

Indira Gandhi Delhi Technical University for Women

Department of Applied Sciences & Humanities

Research Methodology

Session One — from the Calcutta Madrasah of 1781 to the paper you
have not written yet

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Kashmere Gate campus, Delhi



Three questions

01

Where did the Indian university come from?

1542 to 1994 — every rule you study under was written by somebody, for a reason.

02

Whose ground are you sitting on?

A Mughal prince's library, a British Resident's house, and four institutions that grew up here.

03

Why should you care about research?

Because almost everything in your bag started as a paper nobody thought was useful.

By the end of the hour you should be able to say what research is, and why this course exists.



PART I

How the Indian university came to be

1542 — 1994

The engineering college at Roorkee, 1847 — the oldest in Asia

THE FIRST COLLEGE

Two European imports arrive together

1542

- The Jesuits founded Saint Paul's College at Goa.
- It brought India the European college system — fixed curriculum, fixed terms, degrees.
- It also brought the printing of books. India's first press was set up here in 1556.
- For the first time, knowledge could be copied faster than it could be memorised.



Saint Paul's College, Old Goa

1781 — 1824

The Company builds colleges — to run a territory



1781

Calcutta Madrasah

Warren Hastings, first Governor General of Bengal. The first institute of learning set up by the British.



1791

Sanskrit College, Varanasi

Jonathan Duncan, later Governor of Bombay 1795–1811.



1800

Fort William College, Kolkata

Lord Wellesley. Trained Company servants in Indian languages and law.



1824

Sanskrit College, Calcutta

Commemorated on its 175th anniversary stamp.

Notice what they were for: administering a territory. Not producing new knowledge.

1857

Three universities that taught nobody

- Calcutta, Bombay and Madras, all in 1857, on the model of the University of London.
- They did not teach. They set the syllabus, held the examination, and awarded the degree.
- Colleges taught; the university certified. That split still shapes affiliating universities today.
- Delhi got its own university much later, in 1922.



Buildings of the 1857 presidency universities

1882

The Hunter Education Commission

After Class X, education splits into three streams:

Science

Commerce

Arts

Sir William Wilson Hunter's commission also pushed for state support of primary education and for private colleges to be aided by grants — the grant-in-aid habit that still funds much of Indian higher education.



Sir William Wilson Hunter

The stream you chose in Class XI was designed in 1882.

BY 1901

The whole of higher education in British India

5

universities

145

colleges

18,000

students

Today that same system carries more than four crore students. Everything in between — the commissions, the regulators, this campus — is the story of how 18,000 became 4,00,00,000.

Two commissions you still live under



Rayleigh Commission, 1902

- Government funds university posts — fellows and faculty.
- In return, government gains a say in what universities may teach.

Public money and academic autonomy have been negotiating with each other ever since.



Sadler Commission, 1917–19

- School to end at Class X, not the university's business.
- Two years of intermediate college, then university at Class XII.

This is where 10 + 2 comes from. It also recommended honours courses, women's education and applied science.

1916 — 1921

Seven new universities in six years



Mysore



Patna



Benaras



Aligarh



Dacca



Lucknow



Osmania

Teaching universities this time — residential, with their own departments. Several were founded by Indians, not by the Company: Benaras and Aligarh among them.

Engineering arrives, a century before the IITs

1847

Engineering College, Roorkee

1856

Calcutta College of Engineering

1858

Overseers' School, Poona

1951

First IIT, Kharagpur



Roorkee at 150 years; and the first IIT

Roorkee was built to train engineers for the Ganges Canal — engineering education in India begins with a public works problem.

1958 — 1994

The machinery you will publish inside

1958

UGC

Funds and standards for
universities

1961

First IIM

Management education
begins

1985

IGNOU

Open and distance learning
at scale

1987

AICTE

Technical education
regulation

1994

NAAC

Accreditation and quality
assessment

Your thesis format, your credit structure, your journal's standing — all of it is decided somewhere in this row.

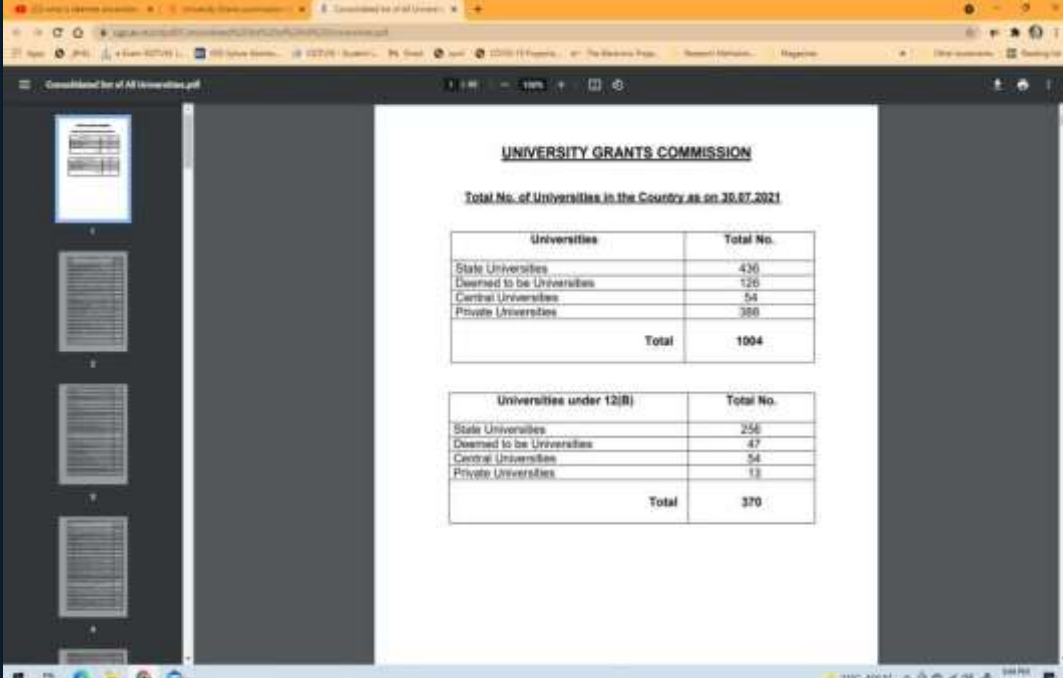
THE RESULT

Five universities became a thousand

1,004

universities in India as on 30.07.2021 (UGC)

- 436 state universities
- 388 private universities
- 126 deemed to be universities
- 54 central universities



UNIVERSITY GRANTS COMMISSION

Total No. of Universities in the Country as on 30.07.2021

Universities	Total No.
State Universities	436
Deemed to be Universities	126
Central Universities	54
Private Universities	388
Total	1004

Universities under 12(B)	Total No.
State Universities	256
Deemed to be Universities	47
Central Universities	54
Private Universities	13
Total	370

UGC consolidated list of all universities

One of those thousand entries is this university. Number 983 on the list — we will come to it.



PART II

This campus

Kashmere Gate, Delhi

Kashmere Gate after the siege of 1857

Delhi before the siege

- The walled city of Shahjahanabad, twelve gates, the Yamuna along its eastern wall.
- The northern quarter around Kashmere Gate is where the British lived — the Residency, the church, the college, Ludlow Castle.
- In September 1857 the assault on the city came through Kashmere Gate itself.
- Everything in this half of the lecture happened within about a kilometre of this room.



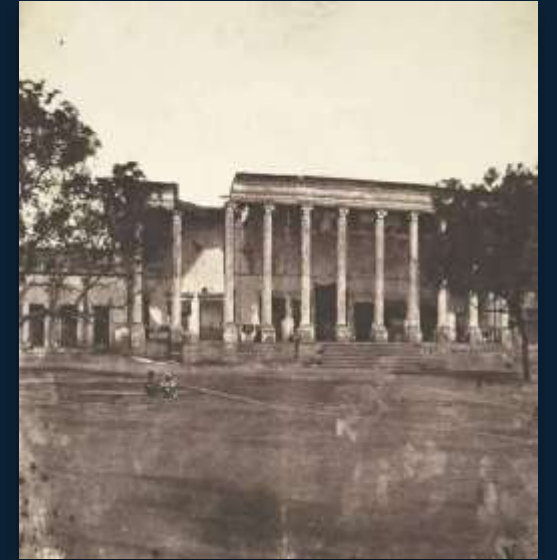
The City of Delhi Before the Siege - The Illustrated London News Jan 16, 1858



The Illustrated London News, 16 January 1858; and the Plan of Delhi, 1857-58

Dara Shikoh's library

- Shah Jahan's eldest son and heir apparent, defeated and executed by Aurangzeb in 1659.
- A scholar-prince: he had the Upanishads translated into Persian, and that translation is how European readers first met Indian philosophy.
- His library stood at Kashmere Gate — a building that is still here.
- Delhi's oldest surviving library building became, in turn, a Residency, a school, and a university department.



Dara Shikoh; his library in the 1850s; and the same building, remodelled, in a 1920s survey

1758 — 1825

Sir David Ochterlony, first British Resident at Delhi



Miniature, East India Company service

- Born in Massachusetts; came to India as a cadet in 1777, aged eighteen.
- Wounded and taken prisoner in the Second Anglo-Mysore War in 1782; released in 1784. Captain in 1796, Major in 1800.
- Appointed Resident at Delhi — responsible for the protection of the Emperor and the safety of the city.
- Defended Delhi in 1804 against Jaswant Rao Holkar, and was given the Mughal title Nasir-ud-Daula, Defender of the State.
- Commanded one of four columns in the Gurkha war of 1815 and ratified the Treaty of Sugauli, which settled the border with Nepal.

The Resident who went native

- He converted Dara Shikoh's library into his residence and adopted the Indo-Persian manners of the Mughal court.
- Thirteen Indian companions — concubines as the British recorded them, wives as others did. Begum Mubarak was the first.
- Every evening, the story goes, all thirteen rode around the walls of the Red Fort, each on her own elephant.
- Delhi nicknamed him Loony Akhtar — the crazy star.
- The Begum built the mosque at Lal Kuan still known as Mubarak Begum ki Masjid; she took the rebels' side in 1857.
- Rebuked by Lord Amherst over Bharatpur in 1825, he resigned, retired to Delhi, and died at Meerut that July.



Ochterlony in Indian dress, smoking a hookah, c. 1820s



THE SAME FEW HUNDRED METRES

Kashmere Gate, 1858 to now



St James' Church, built 1836 by James Skinner



The commercial street, about 1950



The Ritz cinema



Old Delhi railway station, 1947



Kashmere Gate today

Four institutions were born on this campus

1941

The Department of Architecture of Delhi Polytechnic becomes, in time, the School of Planning and Architecture.

1950s

Delhi Polytechnic is upgraded to Delhi College of Engineering, which stays here until 1998.

1961

IIT Delhi opens as the College of Engineering & Technology — its first classes run in this DCE campus.

1984

NSIT works out of the building now occupied by Ambedkar University, until 1998.

1998

Mahila Institute of Technology, later Indira Gandhi Institute of Technology, takes over the campus.

2013

IGIT becomes Indira Gandhi Delhi Technical University for Women.



Four institutions grew up here and moved out. You are studying inside their incubator.

2013 AND AFTER

Entry number 983 on that UGC list



2013 — the university's first year

- Indira Gandhi Delhi Technical University for Women, Kashmere Gate — notified as a state university in 2013.
- Ranked 64th for Innovative University in the WURI Impact rankings of 2021.
- A campus that has been a library, a residency, a polytechnic and four institutions is now a women's technical university.
- What it becomes next is written in the papers that come out of it — including yours.

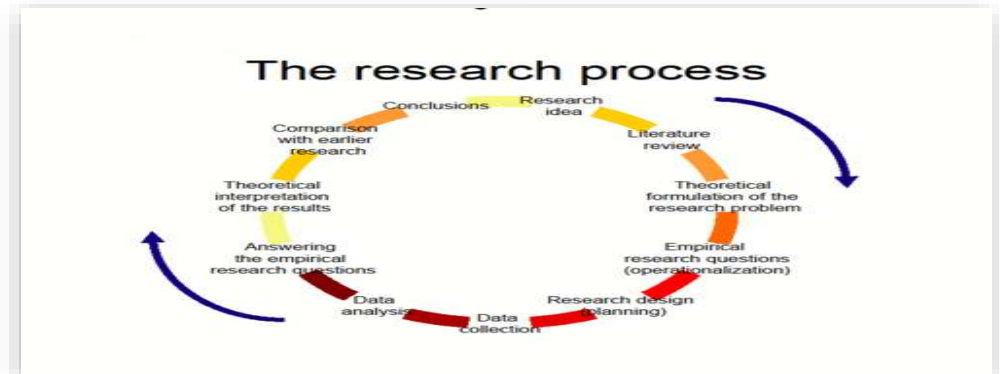


Which brings us to the question this course exists to answer.

PART III

Why research matters

What it is, who judges it, and what it has paid for



THE DISTINCTION TO START WITH

Textbooks tell us what is known.

Journals tell us what was discovered yesterday.

- A textbook is a settlement — the part of the field everyone has stopped arguing about.
- A journal is the argument itself, still in progress, with dates on it.
- Your B.Tech has been textbook work. This course moves you to the other side.
- By the end of it you should be able to read a current paper in your field and say what is new in it.



Physical Review Letters and IEEE Spectrum — the current argument, monthly

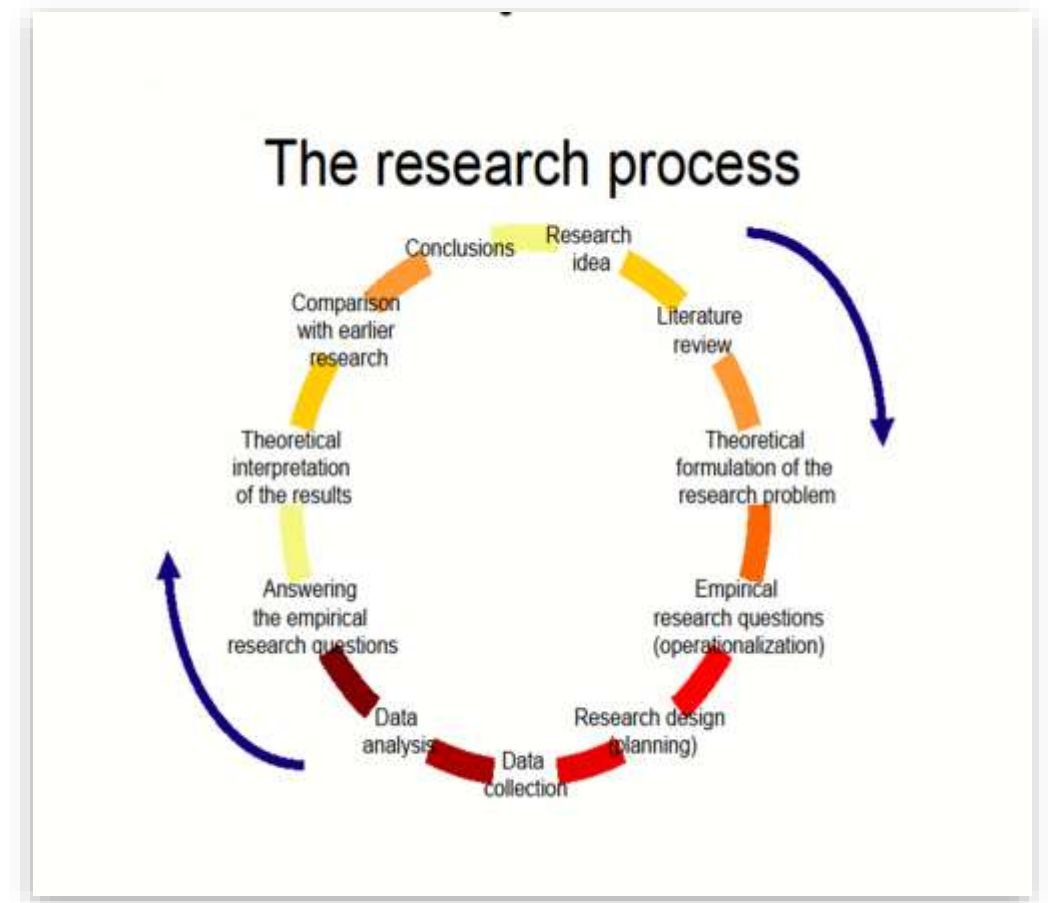
The first journal — Philosophical Transactions, founded 1665 — is still publishing.

Nothing in your textbook was ever anything but a journal paper first.

What research actually is

The systematic pursuit of new knowledge and solutions that expand human understanding and improve society.

- Systematic — the method is decided before the result, and written down.
- New — a search that has already been answered is study, not research.
- Checked by others — a claim nobody can test is an opinion.
- Reported — work that is never written up did not happen, as far as the field is concerned.



The loop you will spend this semester inside

Four centuries of deciding who to believe

1600–1850

Trust the gentleman scientist

Scientists communicated by letter. Papers were accepted largely on the author's reputation.

1850–1950

Editorial judgement

Journal editors became gatekeepers, consulting experts informally when they chose to.

1950–2000

Peer review

Publications exploded after the war. Anonymous referees became the standard.

2000s–now

AI-assisted review

Screening, plagiarism and integrity checks, reviewer matching — and new questions about who is accountable.

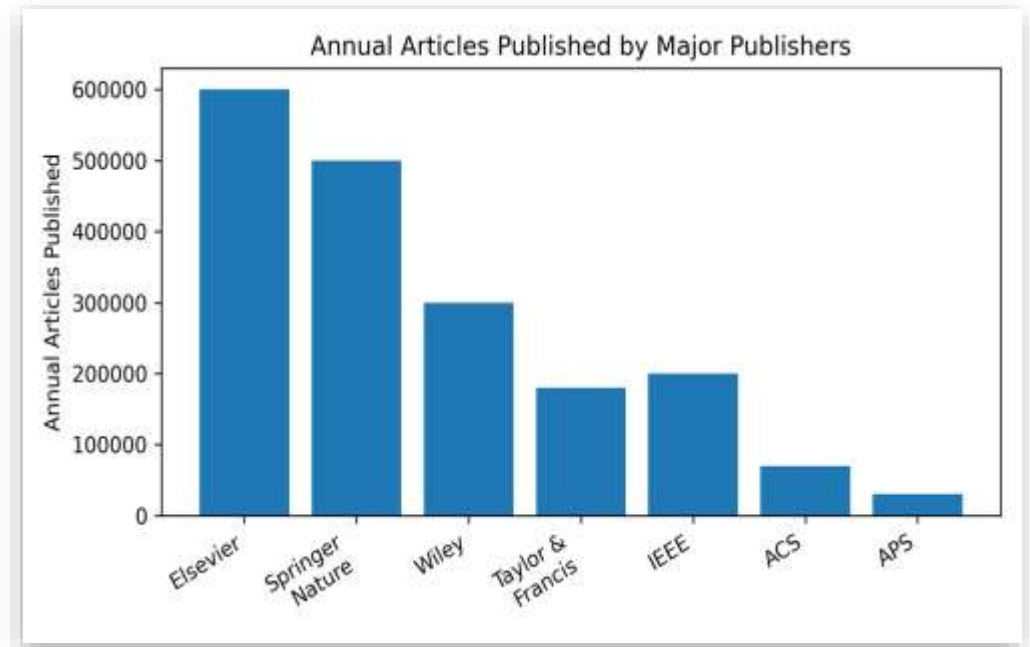
Every one of these systems was invented to answer the same question: whose claim do we let stand?

The metrics, and what each one really measures

Year	Metric	What it measures
1963	Impact factor	Journal prestige
2005	h-index	Researcher impact
2006	g-index	Weight of highly cited papers
2010	Altmetrics	Attention outside the academy

Your competitors are also your reviewers.

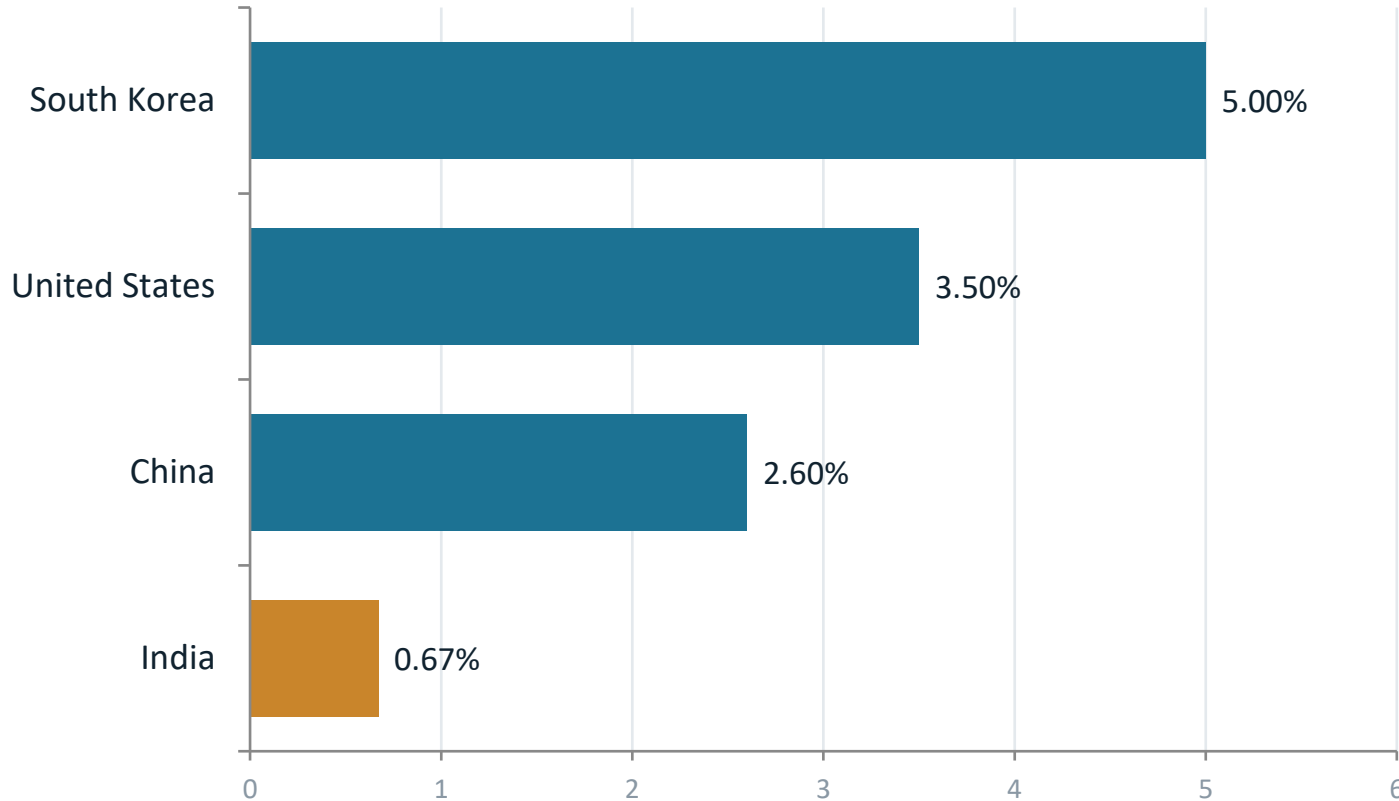
Which is the strongest argument there is for writing carefully, citing honestly, and never overclaiming.



Annual articles published, by major publisher — the volume every metric is trying to sort

WHAT IT COSTS

Research spending as a share of GDP



Can India become a developed nation while investing one-seventh of what Korea invests?

- The gap is not talent. It is sustained funding and the number of people trained to use it.
- That second part is a teaching problem — which is what this course is.

Governments do research before they spend

Census

- Population
- Education
- Migration

Economic surveys

- Employment
- Inflation
- Income

Agricultural surveys

- Crop yield
- Rainfall
- Water availability

Health surveys

- Vaccination rates
- Disease spread
- Nutrition

Without data, policy becomes guesswork.

ONE LABORATORY

Bell Labs changed the modern world

The transistor

The solar cell

The CCD camera sensor

Information theory

UNIX

The C language



What the transistor replaced: the vacuum tube

- None of these was ordered by a customer. They came out of people being paid to understand something.
- The CCD was sketched in an afternoon in 1969; it is the reason your phone has a camera.

Six industries from one building, because someone funded curiosity for thirty years.

The camera in your pocket



About 1910

Glass plates and bellows. Chemistry, not electronics.



About 1975

35 mm film, still chemistry — but with a light meter and a computed exposure.

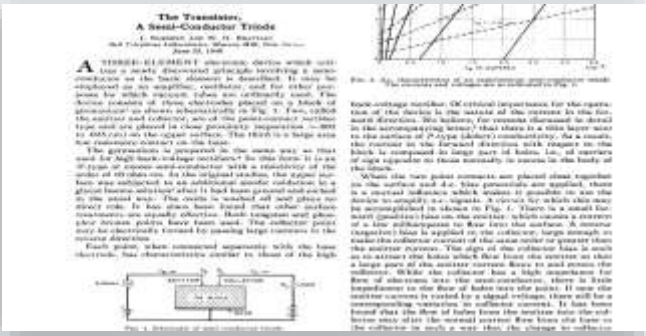


Today

A silicon sensor descended from the Bell Labs CCD, and image processing that is entirely research output.

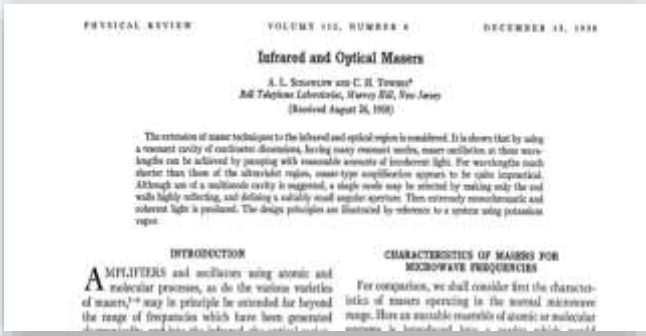
Every jump here was a published result before it was a product.

What the original authors were actually doing



The transistor, 1948

Bardeen and Brattain were studying how electrons behave at a semiconductor surface. Result: every computer you have ever used.



The laser, 1958

Schawlow and Townes asked whether the maser idea could be pushed to optical wavelengths. Result: fibre optics, barcode scanners, laser surgery, CD/DVD, LIDAR.

6% ➤ 27%

efficiency, 1954 to today

The solar cell, 1954

Chapin, Fuller and Pearson at Bell Labs were investigating semiconductor materials. Result: the first practical silicon solar cell, and an entire energy industry.

Not one of these papers promised a product in its abstract.

Fundamental research usually looks useless at first

Looked impractical

- Quantum mechanics
- Relativity
- Semiconductors
- Lasers



Today they run

- GPS
- Computers
- The internet
- MRI
- Fibre optics

The gap between the two columns is usually twenty to fifty years. Nobody funding the left column could see the right one.

MRI



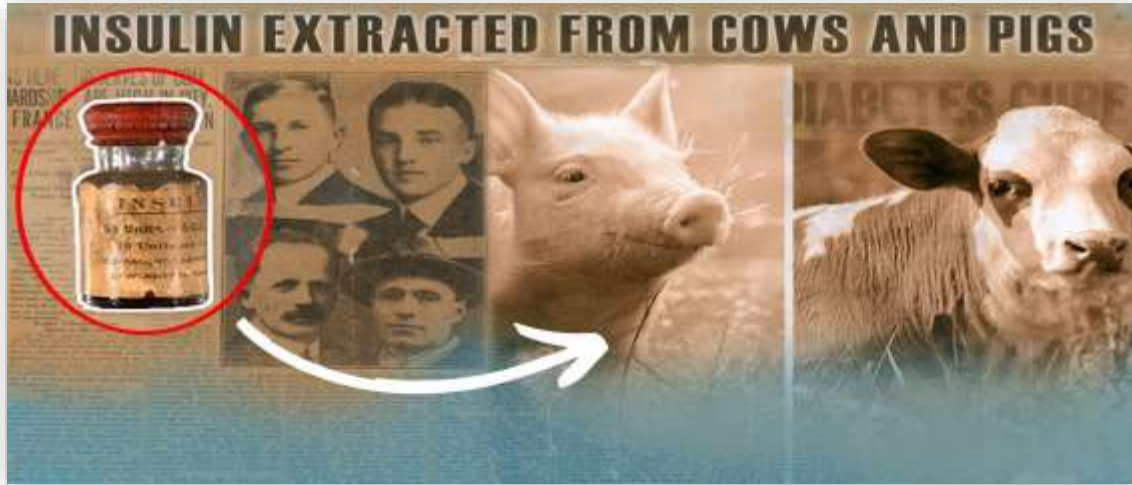
The Mark One scanner, Aberdeen Royal Infirmary — first full-body scan, 1980



A clinical scanner today

- Nuclear magnetic resonance was a physics curiosity of the 1940s — a way to measure nuclear spin.
- Nobody in that work was trying to see inside a patient. Forty years later it became the safest look inside a living body that medicine has.

Insulin



Before recombinant insulin: extraction from the pancreases of pigs and cattle

Construction of Biologically Functional Bacterial Plasmids *In Vitro*

Stanley N. Cohen, Annie C. Y. Chang, Herbert W. Boyer, and Robert B. Helling [Authors Info & Affiliations](#)

November 15, 1973 | 70 (11) 3240-3244 | <https://doi.org/10.1073/pnas.70.11.3240>

Cohen and Boyer, 1973 — construction of biologically functional bacterial plasmids

Roughly one lifetime from a slaughterhouse by-product to a designed molecule.

Then

A single patient's yearly supply took the pancreases of 50 to 100 pigs.

The paper

In 1973 Cohen and Boyer showed that a gene could be spliced into a plasmid and carried by bacteria.

The consequence

Put the human insulin gene into bacteria and the bacteria become insulin factories. Human insulin, in unlimited supply, from a fermenter.

Next

Protein design is now being done computationally — the molecule before the organism.

HAPPENING NOW

CRISPR — find and replace, for DNA



Science, 2012 — a programmable dual-RNA-guided DNA endonuclease

Timeline of discoveries		
Year	Discovery	Impact
1953	DNA double helix	Understanding heredity
1970	Restriction enzymes discovered	Molecular scissors
1973	Cohen-Boyer recombinant DNA paper	Birth of genetic engineering
1978	Human insulin produced in bacteria	Proof of concept
1982	Humulin approved	First biotech medicine
2012	CRISPR-Cas9 paper	Easy genome editing
2023	First CRISPR therapy approved	Beginning of genome medicine

- It began as a question about how bacteria defend themselves against viruses. Nothing medical about it.
- What it gave: precise editing of DNA at a chosen location.
- Already in the clinic for sickle-cell disease; in trials for other genetic disorders and certain cancers.
- Ahead: choosing a treatment from a patient's own genome rather than from an average.
- This is the shortest lab-to-clinic gap on any slide today — about ten years.

Two hundred and forty-five years

1781

A syllabus is written for Indians, by an administration, to run an administration.

1857

Degrees are awarded by examination, from London's template.

1951

India starts building institutions to make its own engineers.

2013

This campus becomes a university for women in technology.

Now

What gets studied here is decided by the people studying here — in papers, by people like you.

SO WHAT WILL WE ACTUALLY DO

Five things, in this order

1

Ask

Turn an interest into a question that can be answered and has not been.

2

Read

Find the literature, read it critically, and place your question inside it.

3

Design

Choose a method that can actually settle the question — and say why.

4

Analyse

Handle data honestly. Know what your numbers can and cannot support.

5

Report

Write it, cite it, submit it. Authorship, plagiarism and research ethics.

Replace this slide with your unit-wise syllabus if you would rather open with that.

BEFORE NEXT CLASS

One paper. That is all.

- Find one research paper published in the last twelve months, in any area you find interesting.
- Read it — not carefully, just all the way through.
- Come ready to say three things: what it claims, how the authors tested it, and one thing you did not understand.
- The third one is the most useful. Bring it.

Everything in this building was once somebody's unanswered question.

