Sabers en construcció / Knowledge (s) in construction

First King's College-CHoSTM and Interuniversity Institute López Piñero encounter around *Sabers en acción*
Valencia, April 4, 2025

Palau de Cerveró.
Plaça Cisneros, 4 (Valencia)

Live streaming:
https://uv-es.zoom.us/j/95620404575

Programme

Thursday, 3

18:00 Welcome to the Instituto López Piñero and visit to the library, archive and permanent exhibition. **Ximo Guillem**

Friday, 4

09:00 Welcoming. **Antonio García Belmar**

09:10 Introducing *Sabers en acció*. **José Ramón Bertomeu**

09:30 The Global History of Science and Technology: is our problem lack of knowledge or what we know? **David Edgerton**

10:00 Coffee

10:15 A history of agricultural techniques in the twentieth century: With some illustrations from India and the United States. **Shankar Nair**

10:45 Strains of a Scientific Breakthrough: Bacteriology and Adoption of Water Filtration in early 20th century India**. Viswanathan Venkataraman**

11:15 Chlorination: the history of a global technology**. Edisson Aguilar Torres**

11:45 Coffee

12:00 The origins of the modern morgue. **Catriona Byers**

12:30 The History of Intelligence Science. **David Brydan**

13: 00 General discussion

13:30 Lunch

17: 00 Concluding remarks and next step tasks. **David Edgerton, José Ramón Bertomeu and Antonio García Belmar.**

18:00 Guided visit to the temporary exhibition *Fontilles. The hidden town*. **Antonio García Belmar.**

The Global History of Science and Technology

-Is our problem lack of knowledge or what we know? -

There is a long tradition in the historiography of science and technology, and indeed in STS, of complaining that we know little about the relations of knowledge, technical practices and society. Indeed, Bruno Latour has suggested that, in modernity, such ignorance is a functional feature which made possible the transformations central to it. There is much of interest in such a thesis, which has more than a whiff of Austrian economics about it. But too often it is wrongly interpreted to mean that the problem we have is ignorance. From that analysis follows the injunction to start from scratch, to write histories following the scientists and engineers, and ignoring existing stories.

A related response is to say that our accounts of 'science' and 'technology' in history, not least in global history, are fatally flawed theoretically. They are, it is routinely claimed, Eurocentric, technologically determinist, embody assumptions about the 'linearity' of innovation, are 'diffusionist' and so on. Such criticisms pepper work in the field, but are highly problematic. The irony is that the histories which result from this critique and the consequent ignoring of the substantive conclusions of previous work are, far too often, themselves Eurocentric, technologically determinist, diffusionist, and even show secret devotion to the linear model!

We need a better way of thinking about and rewriting the global history of those mysterious things called 'science' and 'technology'. For the problem is not ignorance, nor primarily weaknesses in theoretical orientation, but something more basic. It is a lack of criticism and knowledge of what we think we know. For to avoid repeating misunderstandings we need to understand our understanding. What we need to grasp are the substantive empirical claims made, and the hidden framing assumptions which underpin them. Generally, we need to read much more critically, and engage not with invented straw people and imagined hegemonic positions, but with good work taken seriously. We need to read the work of historians of science and technology for their substantive arguments instead of categorising past work as either methodologically flawed or advanced. We need to ask about the deep historiographical assumptions historians make, how useful they are, and why they are made. We might ask for example why so much global history is focussed on trade and communication or on ‘circulation’. Why is so much global history of ‘science’ or ‘technology’ concerned to assume radical difference between colony and metropole? How and why does it assume we know the history of the Eurocentre?

Bombers bringing peace to the world as envisaged in 1936.
The international air police (from Things to Come (1936)

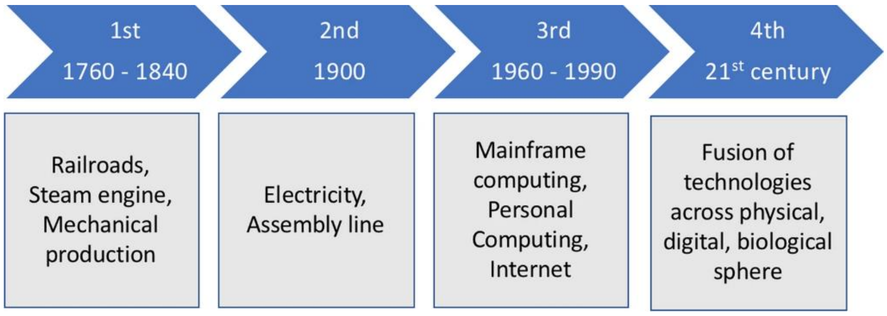
Getting to grips with these issues requires understanding of two forms of literature. The first is a proper understanding of what historians of science and technology have actually claimed. The second is the academic literatures outside the history of science and technology, and also popular understandings over time (what I call ‘historiography from below’). For our culture is suffused with stories about how ‘science’ and ‘technology’ have changed the world, which scientists and engineers, and the histories of science and technology who follow them, are apt to repeat too uncritically, as both celebration and condemnation.

We might for example begin to notice that the problem with such stories is not primarily that they are technologically determinist, Eurocentric or diffusionist or linear. There is a prior, graver problem, not least for not being known. Most technologically determinist arguments get the determining technology and the effect wrong; most Eurocentric theories are wrong about the Eurocentre, and most diffusionist studies are not in fact diffusionist, and the linear model was never put forward as a serious theoretical or empirical proposition. It would be wonderful to find a proper technologically determinist account, which gets the Eurocentre right, which is properly diffusionist, and defends a serious linear model. Such works would be worth arguing with. But we don’t have them.

Uniting the continents through aviation in the 1950s. BOAC poster, 1953, a year in which nearly all BOAC flights were by piston-engined aircraft.

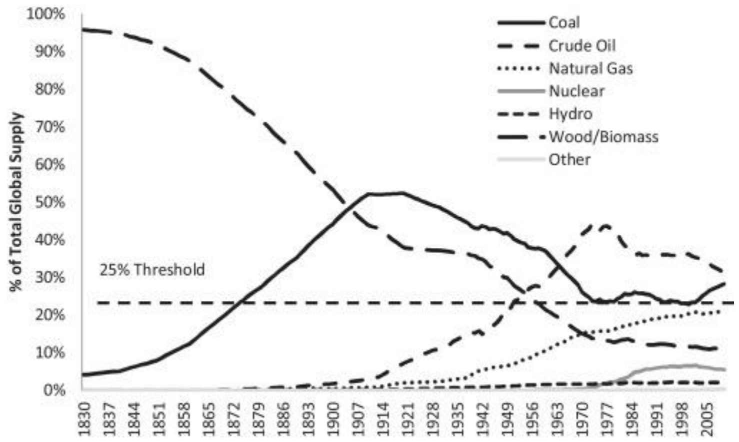
Take the following case. For many historians of the period since the 1880s there was a foundational Second Industrial Revolution at the end of the nineteenth century, and perhaps subsequent revolutions too. But what if these have no empirical basis, focus on arbitrarily chosen novelties, and misrepresent the material constitution of the world? We need to understand that, not merely that these theories are technologically determinist. Many historians assume that we have a good account of the 'sciences' and 'technologies' of North America or Europe in the twentieth century but that this Eurocentric understanding does not apply elsewhere. But, is our account of the 'sciences' and 'technologies' of the Eurocentre in fact adequate? I don't think it is, not least because of its reliance on industrial revolutions, and because, to explain my putting 'science' and 'technology' in quote marks, 'science' tends not to be scientific knowledge, but scientific research, primarily in the academy, and on academic particle physics and molecular biology in particular. And 'technology' does not mean either the material constitution of the world or techniques, but rather a very selected list of novelties at the beginning of their lives.

There are other large scale ideas which are prevalent, both in popular and academic writing which make important claims. Take the enduring cliché, in which the current new technique has globalised the world, bringing people together, or is so destructive it will ensure world peace. Thus, in their time, the steamship, the aeroplane, the radio and television would create a peaceful 'global village'. The bomber, and then the atomic bomb would create perpetual peace. Put like this the theories sound absurd, but they were put forward seriously and elements have been taken as descriptions of reality by historians and others, not least in global history and histories of international relations.



Industrial Revolutions laid out for an academic audience.
From Siekmann, F., Schlör, H. & Venghaus, S. Linking sustainability and the Fourth Industrial Revolution: a monitoring framework accounting for technological development. *Energ Sustain Soc* **13**, 26 (2023).

How do counter and understand such arguments? Well, we should study their history, in both academic and popular works. How did scientists of the past think about the relations of science and war? Well, they tended to repeat liberal cliches about the distance-eliminating and peace-creating effects of new systems of communication (which helps explain the prevalence of communication and exchange in global histories). Where did the idea that the atom bomb would create a new world come from? Not from scientists, but a long tradition of hailing the latest weapons as capable of changing the nature of war and peace. The arguments for the atom bomb were the same as those used just before for the bomber aeroplane. Wars remained stubbornly present, and they involve not only electronics and aeroplanes, but artillery and rifles, infantry, sailors and airmen, but this did not affect the dominant conceptual framing.

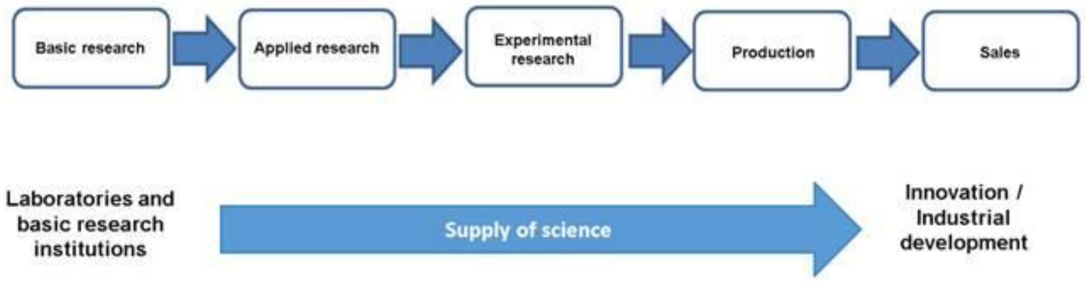


The transition model of energy history as a tool for thinking about the past and future.
Source: Energy transitions: the geological story | The Geological Society Blog

Or to take another case. Where does the idea come from that our globe has undergone a series of energy transitions, and which has powerfully influenced STS, come from? The answer is from nuclear scientists, and it has been sustained by many generations of energy procrastinators. But there has never been an energy transition overall, the process has been one of addition and symbiosis, so that more wood, and coal and oil is exploited today than ever before.

We can also apply this method to the work of historians of science and STS students. We can discover the moment in which scholars invent the idea that everyone before them believed in something very vaguely described as a linear model of innovation, when no such model was ever seriously proposed by anyone. We can also discover the moment when historians of science started complaining about supposed diffusionist histories of global ‘science’ and ‘technology’ and how they relied on citation of two or so works which were not diffusionist, and failed to establish that diffusionism (whatever that meant) was in fact dominant.

In the above I have in effect argued that we are far too blind to the historiographical assumptions and empirical problems with our accounts of knowledge and the material in the global history of the twentieth century.



The linear model of innovation – the butt of nearly all articles on science policy, which nevertheless focus on the basic and applied end of the chain.
Rev. Adm. Pública 55 (3) • May-Jun 2021 https://doi.org/10.1590/0034-761220200583

Which leads to this methodological thought. Instead of assuming we know the Global North and have been ignorant of the Global South, let us study the South and assume, not difference from the North, but rather than what we discover about the South is more likely to be true for the North than much of understanding of the North suggests. For in the North as much as the South is a place where scientific and technical novelties generally come from elsewhere, as do most machines, where most people and institutions are imitators, not innovators, and imitate the old as well as the new, where maintenance is fundamental to technical objects, where students of science and technology mostly chemistry and engineering and medicine, and not molecular biology or particle physics. In short, our implicit models of the North should not be taken as adequate. Turning the world upside down is a very good way to understand this.

David Edgerton

Sources:

Our World in Data

Suggested readings:

Edisson Aguilar Torres, 'Toward a Symmetrical Global History of Technology: The Adoption of Chlorination in Bogotá, London, and Jersey City, 1900–1920', *Technology and Culture* 65.4 (2024): 1195-1221.

David Edgerton, *The Shock of the Old: Technology and Global History since 1900* (London, 2007) trad. *Innovación y tradición. Historia de la tecnología moderna* (Barcelona, 2007)

Jean-Baptiste Fressoz, *More and More and More: An All-Consuming History of Energy* (London, 2024)

Thomas Parke Hughes, *American Genesis: A Century of Invention and Technological Enthusiasm, 1870-1970.* New York, NY: Viking, 1989.

Waqar Zaidi , *Technological Internationalism and World Order*. Cambridge University Press, 2021.

Agricultural techniques in the twentieth century

- A history of agricultural techniques in the twentieth century: With some illustrations from the United States and India/South Asia -

Agriculture is central to our understanding of the modern world. Our dominant models of the twentieth century, including our national histories, are informed by agriculture, or more properly, what is assumed to have happened to agriculture. The role of particular technological and scientific innovations, and forms of production, are central to these models and histories. For instance, Britain, we are told, was an industrial not agricultural nation, and its success rested on it being the first to transition out of agriculture. In other accounts, a *British* Agricultural Revolution, between the eighteenth and nineteenth centuries, based on innovations in drilling, cropping, and livestock breeding, is seen as paving the way for the Industrial Revolution. In the US, the picture is more complex, but one dominant story is the industrialisation of agriculture in the early twentieth century centred on the Midwest, with mechanised farms resembling 'mass production' factories, a model which inspired apparatchiks in the Soviet Union. In the poor world, and particularly India, we are told a Green Revolution transformed the subsistence-bound and traditional peasant into a modern capitalist farmer in the 1960s, as the application of scientific inputs invigorated a dormant agriculture, a colonial legacy. But the Green Revolution is unique in being an agricultural revolution of the twentieth century, a century more commonly identified with successive *industrial* revolutions. However, even the Green Revolution is confined to the poor world. More generally, agriculture in the twentieth century is associated with poverty, subjugation, and the stagnation of the East/Global South, and its absence in histories of the rich world is taken to be a measure of progress or domination of the West/Global North.

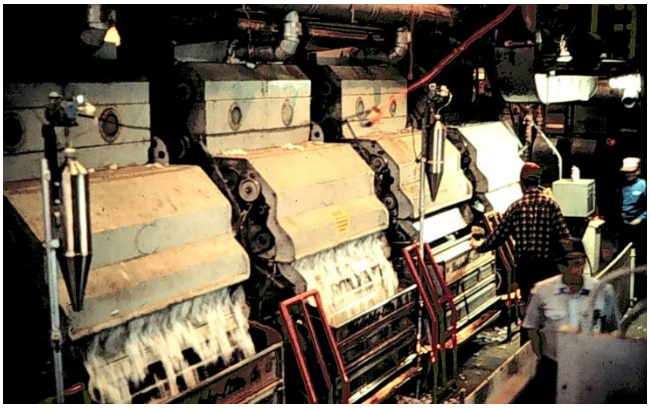
The diesel-powered gin in Burton , Texas is one of the oldest in the United States that still functions.
Source: Wikipedia

There is, to be sure, some truth to these stories, but they are too neat and get important empirical details wrong, and there is therefore good reason to reject them. For instance, we now know that far from being a vestige of the early modern world, agriculture in Britain radically transformed in the middle of the twentieth century, indeed even more so than any previous period. Agricultural output grew at an annual rate of 1 per cent per annum between 1750 and 1860, the period of the ostensible British Agricultural Revolution, and it hardly grew between 1867 and 1934, but the annual rate of growth between 1945 and 1965 was 2.8 per cent.[1] In gross figures, the volume of output tripled from before the Second World War to 1981-85, from £4 billion to £12 billion (in 1968 prices). In the US, the dominant form of farming for much of the century was not the farm-as-factory but the family farm, a global norm in this period. Indeed, the average US farm size was in fact larger in 1850 than in 1900, 1920, 1930, and indeed, in 1940, exceeding this level only in the 1950s, and even then, there were regional variations, with the US South notably bucking the trend.[2] While US farms were larger than the global average, the trend towards bigness was a much more recent phenomenon. Nor were peasants and agricultural labourers confined to the non-West periphery: the share of the labour force working in agriculture in 1950 was 37 percent in Ireland, 33 percent in Italy, and 57 percent in Poland, and in France, where one influential formulation saw peasants becoming Frenchmen by the First World War, 23 per cent, or about one in five Frenchmen, still lived in a peasant world in the middle of the twentieth century.[3] The application of modern science and technology, and large farms, was similarly a global phenomenon, to be found in enclaves of the poor world as much as the rich, most notably in large Javanese farms adjoined to modern sugar mills and using coerced peasant labour.[4] Similarly, small-plot sugar cultivation, far from being pre-capitalist or traditional, was embedded in new circuits of exchange and utilised new tools and production processes, notably in the *colonos* of Cuba and *gur* (molasses) production in North India.

Why do our dominant models, often shared across political divides, overlook these empirical realities? To answer this, we have to look at their underlying assumptions. One such assumption concerns what

[1] Paul Brassley et.al., *The Real Agricultural Revolution: The Transformation of English Farming, 1939-1985* (Boydell & Brewer, 2021).
[2] *United States Census of Agriculture– 1950 – Volume V, Part VI*.
[3] Patrick Joyce, *Remembering Peasants: A Personal History of a Vanished World* (Random House, 2024).
[4] Ulbe Bosma, *The World of Sugar: How the Sweet Stuff Transformed Our Politics, Health, and Environment over 2,000 Years* (Harvard University Press, 2023).

is understood as agriculture or agricultural activity in our histories. We have a very limited conception of agricultural practices and techniques, and indeed when we speak about technology or science in agriculture, we speak of particular innovations when it first appeared, rather than the widespread and global use of techniques, old and new. Importantly, we tend to conflate agriculture with farming or farm inputs, or with activities done on the farm, and overlook the importance of auxiliary activities, like soil preparation, processing, preservation, irrigation, power, transportation, silage, livestock breeding, and so on. We also tend to overlook physical geography, seasons and seasonality, and agricultural cycles and their impact on factors of production. Another assumption is our restrictive definition of capitalist agriculture, typically associated with the appearance of free waged or hired labour, of increasing concentration of land and capital, and with particular industrial models of mass production. These, as we have seen, are wholly inadequate. Yet another assumption concerns our units of analysis, which are often national or imperial. We seldom look below the national (or imperial) level, at the level of regions or individual farms, and the investment decisions of farmers and workers, or indeed above it, in a comparative assessment of different regional economies and state actions. As a result, we let our political contexts – whether nations, West or the Rest, Global North or the South – dictate our understanding of agriculture when it should be the other way round.



Modern cotton gins.
Source: Wikipédia

A diesel-powered shallow tubewell irrigates rice seedlings in Jamalpur, northern Bangladesh
Source: Mamunur Rashid / Alamy).

What might a history of agriculture and agricultural techniques look like if we abandon these assumptions and standard models, and instead focus on use, imitation, agriculture as a whole, and beyond national or pre-given political geographies? Such a history will be alive to the uneven, but combined, development of global agriculture in the twentieth century, its heterogeneity, but also its similarities. It will be less stadialist, account for overlooked innovations, and can provide richer causal answers to global convergence and divergence in production and productivity. I will illustrate this briefly with the example of two machines adopted in regions in the US and India/South Asia: the cotton gin and the internal combustion engine.

India is the world's largest manufacturer of tractors with 50% of world's output in 2016; it is also the world's largest tractor market. Source: [Wikipedia](https://en.wikipedia.org)

A Rot-E-Taek hauling logs in Isan, Thailand. This is one of many types of two-wheel tractor.
Source: [Wikipedia](https://en.wikipedia.org)

The cotton gin, a device used to extract cotton lint from seed cotton, was a peasant activity in colonial Bombay (India) and a plantation activity in the US South.[5] These were divergent systems: in Bombay, the woman of the peasant household utilised a hand-cranked *churka* or roller gin to manually clean the short-stapled local cotton following harvest season, while in the American mid-stapled cotton plantations, reflecting its settler inheritance, draft animals, typically a horse or mule, powered the Whitney saw-gin in a large wooden gin house, which was nonetheless labour-intensive in its use of slaves and slave mechanics. The humble *churka*, however, did find selective use in the long-stapled cotton plantations on the US seaboard, but it was leg rather than hand-powered. By the interwar period, cotton ginning in both regions no longer took place at the point of cultivation, but was now to be found in gin factories in large villages or towns, and was steam powered, with the cotton press following suit. In India, the 'Macarthy' roller gin used in these factories was an American innovation perfected by machinists in Oldham, UK. Peasant women operated these machines in predominantly Indian-owned factories which supplied raw cotton to European and Japanese and domestic markets, not Lancashire. This was far from an imperial story. Instead, it was a global story of convergence in the use of processing machinery, with British machine suppliers diffusing the Macarthy gin around the world, in Egypt, parts of East Africa, and China. This history is written out of our accounts of global cotton and capitalism which stress dependency, imperialism, and de-industrialisation in India instead of the emergence of a massive raw cotton export industry. While US ginneries adopted flow production and became larger in scope and less labour-intensive by the 1940s, in India these systems were adopted in the 1960s, with ginning systems now produced by Indian firms. Indeed, China and India today are the largest producers of cotton, with the US coming in third. Freed from our models, we can explain this turn of events.

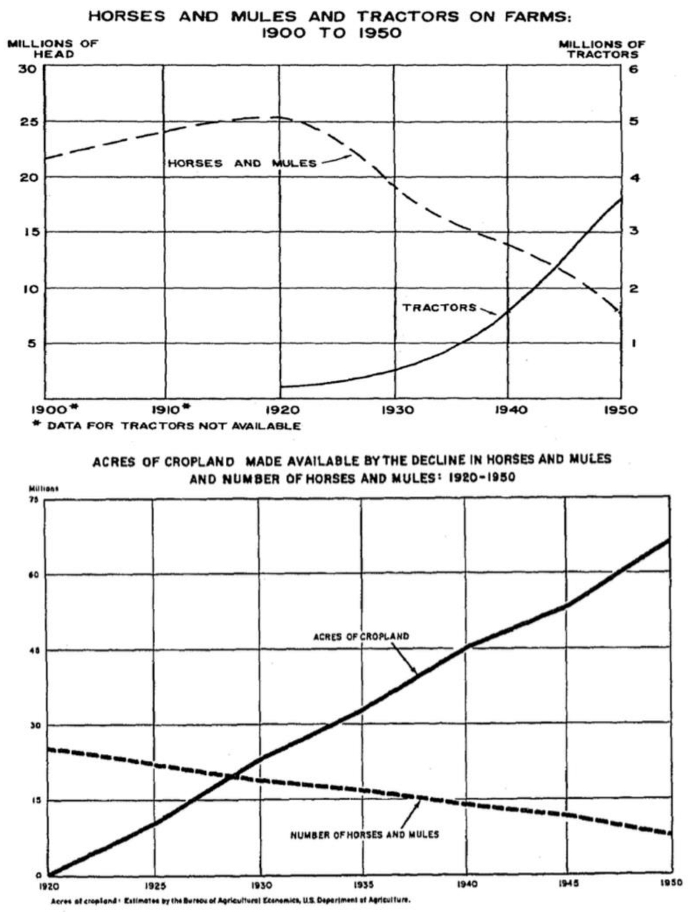
[5] This is drawn from Shankar Nair, 'Technology and Industry in a Colonial Economy: Steam Cotton Ginning and Leaf-Cigarette Manufacture in Late Colonial India, 1860-1940', unpublished PhD thesis, King's College London, 2024.

Sifeng Model 12 HP 2WT with 5.6 tonnes of rice, Bangladesh.
Source: Wikipedia

Or consider the internal combustion engine, an innovation conventionally discussed in relation to vehicular transport, but of immense importance to global agriculture. In the US, the small gasoline engine (the 'Otto' engine, a German innovation), between three-fourths and ten horsepower, was an important source of stationary power (or 'belt power'), used for threshing grain, pumping water, sawing wood, baling hay, shelling corn, separating cream, and grinding feed, most of these traditionally performed by women and children. The stationary gasoline engine could run safely unattended, was more predictable than wind-power, was more economical (fuel cost per horsepower) for small jobs and required less skilled supervision than the steam engine, and with declining oil prices, offered a more reliable and less-resource intensive alternative to the tread and sweep power generated by horses for small tasks. It was estimated that 2.5 million stationary gas engines were in use in 1924 in US farms, concentrated in the North, but the combustion engine was still no match for the horse and mule, which remained the most significant single source of power on US farms until mid-century.[6] By the 1920s, however, farmers increasingly opted for the automobile, owning more than a quarter of all automobiles in the US, but the use of their gas engines to drive belting mechanisms is less well known, providing a versatile alternative to the stationary engine. Gasoline-powered tractors (particularly the Fordson) also came into use in Midwestern wheat and corn fields in this period, but it was not until after the Second World War and with the introduction of general-purpose tractors and auxiliary improvements in the intervening period that it was rapidly adopted, indeed even in the South, for row crops such as cotton and tobacco. By 1960, there were 4.5 million gas tractors in use in US farms, while the number of horses and mules fell below 8 million, against 22 million in 1900.[7] However, this was far from a simple story of displacement, as farms often contained both sources of traction power for different purposes, even as the trend was towards increasing tractorisation.

Shankar Nair

[6] David Edgerton, The Shock of the Old: Technology and Global History since 1900, Reprint edition (Oxford University Press, 2011).
[7] Alan Olmstead and Paul Rhode, 'The Diffusion of the Tractor in American Agriculture, 1910-1960' (October, 2000), NBER Working Paper 7947; *United States Census of Agriculture– 1950*.



Source:
United States Census of Agriculture– 1950 – Volume V, Part VI.

In Asia, it was the diesel engine, in small and large varieties, that was widely used in farms. While accounts of the Green Revolution have centred the High Yielding Variety (HYV) seeds, the region of the Punjab and United Provinces in India typically associated with this phenomenon in fact saw productivity increases as a result of the adoption of deep tubewells, well after the 1960s, and supported by state rural electrification schemes and subsidies.[8] However, as far as South Asia goes, it is not the electrified deep tubewell that is typical, but the smaller shallow tubewell and small low-lift pump powered by single-cylinder diesel engines. In Bangladesh, by 2006, there were about 1.2 million shallow tubewells powered by Chinese diesel engines, against 24,506 deep ones.[9] A similar trend in shallow tubewell irrigation is in evidence in Sri Lanka, Nepal, Thailand, and indeed India, beyond the GR regions. Smaller diesel-powered two-wheel tractors (2WT) similarly underpin Chinese agriculture, numbering some 17 million in 2012, followed by Thailand with 1.8 million units, but diesel engines were used for a variety of purposes in these regions. Interestingly, by the late 1990s the world leader in the production and use of large four-wheel diesel tractors (4WT) was India, increasing from 100,000 in 1970 to 2.6 million in 2000, typically used in large wheat and rice farms in Punjab, while the number of draught animals in use declined from 82.6 million to 60.3 million, still a significant number, and of particular importance to smaller farmers.[10] India today is the largest producer and market for 4WT tractors in the world.

We know far too little of the conditions of adoption of these innovations and their impact on existing techniques, farm sizes, cropping patterns, and indeed the stratification of rural societies and rural politics. But a clear-eyed assessment of this empirical reality, without the blinkers of our dominant models, is a necessary first step.

[8] Kapil Subramanian, 'Revisiting the Green Revolution: Irrigation and Food Production in Twentieth Century India', unpublished PhD thesis, King's College London, 2015.
[9] Biggs, Stephen and Justice, Scott, 'Rural and Agricultural Mechanization: A History of the Spread of Small Engines in Selected Asian Countries' (May 26, 2015). IFPRI Discussion Paper 1443.
[10] G. Singh, 'Agricultural Mechanisation Development in India', *Indian Journal of Agricultural Economics*, 70 (2015), 64–82.

Further reading

Bosma, Ulbe, *The World of Sugar: How the Sweet Stuff Transformed Our Politics, Health, and Environment over 2,000 Years* (Harvard University Press, 2023).

Brassley, Paul, Harvey, David, Lobley, Matt and Winter, Michael, *The Real Agricultural Revolution: The Transformation of English Farming, 1939-1985* (Boydell & Brewer, 2021).

Edgerton, David, *The Shock of the Old: Technology and Global History since 1900*, Reprint edition (Oxford University Press, 2011).

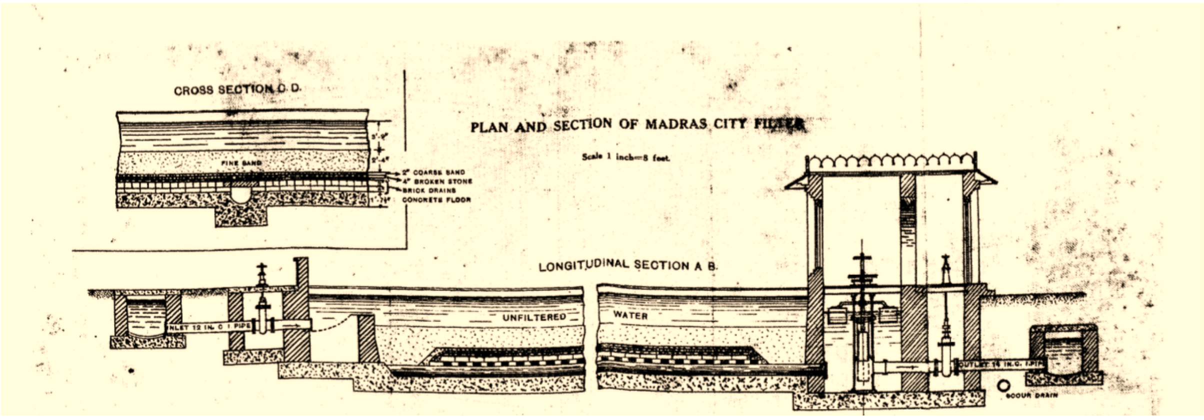
Lakwete, Angela, *Inventing the Cotton Gin: Machine and Myth in Antebellum America* (JHU Press, 2003).

Meyer, Carrie A., 'The Farm Debut of the Gasoline Engine', *Agricultural History*, 87 (2013), 287–313.

Olmstead, Alan L., and Paul W. Rhode, 'Reshaping the Landscape: The Impact and Diffusion of the Tractor in American Agriculture, 1910-1960', *The Journal of Economic History*, 61 (2001), 663–98.

Ron, Ariel, 'When Hay Was King: Energy History and Economic Nationalism in the Nineteenth-Century United States', *The American Historical Review*, 128 (2023), 177–213.

Strains of Scientific Breakthroughs



- History of Water Purification Technologies in the late- 19^{th} Century -

It is customary to think of scientific breakthroughs as solutions rather than problems. Historical accounts of social progress are organised around breakthroughs, either scientific or technological, and they implicitly convey a sense that these breakthroughs became transformative almost seamlessly. But the implementation of new scientific and technological ideas, in the initial stages at the very least, are loaded with risks with uncertain chances of success. Much of their future trajectories relies on the trust and legitimacy enjoyed by socio-political configurations that generate and use these novelties. Where this trust is lacking, even the most revolutionary of ideas would take time to take root. The global adoption of water filtration technologies in urban contexts over the late 19^{th} century shows a ready example.

Water purification technologies emerged in the context of late 19th urbanisation. As cities began to rapidly grow, they began to stretch the capacity of pre-existing living arrangements leading to overcrowded habitations and increased pollution of local sources of water supply. Combined with the growing integration of the world through trade, transport, and imperial conquests, these situations provided the perfect conditions for the spreading of devastating epidemics such as cholera. Britain, which stood at the centre of globe spanning empire and industrial capitalism, suffered from periodic cholera epidemics and saw nearly 100,000 deaths between 1830 and 1860 with nearly half of them in the epidemic of 1848-49. In response to such epidemics, several measures were taken by states including the building of new centralized piped water supplies and sewerage systems, leading to, what has often been called a revolution in urban governance.

Filtration of water was one part of these remedial measures. One of the earliest cases of documented use of water filtration in the 19th century was in Paisley in Scotland in 1804. Global attention to the practise began to emerge after London's Chelsea waterworks company introduced it to purify its water supply in the 1820s. At a very generic level, these filters, called slow sand filters, consisted of shallow open tanks where water was passed through three layers of filtering materials: gravel at the bottom, a layer of coarse sand in the middle, and a layer of fine sand at the top.

	New River Water Company.	East London Water Company.	Kent Water Company.	Hampstead Water Company.
	Grains in an Imperial Gallon.			
Carbonate of lime	7·82	10·16	7·02	4·95
Sulphate of lime	3·23	2·33	11·03	,,
Nitrate of lime	0·02	0·72	0·07	0·07
Carbonate of magnesia	1·09	1·51	3·42	3·53
Chloride of sodium	1·73	1·76	3·50	6·79
Sulphate of soda	1·49	0·94	,,	15·14
Chloride of potassium	,,	,,	0·44	,,
Sulphate of potassa	1·11	1·25	0·70	1·40
Carbonate of potassa	,,	,,	,,	1·80
Silica	0·50	0·62	0·76	0·07
Iron, alumina, and phosphates	traces	0·47	traces	traces.
Ammonia	traces	traces	traces	traces.
Organic matter	2·79	4·12	2·61	1·84
TOTAL	19·78	23·88	29·55	35·59
Solid residue obtained on evaporation	19·50	23·51	29·71	35·41
Free carbonic acid in cubic inches at 44° F.	14·49	12·38	10·15	13·30
Free carbonic acid grains in a gallon	7·24	6·19	5·07	6·67
Suspended matter	1·49	1·07	,,	0·52
Degree of hardness (Clerk's scale)	14°·9	15°·0	16°·0	9°·8

Figure 1: A water analysis table in the pre-bacteriology era from London
Source: Report of the Government Commission on the Chemical Quality of Supply of Water to the Metropolis, 1851)

The adoption of this technique in the initial decades was initially gradual because of two main factors. One, in the mid-19th century there was little consensus on whether water was the medium through which diseases such as cholera were spread. The then prevailing paradigm of disease causation, labelled the 'miasmatic' paradigm of disease, held filthy environments, rather than contaminated water, caused such diseases. Two, it was unclear to the city authorities, as to what was it that the filters were purifying. Between 1830 and the mid-1880s, water filtration was used to ensure the chemical rather than the bacteriological purity of water, and it was felt that they contributed to better sight and smell of water, more than any perceived safety from contaminants in water.

Three important developments changed the role and importance of filtration from the 1880s onwards. Firstly, the research insights from scientists such as Koch, Louis Pasteur, etc., led to an understanding that diseases were caused by microbes, rather than filthy environments inaugurating the emergence of the germ theory of disease. Secondly, experiments conducted in London indicated that the slow sand filters were also effective for bacteriological control with the results showing that they could remove ninety-five percent of micro-organisms present in water. Thirdly, the spectacular success of slow filters in 1892 in bringing a cholera outbreak in Hamburg under control, provided practical demonstration of the bacteriological efficacy of filters, thereby making a strong case for the introduction of water filtration as a public health measure. As a result, water filtration and bacteriological analysis found enthusiastic backers among the medical practitioners with bacteriology becoming the cutting edge medical science of that period.

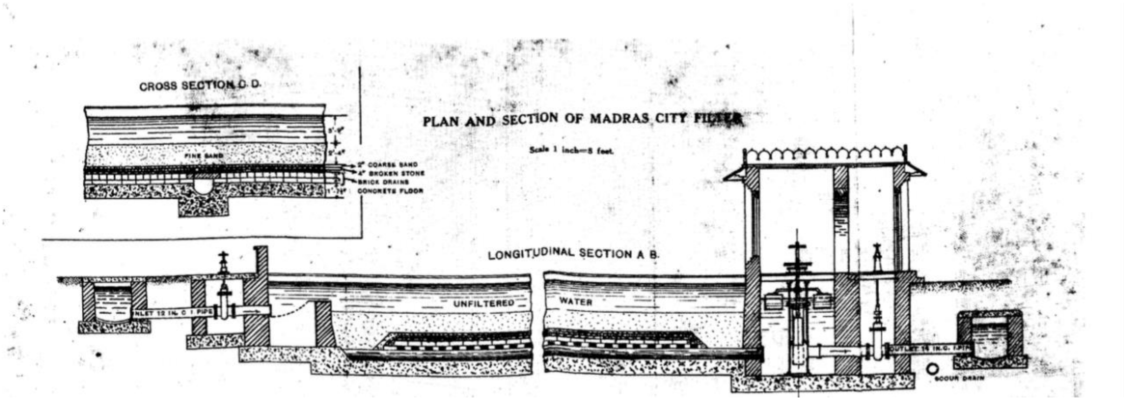


Figure 2: Illustration of the Madras Slow Sand Filters
Source: Note by Special Engineer of Madras Waterworks, 1918

The global diffusion of water filtration technologies over the next three decades however was far from automatic. The key problem here was finding filtration systems that would suit the varied environmental conditions found in different parts of the world. Raw water that was available in one location markedly differed from that in another location, and therefore filtration method that was suitable in one location, was not suitable in another. American waterworks, for instance, began preferring a new method known as mechanical filtration as an alternative to slow sand filters arguing that the latter was unsuitable for their purposes. These pronouncements from American engineers were often inseparable from marketing and advertising claims of American engineering firms about the alleged superiority of mechanical filtration systems over the slow filtration systems. Therefore, between 1890 and 1920, there was uncertainty about what method of filtration would suit what context, and several cities had the painful experience of implementing one system and realising that it was not the ideal one leading to heavy sunk costs. This had the inadvertent effect of undermining the legitimacy of the medical and engineering experts that were active proponents of the implementation of filtration, given that in those periods filtration systems were expensive capital goods that occupied a sizeable part of the expenditure on waterworks.

The case of the Indian city of Madras gives an illustration of this trend. Madras, the third largest city in British India, the sixth in the British empire, was a thriving commercial centre in the early 20th century. The sanitary statistics of the city however belied its stature, indicating instead that it was one of the worst when measured in terms of deaths due to infectious diseases. To deal with this, the city built a water filtration system in 1914 exactly at a time when there was a flux in the global landscape of water filtration due to the competition between the American (mechanical filtration) and British (slow sand filtration) methods. The British experts that were involved in the decision making in Madras, chose to follow the British precedent rather than implement mechanical filters, as in their view the American methods were untested. The city built slow sand filters at a substantial cost to the city's tax payers, a majority of whom were Indians.

But soon it became apparent that the British filtration methods were not suitable for the Madras city's water, causing serious anger among the city's Indian elites. Coincide as this controversy did with the war-time political tensions in India between the British colonialists and Indian nationalists, the filtration debate became a politically charged subject . The inability of British engineers to build a functioning water filtration system became a local nationalist grievance and made its way into nationalist discourse around the demand for greater self-governance. With the controversy refusing to die down, the colonial government ordered an inquiry into identifying the most suitable method for filtering the city's water. Between 1917 and 1925, a series of experiments followed wherein expert opinion shifted from favouring one method of filtration to another, before finally suggesting the use of mechanical filtration to purify the city's water.

Despite the results of the experiments, this was a step that the city's political leaders were reluctant to proceed with. Aside from the costs that were involved in implementing this step, they were unable and unwilling to trust expert views on water filtration due to dissensions, disagreements on the subject in the previous years, and the failure of the slow filtration method which was the expert's choice earlier. This led to a situation wherein the city did not implement the new recommendations and instead decided to continue using the older method. Fortunately for the city, chlorination of water supplies had emerged as a cheaper solution for water sterilisation in the 1920s (See Edisson's chapter) which the city adopted as an interim stopgap method to ensure bacteriological purity even as it made the 'aesthetic' aspects of water, such as taste and smell, undesirable. It was not until after the end of the second world war that the city eventually decided to try mechanical filtration methods when the latter's functioning had become well understood.

The history of water purification technologies in the latter half of the 19th century highlights two important aspects in the historical links between science and technology. One, that the adoption of a technology can take place even before its efficacy and functioning is well understood, like the case of filtration use before the era of bacteriology. Two, that breakthroughs in scientific understandings do not seamlessly transfer from the 'laboratory' to the 'real world'. For that to happen, trust on expertise is an important dimension. With hindsight, the action of Madras city's elites may seem extremely narrow, 'unscientific' and even dangerous. But the protagonists were having to take a decision at a time when there was a changing understanding about disease causation and a changing engineering landscape in water treatment, particularly in a situation when their initial effort to build a filtration plant had been a costly failure. For them, the scientific and engineering breakthroughs were just as much a liability as an asset. Being sensitive to this dimension of scientific breakthroughs can help develop more robust accounts of the relationship between science, technology and society in history.

Viswanathan Venkataraman

Further Reading

Hamlin, Christopher. *A Science of Purity: Water Analysis in Nineteenth Century Britain*. Bristol: Adam Hilger, 1990.

Melosi, Martin V. *Precious Commodity : Providing Water for American Cities*. Pittsburgh, Pa.: University of Pittsburgh Press, 2011.

Sedlak, David. *Water 4.0: The Past, Present, and Future of the World's most Vital Resource*. New Haven: Yale University Press, 2014.

The history of chlorination

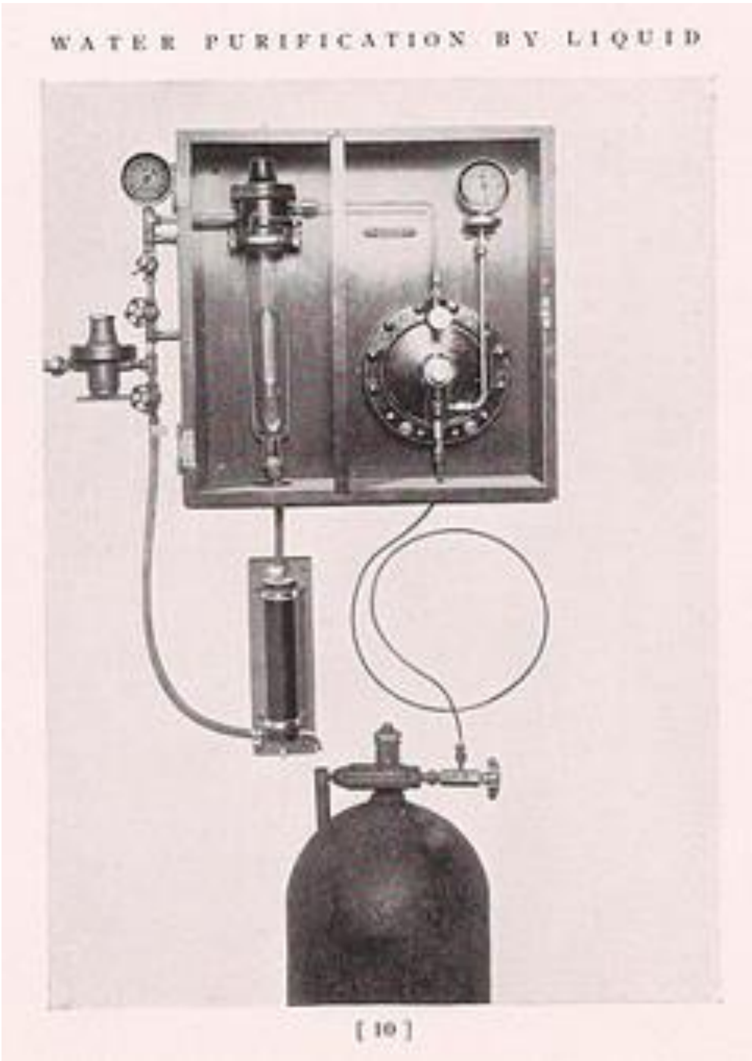
-The role of imitation in technical change- [1]

The history of chlorination, one of the most radical transformations in modern water treatment, illuminates our understanding of urban sanitation and public health in the early 20th century, but it also serves to correct misapprehensions in the historiography of modern technology. The most important one is that technical change follows radically different rules, known beforehand, in North and South, West and non-West, Metropole and Colony or any geographic/political distinction we might prefer. Differences between those places indeed exist, as well as similarities, connected to power relations, but we need to find them through empirical work instead of assuming that if we study, let's say Bogotá, what we will find there is entirely different, almost incommensurable to the workings of technology in London or any other rich city in Europe or North America. A second misapprehension that reinforces the first one is that the historiography of science and technology is excessively 'diffusionist', i.e., assumes that most science and technology developed in the North/West and from there moved to the South/Non-West, giving no agency to the latter. The obvious thing to do, then, would be to find what is unique to the South and the Non-West, revealing their true agency. Suggesting technical similarities between these places due to imitation could give you the doubtful honour of joining the list of 'diffusionists.' The truth, however, is that there is no list, as no one has advocated such a theory, and imitation, far from being a condescending

---

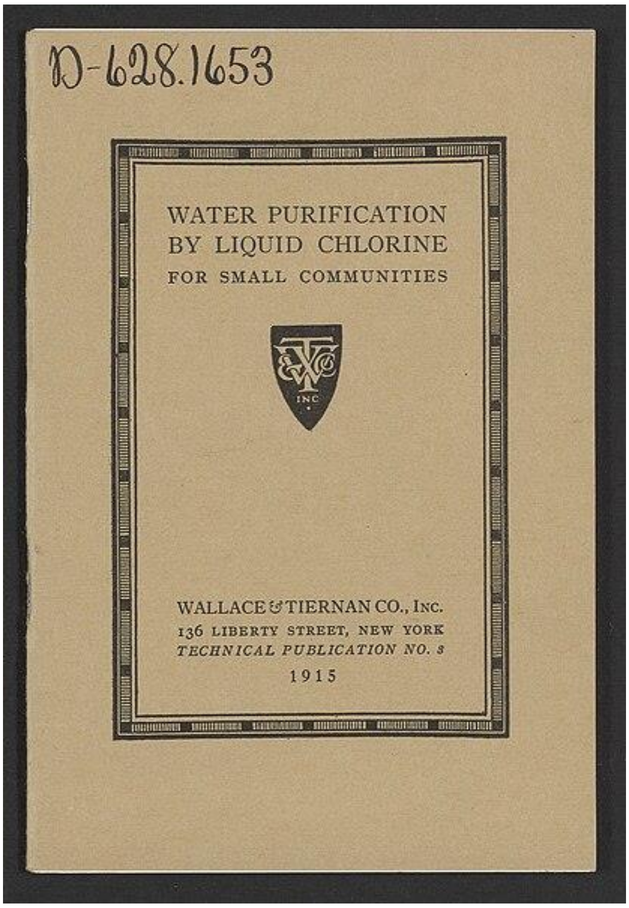
[1] Based on my paper 'Toward a Symmetrical Global History of Technology: The Adoption of Chlorination in Bogotá, London, and Jersey City, 1900-1920', *Technology and Culture* 65 (2024) 4, 1195-1221.

concept, could be a powerful way of correcting erroneous assumptions about how technical change takes place everywhere while highlighting the agency of local actors.



[Chlorinator in a Wallace and Tiernan's manual, 1915]

Chlorination is the use of chlorine as a disinfecting agent to eliminate bacteria from drinking water. During the late 19th and early 20th centuries, physicians and sanitary engineers only used chlorine on sewage or experimentally to treat water during outbreaks of typhoid fever, but not as a permanent measure. Experts and citizens alike distrusted chlorine due to the unpleasant odour and taste it added to water and safety concerns. After all, putting chemicals into the water was, for some, contrary to the idea that 'pure water' was better obtained by protecting watersheds than by treating an already polluted source. Chlorination was first tested in Britain and Germany, but it was adopted as a permanent water treatment technology in the United States in 1908, and from there, it spread worldwide, radically changing water management and reducing mortality and morbidity on an impressive scale. By the 1930s, chlorination had become a standard water treatment in most places. Why was this technology adopted so quickly? What can we learn from this case? Several historical processes converged to make this possible. Still, the factor that made the minds of decision-makers in places as different as London, New Jersey or Bogotá, the cases I will analyse here, was the low cost of this technology in comparison to alternatives considered superior, such as ozone, which made it a good choice to cope with economic challenges.



[Water purification by liquid chlorine for small communities. Wallace and Tiernan, 1915]

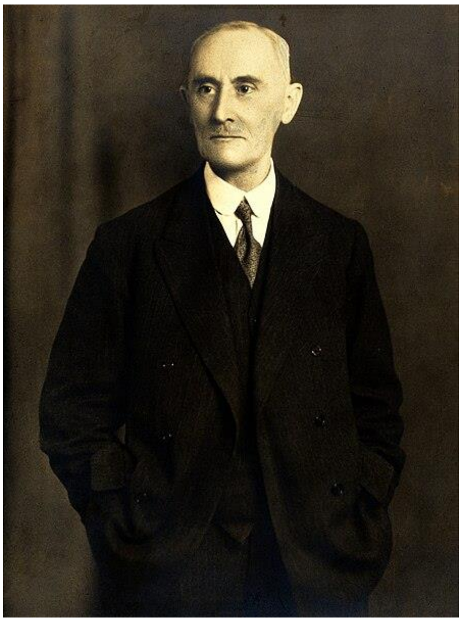
Despite obvious differences (cultural, religious, and economic), rich and poor cities shared a set of challenges that made imitation in water treatment possible and desirable between the late 19th and early 20th centuries: rapid urbanisation connected to capitalist development, increasing outbreaks of typhoid fever, private utilities unable to produce safe drinking water, and doctors and sanitary engineers still adapting their practices to germ theory. The results of experiments in water treatment travelled in papers from academic journals, commercial initiatives, or even diplomatic cables to many different places. As with any technical field, water treatment had plenty of alternatives and none of them was destined to triumph. Ozone, quicklime, ultraviolet light, a combination of storing and slow sand treatment, and even the good old-fashioned protection of the source were available. The catalyser that pushed the decision in favour of chlorination was economical and its logic was imitative in both North and South.

Jersey City was the first city to use chlorine as a permanent water treatment in 1908, but the process that led to it was controversial. Due to water quality problems (high bacterial count) and breaches of contract, the city's authorities sued the Jersey City Water Supply (the private company in charge) in 1906. A year later, in May 1907, the company received a court order to build "sewers and sewage disposal works for various towns in the watershed" to avoid pollution entering the supply.[2] Physician John Leal, consultant to the company, suggested that chlorination, which he knew from contemporary experiments in Germany, England and some of his own, could be a cheaper alternative. After petitioning the court for time to try alternatives to the sewage system, a tremendously expensive option, he designed a 'sterilisation plant' in collaboration with a team of engineers and put it into function in September 1908, where he tried chlorine and other chemicals, including ozone, rejected on the same grounds as elsewhere: expensive and difficult to produce. Leal initially reported to the court what he was doing as the 'works,' and only in 1909, the city came to know he had

[2] J. L. Leal, "The Sterilisation Plant of the Jersey Water Supply Company at Boonton, N.J.," in Proceedings of the Twenty-Ninth Annual Convention of the American Water Works Association Held at Milwaukee, Wis., June 7–12, 1909, 104, Documentary History of American Water-Works, http://www.waterworkshistory.us/NJ/Jersey_City/1909AWWALeal.pdf

been chlorinating the water supply. The subsequent legal process was heated, with many experts in favour and against chlorine debating their arguments in court. The main difference of opinion was the choice between treating already polluted water, as chlorination did, or preventing water pollution, as sewage systems would do. After intense deliberations, though, the court approved the permanent use of chlorine on November 15th, 1910, arguing it was safe, effective as a bactericide, and low-cost. Following a rapid expansion in American cities, industrial improvements and scale production by companies like Wallace and Tiernan made liquid chlorine (compressed and cooled chlorine gas), the most popular version as it was cheaper, and easier to transport and apply to the water supply, facilitating its global expansion.

Dr. John Leal, pioneer of chlorination in Jersey City

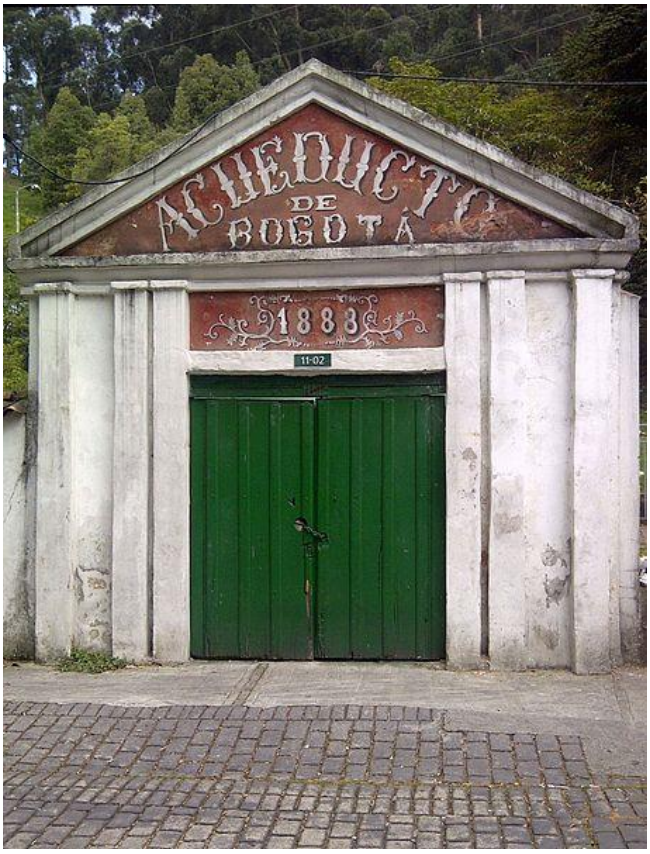


Sir Alexander Houston, director of Water Examination at London's Metropolitan Water Board (1905-1939)

At the beginning of the 20th century, London was a leading city in water treatment. The city's Metropolitan Water Board, under the direction of physician Alexander Houston (after the municipalisation of private utilities), used effectively a combination of storing in large reservoirs and slow sand filtration to provide safe drinking water to Londoners. Houston, who had conducted a large-scale chlorination experiment in Lincoln, England, in 1905 to deal with a typhoid outbreak and knew of experiments elsewhere, was reluctant to chlorinate the river Thames water and, generally, to use any chemicals as permanent treatment previous to 1916. Adding to the displeasure that citizens expressed at the odour and taste of chlorinated water, Houston believed, like other specialists, that ozone was the only bactericide 'absolutely free from any source of reasonable objection.'[3] But expensive and difficult to produce, ozone hardly expanded beyond France although it was admired everywhere. It

[3] Royal Commission on Sewage Disposal, 1909, appendix 4, memoranda on special investigations and experiments by the officers of the commission, sterilization treatment of the Lincoln Water Supply, 114–15, Institute of Civil Engineers.

would be only faced with rising costs during the Great War that Houston changed his mind about chlorine. The storage system, essential to Houston's treatment, worked by pumping raw River Thames water to the Staines reservoirs using coal, whose cost became prohibitive during the war effort. Looking for alternatives and aware that cheap and humble chlorine had exceeded 'the expectations even of the most ardent advocates of this method of treatment' in the United States, he agreed to chlorinate London's water supply on May 1, 1916.[4]



[Old building of the Compañía de Acueducto de Bogotá y Chapinero]

The chlorination of Bogotá's water supply in 1920 followed years of intense controversy among doctors and sanitary engineers over the adequacy of chlorine. Bogotá began the 20th century in a dire drinking water situation: deficient infrastructure, legal disputes over ownership of the utility, and rampant waterborne diseases. Similarly to Jersey City, Bogotá's authorities got into a legal dispute with the *Compañía de Acueducto de Bogotá y Chapinero*, a private utility, due to delays in coverage and water quality issues, which did not resolve until 1914 when the city was finally able of municipalise the water service. In the meantime, an ambitious plan presented by Pearson and Son, a global British engineering company, at the petition of Bogotá's authorities in 1907, included adopting storing in large-scale reservoirs and slow sand filtration, as in London, but not chlorination. Ozone was also suggested but never adopted. Pearson's plan, cherished by local doctors, was too expensive for the city's meagre finances and could never be implemented. Bogotá depended on international credit to purchase the private company and improve its water infrastructure, and given the reluctance of the London banks, the main lenders of the city, both technical upgrading and municipalisation were delayed.

In this context of budgetary paucity, Bogotá learned about chlorination. On May 8, 1917, a diplomatic cable from Eduardo Restrepo Sáenz, Colombia's ambassador to Perú reported on the success of 'liquid chlorine' in Lima. The same year, Roberto de Mendoza, an engineer, learned about the use of 'liquid chlorine' in New York and asked Councilman Simón Araujo to endorse its use. Araujo responded positively, as he already knew about chlorination

---

[4] Twelfth Report on research work, "On the Softening, Purification and Sterilisation of Water Supplies," 1916, ACC/2558/MW/W/011, 16, London Metropolitan Archives.

through William Gorgas, a doctor from the Rockefeller Foundation who was then visiting Colombia. Mendoza began a public campaign in anonymous opinion columns, arguing chlorine was effective and so much cheaper than Pearson's plan. Bogotá's Council attempted to purchase chlorinators from Wallace and Tiernan (the big liquid chlorine manufacturer) in August 1917 but Alberto Portocarrero, president of the now-municipal *Compañía de Acueducto de Bogotá*, said there was not enough information to make that decision, and asked for a recommendation to the Colombian consul in New York, who took a long time replying. Desperate, a group of engineers led by Eugenio Díaz Ortega, a passionate defender of chlorination, travelled to New York, gathered information, and convinced the consult to send a positive recommendation on August 29, 1918, but this only stirred things up.

[**Dr. Pablo García Medina, first director of Colombia's *Dirección Nacional de Higiene***]

Portocarrero replied that chlorination was not as cheap as advertised, as it would require new facilities the city could not afford. Cenón Solano, director of the Hygiene and Sanitation Department of Bogotá, added that the repair of the equipment would have to be done in the United States, increasing costs, and proposed studying alternatives, including ultraviolet light, used at soda factories in Bogotá. Díaz Ortega accused Solano of suggesting useless alternatives, as ultraviolet light was tremendously more expensive than chlorine. Both of them and Portocarrero exchanged accusations and arguments in the newspapers in the following two years with no apparent resolution. The controversy ended somewhat abruptly in 1920, as after the 1918 Spanish Flu ravaged the city, the national government reformed Bogotá's health institutions, centralising decision-making and increasing the hygiene budget. Pablo García Medina, leading the National Direction of Hygiene, backed chlorination on April 30, 1920, arguing that liquid chlorine could be imported at a 'really insignificant amount,' making it possible to produce drinking water at a significantly lower cost than with Pearson's proposal.[5]

Imitation can occur through many means, including replicating experiments learned in academic journals, adopting techniques that seem to be having success elsewhere and reported via reports, diplomatic cables, exchanges with foreign experts, or evaluating and purchasing options available in the market. One or several of these took place in Jersey City, London and Bogotá, despite their institutional and economic differences. Even Jersey City, the innovator, imitated as it was relying on European experiments. Fertile ground for

[5] "El estado sanitario de Bogotá y la desinfección de las aguas," El Tiempo (Colombia), May 14, 1920.

imitation grew as did global scientific and commercial connections. Doctors in the US knew about Houston's experiments with storing and he was aware of recent chlorination success in American cities. Bogotá had ties to British engineering companies and Colombian doctors were familiar with medical and engineering developments in Europe and the US, as they often were trained there. Imitation did not preclude the agency of local actors, something clear in the case of Colombian doctors actively pursuing or rejecting chlorination. There was no passive attitude or mere uncritical copying of US technology there. Imitation is not simple, it requires rigorous evaluation and selection of alternatives, and it does not entail the straightforward adoption of foreign technology. It involves, as this case makes clear, reaching consensus amid fierce disagreement. Everyone imitates. We should study how and why.

Edisson Aguilar Torres

SUGGESTED READINGS:

Gabriel Tarde, *The Laws of Imitation*, (New York, 1903).

Martin Melosi, *The Sanitary City: Environmental Services in Urban America from Colonial Times to the Present*, (Pittsburgh, 2008).

Colleen K. O'Toole, "The Search for Purity: A Retrospective Policy Analysis of the Decision to Chlorinate Cincinnati's Public Water Supply 1890–1920," (Ph.D. diss, University of Cincinnati, 1986).

Kate Foss-Mollan, *Hard Water: Politics and Water Supply in Milwaukee, 1870–1995* (West Lafayette, 2001).

The modern morgue

-From identifying the unclaimed dead to advancing forensic science, the first morgue established in nineteenth-century Paris became the model for modern death management internationally-

When we think of morgues today, we imagine discreet, clinical spaces; waiting rooms between the worlds of the living and the dead. They are ubiquitous in our modern medical landscape, with hospital morgues functioning as a crucial location for the hygienic, bureaucratic, and at times medico-legal processing of the dead. Depending on the state medical system and regulations of local governance, some towns and cities may also have a dedicated municipal morgue, which frequently plays a key role within in local policing as the site where any unknown dead can be brought and identified.

But despite their contemporary significance in urban centres across the world – and prime role in modern police television dramas - the modern morgue is a relatively recent invention. It originally dates back to early nineteenth-century France, when swift population growth, hygienic concerns, changing approaches to medicine and the medico-legal field following the French Revolution, and a growing state and police interest in having all citizens accounted for collided, resulting in the establishment of the first municipal morgue.

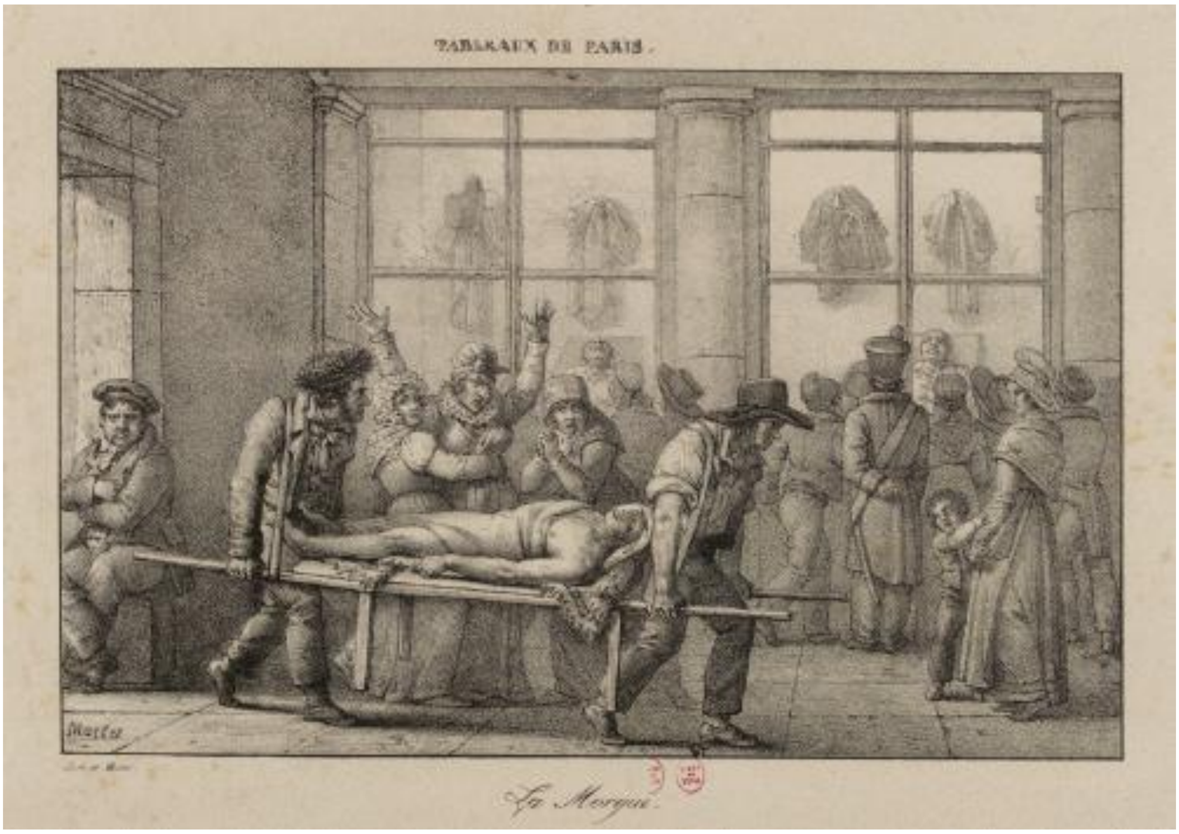
Overseen by the Prefecture of Police and ostensibly designed to process and manage the unclaimed dead found in the river and the streets, it developed into a world-famous site - a hub for scientific and medico-legal advances, and an incredibly popular public attraction that brought in over one million visitors per year by the end of the period, eager to see the Parisian dead laid out on display. Crucially, the combined popular and professional interest in this unassuming Parisian building quickly transformed it into a model example that could be followed: a key municipal institution operating within the complex and overlapping medical, judicial and carceral networks of the nineteenth-century city. As a result, it became the blueprint for urban morgues internationally, leading to the establishment of new institutions in cities around the world including New York, Melbourne, Lisbon, Bucharest, and Berlin, that subsequently influenced the development of medicine and policing in their own countries.

Etching of the exterior of the first morgue, 1829.

William Price, The Morgue, Paris, by Notre Dame (London: Robert Jennings, 1 July 1829)

Source: [The Wellcome Collection]

As in many cities, rudimentary facilities for the management and identification of the unknown dead already existed prior to the introduction of the first morgue. These were often relatively informal, and relied on local justice, charity or religious networks that could provide a makeshift space in a prison or almshouse. In Paris, a form of repository for the unknown and unclaimed dead had existed since at least the fourteenth century. Bodies found in the streets or in the river would be taken to Grand Châtelet, a judicial building containing a court and multiple prisons, a system that was overseen by the order of Saint Catherine. By the 1600s, the staff of "Catherinettes" were receiving approximately one hundred bodies per year, and were recuperating the costs of interring the bodies in the Holy Innocents Cemetery by selling the clothes of the dead.



Body being carried through the exhibition room, 1824 [Jean Henri Marlet, La Morgue].

Source: Paris Musées

Any attempts to identify the bodies during this period is not mentioned, but by 1713 the repository at Châtelet, referred to as the "la basse geôle" (literally "a low dungeon") had incorporated public viewing, exposing the bodies for a number of days in order to facilitate identification. It was during this period the room began to be referred to as a "morgue"; by the early eighteenth century, the word had multiple meanings, including to look at someone insolently, and a room in a prison where the prisoner could be seen through the bars. According to the official *Dictonnaire de l'Academie* in 1718, by this period it had also come to mean "a place at Châtelet, where bodies found dead are exposed for public viewing, so that they can be recognised". The site was located at the end of a courtyard, and consisted of a series of dark, damp basement rooms where bodies were washed with water from a well before being laid out on haphazardly on the ground, nude and piled on top of one another. Anyone searching for a missing person could then view the bodies through a narrow opening.

The morgue, 1923.

Source: Gallica

Even to contemporaries, this early version of a morgue was not fit for purpose. Not only was it broadly considered to be a disrespectful system that allowed the dead very little dignity, the chaotic management of bodies also posed a clear hygienic threat. The unsanitary status of dead bodies, particularly when left to decompose in overcrowded city cemeteries close to lodgings, water sources and markets, represented a significant risk to the growing populous. As a result of decades of violent political and social unrest, the Paris police were also increasingly concerned with new methods for managing, identifying and surveilling the population. Finally, following lengthy discussions, the decision was made to establish a dedicated institution for the management of the unknown dead in the city.

In 1804, the first Paris morgue was then built on the Quai de la Marché- Neuf, designed in the style of a Greek temple. The official purpose of morgue was to establish the "civil status" of any unidentified dead found in the city, who would be brought to the institution and, if fit for public view, laid out on one of ten marble slabs behind a large window in the exhibition room. Their clothing was hung on hooks behind them to help facilitate identification, and cold water dripped on the bodies to help slow down decomposition. The public were encouraged to visit the morgue, and on the other side of the window, they could gather in the exhibition room to see the bodies – with the understanding that they would notify the morgue keeper if they had any information on their potential identity or the circumstances surrounding their death, such as an accident, a murder, or a suicide. Although many did visit in order to help facilitate identification, the institution swiftly became known as a popular attraction, drawing huge crowds of both locals and tourists eager to see the bodies on display. The building also contained a "dead room" where bodies were processed, an office for the morgue keeper, storage rooms, and a number or rooms on the first floor to house the families of the morgue keeper and assistant morgue keeper.

The morgue underwent numerous key changes over the next sixty years, in particular the development of medical and medico-legal facilities. In the 1830s the first dedicated medical inspector, Alphonse Devergie, gained authorisation to use unclaimed bodies to undertake research into developing medical theories including water-based putrefaction, brain haemorrhages, heart attacks and various forms of asphyxiation. New formal registers were introduced and annual statistics kept, establishing new protocols for the bureaucratic processing of the dead, and Devergie also began holding twice-weekly classes in legal medicine at the morgue, in association with the Faculty of Medicine.

However, by the mid-century the institution was no longer able to manage the increasing numbers of unknown urban dead, nor adequately adapt to developments in technology, medicine and policing that required expanded facilities and further financial investment. The decision to build Boulevard Sebastopol through the old medieval streets of Île de la Cité as part of Baron Haussmann's reorganisation of Paris, thus forcing the morgue to relocate from the soon-to-be-razed Marché de la Quai-Neuf, offered a prime opportunity to develop a new, improved institution. Following almost a decade of discussions, the second Paris morgue finally opened in April 1864 on Quai de l'Archevêché, under the shadow of Notre Dame and a short distance away from the former site.

Anthropometric identification of bodies at the morgue (1900).
Source: Crimino Corpus

The new morgue was significantly larger, and designed to increase the capacity for existing functions, as well as providing space and facilities for new forms of policing, investigations, and medico-legal instruction. Supported by an ongoing administrative collaboration between the Palais de Justice, the Prefecture of Police and the Faculty of Medicine, the institution led research into burgeoning disciplines including forensics, criminology, and toxicology, as well as hosting lectures to disseminate emerging knowledge among a growing corps of students and medico-legal professionals. A lecture theatre and a toxicology laboratory were introduced towards the end of the nineteenth century, and from 1882 onwards, the introduction of refrigeration technology allowed the bodies to be frozen at night, stretching the possible viewing period to up to three weeks. Advances in photographic technology also allowed for effective new ways of "preserving" and identifying the unknown dead, with photography of faces adopted from the 1870s onwards and the images displayed at the entrance to the morgue. By the end of the nineteenth century, the Paris morgue had developed a national and international reputation as a formidable and highly respected institution within the still-emerging field of medico-legal investigations.

However, following increasingly intense debates surrounding the nature of publicly displaying the dead, the Paris morgue ended the public exhibition of bodies on March 15th, 1907. A decree signed by Louis Lépine, then Prefect of Police, announced that unless under "exceptional circumstances", a new policy had been put in place to separate those who could "offer useful information" from those who were visiting with "curious intentions". No public protest over the closure of the morgue has been recorded, despite its seeming abruptness and continued popularity. The press had been debating the value of exhibiting bodies in the years prior to the closure, and the only well-publicised outcry involved merchants near the morgue complaining about reduced business.

The morgue remained opened for private identification for several years, and its medico-legal functions continued until the operations of the institution were officially transferred to the Medico-Legal Institute in 1921. Discussions for the new institution had been ongoing since at least 1908, with construction commencing in 1913, but both the completion of the building and the administrative transfer were delayed by the First World War. The Medico-Legal Institute was established outside of central Paris, in an underdeveloped industrial area of the 12th arrondissment, close to Gare de Lyon. A simple, non-descript municipal building, it still serves as the city’s morgue for the unknown and unclaimed dead, as well as the main hub for medico-legal investigations under the management of the Prefecture of Police to this day.

The influence of the Paris morgue was not only limited to the city it existed within; as well as being responsible for the framework of the current medico-legal system, the Paris morgue became the international model for modern urban death management in the nineteenth century. Institutions based on Paris were established across the world in cities including Berlin, Bucharest, Buenos Aires, Lisbon, Melbourne and New York, and the legacy of these morgues continues to influence contemporary processes in medicine, policing, and death management into the present day.

Catriona Byers

Bibliography

• Further reading

Cage, E. Claire, *The Science of Proof: Forensic Medicine in Modem* France (Cambridge: Cambridge University Press, 2022).

Mitchell, Allan, "The Paris Morgue as a social institution in the nineteenth century", *Francia* 4 (1976): 581-596.

Schwartz, Vanessa R., *Spectacular Realities: Early Mass Culture in Fin-de-Siècle Paris* (Berkley: University of California Press, 1998).

• Studies

Bertherat, Bruno, « VISITER LES MORTS. La Morgue (Paris, xixe siècle) », *Hypothèses* 19 (2016): 377-390

Bertherat, Bruno. "La mort en vitrine à la morgue à Paris au XIXe siècle (1804-1907)", in Bertrand, Régis, et al. *Les narrations de la mort (*Aix-en-Provence: Presses universitaires de Provence, 2005): 181-196

Byers, Catriona, "Death as an institution: managing the unclaimed dead at the morgues of Paris and New York, c.1864-1914", *PhD Dissertation* (King's College London, 2025)

Brown-May, Adam, Cooke, Simon, "Death, Decency and the Dead-House: The City Morgue in Colonial Melbourne", *Provenance: The Journal of Public Record Office Victoria* 3 (2004).

Buda, Octavian, Caepa, Irinela-Nina and Kozma, Andrei "Bertillonage and criminal anthropology in Bucharest, 1893" *Romanian Journal of Legal Medicine* 26 (2018): 209-211.

Higonnet, Patrice, Higonnet, Anne and Higonnet Margaret, 'Façades: Walter Benjamin's Paris', *Critical Inquiry* 10, no.3 (1984): 391-419.

Strauss, Johnathan, *Human remains: medicine, death, and desire in nineteenth-century Paris,* (New York: Fordham University Press, 2012).

Vita, Paul, “Returning the look: Victorian writers and the Paris Morgue”, *Nineteenth-Century Contexts* 25 no.3 (2003): 241-255.

Weiner, Dora B., Sauter, Michael J., “The City of Paris and the Rise of Clinical Medicine”, *Osiris* 18 (2003):23-42

• Primary Sources

Devergie, Alphonse, « La Morgue de Paris : sa description, son service, son système hygiénique – de l’autopsie judicaire, comparée à l’autopsie pathologique » *Annales d’hygiène publique et de médecine légale* 2, no. 49 (1878)

Guillot, Adolphe, *Paris qui souffre: la basse geôle du Grand châtelet et les morgues modernes* (Paris: Roquette, 1888).

Hunter, James B., (ed.), “Lectures at the Paris Morgue”, *New York Medical Journal* XXVII (New York: Miller & Matthews, 1878).

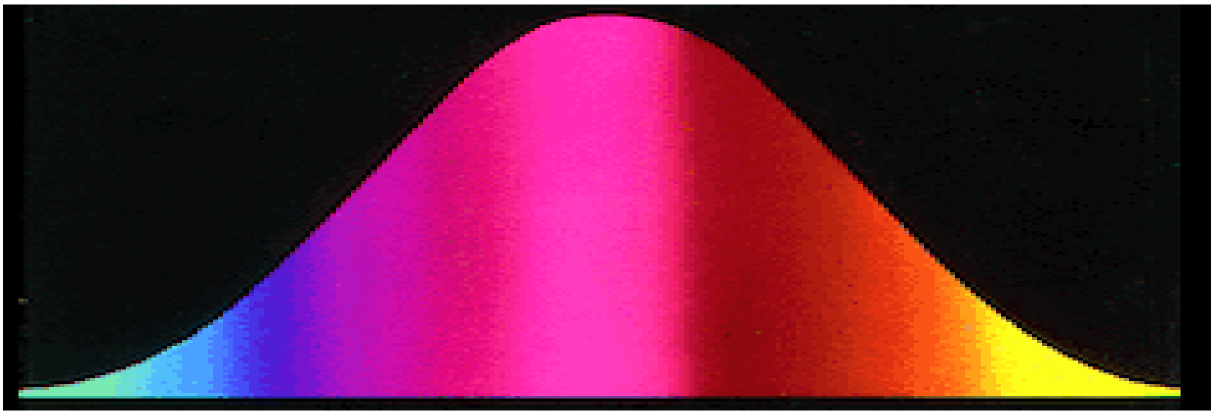
Maillard, Firmin, *Recherches historiques et critiques sur la morgue*, (Paris : Adolphe Delahays, 1860),

Pernet, George, "Remarks on the Teaching of Medical Jurisprudence in Paris and London." Transactions of the Medico-Legal Society 4 (1906-1907): 113-124.

• Internet

Delaney, Anthony; Pelling, Madeline (hosts), Byers, Catriona (guest). “Episode 45: The Paris morgue’s dark story” [Audio Podcast Episode] *History Hit: After Dark.* February 29, 2024. [https://shows.acast.com/after-dark-history-of-myths-misdeeds-the-paramormal-1/episodes/the-paris-morgue]

Human Intelligence



- Psychology, human difference, and the controversial history of intelligence science -

Intelligence has been understood in very different ways by different cultures over the course of human history. Our modern understanding of intelligence only really began to emerge during the Enlightenment. A period which celebrated human reason and its power to overcome superstition and fanaticism naturally prompted interest in what such reason consisted of, who possessed it, and what role it should play in the organisation of society. This interest was also driven by ideas about human difference and inequality. Economic and social change, colonial expansion, and the emergence of evolutionary theory encouraged the view that differences in mental ability explained the inequalities between white Europeans and other races, between rich and poor, and between men and women.

By the 19th century, the way intelligence was understood had begun to look familiar to the ways we understand it today. The term itself was increasingly being used to refer to high mental ability, rather than the various other meanings it had carried in past. It was becoming more closely associated with reason and rationality, losing its link to ideas about virtue and character, as well as its entanglement with notions of religion and the divine. And it was understood as something that certain individuals and groups possessed more than others. At around the same time, the first modern psychologists began to study mental abilities and found, in these new ideas about intelligence, a conceptual toolkit and a convenient label to build their work around. They set about turning intelligence into a science.

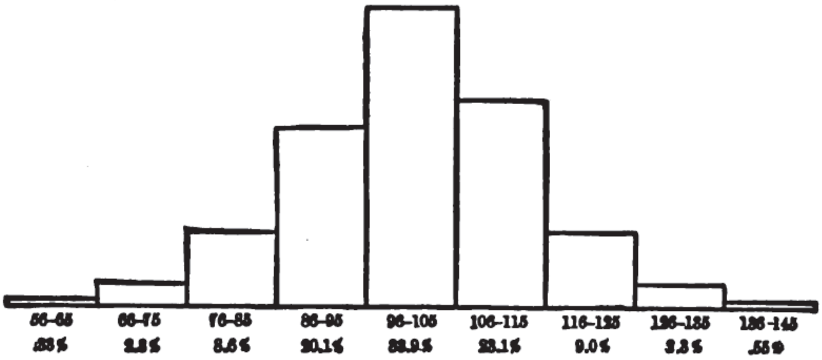


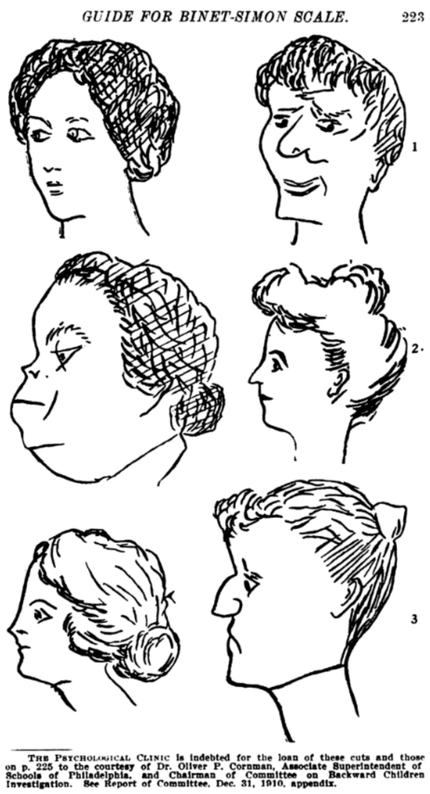
Fig. 2. DISTRIBUTION OF I Q'S OF 905 UNSELECTED CHILDREN, 5–14 YEARS OF AGE

Score distribution chart from sample of 905 children tested on the 1916 Stanford-Binet test.

Source: Lewis Terman, *The Measurement of Intelligence* (1916),

One of the first people to try to scientifically study human intelligence was Francis Galton, the scientific polymath and father of eugenics. Galton was particularly interested in the scientific measurement of people, and their mental and physical abilities. His major contribution to the scientific study of intelligence came in 1869 with the publication of his book, *Hereditary Genius.* The book promised to uncover the secrets of genius through statistical analysis of 1000 eminent British men (no women, because of 'decorum', apparently) from 300 families, including the leading statemen, military commanders, judges, writers and scientists of recent history. According to Galton, his study proved decisively that the mental abilities on which the eminence of these men rested was inherited; that they were a product of nature rather than nurture.

The French psychologist, Alfred Binet, took this process further by introducing the technologies of intelligence testing. As France sought to introduce universal elementary education, its government called for new ways to identify "abnormal" children who needed to be separated into special schools or classes. In response, Binet and his collaborator, Théodore Simon, developed a new test in 1905 entitled "New methods for the diagnosis of the intellectual level of the abnormal". One of the most influential innovations Binet and Simon introduced was the idea that there were age-specific mental level against which individual children could be measured.



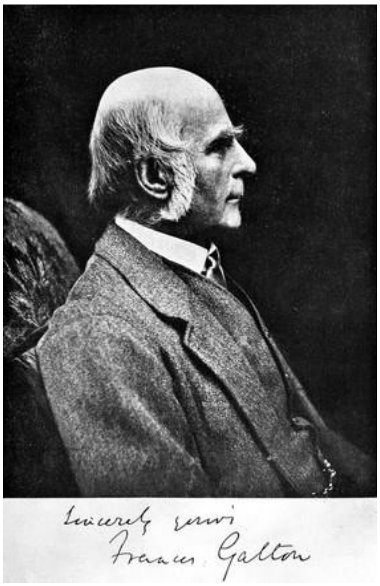
Which of these two faces is prettier? A question from the 1908 Binet-Simon test.
Source: J. E. Wallace Wallin, 'A Practical Guide for Administering the Binet-Simon Scale for Measuring Intelligence', *The Psychological Clinic*, 5:1 (1911),

Binet's tests turbocharged research on intelligence and testing among psychologists in Europe and the United States. Where Binet had been content to average out the scores from different tests to identify vaguely-defined "mental levels", the British psychologist Charles Spearman argued in 1904 that underlying all of these different measures of intelligence was a real existing thing called "general intelligence", or *g*. In California, another psychologist named Lewis Terman translated and revised Binet's tests, publishing the *Stanford Revision of the Binet-Simon Scale* in 1916. Inspired by a proposal from the German psychologist Willian Stern a few years earlier, Terman replaced Binet's language of mental levels with the new concept of "intelligence quotient", or IQ - calculated as the ratio of mental age (as determined by the tests) to chronological age, times one hundred. For the first time in history, it was now possible to give someone a test which would produce a single number offering a definitive assessment of their intelligence

Terman's tests proved wildly popular. Just a year after their publication, the United States entered the First World War. Terman was appointed to a panel of psychologists designing a new set of intelligence tests to be given to new army recruits. Nearly two million American servicemen sat these tests before the end of the war, with results helping to dictate who would be sent for officer training.

The Army tests and their results received huge media attention, not least because they were interpreted as showing that immigration was undermining the intelligence levels of US society. They seemed to offer an official endorsement for the new, and until then largely untested, technology of intelligence testing. At the end of the war there was a huge demand for these tests from teachers and school administrators. Pirated copies of Terman's test quickly sprang up across the country. By 1925 his tests were selling one and a half million copies a year. Terman was inundated with requests to approve translations and revision from countries across the globe, including Peru, Mexico, Poland, China and India. The intelligence testing industry had been born, and was quickly becoming a global phenomenon. Intelligence testing had come to be seen as a tool that could be used to engineer society.

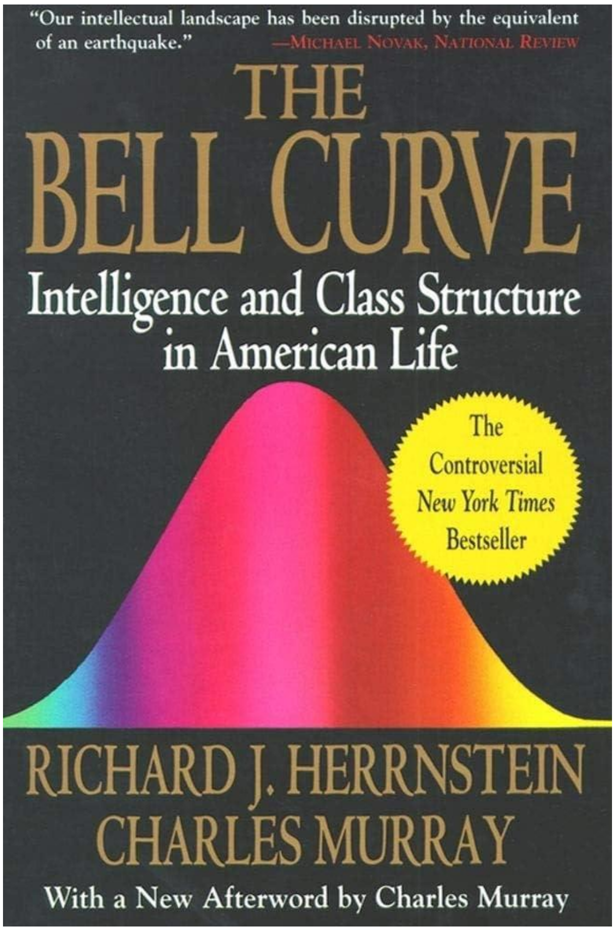
Alfred Binet. Source: Wikipedia,



Francis Galton.
Source: The Wellcome Collection:

These tests quickly became entangled in controversies over intelligence and race. Terman and other intelligence scientists were interested, not just in intelligence differences between individuals, but in differences between racial groups. They showed little interest in criticisms about their sampling methods or the obvious cultural loading of the questions in their tests. When Terman was collecting children with IQ scores of over 140 for his gifted children study, he noted that children with English, Scottish and Jewish parentage were overrepresented, and that there were low proportions of Mexicans, Italians and Blacks, offering this as proof of different native levels of intelligence between different races. Like so many of those involved in the birth of intelligence science, he was also an enthusiastic eugenicist and active participant in the work of the Eugenics Society.

These arguments about race and intelligence were entangled with the question of genetics and heritability. Since the start of the 20th century, intelligence scientists have debated what proportion of the variation in IQ levels is attributable to hereditary or environmental factors. In the early 20th century, the consensus was that intelligence differences were largely inherited. This changed in the middle of the 20th century, particularly in the 1960s and 1970s, which witnessed a turn towards environmentalist explanations. In the 1980s, James Flynn argued that average IQ scores had increased significantly in most societies over the course of the 20th century. The "Flynn effect", as it is often called, was interpreted by many as evidence that intelligence levels are shaped by things like education, work, nutrition and public health.



The Bell Curve
Soource. [Amazon]

Despite this, the period from the 1970s to the 1990s witnessed a series of public controversies over the nature of intelligence and its heritability, controversies which revolved around the issue of race. Between 1969 and 1972, three high-profile psychologists – Arthur Jensen at Berkeley, Hans Eysenck at the Institute of Psychiatry in London, and Richard Herrnstein in Harvard - all published works arguing that differences in intelligence, including measured differences between people from different racial groups, were substantially inherited. These arguments met a huge amount of resistance, particularly from student groups, and became a central part of the campus culture wars of the era. Two decades later, these controversies were revived by Herrnstein in *The Bell Curve*. Co-written by the conservative political scientist Charles Murray, the book argued that average intelligence levels in the US were declining, that genetic factors played a key role in intelligence differences, and the social inequality between racial groups were partly rooted in unequal intelligence levels.

The controversies surrounding these arguments prompted the search for new ways to study and understand human intelligence. In 1983, for example, the educational psychologist Harold Gardner developed the idea of "multiple intelligences", arguing that there were in fact *seven* distinct human intelligences. Since then, psychologists and social scientists have turned their attention to ideas about emotional intelligence, social or collective intelligence, and other ways of understanding human abilities. These ideas, and the association of IQ with race science, helped to undermine the popular cultures of IQ and intelligence testing which were so pervasive in the mid-20th century. Intelligence testing was even banned in a number of places because of concerns over its racial and other biases.

In recent years, however, there has been a scientific and popular turn back towards emphasising the role of genetics in explaining human differences, including differences in intelligence. This was influenced by the rise of neuroscience from the 1990s, driven by new scientific studies of the brain which inspired popular and political enthusiasm for brain-led explanations of psychological and social phenomena. It also reflected a renewed enthusiasm for genetics, inspired by the success of the Human Genome Project in 2003 and the various technologies to map and manipulate human genes which followed in its wake. Alongside these scientific developments, intelligence science and the language of IQ have remained popular among parts of the transatlantic right, which use them to justify arguments about social hierarchy and economic inequality.

Today, the technologies of intelligence testing continue to be used, often uncritically, in fields such as genetics, health research, neuroscience and even AI. Beyond the laboratory, the ideas that emerged from 20th century intelligence science continue to shape the way we understand human intelligence both as a force for progress and an explanation of inequality.

David Brydan

Further reading

John Carson, *The Measure of Merit: Talents, Intelligence, and Inequality in the French and American Republics, 1750-1940* (Princeton, NJ.: Princeton University Press, 2007)

Elaine E. Castles, *Inventing Intelligence: How America Came to Worship IQ* (Santa Barbara, CA: Praeger, 2012)

James Flynn, *What is Intelligence? Beyond the Flynn Effect* (Cambridge: Cambridge University Press, 2007)

Studies

Michael Collins, 'W.E.B Du Bois's Neurological Modernity: I.Q., Afropessimism, Genre', in The Triangle Collective (eds.), *The Palgrave Handbook of Twentieth and Twenty-First Century Literature and Science* (Palgrave Macmillan, 2020), 559-576.

Paul Davis Chapman, *Schools as Sorters: Lewis M. Terman, Applied Psychology, and the Intelligence Testing Movement, 1890-1930* (New York: New York University Press, 1988)

Saul Dubow, 'Mental Testing and the Understanding of Race in Twentieth-Century South Africa', in Teresa Meade and Mark Walker (eds.), *Science, Medicine and Cultural Imperialism* (London: Macmillan, 1991), 148-177

Erik Linstrum, *Ruling Minds: Psychology in the British Empire* (Cambridge, Mass.: Harvard University Press, 2016

Niclas Lemann, *The Big Test: The Secret History of American Meritocracy* (New York: Farrar, Straus and Giroux, 1999)

Génesis Núñez-Araya and Annette Mülberger, 'Buscando el «Tesoro» de la nación: el niño superdotado en España, 1911-1936', *Dynamis,* 40: 2 (2020). 299-24

Quinn Slobodian, 'The Unequal Mind: How Charles Murray and Neoliberal Think Tanks Revived IQ', *Capitalism*, 4:1 (2023), 73-108

Michael E. Staub, *The Mismeasure of Minds: Debating Race and Intelligence between Brown and The Bell Curve* (Chapel Hill: University of North Caroline Press, 2018), John White, *Intelligence, Destiny, Education: The Ideological Roots of Intelligence Testing* (Abingdon: Routledge, 2006)

Sources

N.J. Block and Gerald Dworkin (eds.), *The IQ Controversy: Critical Readings* (New York: Pantheon Books, 1976)

Francis Galton, *Hereditary Genius: An Inquiry into its Laws and Consequences* (London: Macmillan and Co, 1869)

R.J. Herrnstein, *I.Q. in the Meritocracy* (London: Allen Lane, 1973)

Richard J. Herrnstein and Charles Murray, *The Bell Curve: Intelligence and Class Structure in American Life* (New York: The Free Press, 1994)

Charles Spearman, '"General Intelligence," Objectively Determined and Measured', *The American Journal of Psychology*, 15:2 (1904), 201-92

Internet

'Intelligence testing, race and eugenics, *Wellcome Collection,* *https://wellcomecollection.org/stories/intelligence-testing--race-and-eugenics*

'Searching for genius', Wellcome Collection, https://wellcomecollection.org/series/searching-for-genius

'In Our Time: Intelligence', BBC, https://www.bbc.co.uk/sounds/play/p0054513