

Invisible Contributors

Gender, Race, and Minorities in the History of European Science

The Matilda effect, and what it looks like alongside it: religious and ethnic exclusion, colonial appropriation of knowledge, the criminalisation of sexuality, and disability — five axes of the same underlying question about how credit gets distributed.

Turning the question of credit around

Every earlier chapter told a story of credit: who discovered what, whose name a law or effect now carries. This chapter asks how credit itself gets distributed — and how often it is distributed unevenly, along lines of gender, religion, ethnicity, race, sexuality, and disability, quite apart from the quality of the work done. The claim is not that European science was built outside its recognised centres; it is that the tradition also depended, at every period, on contributors whose work was minimised, misattributed, or suppressed because of who they were.

1

Naming the pattern

Merton's 1968 “Matthew effect” and Rossiter's 1993 “Matilda effect” — how credit concentrates, and how gender skews it further.

2

Five case studies

Herschel, Lovelace, Marić, Franklin, Bell Burnell — examined on the evidence, not the legend.

3

Beyond gender

Religious and ethnic quotas, colonial extraction of knowledge, criminalised sexuality, and disability — four more axes of the same question.

4

The limits of recovery

Why the archive itself is biased, and why over-correction is a real risk, not just the original erasure's opposite.

What follows traces five axes of exclusion, §6.1 through §6.7, then asks why full recovery is so often impossible.

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Naming a Pattern: the Matthew Effect and the Matilda Effect

How credit concentrates around the already-eminent — and how gender adds a further, distinct bias on top.

Merton, 1968 — Rossiter, 1993

- 1 **Robert K. Merton, 1968 (Science)** names the “Matthew effect”: eminent, already-recognised scientists receive disproportionate credit for work done jointly with less well-known collaborators — junior colleagues, students, technicians — whose own contribution is correspondingly obscured. Named after the Gospel line: “For unto every one that hath shall be given... but from him that hath not shall be taken away even that which he hath.”
- 2 **Margaret W. Rossiter, 1993 (Social Studies of Science)** shows the same mechanism operates with particular and additional force along the axis of sex, and proposes a companion name: the “Matilda effect” — after Matilda Joslyn Gage (1826–1898), the American suffragist whose 1883 essay “Woman as Inventor” had already argued, a century earlier, that women's technical contributions were systematically credited to the men around them.

Not simply the Matthew effect falling by coincidence on women more often — a distinct and additional bias, operating on top of it.

Not usually a matter of individual dishonesty

Historiographical note

The mechanism typically works through diffuse channels rather than deliberate fraud: a woman's institutional position (unpaid “assistant” rather than salaried researcher) that formally entitled a male relative or supervisor to sole authorship; contemporaries' and later historians' unreflective assumption that the more famous name in a working pair must have done the more important thinking; and, simply, the far narrower range of institutional positions — university posts, academy memberships, journal editorships — through which formal credit was historically assigned to women at all.

Recognising the pattern does not require assuming every underrepresented figure was the unappreciated genius behind a more famous name. It requires examining each case on its own evidence — exactly what the case studies that follow try to do.

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Case Studies in the Matilda Effect

Five careers, examined on the documented evidence — including where the popular version overreaches it.

The first woman paid for scientific work in Britain



Caroline Herschel (1750–1848), 1829 portrait.

- **Four decades at the telescope** the indispensable collaborator of her brother William Herschel: ground and polished mirrors, recorded and reduced his observations, and, increasingly, observed independently.
- **Eight comets, 1786–1797** discovered in her own right; compiled a corrected index to Flamsteed's British star catalogue, published by the Royal Society in 1798.
- **£50 a year, from 1787** King George III's salary for her astronomical assistance — the first payment made to a woman in Britain specifically for scientific work.
- **Gold Medal, 1828** the Royal Astronomical Society's highest honour — its first woman recipient. The next woman would not receive it again until Vera Rubin, in 1996: a 168-year gap.

“Note G,” 1843 — and a genuinely contested claim

Working with Charles Babbage on his unbuilt Analytical Engine, Lovelace published in 1843 a set of notes longer than the paper they annotated. Her “Note G” includes an algorithm for computing Bernoulli numbers on the Engine, and articulates a conceptual leap beyond Babbage's own framing: that such a machine could manipulate any symbols following defined rules, not only numbers.

Historiographical note — “the first computer programmer”?

Lovelace's status as “the first programmer” is genuinely contested, not settled. The Babbage scholar Doron Swade and others argue Babbage's own unpublished working notes already contain comparable algorithms, and that Lovelace's most distinctive, durable contribution was conceptual — general symbolic manipulation — rather than the specific algorithm.

What is not contested: Note G is the most detailed, clearly reasoned published account of how the Engine might be used; it appeared under her own name when women rarely published original mathematical work at all; and it anticipated, by a century, the distinction between calculation and general-purpose computation.

The most contested claim in this chapter

Marić (1875–1948) was one of the small number of women admitted, in the late 1890s, to the physics section of the Swiss Federal Polytechnic in Zurich, where she was Einstein's classmate and, from 1903 to 1919, his first wife. A body of popular writing, since the 1970s, claims she was an uncredited co-author of Einstein's 1905 papers, including special relativity.

Historiographical note

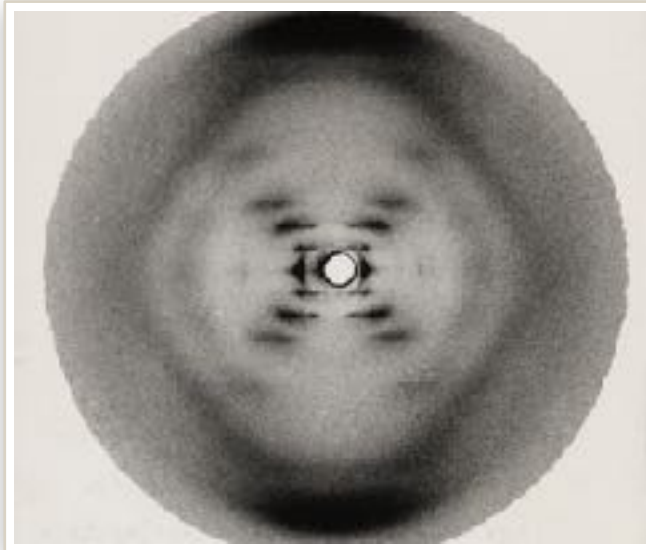
The mainstream historical consensus — based on surviving correspondence, examination records, and contemporaries' testimony — does not support the co-authorship claim; specialists in Einstein's early work regard it as unsubstantiated. This course states that plainly: the corrective to one kind of erasure is not a second, equally unevidenced, story.

What the documented record does show, without inflation: Marić was one of very few women in Europe studying physics at this level in the 1890s; she failed her final examinations twice (the second time while pregnant), in a programme offering essentially no institutional accommodation for a woman in her position; and she did not pursue an independent research career thereafter. A different, better-evidenced, and ultimately more instructive story than the co-authorship claim.

Photo 51, and the Nobel that came after her death



Rosalind Franklin (1920–1958).



"Photo 51," Franklin's May 1952 X-ray image of DNA.

- **May 1952** Franklin's X-ray diffraction image gave the clearest evidence then available that DNA had a helical structure.
- **Jan 1953** Maurice Wilkins showed the image to James Watson without Franklin's knowledge; Watson and Crick used it, with her unpublished data, to complete their model, published in *Nature* alongside papers by Franklin and Wilkins.
- **1962 Nobel Prize** went to Watson, Crick, and Wilkins. Franklin had died in 1958; the Nobel is never awarded posthumously — she was ineligible regardless.
- **The record corrected** Watson's 1968 memoir portrayed her dismissively; Anne Sayre (1975) and Brenda Maddox (2002) reconstructed a far more accurate account of her independent standing.

The 1974 Nobel that went to her supervisor



Jocelyn Bell Burnell (b. 1943).

1

1967, as a PhD student at Cambridge helped build a large radio telescope and identified an unusual, precisely repeating radio signal in its data — the first observed pulsar, a rapidly rotating neutron star.

2

1974 Nobel Prize in Physics awarded to her supervisor Antony Hewish and to Martin Ryle for this discovery. Bell Burnell was not included — controversial at the time (Fred Hoyle publicly criticised it within days), though she herself has consistently declined to call it an injustice, noting PhD students were not customarily named on such awards.

3

2018 Breakthrough Prize, \$3 million awarded for the 1967 discovery. She donated the entire sum to the UK Institute of Physics, to fund PhD studentships for women, under-represented ethnic minorities, and refugees entering physics.

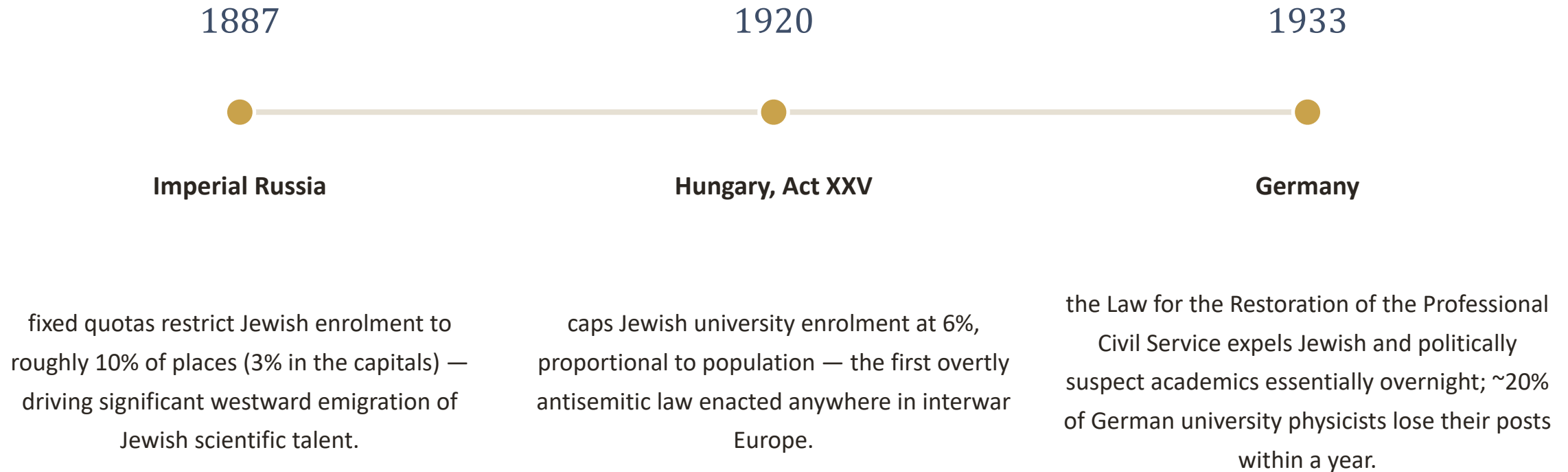
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Religious and Ethnic Exclusion in European Science

Formal, statutory exclusion recurred across the century before the Second World War — not only under the Nazi regime.

6.3 · A NUMERUS CLAUSUS, THREE TIMES OVER

Russia 1887 → Hungary 1920 → Germany 1933



A parallel movement, “Deutsche Physik,” denounced relativity and quantum theory as expressions of an allegedly alien “Jewish physics” (cf. Ch.5, §5.4). Meitner’s 1938 escape is recounted in Appendix E; Born, Franck, and Schrödinger (in protest, though not himself Jewish) all left within a few years of the 1933 law.

Statute versus custom

Historiographical note

It is worth being precise about chronology, because these three episodes are often run together. The Russian and Hungarian quotas were explicit, statutory *numerus clausus* laws restricting admission by fixed percentage, enacted well before the Nazi period. Earlier exclusion of Jewish scholars elsewhere in nineteenth-century Europe — for instance the informal social and professional barriers that kept most German universities from appointing Jewish full professors before the 1860s–80s — operated through custom, university statute, and professional gatekeeping rather than national law, and so is a different, if related, phenomenon from either the 1920 Hungarian or 1933 German legislation.

The pattern across all three, however, is the same one this chapter is tracing: formal institutional mechanisms, not merely private prejudice, determined who could enter and remain in European scientific life.

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Iberian Expulsions and the Fate of al-Andalus Science

1492 and 1609–1614: two state-mandated expulsions that dismantled a distinctive scientific culture.

6.4 • AL-ANDALUS, AND ITS EXPULSIONS

A religiously mixed scientific culture, then two removals



The Alhambra, Granada — fell January 1492, weeks before the expulsion decree.

- **Al-Andalus (from 711)** hosted one of medieval Europe's most productive scientific cultures, sustained by Muslim, Jewish, and Christian scholars — Averroes (1126–98) and Maimonides (1138–1204) both worked within, and were eventually displaced from, this milieu.
- **Alhambra Decree, March 1492** expelled all Jews from Castile and Aragon who would not convert; 40,000–100,000 people left.
- **Morisco expulsion, 1609–1614** removed an estimated 300,000 nominally-converted Muslims and their descendants — a substantial share of the population in Valencia and Aragon.

A claim more contested than it is often presented as being

Historiographical note

That the expulsions caused enormous suffering and permanently ended a distinctive scientific culture is not in dispute. Whether they are the principal explanation for Spain's relative scientific decline over the following two centuries — a claim made repeatedly in general histories — is more contested among specialists.

Historians of early modern Spain point to other, contemporaneous factors of comparable weight: the Inquisition's tightening censorship of books and foreign study from the mid-sixteenth century, the economic strain of near-continuous imperial warfare, and the Counter-Reformation church's growing caution toward the new experimental philosophy elsewhere in Europe. The defensible claim: the expulsions removed communities structurally important to al-Andalus's earlier science, compounding — rather than single-handedly causing — Spain's altered trajectory thereafter.

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Colonial Science and Unattributed Knowledge: Quinine

Two centuries of Andean Indigenous pharmacological knowledge, and the European chemistry credited instead.

Whose knowledge, whose credit?



Cinchona officinalis, source of quinine — Köhler's *Medizinal-Pflanzen*, 1887–98.

- **Quechua and Andean peoples** understood the antimalarial value of cinchona bark well before European contact — knowledge transmitted to Spanish colonists and Jesuit missionaries in early-17th-century Peru.
- **“Jesuit's bark”** exported to Europe as the most effective treatment then available for malarial fevers — the finished commodity, not the knowledge behind it, is what travelled and was credited.
- **1820: quinine isolated** French chemists Pierre-Joseph Pelletier and Joseph-Bienaimé Caventou isolate the specific alkaloid, letting physicians dose the drug precisely — correctly credited as a landmark of early natural-products chemistry.

The asymmetry: two centuries of prior Indigenous Andean knowledge — without which the raw material and rationale would not have existed — left almost no trace of attribution in the European record.

A popular story the evidence does not support

Historiographical note

A popular legend holds that the bark reached Europe after it cured the Countess of Chinchón, a Spanish viceroy's wife, of a fever in 1638 — the story behind Linnaeus's genus name, *Cinchona*. A detailed 1941 study by A. W. Haggis, examining the Countess's own surviving diary and travel dates, found the story does not hold up: the timeline is inconsistent with the legend, and no contemporary source closer to the events supports it.

The better-evidenced history is the one this chapter follows instead: Andean Indigenous communities possessed and used the relevant medical knowledge first, and transmitted it to European colonisers, who exported the finished commodity while the knowledge itself went essentially uncredited.

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Sexual and Gender Minorities: Alan Turing

The ordinary operation of a law that criminalised an unknown but substantial number of European scientists.

Bletchley Park, prosecution, and a contested death



Alan Turing (1912–1954).

- **1936** supplies the theoretical foundation of modern computing — the abstract “Turing machine” — while still in his twenties.
- **WWII, Bletchley Park** leads the team whose codebreaking against Enigma is widely credited with shortening the war substantially and saving many lives.
- **1952** convicted of gross indecency after disclosing a relationship with another man to police investigating a burglary; offered imprisonment or probation conditional on hormonal treatment — chemical castration — and accepts the latter.
- **7 June 1954** dies of cyanide poisoning; an inquest returns a verdict of suicide.

Copeland's dissent, and forty years to redress

Historiographical note — the suicide verdict

The suicide verdict, though standard, has been disputed. Historian Jack Copeland (Turing: Pioneer of the Information Age, 2012) argues the original inquest was hasty and did not fully weigh an alternative: Turing kept a home laboratory including cyanide, used in electroplating, and accidental inhalation cannot be ruled out on the available evidence. This course states both accounts, because the evidence does not permit full certainty either way.

1952

Prosecuted and convicted

2009

PM Gordon Brown's public apology

2013

Posthumous royal pardon

2017

“Turing Law” pardons others convicted

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Disability and Scientific Achievement: Saunderson and Beyond

The Lucasian chair, occupied blind in 1711 — and again, differently disabled, from 1979.

Two disabilities, one chair, two and a half centuries apart

1

Nicholas Saunderson (1682–1739) blind from smallpox at about one year old, appointed Lucasian Professor of Mathematics — Newton's own former chair — in 1711. Lectured for nearly three decades on Newtonian mechanics and optics; developed a tactile calculating board (“palpable arithmetic”) letting him and blind students compute by touch.

2

Stephen Hawking (1942–2018) diagnosed with ALS in 1963, held the same Lucasian Professorship from 1979 to 2009. The difference between the two careers lies less in attitudes toward disability — which changed only unevenly — than in institutional and technological accommodation: motorised wheelchairs, care support, and computer speech synthesis gave Hawking means of continued research with no equivalent available to Saunderson.

Historiographical note

Saunderson's case is often framed purely as an inspirational anomaly. More useful: his blindness required specific instructional technology — the tactile board — that did not previously exist, a documented instance of disability driving methodological innovation, not merely an obstacle overcome despite the surrounding institutions.

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Why Recovery Is Hard: Sources, Silence, and Historiography

The archive itself is biased — and the corrective effort carries its own, opposite risk.

Under-recovery, and over-correction

The cases in this chapter did not become visible by accident. Rossiter's own multi-volume history and Londa Schiebinger's *The Mind Has No Sex?* (1989) deliberately went looking for exactly this kind of case in archives not organised to preserve it. That project has real limits.

Under-recovery

A scientist never given a laboratory, a publication venue, or an official position generally left behind fewer of the documents historians rely on. The cases historians CAN document — Herschel, Franklin, Bell Burnell — are the better-documented, and so the less severely excluded, examples of a much larger, less recoverable pattern.

Over-correction

Once a pattern of erasure is established and publicised, claims that fit it can spread well beyond what the evidence supports — as with the Mileva Marić case, §6.2 — producing a new distortion in the act of correcting an older one.

Crediting what the evidence shows, flagging clearly what it does not, and resisting both the erasure and its overcorrected inverse — simply the ordinary standard of historical evidence, applied to cases that too often escaped it.

Five axes, none of them closed questions

This chapter examined five axes — gender, religion and ethnicity, race and colonial extraction, sexuality, and disability — along which European science's own record of credit has been demonstrably uneven, from the seventeenth century to the twenty-first.

None of these axes operated in isolation:

the institutional mechanisms this chapter describes — from admissions quotas to criminal prosecution to unattributed extraction of Indigenous knowledge — changed form across the periods this course has covered without ever fully disappearing. Assessing how far they have genuinely receded in the present is a live question for the historiography of science, not one this course can answer on its behalf.

FURTHER READING

- Margaret W. Rossiter, "The Matthew Matilda Effect in Science," *Social Studies of Science* 23:2 (1993)
- Margaret W. Rossiter, *Women Scientists in America: Struggles and Strategies to 1940* (1982)
- Londa Schiebinger, *The Mind Has No Sex? Women in the Origins of Modern Science* (1989)
- Patricia Fara, *A Lab of One's Own: Science and Suffrage in the First World War* (2018)
- Anne Sayre, *Rosalind Franklin and DNA* (1975)
- Brenda Maddox, *Rosalind Franklin: The Dark Lady of DNA* (2002)
- Andrew Hodges, *Alan Turing: The Enigma* (1983; 2012)
- B. Jack Copeland, *Turing: Pioneer of the Information Age* (2012)
- Henry Kamen, *The Disinherited: Exile and the Making of Spanish Culture, 1492–1975* (2007)
- Saul Jarcho, *Quinine's Predecessor: Francesco Torti and the Early History of Cinchona* (1993)

Chapter 6

Questions?

From Caroline Herschel's £50 salary to Jocelyn Bell Burnell's donated prize money: the record of who gets credit in science is itself a historical object, worth studying as carefully as the science it records.