Homi Jehangir Bhabha

"Father of the Indian Nuclear Industry"

30th October 1909 ~ 24th January 1966

About Me

Sharan Kalwani

- Senior Member of IEEE, ACM
- Member SAE, ASEE and ASEI
- Member - Emeritus, Michigan!/usr/group (mug.org)
- Currently Chair - IEEE Southeastern Michigan Section (since late 2021)
- Chair - IEEE Southeastern Michigan Computer Society Chapter (2024)
- Editor of the Section's Monthly Newsletter ~ *Wavelengths*
- Published author & enjoys teaching, student mentoring
- Advisory Board member – CS Department @ Loyola University-Chicago
- Recipient of the IEEE MGA Achievement Award (2018), R4 Jack Sherman Award (2021), Bob Neff Section Award (2022), R4 Outstanding Service Award (2023)

Outline

- *Early Life*
- *Education*
- *Research Work in Physics*
- *Career*
- *Birth of Atomic Energy in India*
- *Unfortunate Demise*
- *Legacy*
- *Other Glimpses*
- *Further Reading*

Early Life….(1)

- Homi Jehangir Bhabha (HJB) was born into a prominent & wealthy Parsi family, on 30 October 1909
- Father was Jehangir Hormusji Bhabha, a well known Parsi lawyer
- His mother Meherbai (aka Meheren)
- Studied at Bombay's Cathedral School and John Connon School
- Sailed thru Senior Cambridge Examination* (with Honors) at age 15
- Later joined Elphinstone College in Bombay

Early Life….(2)

Early Life….(3)

Homi Bhabha with his mother Meherbai Bhabha, father Jehangir Bhabha and brother Jamshed Bhabha.

Early Life….(4)

Homi Bhabha with his mother Meherbai Bhabha, father Jehangir Bhabha and brother Jamshed Bhabha.

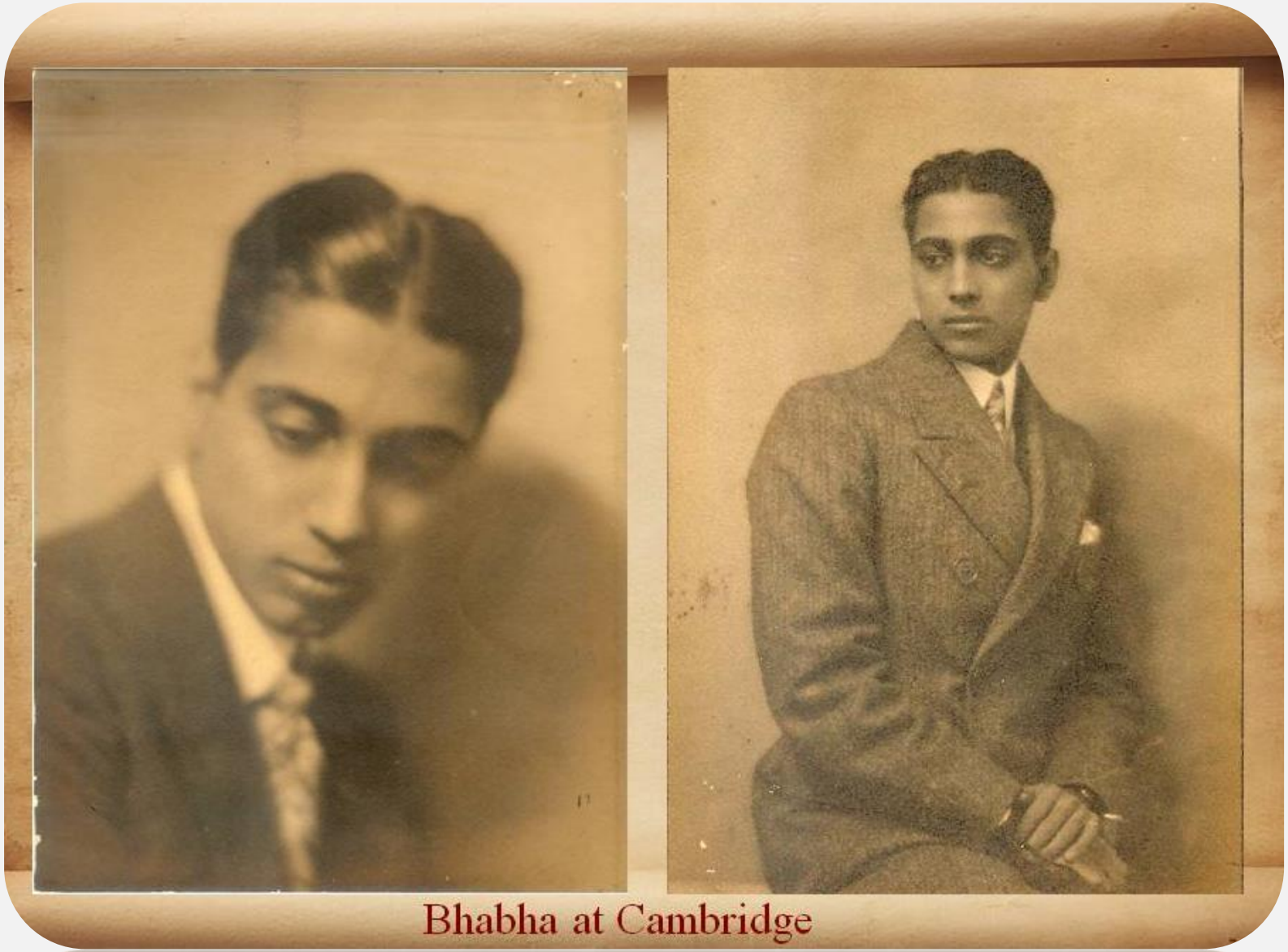
Education….(1)

- For a brief period attended the Royal Institute of Science in 1927
- Then joined Caius College* at Cambridge University
- This was due to the insistence of his father and his uncle Dorabji, who planned for HJB to obtain a degree in mechanical engineering and then…..
- Later return to India, where he was *supposed* to join the Tata Steel Mills in Jamshedpur as a *metallurgist*

Education….(2)

- But HJB, was more keen on mathematics than engineering!
- So after he obtained a 1st class ranking on his Mechanical Science Tripos* in 1930
- He sought and got permission to do his Mathematical Tripos
- Started work with *Paul Dirac*, later *Ralph Fowler*
- Joined Cavendish Lab at Cambridge to work on his doctorate
  - Many luminaries at the time: *James Chadwick* (discovery of the neutron), *John Cockcroft/Ernst Walton* (HE protons), Cloud chambers, etc.
  - Also visited *Wolfgang Pauli* in Zurich, *Enrico Fermi* in Rome, and *Kramers* in Utrecht.

Education….(3)

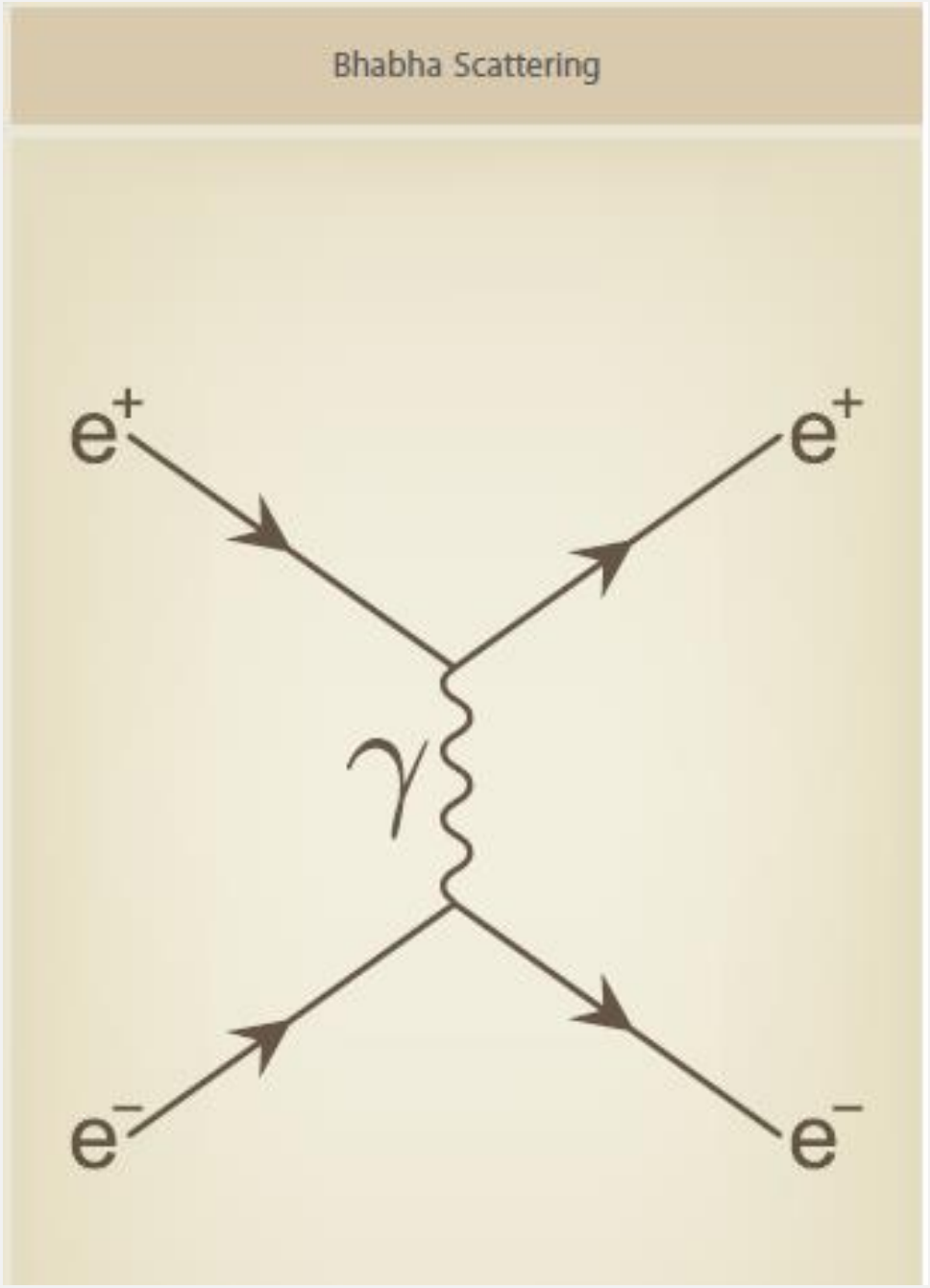


Bhabha at Cambridge

Research….(1)

- January 1933 – HJB publishes his first scientific paper, *"The Absorption of Cosmic Radiation"*
- He offered an explanation of the absorption features and electron shower production in cosmic rays
- Wins the Isaac Newton Studentship in 1934, which he holds for 3 years
- Spends his time between Cavendish Lab and *Niels Bohr* in Denmark
- In 1935, HJB publishes in *Proceedings of the Royal Society, Series A*
- The 1st calculation to determine the cross section of electron-positron scattering.
- This is later named as *Bhabha Scattering*, in his honor

Research….(2)



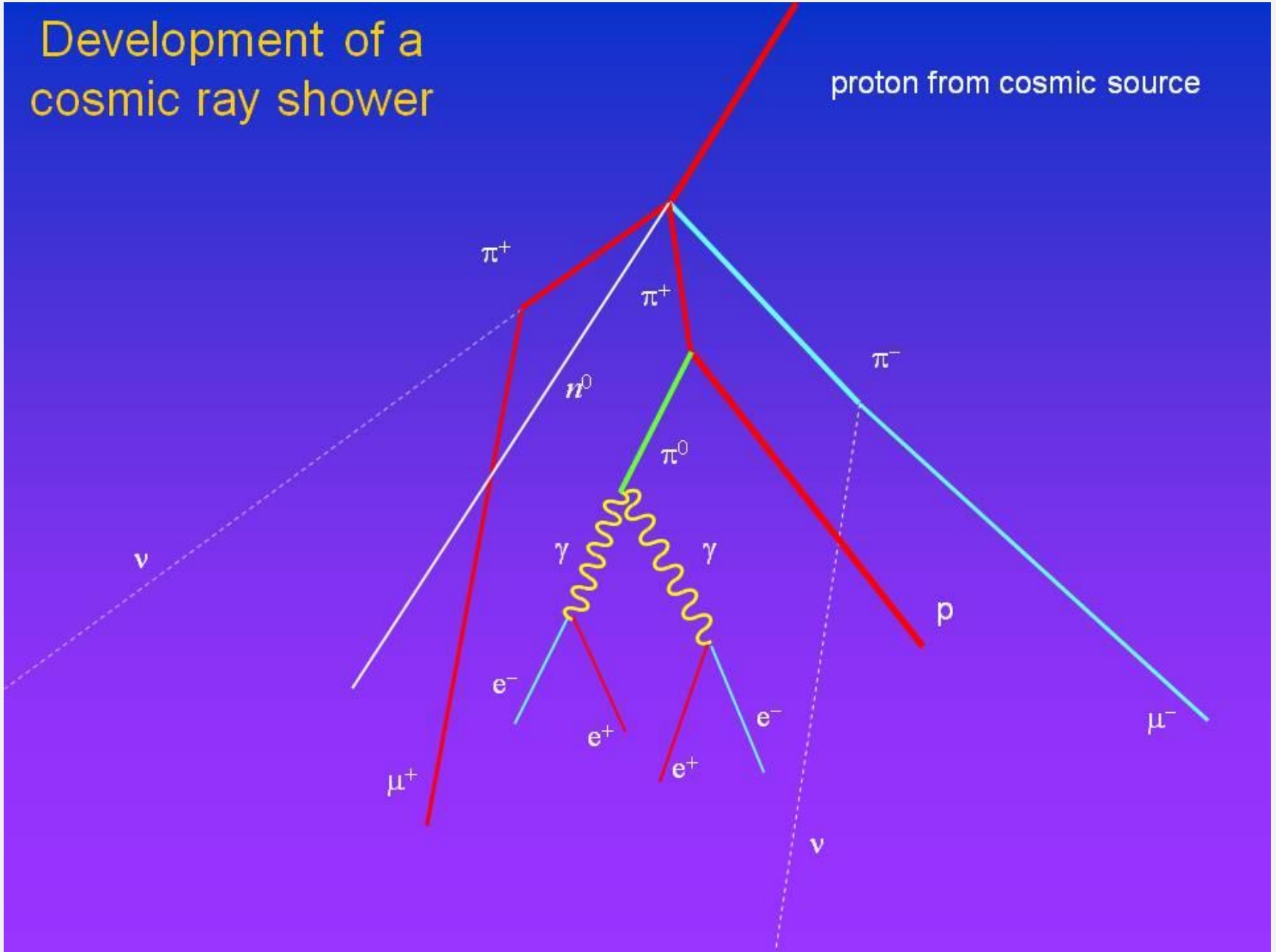
Research….(3)

Homi Bhabha with Paul Dirac

Research….(4)

- In 1936, w/ *Walter Heitler*, he co-authors "*The Passage of Fast Electrons and the Theory of Cosmic Showers*“
- Published in the *Proceedings of the Royal Society, Series A*
- Described how primary cosmic rays from outer space interact with the upper atmosphere to produce particles observed at the ground level.
- Later made numerical estimates of the number of electrons in the cascade process at different altitudes for different electron initiation energies.
- HJB also concluded that such observations could lead to experimental verification of Einstein's theory of relativity

Research….(5)


Development of a
cosmic ray shower
proton from cosmic source
π+
π+
π−
n0
π0
γ
γ
ν
p
e−
e+
e+
e−
μ+
μ−
ν

Research….(6)

The Passage of Fast Electrons and the Theory of Cosmic Showers

By H. J. Bhabha, *Gonville and Caius College, Cambridge*
and W. Heitler, *Wills Physical Laboratory, University of Bristol*

(*Communicated by N. F. Mott, F.R.S.—Received* 11 *December* 1936)

Introduction

It is well known that according to relativistic quantum mechanics, electrons and positrons with energy large compared with their rest mass have a very large probability when passing through the field of a nucleus of losing a large fraction of their energy in one process by emitting radiation. Hard quanta have a correspondingly large probability of creating electron pairs. Until recently it was believed that the direct measurements of Anderson and Neddermeyer on the energy loss of fast electrons showed that though this energy loss by radiation existed, it was much smaller for energies greater than about 10^8 e-volts than that theoretically predicted, and it was therefore assumed that the present quantum mechanics began to fail for energies greater than about this value. More recent experiments by Anderson and Neddermeyer (1936) have, however, led them to revise their former conclusions, and their new and more accurate experiments show that up to energies of 300 million e-volts (the highest energies measured in their experiments) and probably higher, the experimentally measured energy loss of fast electrons is in agreement with that predicted theoretically. In fact, one may say that at the moment there are no *direct* measurements of energy loss by fast electrons which conclusively prove a breakdown of the theory. This is particularly satisfactory, inasmuch as the theoretical reasons for expecting a breakdown of the theoretical formulae at energies greater than about 137 mc^2, namely the neglect of the classical "radius" of the electron, have been shown by v. Weizsäcker (1934) and Williams (1934) to be unfounded. Under these circumstances, and in view of the experimental evidence mentioned above, it is reasonable *as a working hypothesis* to assume the theoretical formulae for energy loss and pair creation to be valid for all energies, however high, and to work out the consequences which result from

Research….(6’)

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Article

The passage of fast electrons and the theory of cosmic showers

H. J. Bhabha and W. Heitler

Published: 01 April 1937 | https://doi.org/10.1098/rspa.1937.0082

Abstract

It is well known that according to relativistic quantum mechanics, electrons and positrons with energy large compared with their rest mass have a very large probability when passing through the field of a nucleus of losing a large fraction of their energy in one process by emitting radiation. Hard quanta have a correspondingly large probability of creating electron pairs. Until recently it was believed that the direct measurements of Anderson and Neddermeyer on the energy loss of fast electrons showed that though this energy loss by radiation existed, it was much smaller for energies greater than about 10^8 e-volts than that theoretically predicted, and it was therefore assumed that the present quantum mechanics began to fail for energies greater than about this value. More recent experiments by Anderson and Neddermeyer (1936) have, however, led them to revise their former conclusions, and their new and more accurate experiments show that up to energies of 300 million e-volts (the highest energies measured in their experiments) and probably higher, the experimentally measured energy loss of fast electrons is in agreement with that predicted theoretically. In fact, one may say that at the moment there are no *direct* measurements of energy loss by fast electrons which

Details | References | Related | Figures

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World War II breaks out….(1)

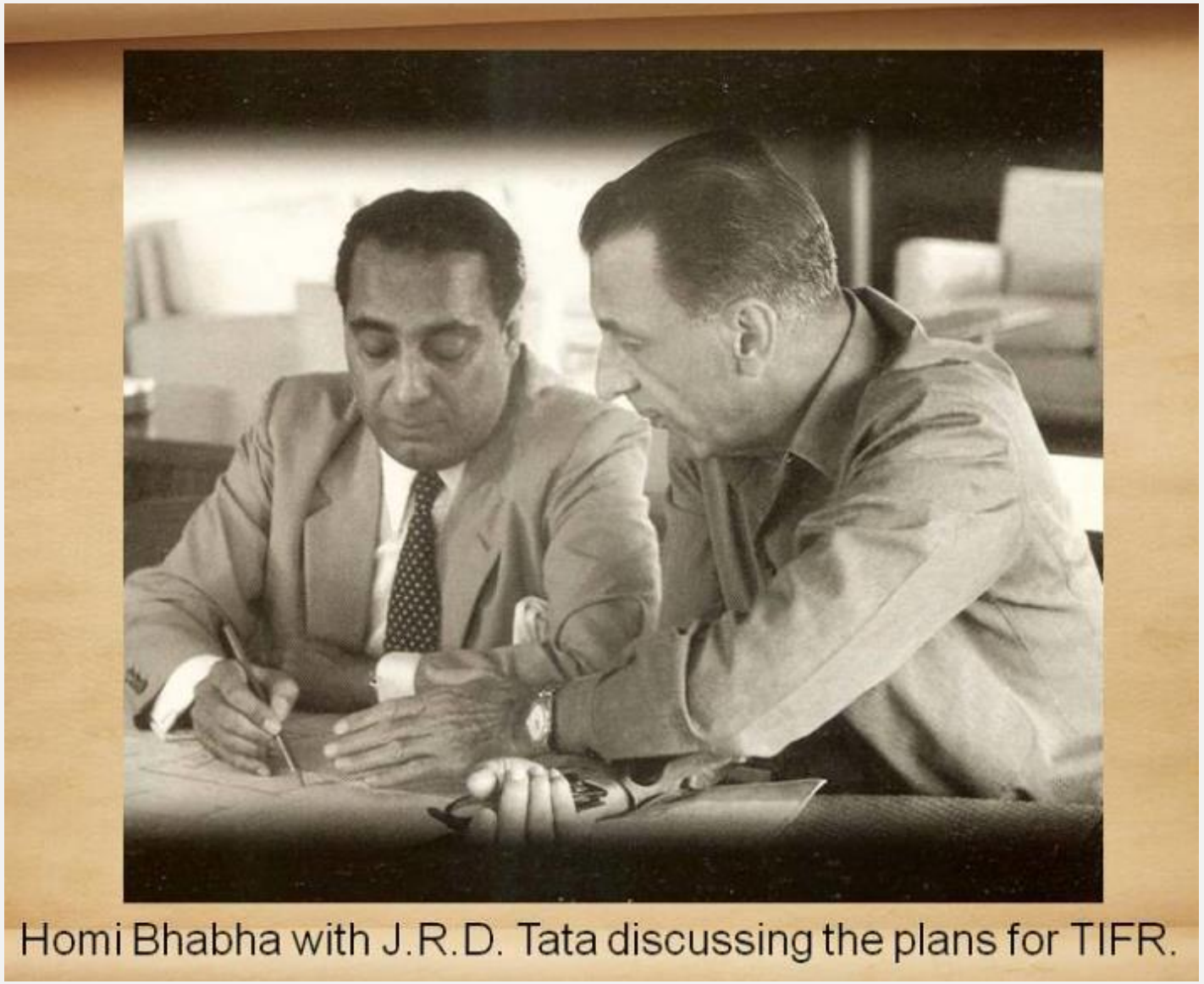
- September 1939, HJB is in India for a holiday when WW-II starts
- He decides **not** to return to England
- Accepts an offer in the Physics Department of the Indian Institute of Science (Bangalore), then headed by Nobel Laureate physicist *C. V. Raman*

Homi Bhabha and C.V. Raman with others at the Physics department of IISc in 1948

Career in India….(1)

- Establishes the Cosmic Ray Research Unit at the Institute
- 20th March 1941, he is elected a *Fellow of the Royal Society*.
- Creates the Tata Institute of Fundamental Research with generous support from the Tata Trust

Career in India….(2)



Homi Bhabha with J.R.D. Tata discussing the plans for TIFR.

Career in India….(3)

The Institute was soon shifted to Bombay and housed in a part of *Kenilworth*, a sprawling bungalow on Pedder Road owned by Bhabha's aunt.

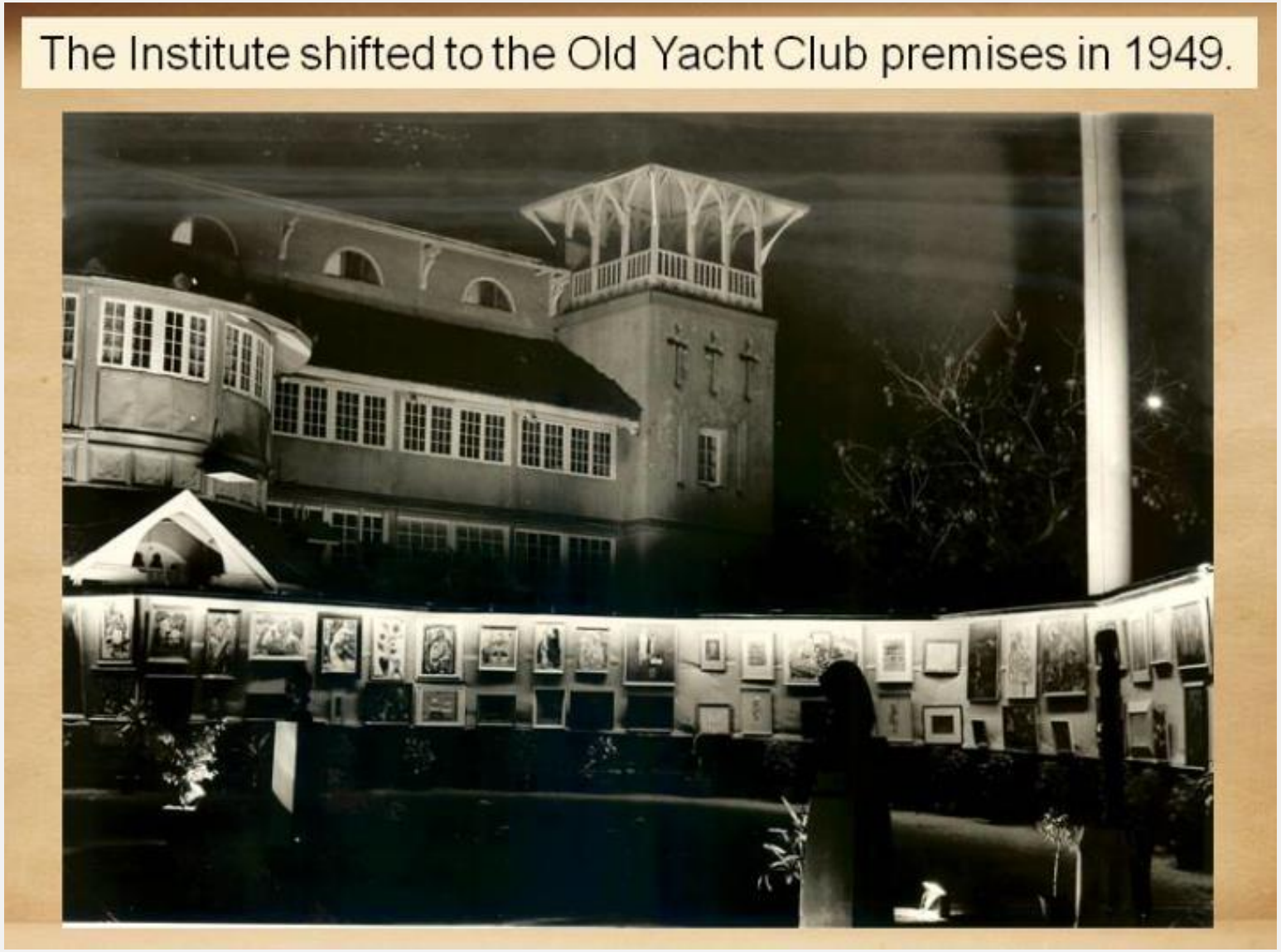
Career in India….(4)

Inauguration of TIFR at Kenilworth, Bombay, on 19th December 1945.

Bhabha explaining a publication to the Governor of Bombay, Sir John Colville at the inauguration of TIFR

Bhabha's inaugural lecture. Seated: Sir John Colville and Sorabji Saklatvala

Career in India….(5)

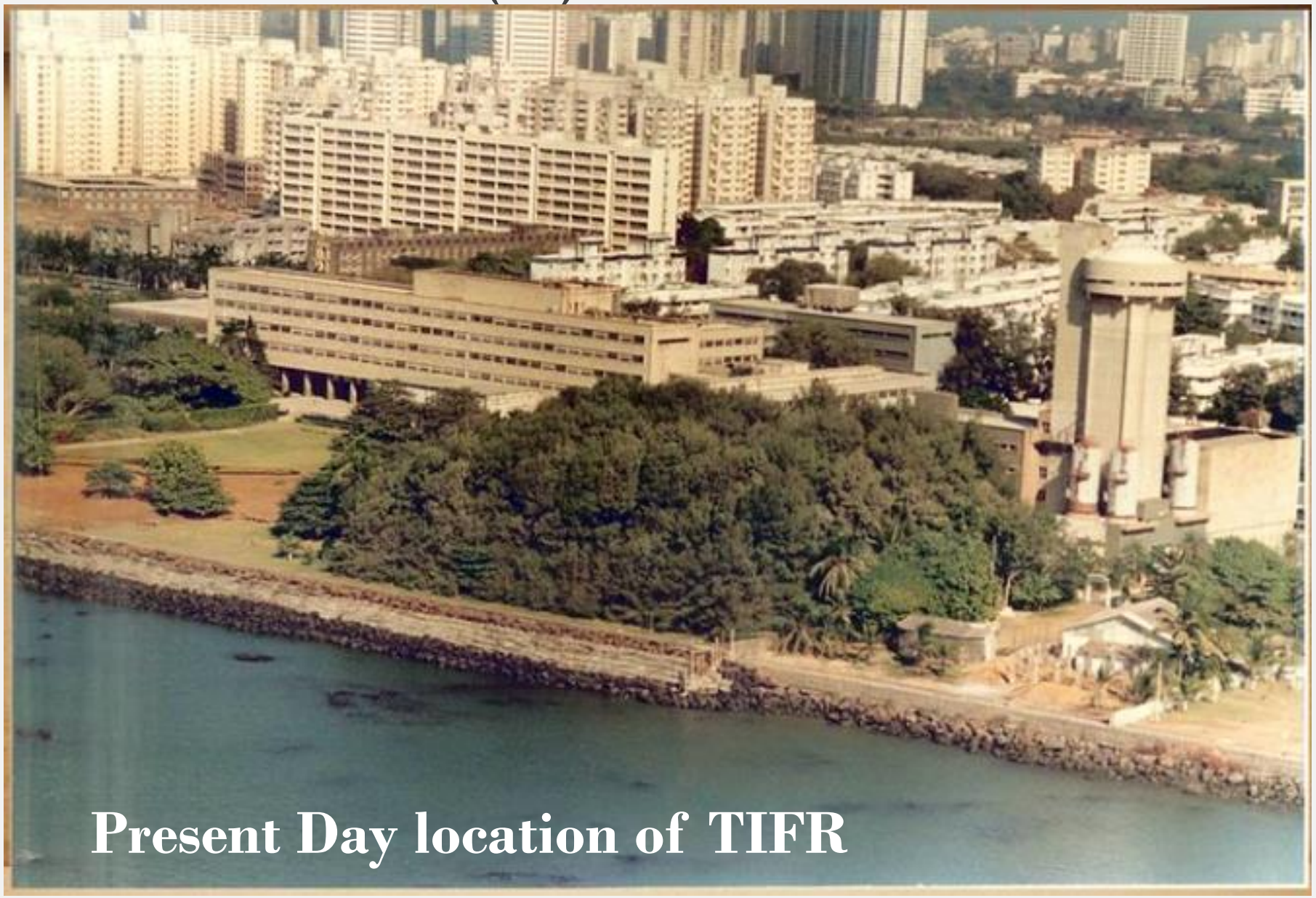


Career in India….(6)

In the 1950s it was again time for TIFR to change residence. This time it was meant to be permanent. Bhabha selected a spacious plot in Colaba that belonged to the Defence Ministry. He went directly to the Prime Minister Jawaharlal Nehru for this and his request was granted.

View of proposed site for the construction of the TIFR Building in Colaba.

Career in India….(7)



Present Day location of TIFR

Career in India….(8)

After the Inauguration ceremony, the Prime Minister visited the laboratories of the Institute.

Homi Bhabha showing Pandit Nehru the Glass Blowing section of TIFR

Homi Bhabha showing Pandit Nehru the computer Tifrac.

Career in India….(9)

- HJB represented India at several IAE forums
- He served as the Chair, UN Conference on the Peaceful Uses of Atomic Energy
- Was elected a Foreign Honorary Member of the AAAS in 1958
- Also nominated for the Nobel Prize for Physics in 1951 and 1953–1956

Bhabha (right) at the International Conference on the Peaceful Uses of Atomic Energy in Geneva, Switzerland, 20 August 1955

Birth of Atomic Energy in India (1)

- HJB proposed to the government to build a new laboratory entirely devoted to atomic energy research
- In 1950 over 1200 acres of land was acquired at Trombay from the Bombay Government.
- In 1954: Atomic Energy Establishment, Trombay (AEET) started (later renamed BARC)
- The same year the Department of Atomic Energy (DAE) was also established
- Also served on the Indian Cabinet's Scientific Advisory Committee
- Asked Vikram Sarabhai to set up Committee for Space Research (later ISRO)

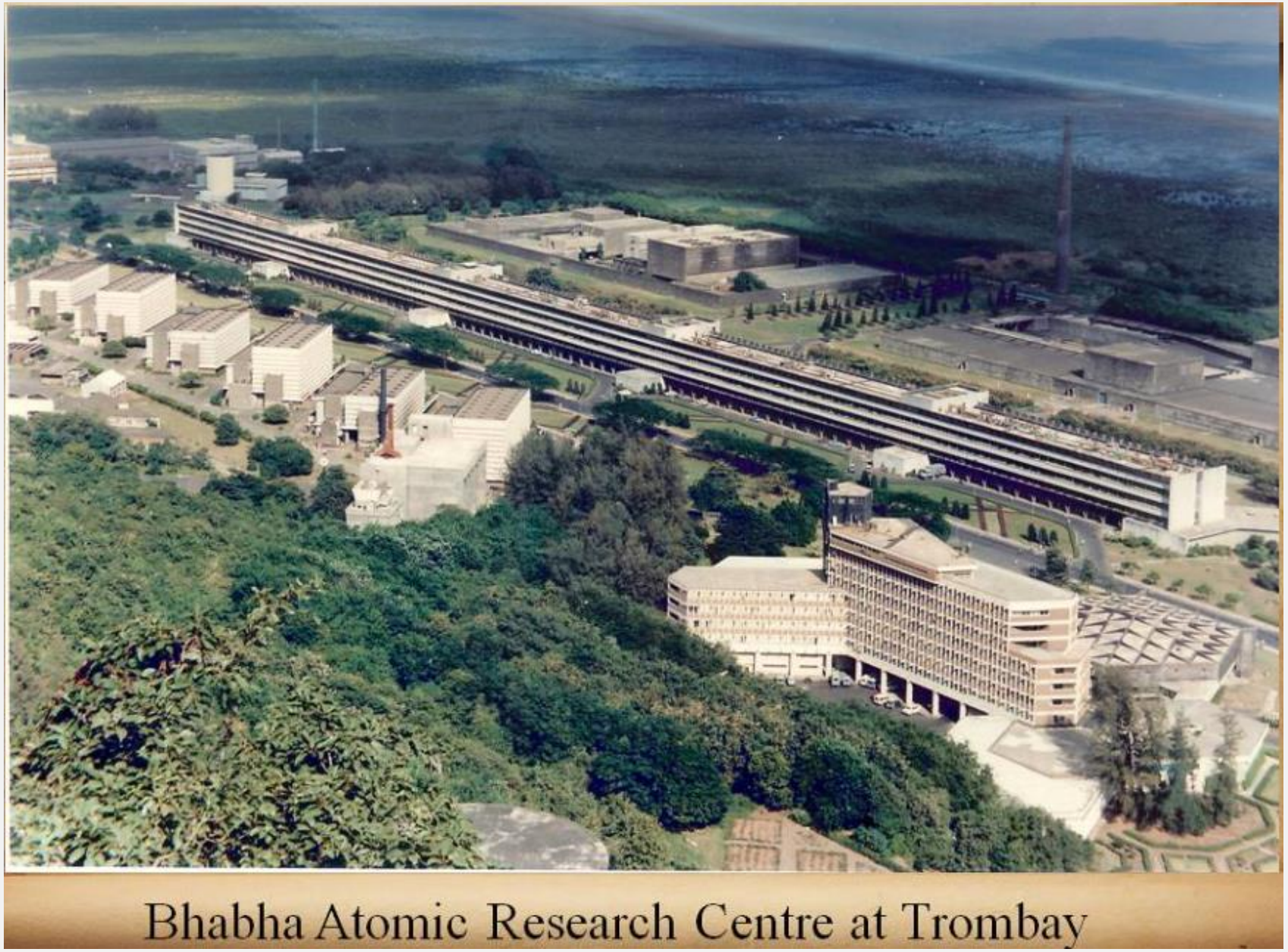
Birth of Atomic Energy in India (2)

Cirus Nuclear Reactor in Bhabha Atomic Research Centre at Trombay

Birth of Atomic Energy in India (3)

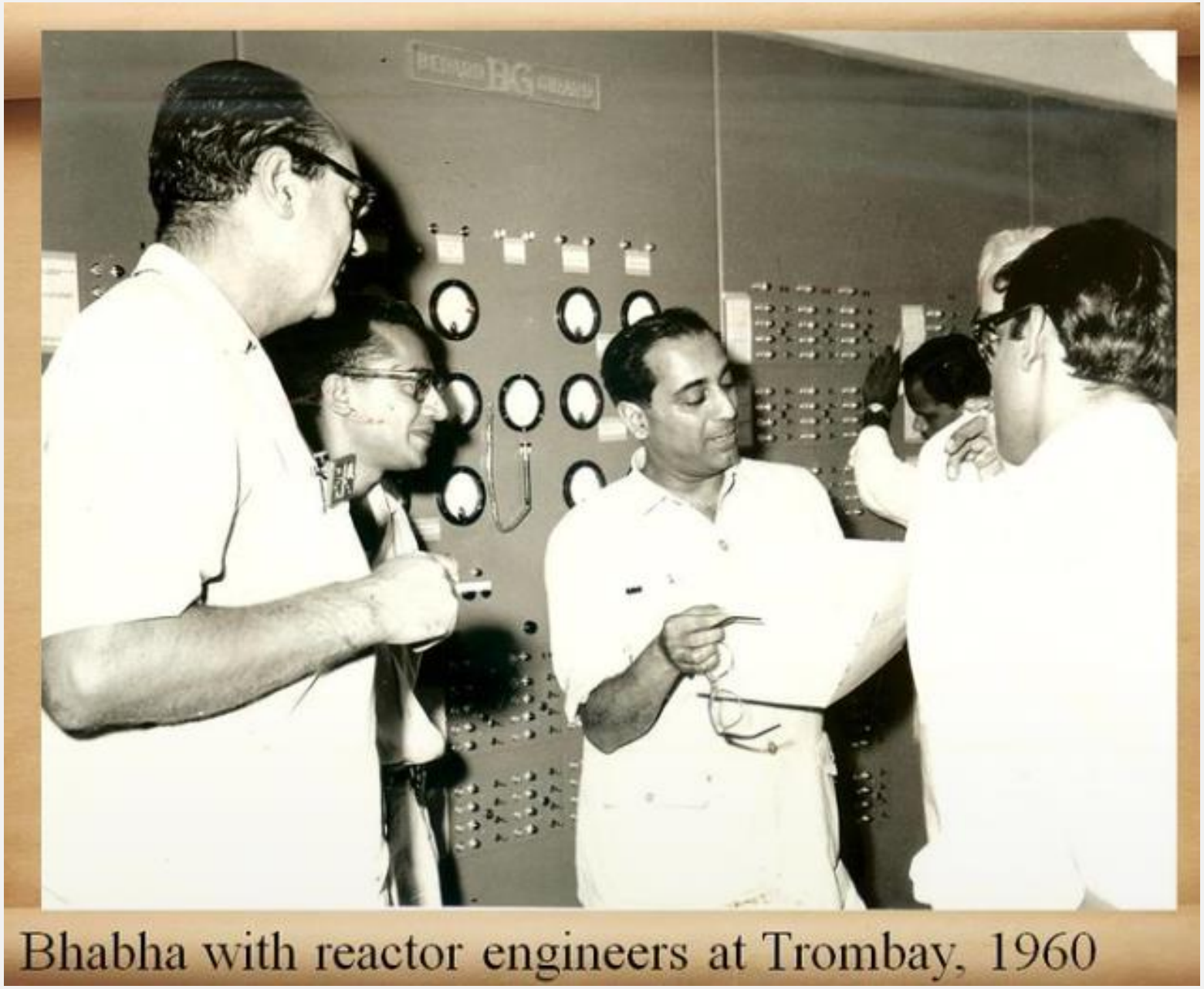
India's first reactor and a plutonium reprocessing facility, Mumbai, as photographed by a US satellite on 19 February 1966

Birth of Atomic Energy in India (4)



Bhabha Atomic Research Centre at Trombay

Birth of Atomic Energy in India (5)

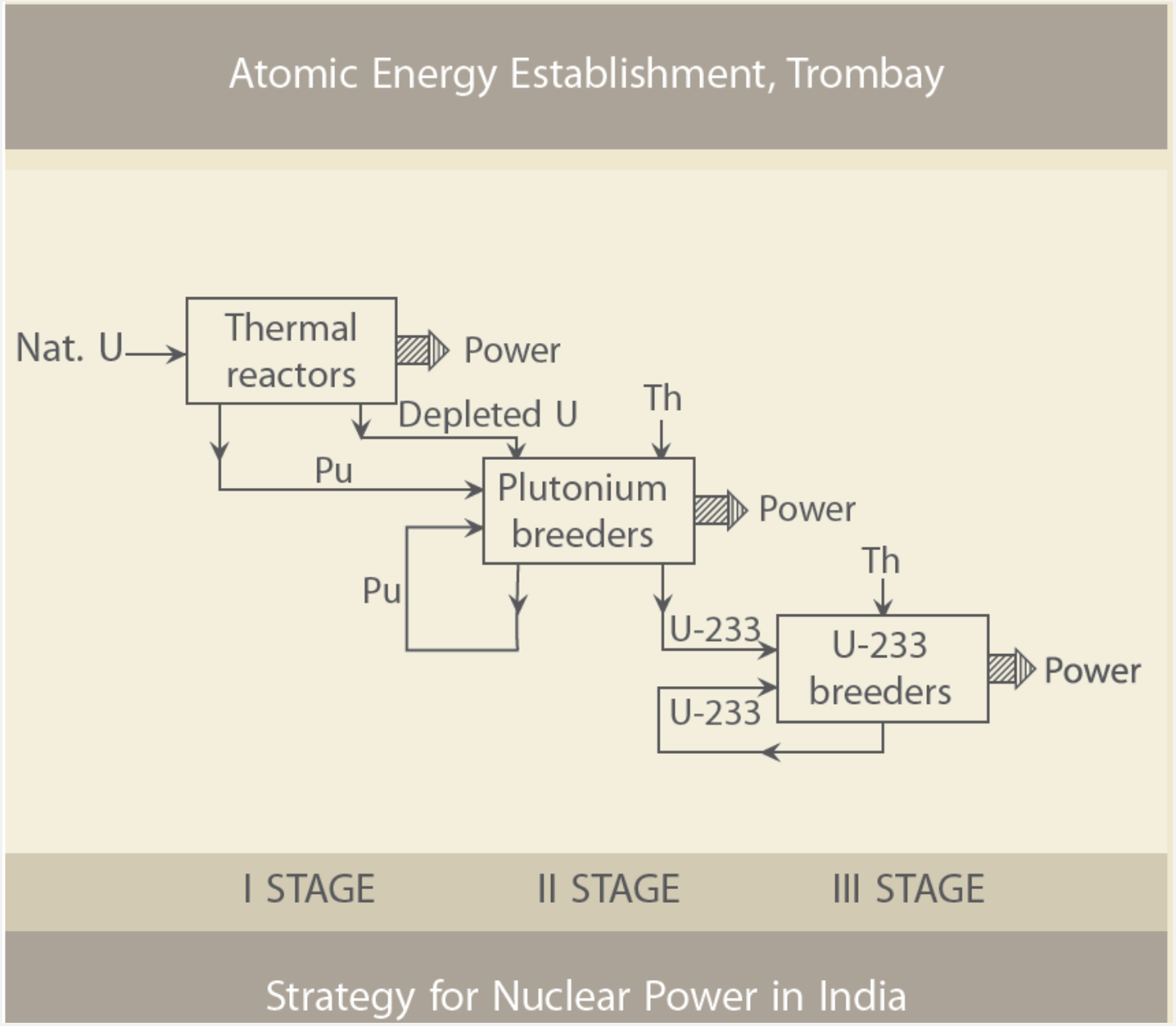


Bhabha with reactor engineers at Trombay, 1960

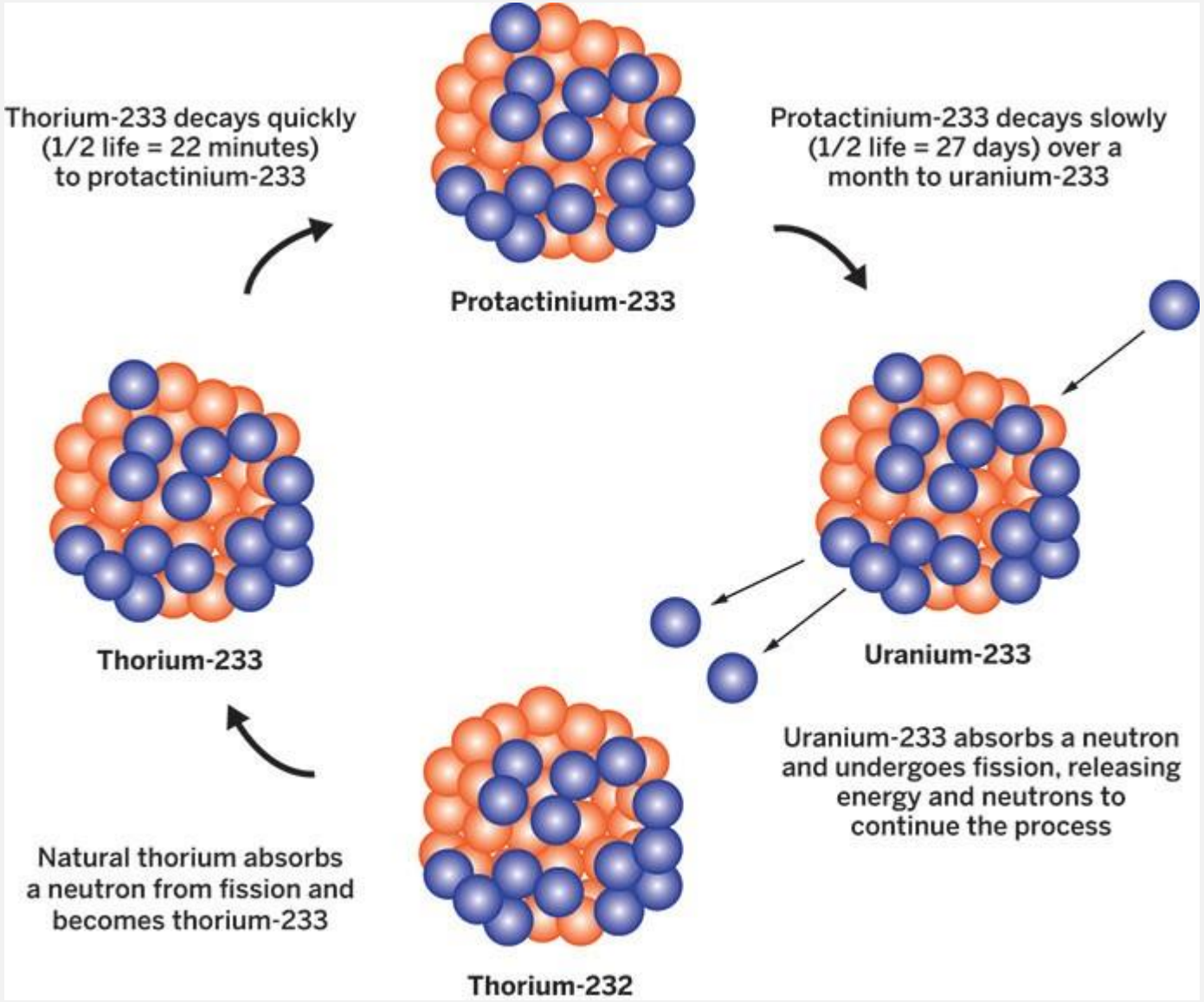
Birth of Atomic Energy in India (6)

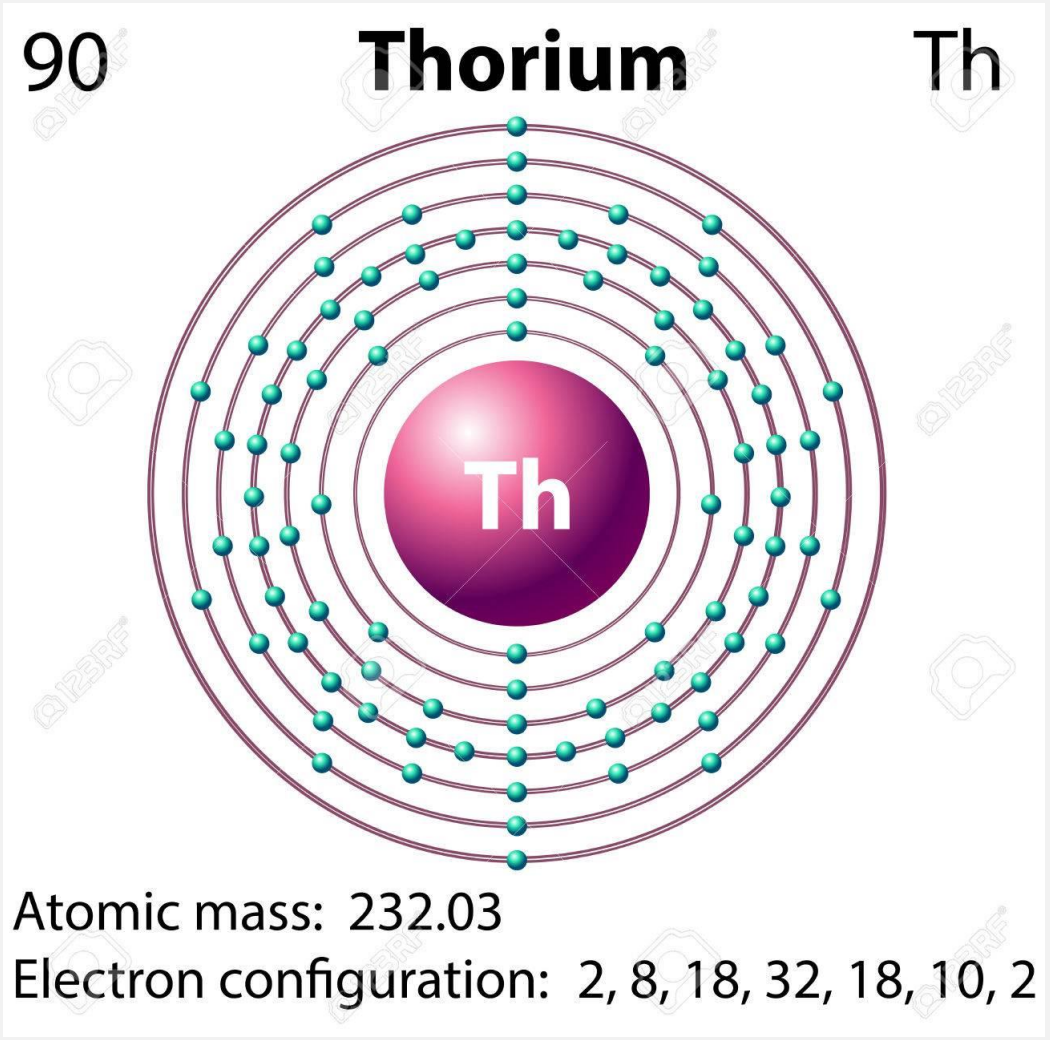
- India's 3-phase program
  - *The aim of long range atomic power program in India must be based as soon as possible on thorium rather than uranium*
  - *The 1st generation of atomic power stations based on natural uranium be used to start off an atomic power program*
  - *The plutonium produced by the 1st generation power stations can be used in a second generation of power stations designed to produce electric power and convert thorium into U-233, or depleted uranium into more plutonium with breeding gain*
  - *The 2nd generation of power stations may be regarded as an intermediate step for the breeder power stations of the third generation all of which would produce more U-233 than they burn in the course of producing power*

Birth of Atomic Energy in India (6a)

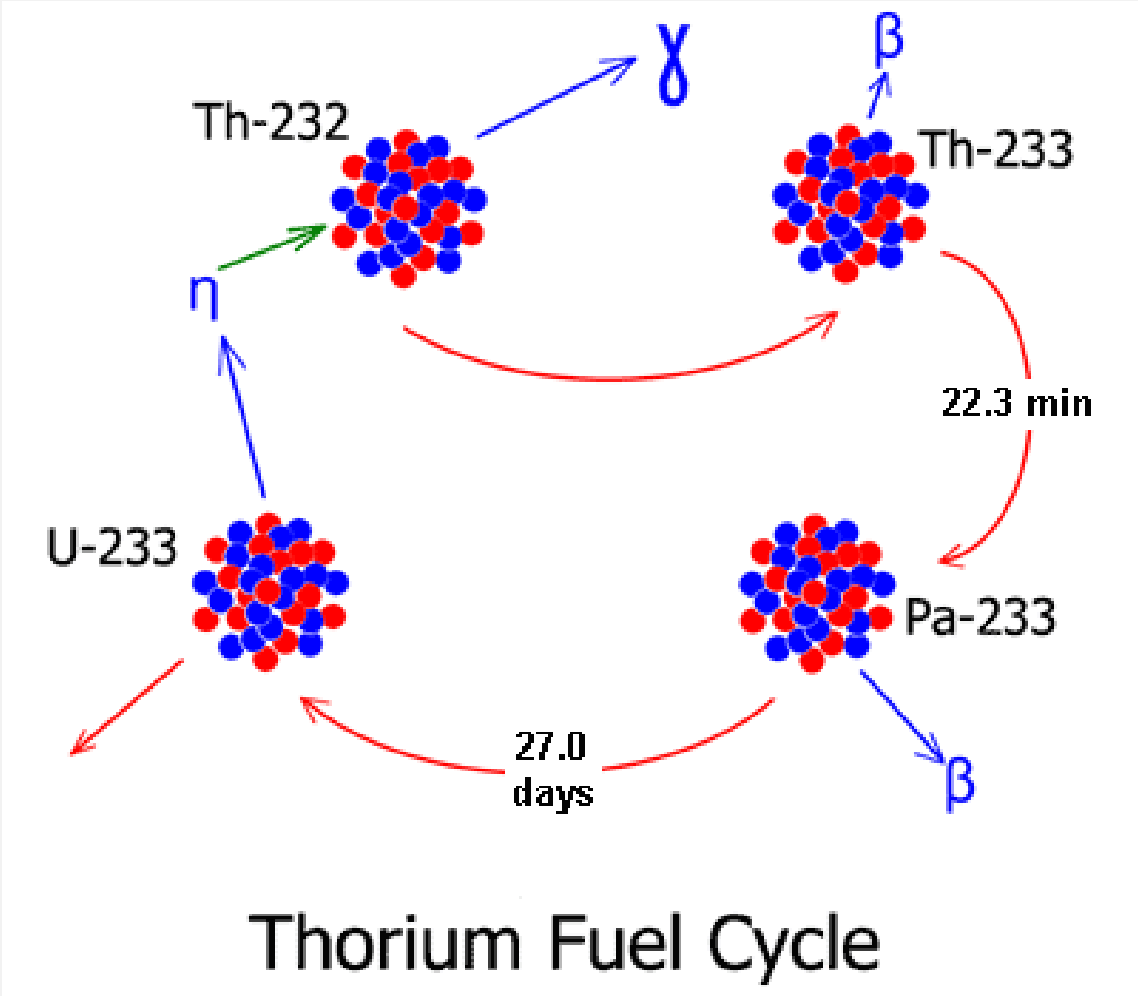


Birth of Atomic Energy in India (6b)





Birth of Atomic Energy in India (6c)



Thorium Fuel Cycle

Demise

- HJB was killed when Air India Flight 101 crashed near Mont Blanc on 24 January 1966.
- He was on his way to an IAEA Scientific Advisory Committee meeting in Austria at the time
- Apparently, a misunderstanding between Geneva Airport and the pilot about the aircraft position near the mountain, is listed as the official reason for the crash

Demise

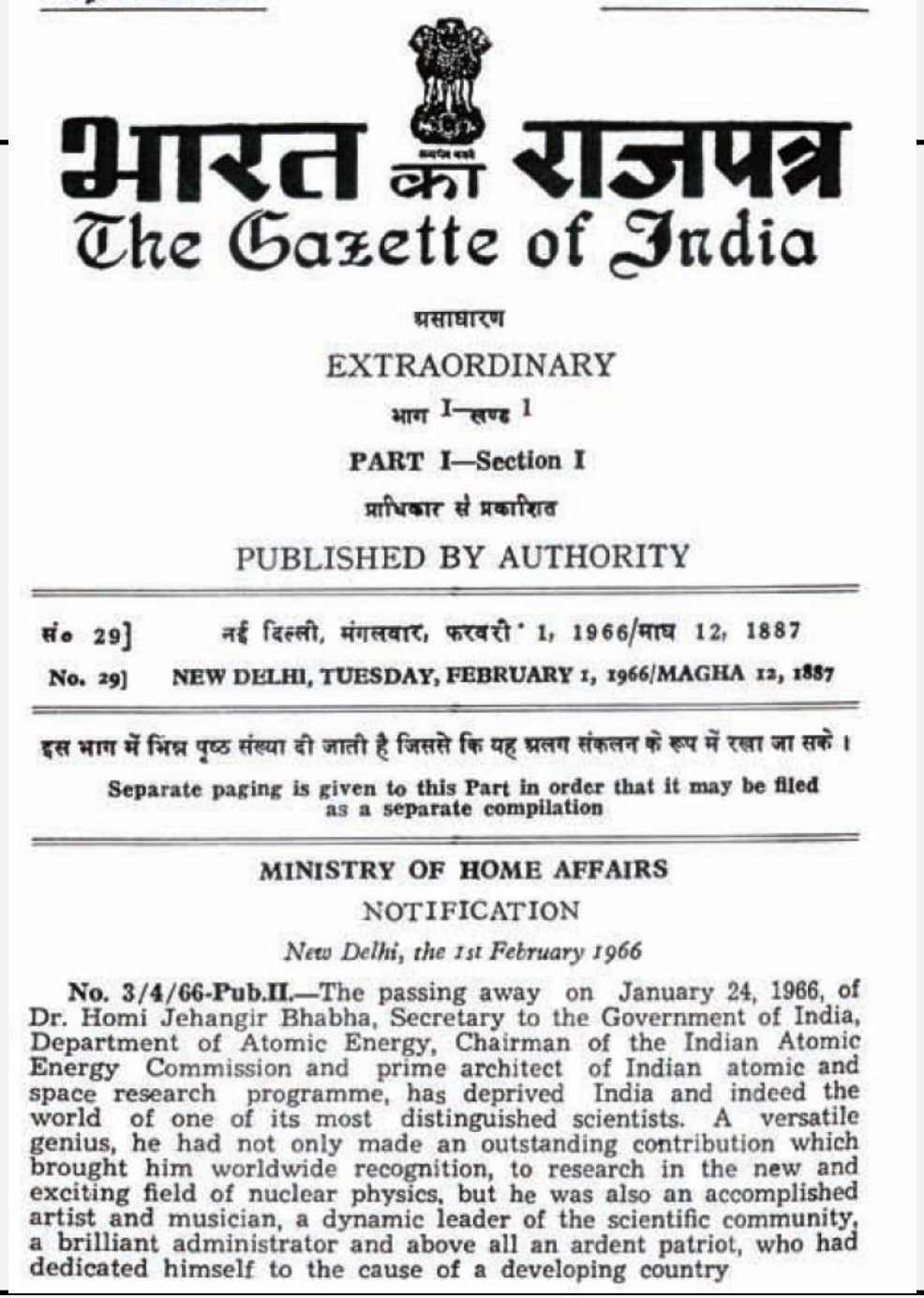
Mourning at the meeting in Vienna which Bhabha had been scheduled to attend in January 1966

Uthamna ceremony at TIFR

Condolence meeting at BARC

Legacy

After his death, the AEET was renamed Bhabha Atomic Research Center (BARC)



भारत का राजपत्र
The Gazette of India

असाधारण

EXTRAORDINARY

भाग I—खण्ड 1

PART I—Section I

प्राधिकार से प्रकाशित

PUBLISHED BY AUTHORITY

सं० 29] नई दिल्ली, मंगलवार, फरवरी 1, 1966/माघ 12, 1887

No. 29] NEW DELHI, TUESDAY, FEBRUARY 1, 1966/MAGHA 12, 1887

इस भाग में भिन्न पृष्ठ संख्या दी जाती है जिससे कि यह अलग संकलन के रूप में रखा जा सके ।

Separate paging is given to this Part in order that it may be filed as a separate compilation

MINISTRY OF HOME AFFAIRS

NOTIFICATION

New Delhi, the 1st February 1966

No. 3/4/66-Pub.II.—The passing away on January 24, 1966, of Dr. Homi Jehangir Bhabha, Secretary to the Government of India, Department of Atomic Energy, Chairman of the Indian Atomic Energy Commission and prime architect of Indian atomic and space research programme, has deprived India and indeed the world of one of its most distinguished scientists. A versatile genius, he had not only made an outstanding contribution which brought him worldwide recognition, to research in the new and exciting field of nuclear physics, but he was also an accomplished artist and musician, a dynamic leader of the scientific community, a brilliant administrator and above all an ardent patriot, who had dedicated himself to the cause of a developing country

Legacy

Bust of Bhabha at
JD Birla Industrial & Technological Museum, Kolkata

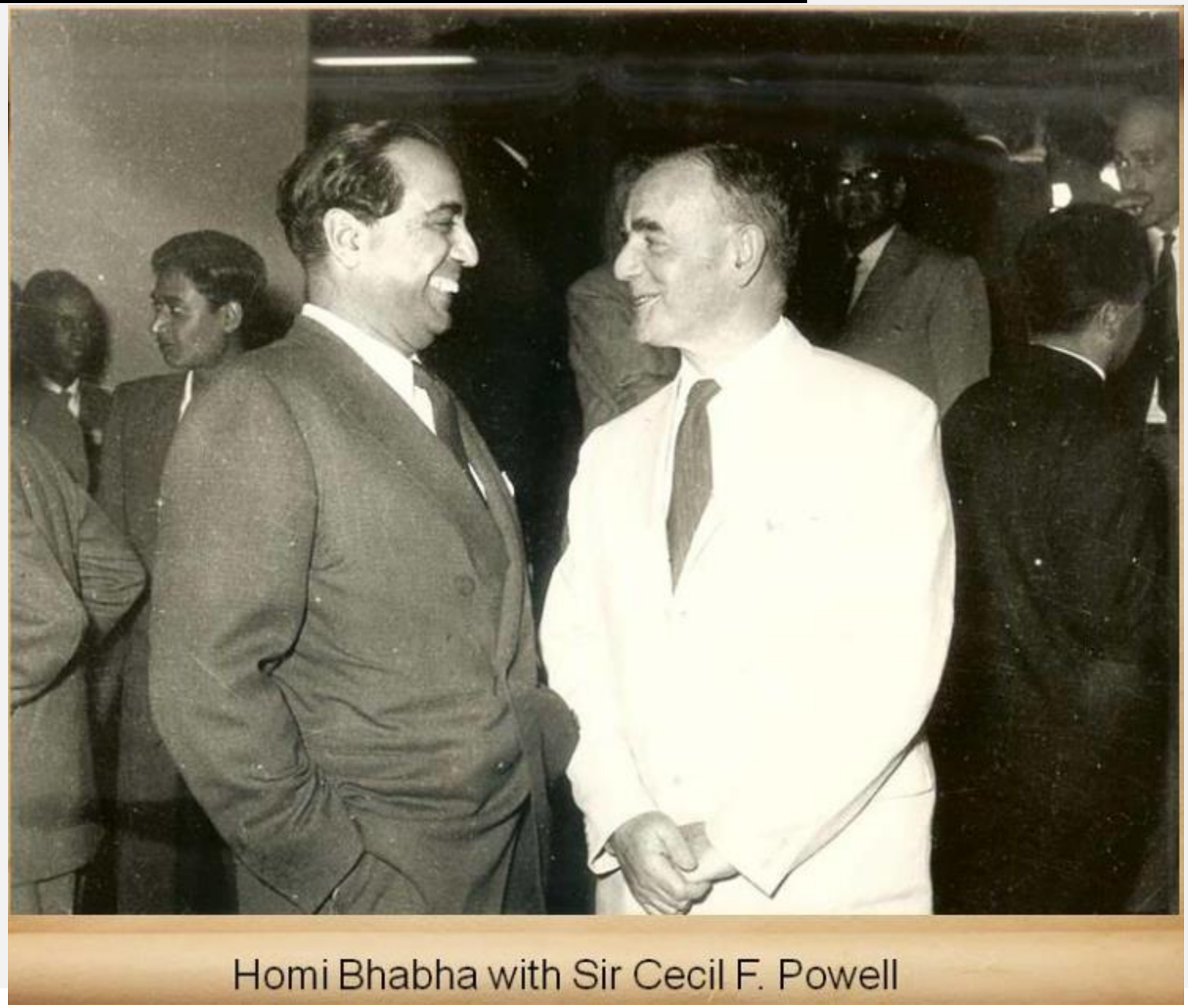
Other Glimpses from his life

The Queen Mother conferring the HonoraryDoctorate of Science on Homi Bhabha at the Royal Festival Hall, London, July 1960.

Other Glimpses from his life

The visit of Queen Elizabeth II.

Other Glimpses from his life



Homi Bhabha with Sir Cecil F. Powell

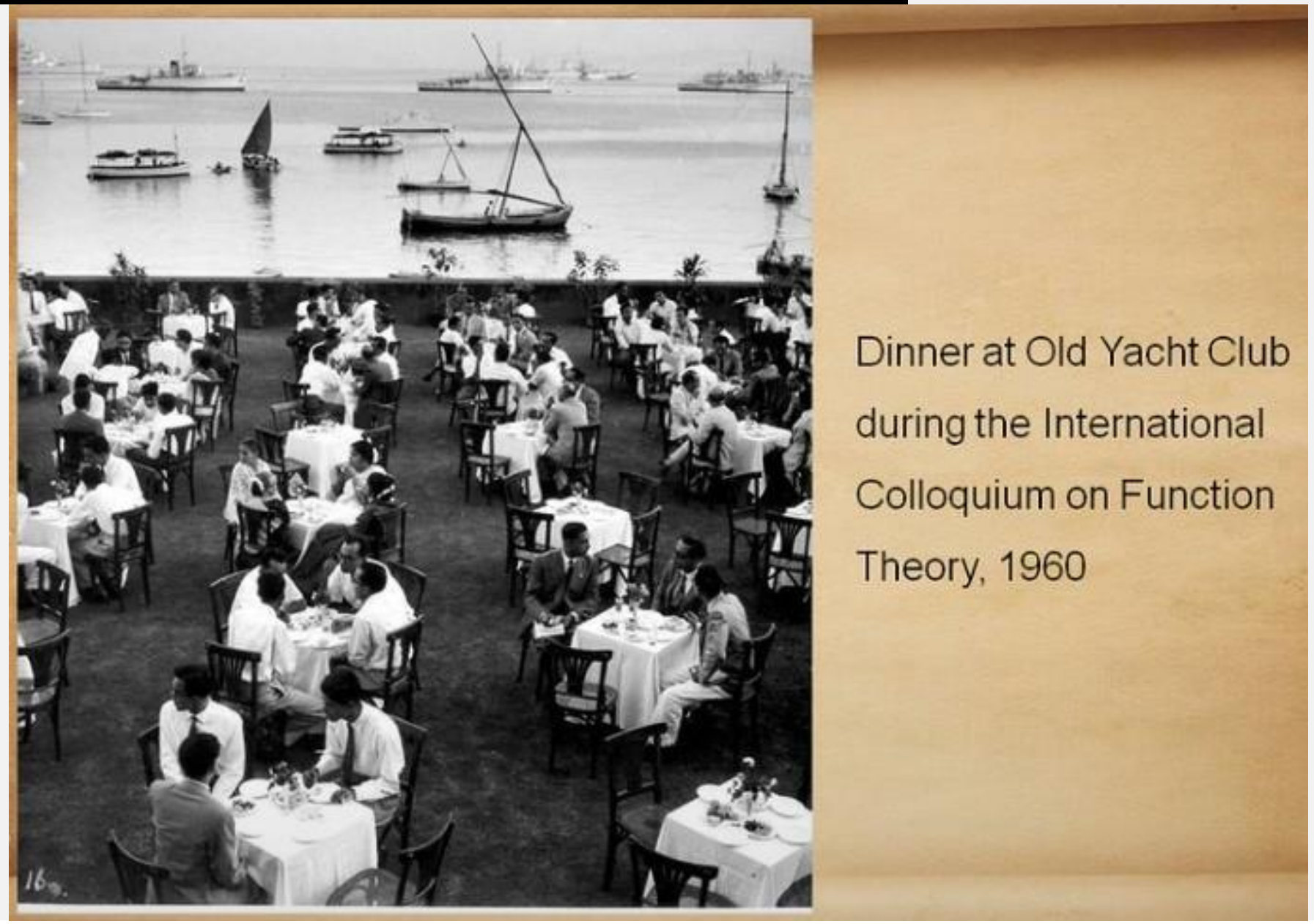
Other Glimpses from his life

(L-R) Albert Einstein, Hideki Yukawa, John Wheeler (the one who coined the word 'black hole') and Homi Bhabha at the Institute for Advanced Studies in Princeton (Image Credit: Princeton University)

Other Glimpses from his life

Bhabha with Niels Bohr during the International Colloquium on Function Theory at TIFR in 1960.

Other Glimpses from his life



Dinner at Old Yacht Club during the International Colloquium on Function Theory, 1960

Other Glimpses from his life

Bhabha was known for his deep love of the arts. An accomplished artist himself, he began building up a remarkable collection of Indian contemporary art at the TIFR. Cultural performaces were also held frequently and especially during conferences.

Other Glimpses from his life

Ustad Alla Rakha and Pandit Ravishankar

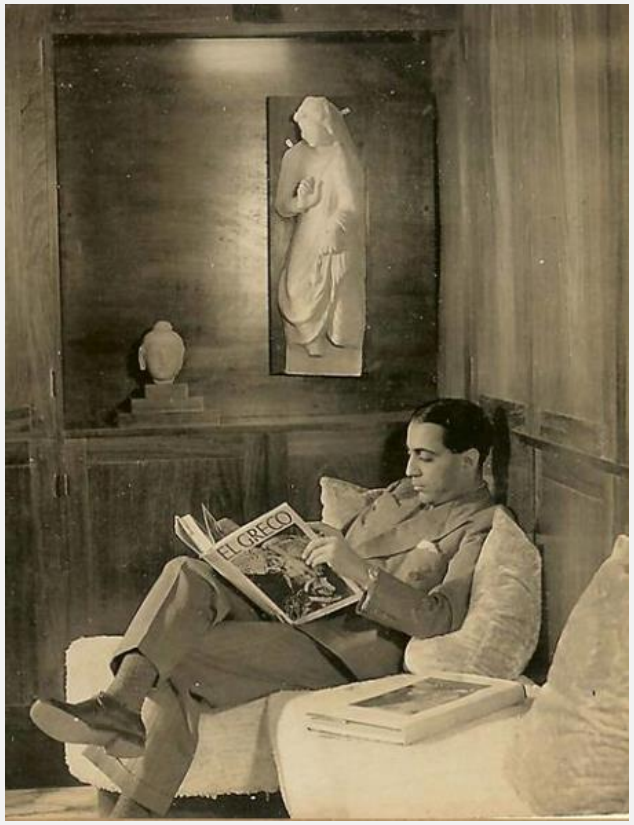
Other Glimpses from his life

Bhabha painting the 'Dove sono I belli momenti' in Cambridge. Photograph by Lettice Ramsay

Other Glimpses from his life

Sarojini Naidu

C.V. Raman



Bhabha's sketch of M.F. Husain

Quotes

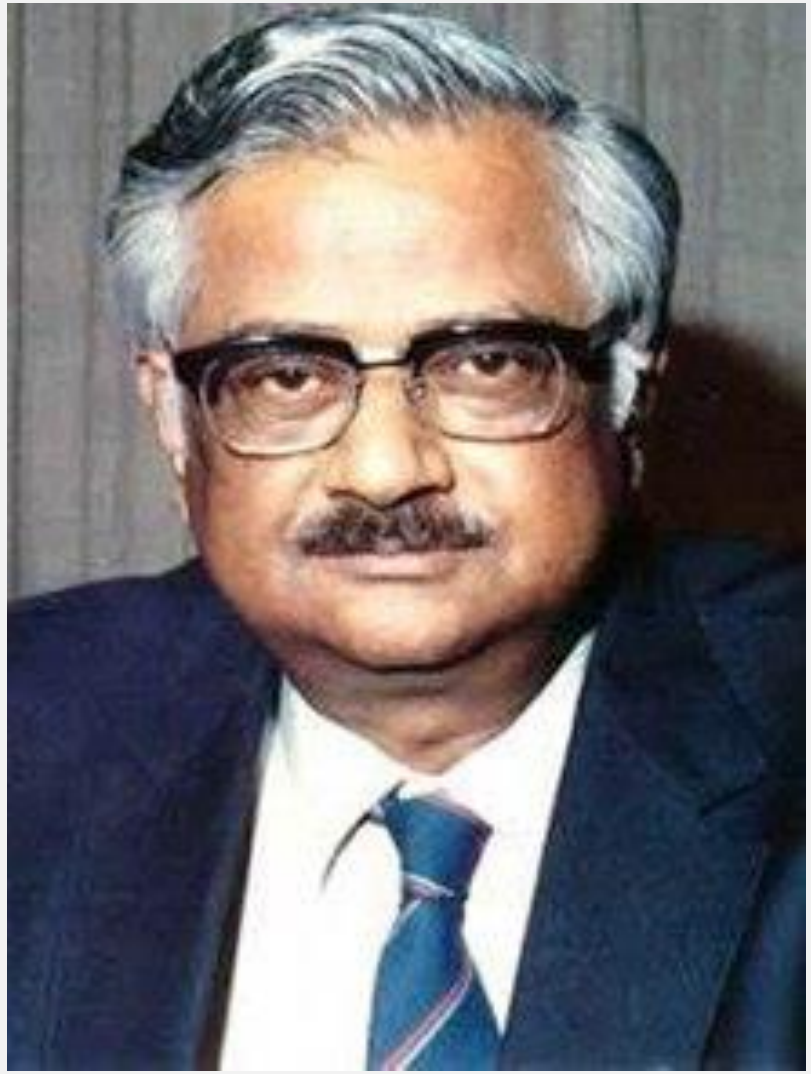
"I know quite clearly what I want out of my life. Life and my emotions are the only things I am conscious of. I love the consciousness of life and I want as much of it as I can get.

But the span of one's life is limited. What comes after death no one knows. Nor do I care.

Since, therefore, I cannot increase the content of life by increasing its duration, I will increase it by increasing its intensity. Art, music, poetry and everything else that consciousness I do have this one purpose - increasing the intensity of my consciousness of life."

Influences/Protégés (no particular order)

- ✓ *Raja Ramana*



Influences/Protégés

- ✓ *Homi Sethna*

Bhabha and Homi Sethna supervising work in Trombay

Influences/Protégés

- ✓ *Vikram Sarabhai*

Bhabha with Cecil Powell,
Patrick Blackett and Vikram Sarabhai

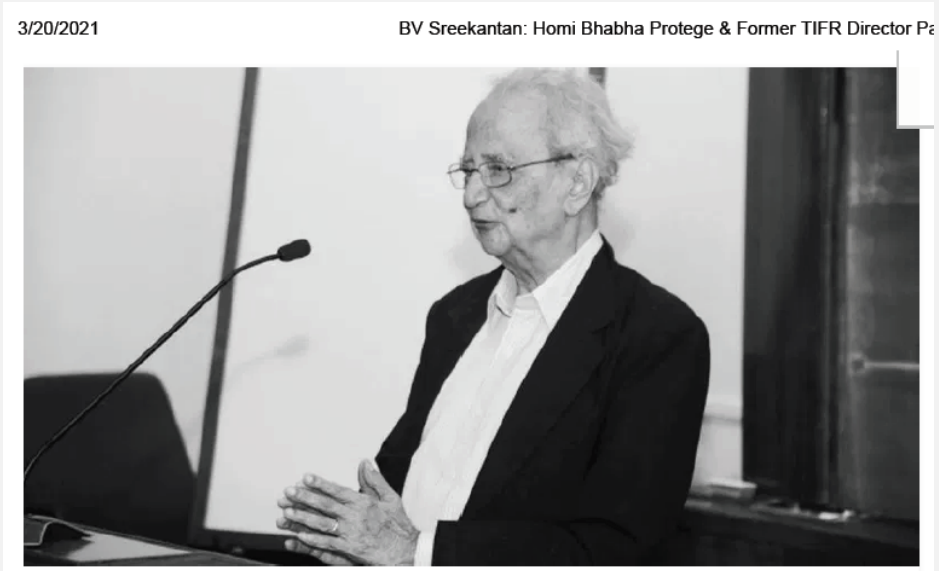
Influences/Protégés

- ✓ *MGK Menon*

In the words of M.G.K.Menon, Bhabha excelled in "institution building for a directed purpose". His emphasis on both theoretical and experimental research at TIFR resulted in some pioneering efforts.

Influences/Protégés

✓ *BVK Sreekantan*



Science Society

BV Sreekantan: Homi Bhabha protege & former TIFR Director passes away at 94

October 31, 2019 The ID Staff

Professor BV Sreekantan, former director of the Mumbai-based Tata Institute of Fundamental Research (TIFR), passed away at the age of 94 in Bangalore on Sunday,

B.V. Sreekantan (left) during the visit of John Cockcroft in TIFR

Influences/Protégés

- ✓ *Raja Ramana*
- ✓ *Homi Sethna*
- ✓ *Vikram Sarabhai*
- ✓ *MGK Menon*
- ✓ *BVK Sreekantan*

Various Links/References/Further reading

- https://en.wikipedia.org/wiki/Parsis aka Pharsee, endonym of Persia (a few famous Parsis: Zubin Mehta, Eric Avari, JRD Tata, etc)
- https://iscm.ac.in/ formerly Royal Institute of Science 1920, now renamed as The Institute of Science. Mumbai
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Various Links/References/Further reading

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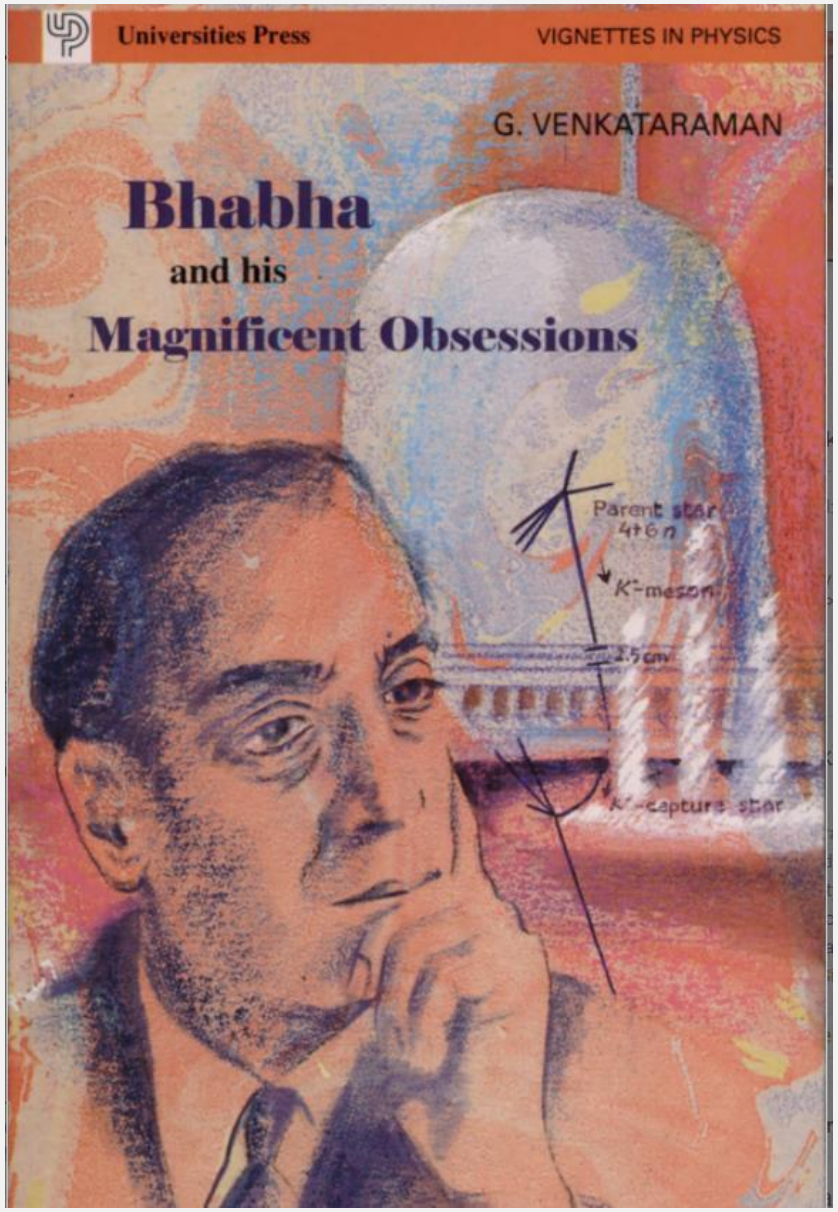
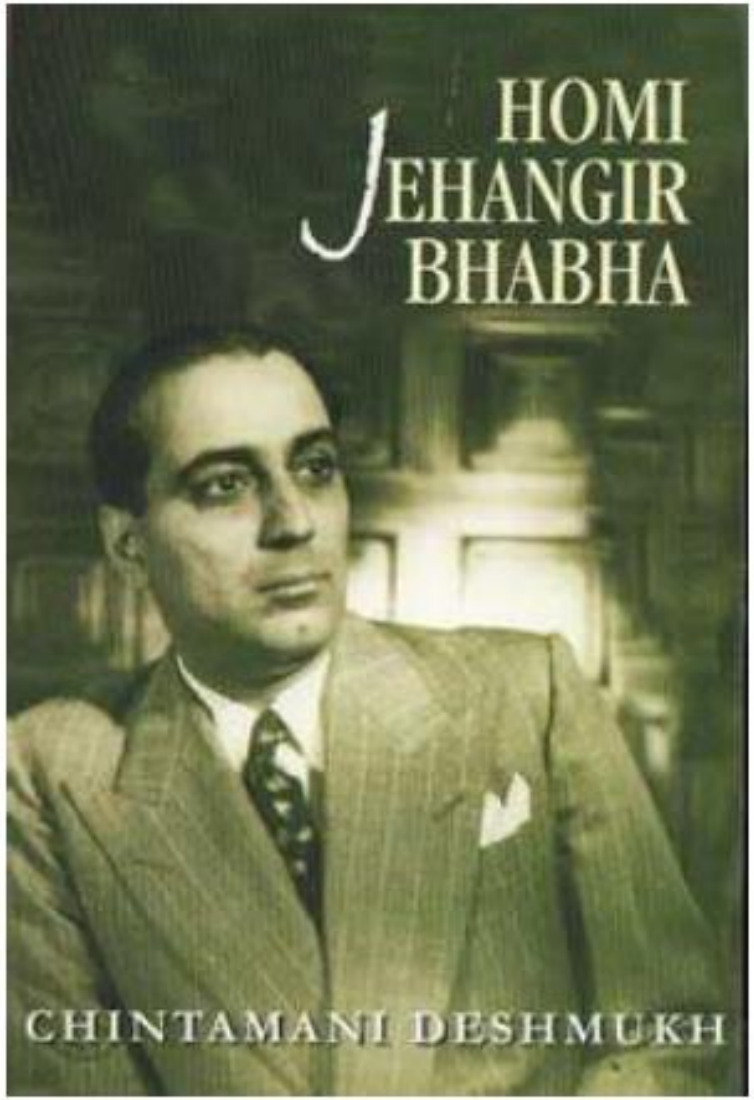
Links

Various Links/References/Further reading

- https://www.google.com/books/edition/Bhabha_and_His_Magnificent_Obsessions/



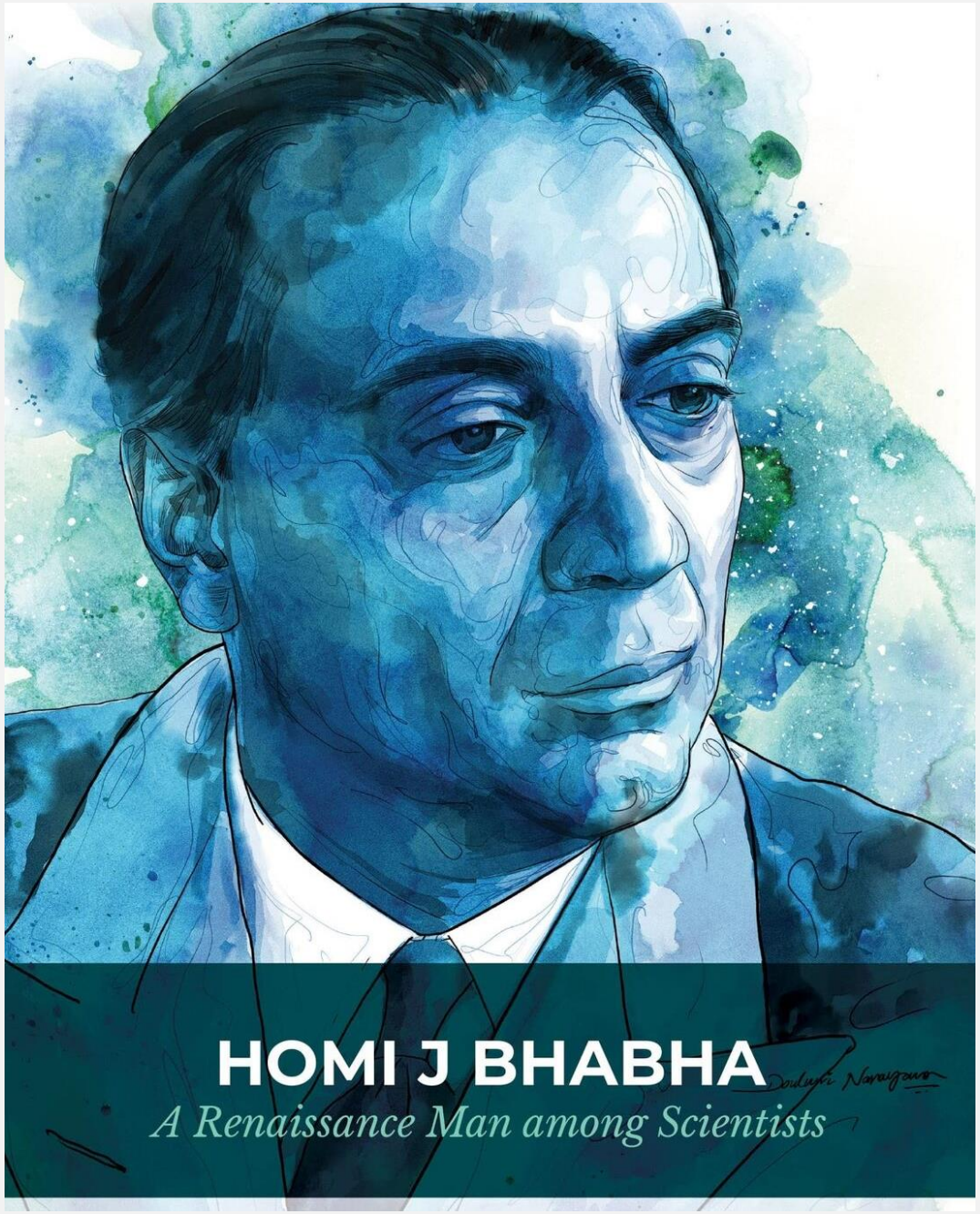
Various Links/References/Further reading



HOMI JEHANGIR BHABHA

CHINTAMANI DESHMUKH

Various Links/References/Further reading



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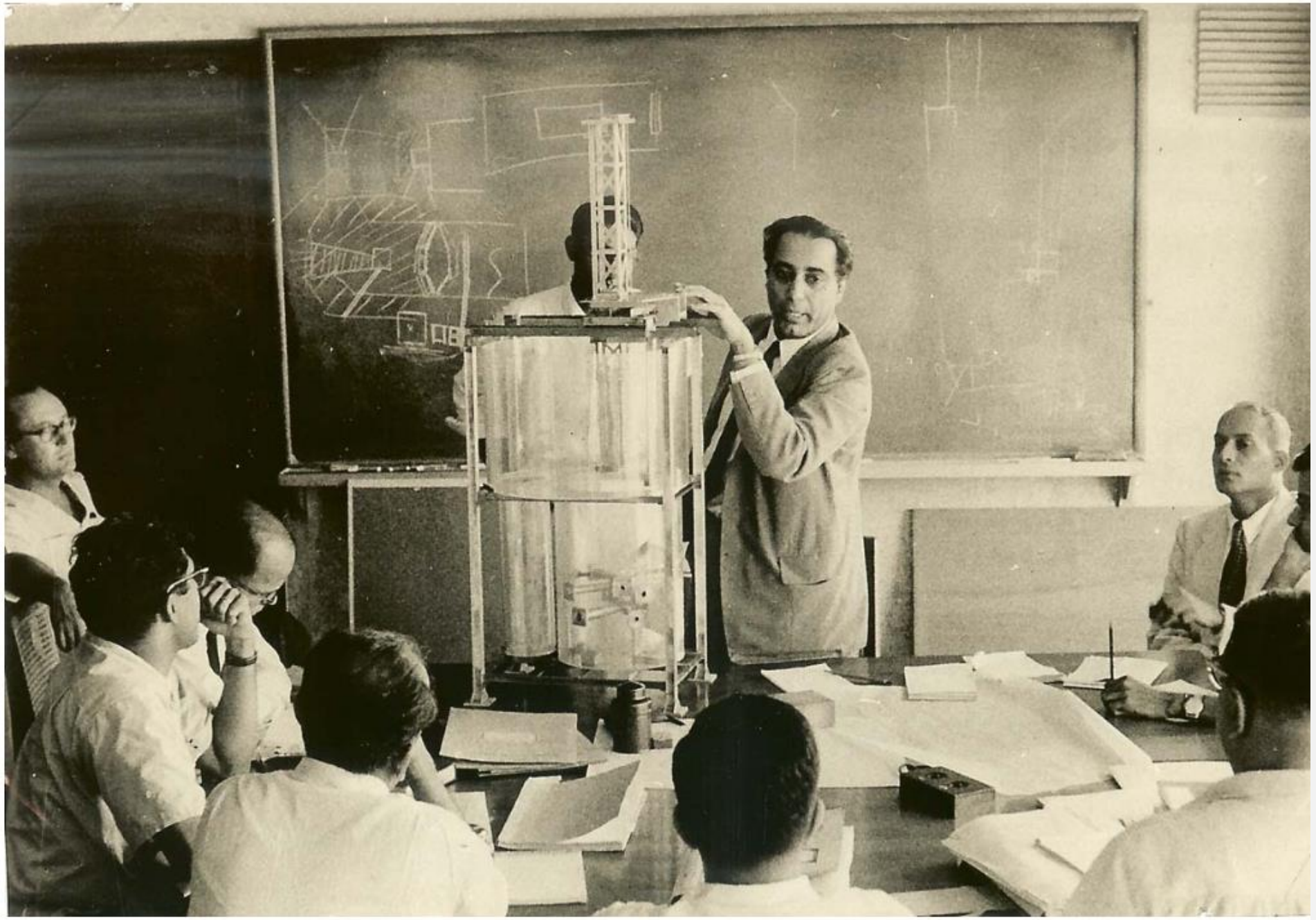

https://artsandculture.google.com/asset/_/KgF0iuE_GLvWQA

HONOURS AND RECOGNITIONS for Homi J. Bhabha

- Fellow of the Royal Society, 1941
- Adams Prize, Cambridge, for a thesis on “The theory of the elementary physical particles and their interactions,” 1942
- Hopkins Prize of the Cambridge Philosophical Society, 1948
- Padma Bhushan, 1954
- President, First International Conference on Peaceful Uses of Atomic Energy, held under the auspices of the UN, 1955
- Honorary fellowship of the Gonville andCaius College (1957), Royal Society of Edinburgh (1957), American Academy of Arts and Sciences (1959), National Academy of Sciences of the UnitedStates (1963)
- Honorary Doctoral degrees in science: Patna (1944), Lucknow (1949), Banaras (1950), Agra (1952), Perth (1954), Allahabad (1958), Cambridge (1959), London (1960), Padova (1961)
- President, International Union of Pure and Applied Physics, 1960-63
- Melchett Medal of the Fuel Institute, 1964


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https://www.linkedin.com/in/sharankalwani/

- Video recording (most recent) can be streamed (no download possible at this time)

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