398.jpg

6.6 Man met 27 MC zend ontvanger ; nr. 16 , 17: winkel voor 27 MC zend ontvangers , nr. 18 , 19: 27 MC ontvanger. Nationaal Archief / Anefo, Fernando Pereira, 930-6614 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Man_met_27_MC_zend_ontvanger_nr_16_,_17_winkel_voor_27_MC_zend_ontvangers_,_,_Bestanddeelnr_930-6614.jpg

6.7 Drukte op Firato in RAI. Nationaal Archief / Anefo, Rob Bogaerts, 933-0619 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Drukte_op_Firato_in_RAI,_Bestanddeelnr_933-0619.jpg

Object 6 · 1959 Kopiator, Rank Xerox 660-1. Photo: Peter Häll, Tekniska museet (CC BY). Licence: CC BY (DigitaltMuseum record; version unstated there). https://digitaltmuseum.se/021026305617

O6.1 Stencilapparat, Gestetner 460 S. Photo: Per Ivar Lindekrantz, Tekniska museet (CC BY). Licence: CC BY (DigitaltMuseum record; version unstated there). https://digitaltmuseum.se/021026356596

7 (opener) persconferenties, schotelantennes, TV-omroepen. Nationaal Archief / Anefo, Rob C. Croes, 934-5046 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Persconferenties,_schotelantennes,_TV-omroepen,_Bestanddeelnr_934-5046.jpg

7.3 De nieuwe Amsterdamse disctrictscentrale van de PTT, gezicht vanaf het Singel; een onderdeel van de digitale telefooncentrale. Nationaal Archief / Anefo, Roland Gerrits, 933-5198 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:De_nieuwe_Amsterdamse_disctrictscentrale_van_de_PTT,_gezicht_vanaf_het_Singel_e,_Bestanddeelnr_933-5198.jpg

7.4 Mérleg utca, az SZDSZ székháza, Kőszeg Ferenc, a párt egyik alapítója és Pesty László a Fekete Doboz operatőre.. FORTEPAN / Bátonyi Csaba (CC BY-SA 3.0). Licence: CC BY-SA 3.0. https://fortepan.hu/en/photos/?id=162755

7.5 de schotelantenne van Teleport. Nationaal Archief / Anefo, Bart Molendijk, 933-6248 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:De_schotelantenne_van_Teleport,_Bestanddeelnr_933-6248.jpg

7.6 Layout met behulp van een computer. Nationaal Archief / Anefo, Rob C. Croes, 932-7268 (CC0). Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:Layout_met_behulp_van_een_computer,_Bestanddeelnr_932-7268.jpg

7.8 Modem: Datel 9600 FD/F Nokia ECM 4896. Photo: Häll, Peter, Tekniska museet (CC BY). Licence: CC BY (version not stated by DigitaltMuseum). https://digitaltmuseum.se/021026487110

Object 7 · 1980 Telefax: Panafax UF-400. Photo: Sundell, Per, Tekniska museet (CC BY). Licence: CC BY (version not stated by DigitaltMuseum). https://digitaltmuseum.se/0210213150057

Object 8 · 1976 VHS E-30 videocassette, front. Photo: LoMit, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:VHS_videocassette_-_front.jpg

O8.1 Ferguson Videostar, typ 3V01A. Photo: Häll, Peter, Tekniska museet (CC BY). Licence: CC BY (version not stated by DigitaltMuseum). https://digitaltmuseum.se/021026360625

8 (opener) Dokumentation av KTHNOC: basement server rooms. Photo: Cronestrand, Nisse, Tekniska museet (CC BY). Licence: CC BY (version not stated by DigitaltMuseum). https://digitaltmuseum.se/9445d2d6-3c36-47c0-ae72-5cd8cfa1cd3c

8.1 Cyberia cyber café, London, 1995. Photo: Roger Green, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:Cyberia_London_1995.jpg

8.2 NSFNET T1 backbone and regional networks traffic, September 1991. Visualization: Donna Cox and Robert Patterson, NCSA, University of Illinois; data Merit Network (CC BY-SA 3.0, via Wikimedia Commons). Licence: CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:NSFNET-traffic-visualization-1991.jpg

8.3 U.S. Robotics 56K Sportster Voice faxmodem (cut-out). Photo: Xiaowei; derivative by Pittigrilli, CC BY 3.0, via Wikimedia Commons. Licence: CC BY 3.0. https://commons.wikimedia.org/wiki/File:US_Robotics_56K_Sportster_Voice_telephone_modem,_front_(removed_background,_horizontal,_perspective).jpg

8.8 Bredbandsmodem (Zyxel ADSL2+ P-660H) with wireless router. Photo: Häll, Peter, Tekniska museet (CC BY). Licence: CC BY (version not stated by DigitaltMuseum). https://digitaltmuseum.se/d9120c9d-181a-4b2d-9bc6-e1631daf8166

Object 9 · 1993 NeXTcube used as the first web server, CERN. Photo: Geni, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:NeXTcube_first_webserver.JPG

9 (opener) King's Cross station, 23 July 2005. Photo: CGP Grey (cgpgrey.com), CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:2005-07-23_-_London_-_King%27s_Cross_4887496077.jpg

9.2 CCTV in London 21. Photo: Gammew, CC0, via Wikimedia Commons. Licence: CC0 1.0. https://commons.wikimedia.org/wiki/File:CCTV_in_London_21.jpg

9.4 Memorial to the 7 July 2005 bombings, Tavistock Square. Photo: Ethan Doyle White, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:Memorial_to_the_7_July_Bombings_in_Tavistock_Square.jpg

9.5 7 July Memorial - Hyde Park. Photo: hahnchen, CC BY-SA 3.0, via Wikimedia Commons. Licence: CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:7_July_Memorial_-_Hyde_Park.jpg

Object 10 · 1959 9V PP3 battery, side view. Photo: Nevit Dilmen, CC BY-SA 3.0, via Wikimedia Commons. Licence: CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:9V_PP3_Battery_1530632.JPG

10 (opener) An iPhone in a hand at an Apple shop, July 2007. Photo: Marcus Quigmire, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:IPhone_(962904388).jpg

10.1 Garmin eTrex handheld GPS in a hand, 2005. Photo: thms.nl, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Etrex_in_hand.jpg

10.5 Chhatrapati Shivaji Terminus, Mumbai, 2011. Photo: Joe Ravi, CC BY-SA 3.0, via Wikimedia Commons. Licence: CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:Chhatrapati_Shivaji_Terminus_(Victoria_Terminus).jpg

10.6 Signed "One Boston" bibs at a memorial in Boston, June 2013. Photo: Travis Wise, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Boston_Marathon_Bombing_Memorial_(14980743367).jpg

10.7 Concertgoer filming on a smartphone, Okinawa, 2014. Photo: Cpl. Henry Antenor, US Marine Corps (public domain), via Wikimedia Commons. Licence: Public domain (US government work, PD-USGov-Military-Marines). https://commons.wikimedia.org/wiki/File:John_Michael_Montgomery,_Colbie_Caillat_captivate_at_Courtney_141207-M-FX659-009.jpg

Object 11 · 2007 Black iPhone 4 (2010), front. Photo: K2025, CC0, via Wikimedia Commons. Licence: CC0. https://commons.wikimedia.org/wiki/File:IPhone_4_-_front.jpg

11 (opener) Facebook data centre, Luleå, Sweden, September 2016. Photo: Christopher Down, CC BY 4.0, via Wikimedia Commons. Licence: CC BY 4.0. https://commons.wikimedia.org/wiki/File:Lulea_Facebook_datacenter_building.jpg

11.2 Twitter headquarters on Market Street, San Francisco, June 2014. Photo: MatthewKeys, CC BY 3.0, via Wikimedia Commons. Licence: CC BY 3.0. https://commons.wikimedia.org/wiki/File:Twitter%27s_San_Francisco_Headquarters.jpg

11.4 Flowers at a memorial wall in Christchurch, 21 March 2019. Photo: Alan Tennyson, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:Christchurch_mosque_shootings_memorial_flower_wall.jpg

11.6 Europol headquarters, The Hague, 2015. Photo: OSeveno, CC BY-SA 3.0, via Wikimedia Commons. Licence: CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:Europol_building,_The_Hague,_the_Netherlands_-_002.jpg

11.7 European Parliament chamber, Brussels, October 2011. Photo: MichalPL, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:European_Parliament_Brussels_plenary_sessions_hemicycle.jpg

Object 12 · 2007 Reading Twitter Moments on a smartphone, Brasília, May 2016. Photo: Senado Federal, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Senado_Not%C3%ADcias_no_Twitter_Moments_(26721094992).jpg

12 (opener) Drone view of the Astoria-Megler Bridge inspection, May 2020. Photo: Oregon Department of Transportation, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Drone%27s_eye_view_of_the_inspection_(49946750172).jpg

12.1 Farmer flying a DJI Phantom 4 over a soybean field, September 2018. Photo: United Soybean Board, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Farmer_Flying_Drone_(48766601332).jpg

12.4 Search and rescue drone operator, Grand Canyon National Park, March 2021. Photo: Grand Canyon National Park, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Search_and_Rescue_Drone_Operator_(51046738612).jpg

12.5 Gatwick Airport North Terminal from the air, 21 July 2012. Photo: Chris Sampson, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Gatwick_Airport_aerial_view_-_Chris_Sampson.jpg

12.6 No Drone Zone sign near Sedona, Arizona, January 2017. Photo: Coconino National Forest, USDA Forest Service (public domain). Licence: Public domain (PD-USGov-USDA). https://commons.wikimedia.org/wiki/File:Sedona_No_Drone_Zone_(32537858852).jpg

12.7 NASA STEReO drone traffic management test near Redding, California, 5 May 2021. Photo: NASA/Joel Kowsky (public domain). Licence: Public domain (PD-USGov-NASA). https://commons.wikimedia.org/wiki/File:STEReO_Field_Testing_(NHQ202105050035).jpg

Object 13 · 2013 DJI Phantom 3 Standard in flight. Photo: Clemenspool, CC0, via Wikimedia Commons. Licence: CC0. https://commons.wikimedia.org/wiki/File:DJI_Phantom_3_Standard.jpg

13 (opener) Summit supercomputer, Oak Ridge National Laboratory, May 2018. Photo: Carlos Jones/ORNL, CC BY 2.0, via Wikimedia Commons. Licence: CC BY 2.0. https://commons.wikimedia.org/wiki/File:Summit_supercomputer_(44552258450).jpg

13.1 VisionTek GeForce 256 DDR graphics card (c. 1999–2000). Photo: Hyins (public domain), via Wikimedia Commons. Licence: Public domain (PD-self, released by the photographer). https://commons.wikimedia.org/wiki/File:VisionTek_GeForce_256.jpg

13.4 Object detection with YOLOv3 on a test photograph of a desk, January 2019. Photo: MTheiler, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:Detected-with-YOLO--Schreibtisch-mit-Objekten.jpg

13.7 Interpreting booth, Jacques Delors building, Brussels, December 2023. Photo: FrDr, CC BY 4.0, via Wikimedia Commons. Licence: CC BY 4.0. https://commons.wikimedia.org/wiki/File:Interpreting_booth_Jacques_Delors_building_Brussels_02.jpg

Object 14 · 2022 Stable Diffusion v1.5 denoising steps (DDIM), X/Y plot of one generated image, November 2022. AI-generated. Image: Benlisquare, made with Stable Diffusion v1.5, CC BY-SA 4.0, via Wikimedia Commons. Licence: CC BY-SA 4.0 (dual-licensed with GFDL). https://commons.wikimedia.org/wiki/File:X-Y_plot_of_algorithmically-generated_AI_art_of_European-style_castle_in_Japan_demonstrating_DDIM_diffusion_steps.png