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EDITORIAL ANALYSIS

The Chemist Who Refused to Stay in the Lab: Prafulla Chandra Ray and Swadeshi Science

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HISTORY & CULTURE

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GS1

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INTERVIEW ANGLE

"Ray argued that a nation which only publishes research but manufactures nothing has not achieved scientific independence. India today files patents and publishes prolifically while importing most of its bulk drug intermediates. Would Ray consider that progress?"

Source: [Original editorial](#)

Mint

 Every fact web-verified against primary sources

THE LIFT LINE

Ray could have been a distinguished research chemist and left it there. He decided that a country which could describe a compound but not manufacture it had not become scientifically free, only scientifically literate. So he started a factory with seven hundred rupees.

WHY THIS EDITORIAL MATTERS FOR YOUR EXAM

This is a GS1 history and culture item that doubles as a GS3 argument about industrial capability, which makes it unusually efficient to prepare. Personalities of the [Swadeshi](#) era appear regularly in Prelims, and Ray is a reliable candidate because he sits at the intersection of the national movement, the history of Indian science and the origins of Indian industry. The essay potential is considerable: the relationship between knowledge and production is a genuinely examinable theme.

UPSC RELEVANCE

The Mint article by Sundeep Khanna is behind a paywall beyond its opening. The thesis attributed to it here rests on the published lead and summary, which state Ray's central claim: that scientific freedom means more than producing knowledge, and that he built Bengal Chemical to prove Indians could manufacture what science made possible. The biographical detail below is drawn from independently verifiable sources rather than from the article.

BACKGROUND AND CONTEXT

Prafulla Chandra Ray was born on 2 August 1861 at Raruli-Katipara in what was then Jessore district of undivided Bengal, in present-day Bangladesh. He studied in Calcutta and at **Presidency College**, and in **1882** won a **Gilchrist Prize Scholarship** to the **University of Edinburgh**, where he took his **BSc in 1885** and his **DSc in 1887**. He returned to India in 1888 and joined **Presidency College** as an assistant professor of chemistry in **1889**.

The India he returned to had a particular economic shape, and Ray's career is unintelligible without it. Under the colonial settlement, India supplied **raw materials** to British industry and absorbed **finished manufactures** in return. The critique of this arrangement was already well developed: **Dadabhai Naoroji's** drain of wealth thesis, set out in *Poverty and Un-British Rule in India*, and **R. C. Dutt's** *Economic History of India* had documented the deindustrialisation of Indian handicrafts and the transfer of surplus. What the critique lacked was a demonstration that the alternative was practicable.

Ray supplied one. In **1892**, with a capital of about **seven hundred rupees**, he established the **Bengal Chemical Works**. On **12 April 1901** it was incorporated as the **Bengal Chemical and Pharmaceutical Works Limited**. The enterprise preceded the **Swadeshi movement** that followed the **partition of Bengal in 1905**, and then became one of its most cited examples, alongside ventures such as the **Bengal National College**, the **Swadeshi Steam Navigation Company** of V. O. Chidambaram Pillai, and, in a different register, **Jamsetji Tata's** industrial projects.

THE ANALYSIS

The distinctive claim, and the one that makes Ray worth an editorial in 2026, is that scientific independence is a manufacturing question. It is possible for a colonised society to produce competent researchers, publish in European journals and win recognition, while remaining entirely dependent on imported goods. Ray's judgement was that such a society has acquired scientific *literacy* rather than scientific *freedom*, because the capacity that matters is the capacity to convert knowledge into things.

His research record establishes that this was a choice rather than a consolation. His DSc at Edinburgh examined conjugated sulphates of the copper-magnesium group. In **1896 he discovered mercurous nitrite**, a compound previously thought not to exist in stable form, and the finding brought international attention along with a body of subsequent work by his students on nitrites and related compounds. He was not a failed researcher who turned to business.

His second intervention was historical, and it is often underrated. *A History of Hindu Chemistry*, whose first volume appeared in **1902** and second in **1909**, assembled Sanskrit and other sources to argue that Indian enquiry into materials, metallurgy and medicine constituted a documented tradition with its own methods and results. The political function of the book is inseparable from its scholarship. A central colonial proposition was that science was a European gift to a society without a scientific past. Ray's answer was archival rather than rhetorical.

The third intervention was institutional, and it may be the most consequential of all. Ray taught at Presidency College and, from **1916**, held the **Palit Professorship of Chemistry at the University College of Science** of Calcutta University, the institution commonly known as Rajabazar Science College. Among those who passed through his orbit were **Meghnad Saha**, whose thermal ionisation equation transformed astrophysics, and **Satyendra Nath Bose**, whose work with Einstein gave us Bose-Einstein statistics, along with chemists including **Jnanendra Chandra Ghosh**, **Nil Ratan Dhar** and **Jnanendra Nath Mukherjee**. In **1924** he founded the **Indian Chemical Society**.

This matters analytically. A scientific tradition is not a sequence of individuals; it is a **school**, with a journal, a society, a laboratory and a succession. Ray built all four. The reason Indian physics and chemistry produced world-class work in the 1920s, in a colony with negligible research funding, is substantially that people like Ray had built the institutions in the preceding thirty years.

The fourth dimension is ethical, and it is what earned him the title Acharya. Ray lived austere, directed much of his income to education and relief, and was closely associated with flood and famine relief work in Bengal. His autobiography, *Life and Experiences of a Bengali Chemist*, is a primary source that repays reading, and his insistence that the educated Bengali youth should enter industry and trade rather than queue for government clerkships was a direct challenge to the social prestige ordering of his time.

The uncomfortable question the editorial's framing invites is whether Ray's model succeeded. Bengal Chemical survived, and survives today as a Government of India public sector undertaking under the Ministry of Chemicals and Fertilizers. But the broader ambition, that Indian science would be organised around Indian manufacturing, was not realised in his lifetime, and arguably has still not been. That gap is what makes the piece contemporary rather than commemorative.

DATA AND INSTITUTIONS VAULT

Biography:

- Born **2 August 1861**, Raruli-Katipara, Jessore district, undivided Bengal (now in Bangladesh)
- Died **16 June 1944**, Calcutta
- Educated at **Presidency College**, Calcutta; **Gilchrist Prize Scholarship, 1882**
- **University of Edinburgh: BSc 1885, DSc 1887**
- Joined **Presidency College** as assistant professor of chemistry, **1889**
- **Palit Professor of Chemistry**, University College of Science, Calcutta University, from **1916**
- Honours: **Companion of the Order of the Indian Empire (CIE), 1912; Knight Bachelor, 1919**
- Known as **Acharya**; commonly described as the father of Indian chemistry and a pioneer of the Indian pharmaceutical industry

Scientific and scholarly work:

- **1896:** discovery of **mercurous nitrite**
- **1902 and 1909:** *A History of Hindu Chemistry*, volumes I and II
- **1924:** founded the **Indian Chemical Society**
- Autobiography: *Life and Experiences of a Bengali Chemist*

The enterprise:

- **1892: Bengal Chemical Works** founded with a capital of about **seven hundred rupees**
- **12 April 1901:** incorporated as **Bengal Chemical and Pharmaceutical Works Limited**
- Today **Bengal Chemicals and Pharmaceuticals Limited (BCPL)**, a public sector undertaking under the **Ministry of Chemicals and Fertilizers**

Students and associates:

- **Meghnad Saha:** the Saha ionisation equation
- **Satyendra Nath Bose:** Bose-Einstein statistics; the boson is named for him
- **Jnanendra Chandra Ghosh, Nil Ratan Dhar, Jnanendra Nath Mukherjee**

The Swadeshi and economic nationalism context:

- **Partition of Bengal, 1905;** the **Swadeshi movement** and the **boycott** campaign
- **Dadabhai Naoroji:** the **drain of wealth** thesis, *Poverty and Un-British Rule in India*
- **R. C. Dutt:** *The Economic History of India*
- **Mahadev Govind Ranade:** early advocate of Indian industrialisation
- Contemporary Swadeshi enterprises: **Swadeshi Steam Navigation Company** (V. O. Chidambaram Pillai), **Bengal National College**, **Tata Iron and Steel Company (1907)**
- **Indian Association for the Cultivation of Science (IACS)**, founded **1876** by **Mahendra Lal Sircar**, where **C. V. Raman** later worked

Related science institutions of the period, useful for Prelims:

- **IACS, Calcutta, 1876**
- **Indian Institute of Science, Bangalore, 1909**, endowed by **Jamsetji Tata**
- **Bose Institute, Calcutta, 1917**, founded by **Jagadish Chandra Bose**
- **Indian Chemical Society, 1924**
- **Council of Scientific and Industrial Research (CSIR), 1942**, with **Shanti Swarup Bhatnagar** as first Director

THE DEBATE

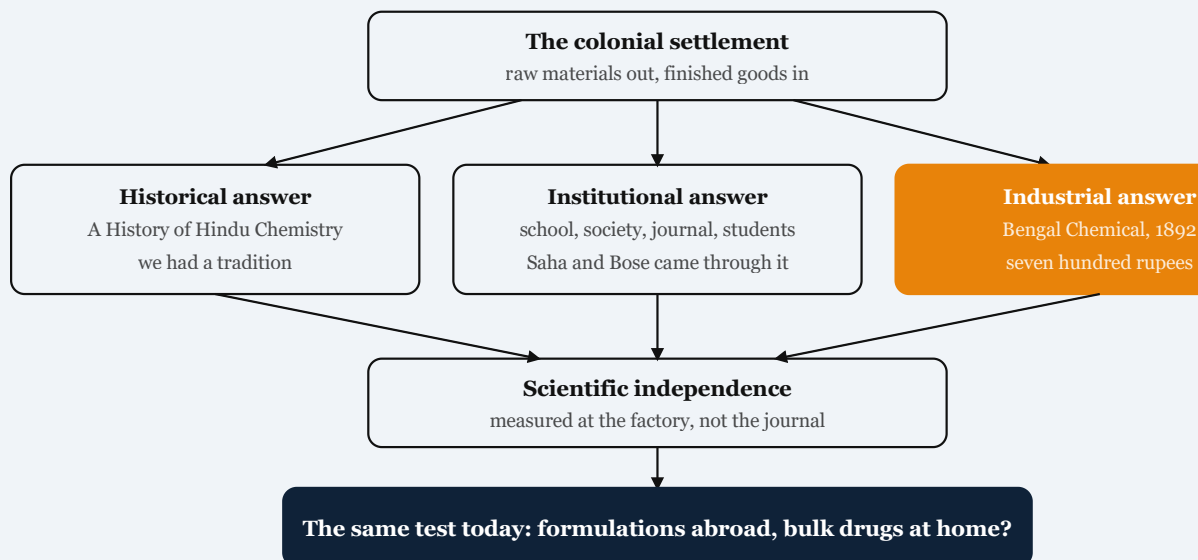
The strongest case for Ray's model is that in a colonial economy there was no alternative. There was no Indian industrial finance system, no research council, no state procurement directed at Indian firms and no technical education infrastructure worth the name. If a scientist did not build the company, the laboratory, the society and the journal himself, nobody else was going to. Under those conditions the scientist-industrialist was not an eccentricity but a necessity, and Ray's insistence that educated Indians enter industry rather than the clerical services was a serious attempt to change an entire social preference.

The case for qualification is that the model does not transfer. In a developed innovation system the productive arrangement is a **division of labour**: universities generate fundamental knowledge, translational institutions and incubators bridge to application, venture and industrial finance fund scale-up, and firms manufacture. Expecting the same individual to occupy all four roles is inefficient where the intermediate institutions exist. Ray's example is therefore best read as a diagnosis of a **missing institutional layer**, not as a prescription that every scientist should found a factory.

The sharper contemporary question, and the one the editorial's framing points to, is whether India has closed the gap Ray identified. The honest answer is partly. India is among the world's largest producers of pharmaceutical formulations by volume and a major supplier of generic medicines globally. But a substantial share of the **bulk drugs, active pharmaceutical ingredients and key starting materials** those formulations require has been imported, with a heavy concentration of supply in a single country, a dependence that became visible during the pandemic-era supply disruptions and that the **Production Linked Incentive scheme for bulk drugs** and the bulk drug parks programme were designed to address.

That is Ray's argument in modern dress. A country that formulates but does not synthesise occupies a position structurally analogous to one that publishes but does not manufacture. **The capability that confers independence is the one furthest upstream.**

DIAGRAM-IN-WORDS



Ray attacked the colonial settlement on three fronts at once, and treated manufacturing as the decisive one because it is the capability a dependent economy is structurally denied. The modern version of his test is not whether India publishes or formulates, but whether it synthesises the upstream inputs those depend on.

HOW TO THINK ABOUT THIS

The transferable frame is the distinction between **knowledge capability** and **production capability**, and the recognition that only the second confers independence.

A country can rank highly on research publications, patents filed and doctorates awarded, and remain unable to make the things its economy needs. The two capabilities are related but not the same, and the bridge between them, sometimes called the **translation gap** or in policy language the **valley of death** between laboratory and market, has to be built deliberately. It consists of pilot plants, process engineering, standards and testing infrastructure, patient capital and procurement that will buy a first-of-kind domestic product.

Test the frame across contemporary policy. **Semiconductors**: India has world-class chip *design* talent and, until the Semicon India programme, almost no *fabrication*. **Pharmaceuticals**: large-scale formulation with substantial import dependence in active pharmaceutical ingredients. **Defence**: strong design and development records at DRDO alongside persistent production and integration bottlenecks. **Solar energy**: the world's most ambitious deployment targets with module and cell manufacturing built only recently. In each case the diagnosis is Ray's, restated.

A second and subtler frame concerns **the role of history-writing in a national movement**. *A History of Hindu Chemistry* is a scientific monograph and a political act at once. Colonial ideology held that the colonised had no scientific past and therefore no independent scientific future. Establishing a documented tradition attacked the premise directly. The same move recurs across the period: **R. C. Dutt** on economic history, **Romesh Chunder Dutt** and later **R. K. Mukherjee** on ancient polity, **Jadunath Sarkar** and the Deccan school on medieval history. Recovering a past is part of claiming a future, which is a theme worth having available for an essay.

Third, for GS4 and for interviews, note the **ethic of the scientist-citizen**. Ray held that expertise carries an obligation to the society that produced it, and he acted on it in famine and flood relief, in funding students, and in urging young graduates towards enterprise rather than secure clerkship. The question of what a scientist owes beyond the laboratory is live, and Ray is one of the clearest Indian answers to it.

WAY FORWARD

Read Ray as a diagnosis of missing institutions, not as a call for heroic individuals. The policy lesson is to build the layer between laboratory and factory, which today means pilot facilities, common testing infrastructure, process chemistry capability and procurement willing to buy a first domestic product.

Close the upstream dependence in pharmaceuticals. The bulk drug and key-starting-material gap beneath India's formulations industry is the direct modern analogue of the problem Ray identified, and the bulk drug parks and Production Linked Incentive programmes are the instruments currently deployed against it.

Fund the unglamorous middle of the innovation chain. Discovery attracts prestige and deployment attracts subsidy; scale-up, process engineering and certification attract neither, and that is exactly where Indian projects have historically stalled.

Preserve and use the historical record. Ray's autobiography and *A History of Hindu Chemistry* are primary sources in the history of Indian science, and the discipline deserves a place in curricula rather than being confined to anniversary commemoration.

Restore the social prestige of building things. Ray's campaign to turn educated youth towards enterprise rather than salaried security is an argument about status as much as about economics, and status is not costless to change.

PYQ LINKAGE AND PRACTICE

Connects to standing UPSC themes on the **Swadeshi movement and economic nationalism, the drain of wealth and deindustrialisation, personalities of the freedom struggle, and the development of science and technology in colonial India**, and pairs with GS3 questions on **indigenisation** and self-reliance.

Practice question: *“The Swadeshi movement was as much a scientific and industrial project as a political one. Examine this proposition with reference to the life and work of Prafulla Chandra Ray.”* (250 words)

Sources: *Mint, Indian Chemical Society*

Source: The Chemist Who Refused to Stay in the Lab: Prafulla Chandra Ray and Swadeshi Science — [Ujjyari.com](https://ujjyari.com) |

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• KEY ARGUMENTS AT A GLANCE

Writing in Mint, Sundeep Khanna revisits Prafulla Chandra Ray to argue that his quarrel with colonial rule went beyond politics: Ray held that scientific freedom meant more than producing knowledge, that a subject nation had to be able to manufacture what its science made possible, and he founded Bengal Chemical in 1892 with seven hundred rupees to demonstrate that Indians could.



SUPPORTING

- Ray's scientific credentials were not in question, since he took his BSc and DSc at Edinburgh on a Gilchrist Prize Scholarship, discovered mercurous nitrite in 1896, and published A History of Hindu Chemistry to establish that Indian scientific tradition had a documented lineage of its own.
- His decisive innovation was institutional rather than experimental: converting a laboratory demonstration into a manufacturing company, Bengal Chemical Works in 1892 and Bengal Chemical and Pharmaceutical Works Limited in 1901, at a moment when Indian industrial enterprise was widely held to be impossible.
- The venture was a direct answer to the colonial economic settlement, under which India exported raw materials and imported finished goods, and it therefore belonged to the same intellectual movement as the drain-of-wealth critique and the Swadeshi campaign that followed the partition of Bengal in 1905.
- Ray's teaching lineage at Presidency College and later at the University College of Science was as consequential as his enterprise, since he taught a generation including Meghnad Saha and Satyendra Nath Bose and founded the Indian Chemical Society in 1924, building the institutional base that a scientific tradition requires.



COUNTER

Ray's model of the scientist-industrialist was a response to a specific colonial vacuum in which no Indian capital market, no research council and no state procurement existed, and it does not straightforwardly transfer to a modern economy where the division of labour between university research, translational institutions and firms is generally more productive than expecting the same individual to occupy all three roles.



WAY FORWARD

Read Ray as an argument about the translation gap rather than about individual heroics: India's contemporary equivalent is its dependence on imported bulk drugs and key starting materials despite a large formulations industry, and closing it requires the same insistence Ray made, that scientific capability is measured by what a country can manufacture rather than by what it can publish.


MAINS ANSWER FRAMEWORK
QUESTION

The Swadeshi movement is usually assessed as a political and economic programme. Examine its scientific and industrial dimension with reference to Prafulla Chandra Ray, and evaluate the argument that scientific self-reliance requires manufacturing capability rather than research output alone. (250 words)

INTRODUCTION

Prafulla Chandra Ray occupies an unusual position in the history of Indian science because he refused the separation between discovery and production. Trained at Edinburgh and established as a research chemist, he founded a manufacturing company in 1892 on the argument that a colonised country which could publish but not produce had not achieved scientific independence at all.

BODY

The colonial economic settlement provided the context. India supplied raw materials and consumed manufactured imports, an arrangement documented in the drain-of-wealth analyses of Dadabhai Naoroji and R. C. Dutt, and reinforced by the absence of industrial finance, technical education and state procurement for Indian firms.

Ray's response operated on three levels simultaneously. Intellectually, A History of Hindu Chemistry asserted that Indian scientific enquiry possessed a documented tradition, countering the colonial claim that science was a European transplant.

Institutionally, he taught at Presidency College and later held the Palit Professorship at the University College of Science, and founded the Indian Chemical Society in 1924, creating the professional infrastructure a discipline requires. Industrially, Bengal Chemical Works, begun with seven hundred rupees in 1892 and incorporated as Bengal Chemical and Pharmaceutical Works Limited in 1901, demonstrated that Indian-owned chemical manufacturing was viable.

The venture preceded the Swadeshi movement that followed the partition of Bengal in 1905 and then became one of its exemplars, which is why Ray belongs to economic nationalism as much as to the history of science.

CONCLUSION

Ray's enduring argument is that scientific self-reliance is measured at the factory rather than in the journal. The contemporary resonance is direct: India is among the largest producers of pharmaceutical formulations while importing a substantial share of the bulk drugs and key starting materials they require, which is precisely the translation gap Ray identified in a different form.

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