CASI WORKING PAPER SERIES

Number 12-01

06/2012

THE LABORATORY AND ITS DOUBLE: THE MAKING OF THE SCIENTIST-CITIZEN AT TIFR

INDIRA CHOWDHURY
CASI-New India Foundation Visiting Scholar (Spring 2011)
Center for the Advanced Study of India
University of Pennsylvania
Centre for Public Policy, Srishti School of Art, Design and Technology, Bangalore

CENTER FOR THE ADVANCED STUDY OF INDIA
University of Pennsylvania
3600 Market Street, Suite 560
Philadelphia, PA 19104
http://casi.ssc.upenn.edu/index.htm

CENTER FOR THE ADVANCED STUDY OF INDIA

Penn Arts & Sciences

Acknowledgements

Many of the ideas in this paper were clarified and first iterated during my two month stay at the Center for the Advanced Study of India (CASI) at the University of Pennsylvania, Philadelphia in 2011. I am especially grateful to Professor Devesh Kapur, Director, CASI, for long hours of insightful discussions. I am also grateful to Mekhala Krishnamurthy and Sanjoy Chakravorty for lively interactions and debates during this period. I also benefitted greatly from my discussions with Robert Anderson and Mahesh Rangarajan. As always, I am grateful to Vivek Dhareshwar for perceptive comments.

Introduction

The first day of Indian independence is popularly identified with Nehru's famous "tryst with destiny" speech delivered at the Red Fort – the symbolc seat of power at New Delhi, the capital of the new nation. At the Tata Institute of Fundamental Research, that the physicist Homi Bhabha had set up two years ago, the day was celebrated quietly, though not without its lessons for the scientists who now had to be nurtured into becoming scientist-citizens. The available records of TIFR do not have any reference to the ceremonies that took place on August 15, 1947. However, the oral history interviews of a scientist present on that day bear testimony to the relationship that was being imagined between nationalism and science.

Prahlad Chunilal Vaidya, had come to TIFR as a research worker in 1947. By then he had had several years of experience working with Professor V.V. Narlikar at the Benaras Hindu University and in fact, had discovered an elegant solution to Einstein's equation for a radiating star. Present at the Institute on the day of India's independence, Vaidya recalled that he had hoisted the flag quite early. Since he had been a freedom fighter, he had done this in a way that he was familiar with – he had folded the flag and then unfurled and hoisted it. However, there were elements of ceremony, thoughtfulness and solemnity that were missing in that act as Bhabha pointed out. In Vaidya's words:

> When Bhabha came he asked, "Where is the flag?" I said, "There it is." Then he said, "No! On the first day of independence you don't unfurl the flag – you raise

> the flag. Bring it down!" After that we raised the flag and then sang *Jana gana mana* [the national anthem].[1]

For Vaidya the inclusion of ceremony and the accompanying solemnity to mark the occasion remained an important lesson in citizenship.

> Raising the flag! Now that is something I learnt from Bhabha. This incident made me feel that even a famous scientist is an ordinary citizen.[2]

Bhabha, however, was no ordinary citizen – he shared a particularly close relationship with Nehru, India's first Prime Minister. Besides, within ten days of India becoming independent, Bhabha became the Chairman of the newly set up Board of Atomic Energy, which placed him in a particularly powerful position within the Indian state. Bhabha's participation in the ceremonies of the new nation can only be understood if we think of his actions as exemplary actions designed to initiate and train new citizens. However, as this paper will demonstrate, the setting up of Bhabha's laboratory at Kenilworth, a bungalow on Peddar Road in 1945, had another unstated task – training young Indians in ways of belonging to a larger international community. Therefore, Bhabha's institute was not only a laboratory where young Indians were trained to do science, but also a place where they learnt how to build and sustain a relationship with the world – a relationship that was both scientific and cultural. Bhabha's laboratory,

[1] For a more elaborate excerpt see Indira Chowdhury and Ananya Dasgupta, *A Masterful Spirit: Homi Bhabha 1909-1966*, Penguin, 2010, p. 142.
[2] *Ibid.*

as this paper will demonstrate, had within it another laboratory that was designed for learning the social and cultural dimensions of becoming, what I shall for term a 'citizen-scientist'.

On that first day of Indian independence, the idea of becoming a scientist-citizen in a new nation state was a way of redefining the relationship between the state and the scientist. The moment of independence saw changes in forms of control and ownership between the state and the scientific establishment. The promise of autonomy for science in India in this new India where science was expected to play an extremely important role, brought in its wake the idea of the scientist-citizen whose work would be to deliver those dreams. The idea of the scientist-citizen was however, not a simple political one – where the moment of independence conferred citizenship status on the former scientist-subjects of the British Empire. Instead, this idea drew on larger ideas of belonging to the world and to India that scientists in India were attempting to define for some time, and in the following section, we shall explore one of the ideas that seems to be central to Bhabha's institution-building practice.

A Scientist's Utopia

On October 17, 1945, just a few days before the formal founding of the United Nations and a little over two months after the destruction of Hiroshima, Sir Shanti Swarup Bhatnagar, Director of the newly set up Council for Scientific and Industrial Research of India, gave a radio talk on All India Radio, New Delhi. Presenting, what he called "My Utopia," Bhatnagar claimed that the very fact that

a scientist had been invited to speak on what Sir Thomas More had offered as a perfect albeit imaginary political system, indicated a critical shift in worldview.

"The true scientist," Bhatnagar said, "who is as much a visionary as a realist, should accept the invitation not as a challenge but as a triumph of the cause he stands for."[3] Bhatnagar, like many other liberals during the Cold War period, of that time, used a beneficial model of science where scientific research was directly responsible for the "abolition of poverty and disease." Social benefits constituted therefore, the promise that science held out against the disorderly world created by politics and religion:

> The appreciation of these advantages as pre-eminently the gifts of science against the mess which is created in the world by diplomats and fanatical religious leaders, is indeed helping to establish science in its exalted position.[4]

Since perfect order in the social world was an almost unachievable ideal, Bhatnagar emphasized the ways in which science could translate this ideal into reality. Emerging out of the chaos that had been inflicted on the world by politics and religion, Bhatnagar envisaged a utopian order emerging through the applications of science. Despite the devastation inflicted by the applications such as the atomic bomb as a political weapon, the message of science was to harness

[3] Sir S.S. Bhatnagar, "My Utopia – A Scientist speaks," text of speech delivered at All India Radio, New Delhi, October 17, 1945, p. 1. TIFRARCH D 2004-00001.
[4] *Ibid.*, p.1.

"atomic energy, in fact any energy" for the good of mankind. Further, science was capable of overcoming natural and manmade boundaries and integrating and unifying the world.

The scientist's Utopia, Bhatnagar stressed was "One World": a world that was not divided by power and secrecy. His message was especially significant in the context of the Cold War. The secrets of atomic energy should therefore, not become a privilege of the USA, Canada and England. Bhatnagar warned that should the unfortunate climate of secrecy prevail, the consequences for the world would be extremely divisive as it would hasten the race for "discovering and utilizing this energy for destructive ends." Therefore, Bhatnagar cautioned:

> The American and the British scientists, amongst whom I count many friends, have a clear duty before them of lodging an emphatic protest against this unscientific attitude of their Governments; otherwise science will destroy all that it has created for the good of mankind. On no account should a decent scientific man agree to a procedure of abject secrecy in a matter which has such enormous potentialities as the atomic energy.[5]

The scientist's Utopia then, was a world that resembled a laboratory with permeable walls. The annihilation of space and time were as much a scientific

responsibility as a political duty. For the scientist's world was one envisioned without national boundaries where 'political controversies will not be analysed from a racial, parochial or emotional perspective, rather, they will be examined "from the broader view of sound sense" which will make it possible to consider how they affect the world as an organic whole. Culture too would have to abandon its narrow nationalist definitions:

> Culture instead of being Greek, Roman, Indian, Egyptian or British will rather acquire prominence as human culture. It may be a hotch potch of a great many diverse achievements, but like the American race which has shown a unique genius for a racial and cultural synthesis in the modern world it will be a distinct entity worth acquiring and developing.[6]

Bhatnagar's portrayal of culture without national frontiers logically followed from his delineation of the "One World" Utopia. It was a world where perfection was sought through science and which harboured universal and cosmopolitan dreams. Indeed, Bhatnagar's idea of a scientific utopia resonated in the conceptualization and construction of science institutions in independent and modern India. It also represented liberalism's dreams of freedom and unfettered development. The end of World War II and the coming of Indian independence formed the twin contexts of Bhatnagar's scientific utopia. Visions for science in

[5] *Ibid.*,p. 2.
[6] *Ibid.*, p. 4.

India, however, did not exist in isolation, nor were they of recent provenance. As early as 1938, the National Planning Committee that the Congress had put in place when Subhash Chandra Bose was Congress President had articulated the role science would play in the life of the new nation. The National Planning Committee with Jawaharlal Nehru as its head drew on the advice and guidance on scientists, industrialists and economists. It was joined by scientists like M.N. Saha and J.C. Ghosh, industrialists like Puroshotamdas Thakurdas, Walchand Hirachand and Ambalal Sarabhai and economists like KT Shah. This miscellaneous group served as a "common platform where people from different walks of Indian society collaborated to plan national reconstruction."[7] The disruption caused by the outbreak of World War II the following year and the beginning of the Quit India agitation in 1942 brought the work of the Committee to a halt. However, most of its members remained committed to science, technology and industrial development in the years that followed. As early as 1937, Jawaharlal Nehru had declared:

> It is science alone that can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people... Who indeed could afford to ignore science today? At every turn we have to seek its aid... the future belongs to science and

[7] Jagadish N. Sinha, "Science and the Indian National Congress" in Deepak Kumar ed., *Science and Empire: Essays in Indian Context*, Delhi: Anamika Prakashan, 1991, p. 169.

those who make friends with science.[8]

After the coming of independence, it was Nehru's consistent support for science as the first Prime Minister of India that enabled science institutions to thrive. However, in the years that directly preceded Indian independence, the Indian National Congress was not the only influence on the scientific community. During the War and immediately after that, the emerging scientific community had become increasingly aware of the influence it could exert on the politics of the new nation. It is not surprising therefore that this community of Indian scientists imagined themselves as belonging to a larger community of international scientists with whom they could speak the same language and at the same time see themselves as taking a position within the new nation state that was similar in power, prestige to their international counterparts. The freedom of decision-making that the coming of independence promised unleashed new synergies between the state and scientific communities. It also placed scientists like Bhatnagar and Homi Bhabha in a position of leadership where they could envisage conversations with the world where they spoke as equals.

Bhatnagar's radio talk on the scientist's Utopia, also raised interesting questions about the relationship between science, nation building and ways of being a scientist-citizen. Bhatnagar's idea that scientists belonged to a community that was miraculously liberated from notions of territoriality reflects

[8] Quoted in Atmaram, "The making of Optical Glass in India:Its lessons for Industrial Development", *Proceedings of the National Institute of Sciences of India* (1961), 27, pp. 564-5.

the larger ideology of liberal thought within which the idea of citizen-scientist was nurtured. These ideas played themselves out in several institution-building practices in independent India. Homi Bhabha's institution – the Tata Institute of Fundamental Research in Bombay was one such.

Science sans frontier and the notion of citizenship

Bhabha's Institute presented a unique setting for the playing out of Bhatnagar's visualization of a scientist's utopia. The institute that Bhabha built was implanted in a matrix that resonated with the hope of integrating human cultures while remaining simultaneously committed to national capacity building.

But if the scientist's Utopia was literally, what its name implied, i.e., "no country," then how could Indian scientists belong to it and still remain Indian? In other words, what notions of citizenship did such a utopia conceive of? As an enterprise, science was always perceived as universal, addressing a global audience. How did such an ecumenical endeavour define its Indianness? The period of preparation that preceded Indian independence was one which had formulated several answers. For M. Visesvaraya the answer involved "familiarizing" the "Indian mind" with the "principles of progress" and awakening in Indians the "universal impulse for enquiry and enterprise." Visvesvaraya hoped that "self-reliant nationhood" would emerge through the forging of a new relationship between citizen and nation that would be

"purposeful," "progressive" and "self-respecting."[9] On the eve of Indian independence, such questions surfaced in different guises again and again. For Homi Bhabha, who shared Bhatnagar's ideals of universality for science, political freedom gave India the opportunity to adopt and create the notion of a citizen that transcended the narrow boundaries of territoriality.

In a letter to Maulana Abul Kalam Azad, the Minister for Education in the Provisional Government, written three weeks before India became independent, Bhabha urged that the newly constituted state reflect on who was an Indian citizen. Speaking about post-war America, Bhabha wrote:

> ...the United States has followed a policy in cultural and scientific matters despite the fact that its immigration laws in other respects are extremely rigorous. It has followed a policy of welcoming to America any men of distinction in the sciences, letters or arts who wishes to make America his home.[10]

It is worth recollecting that questions about citizenship were articulated at that juncture within the context of huge numbers of displaced populations as a direct consequence of the Partition of India. By contrast, the immediate setting for Bhabha's communication with the "Maulana Saheb," was essentially liberal and almost apolitical. A committee that was in-charge of selecting paintings for

[9] M Visesvaraya, "Preface," *Reconstructing India*, 1920.
[10] HJB to Maulana Abul Kalam Azad, July 24, 1947, p. 4. TIFR Archives, D-2004-00004.

an art exhibition in London later that year had rejected the work of Magda Nachman Acharya, an exiled Russian painter. Nachman a communist, was an Indian citizen by marriage and had spent more than two decades in India. Nachman-Acharya painted Indian subjects and as such saw herself belonging to the Indian milieu. Bhabha argued that the rejection of her paintings were unrelated to the style in which she painted, for "half a dozen of the pictures chosen by the committee are painted in purely European style, and practically all the others show the unmistakeable influence of European art." Bhabha feared that the grounds on which Magda Nachman's paintings were rejected had more to do with her European origins. Expressing his concern that the committee had taken a very narrow and parochial view of the identity of the Indian painter, Bhabha cited three examples of artists who transcended such confining categorization: Picasso, who despite his Spanish origins was always included in exhibitions in France, Amrita Sher Gil, who was Indian and Hungarian at the same time, and Simki the French dancer without whom Uday Shankar's troupe could not have functioned.

Bhabha then went on to elucidate why it was important for India not only to cultivate and adopt broader definitions of citizenship, but also synthesize a new vision for Indian art. Bhabha's substantive conception of artistic freedom was equally matched by his substantive conception of scientific freedom. As he rationalized: "Art like Science knows no frontiers."

In the context of the 1940s and 1950s, Bhabha's hopes found a political resonance in the discourses of internationalism articulated in the legacies in the Bandung conference.[11] Moreover, his ecumenism was positioned against the cultural nationalism which advocated the establishment of narrow, closed societies. Instead, Bhabha promulgated a liberal nationalism that was "characterized by plurality and openness, structured along the lines of ethical individualism" and placing, as we shall see, "a strong emphasis on choice."[12] Within such a framework, the scientific institution was one which was distinguished by its openness. Bhabha attempted, at TIFR, a redefinition of space for science. Science would have to be serviceable to the nation; it had to be a tool of nation-building, but simultaneously the institutional space for science that Bhabha was intent on building at TIFR had to be a space without boundaries. Thus an interesting dynamic was brought into play between scientific nationalism and scientific internationalism which directed the recharacterization of institutional space of science as unfettered, free of national boundaries. Writing a historical note on his Institute, on the eve of the foundation stone laying ceremony on January 1, 1954, Bhabha wrote:

> Fundamental research thrives best in an atmosphere that is free, permitting an unrestricted exchange of ideas. An institution for fundamental research should be open to all scientists of eminence, *whatever the country to which they belong,* and should be

[11] For a comparative perspective of the two conflicting discourses of internationalism in Asia, see Sunil S. Amrith, "Asian Internationalism: Bandung's echo in a colonial metropolis" in *Inter-Asia Cultural Studies,* 6:4, Dec 2005, 557-569.

> unfettered by the secrecy regulations required in commercial and strategic establishments. [emphasis mine.] [13]

Many of the international scientists whom Bhabha invited were victims of political upheavals in their own countries. Thus in 1948 when the civil war in China had intensified, Bhabha along with D.D. Kosambi had written to the mathematician S.S. Chern who was then at the Mathematical Institute of the Academia Sinica at Nanking. Chern had founded his Institute after his returned to Shanghai from Princeton in 1946.

> Kosambi and I have read with concern of the spread of the war in China and the approach of the fighting to the region where your Institute is located. Although we know the patriotism which prompted you to prefer to work in your own country despite the many attractive offers from abroad, we realize that the present conditions must make work in your neighbourhood extremely difficult, if not impossible. ...I am therefore, writing to offer you the hospitality of this Institute, and to enquire if you would like to spend one year in the first instance with us as a Visiting Professor?

---

[12] Yael Tamir, *Liberal Nationalism*, pp. 83-84.
[13] HJ Bhabha, "Historical Note on the Tata Institute of Fundamental Research," 1954, pp. 15-16.

The offer was also extended to any of his close collaborators whom Chern might wish to bring along.

> If you desire that some of your close collaborators should come with you, will you please let me know their names and their academic status so that, if possible, we might be able to do something for them too.[14]

By the time, the letter reached him, Chern, who had spent some time at Bhabha's Institute in 1946-47, had already accepted Oppenheimer's offer of a position at the Institute of Advanced Study at Princeton. He wrote back about his deep gratitude "for the concern of my foreign friends, which has never failed me."[15]

A similar example from Cosmic Ray Physics is represented by the Cosmic Ray Physicist, Bernard Peters (1910-1992). The Peters family, Polish Jews, had moved to Germany in 1912. At the age of 22 he was run away from the Concentration Camp at Dachau in Nazi Germany and arrived at the USA as a fugitive. Beginning his scientific career as Oppenheimer's student at the University of California, Berkeley, Peters' worked on Cosmic Rays. After completing his Ph.D. in 1942, he spent three years working on the Manhattan

[14] D-2004-0004.
[15] D-2004-0005.

Project. Peters had then joined the University of Rochester, where he was Assistant Professor of Physics. Peters then did collaborative work with the Minnesota Cosmic Ray group which lead to breakthroughs in the measurement of heavy primaries.

In 1949 Oppenheimer's testimony in the House UnAmerican Actitivies Committee had labelled Peters as 'a dangerous man and quite Red'. Needless to say, this had done considerable harm to Peters despite Oppenheimer's attempt to undo the damage in his letter to a Rochester newspaper, which stated, 'I have never known Dr. Peters to commit a dishonourable act, nor a disloyal one'. Such statements did little to dispel the controversies around Peters. Although Peters could keep his job at Rochester, his foreign travel was considerably restricted.

Peters had met Bhabha in 1948 and discussed the possibility of undertaking a joint project with TIFR that would take high altitude measurements of cosmic radiation at Magnetic Equator by photographic plates at Bangalore. Peters had a grant from the US Government for undertaking this research, and apart from expenditure like travelling and halting allowance to the members of the Institute who would accompany Peters to Bangalore, the Institute did not anticipate substantial expenditure as Peters was expected to pay a proportionate share of costs of photographic plates etc. As the minutes of the 16th Council meeting held on March 9, 1949 show, Bhabha was "considering the question of offering a visiting professorship to Dr. B. Peters of the Rochester University and Dr. Peters had signified his willingness to accept the appointment

for a year or two provided Mrs Peters who was a trained and practicing doctor with research experience in gynaecology and cancer was able to obtain a suitable appointment in Bombay."[16]

Although Peters was expected to start his experiments in March 1950, he was refused a passport by the US government. He arrived later that year and finally started his experiments in Bangalore in October 1950. The following year, in 1951, he was invited by Bhabha to join TIFR as Professor in Experimental Physics. Peters stayed on for eight years, during which period he directed the balloon flights programme of the Institute, which achieved several breakthroughs.

The balloon experiments and the discovery of new elementary particles indicated the ways in which simple techniques could be used to make path-breaking discoveries. Peter's played a central role in training scientists like Yash Pal (who went on to head the Space Applications Centre at Ahmedabad, the University Grants Commission and is currently the Chancellor of Jawaharlal Nehru University) and Devendra Lal (currently Professor of Nuclear Geophysics at the Scripps Institute of Oceanography, La Jolla). The leadership role played by scientists at TIFR could be attributed to their extended exposure to international science and interactions with scientists like Bernard Peters. There were also networks of scientists who visited the Institute giving lectures and seminars which enabled the adaptation of the processes of science into a new environment.

[16] Extract of minute from ND Godbole's correspondence, TIFR Archives, D-2004-00315.

Although the "conditions were not equal"[17] to the environment within which international scientists worked, the mode of formal and informal interactions that such prolonged visits sustained, created an environment for scientific practice that fetched results that were admired and appreciated internationally. It was this environment that encouraged experimentation and equipment building that formed the basis of cutting edge science at the Institute and it is one example of equipment building that we will now turn.

Of men and machines

Among the other first appointments at the institute were two Mathematicians, D. D. Kosambi and F. W. Levi. Writing to Sir Sorab Saklatvala about Kosambi's work on tensor analysis, path geometry and statistics, Bhabha wrote that apart from the applicability of the mathematics Kosambi would be a great asset to the institute. Kosambi, Bhabha wrote to Saklatvala "besides continuing his own research in mathematics…would be in a position to lecture to the students on those branches of mathematics which would be required in their research."[18] The interest in calculating machines began around the same time. Both Bhabha and Kosambi seemed interested in acquiring one for the Institute. Kosambi, moreover had tried in 1946 to design a Kosmagraph with the help of McCabe. As he wrote to Bhabha who was visiting England at the time, his scheme had been unsuccessful on account of the lack of cooperation from McCabe.[19] Bhabha's letter to Kosambi had mentioned his discussions with Julian Huxley

[17] Several scientists I interviewed used these words even as they recounted how they felt equal to all their international peers.
[18] Homi Bhabha to Sir Sorab D Saklatvala, May 9, 1945, TCA, DTT/TIFR Box 194.

and the possibility of starting a Mathematics Institute funded by the UNESCO at the Institute. In his response, Kosambi had argued, such an Institute would need not only an ordinary arithmetic calculating machine but also an IBM machine.[20]

There was perhaps inter-institutional competition for a Mathematics Institute and the associated machines. Kosambi feared that PC Mahanolobis would object to such an Institute being housed at TIFR. Mahanolobis's needs at the Indian Statistical Institute were however different and in many ways easily met with either an IBM machine or a Holerith punched-card machine. "The differential analyzer and such instruments are not for them."[21] Two years later, Kosambi was sent on deputation for one year. The Council in its resolution granting Kosambi deputation noted that "During his deputation, besides his work on pure mathemtics, Professor Kosambi would study the development of the latest type of calculating machines."[22] There is no record of Kosambi's recommendations after his return from the United States in 1949.

The limited availability of foreign exchange and the need for a modern calculating machine remained a matter of concern. In January 1948, Bhabha visited Princeton for a day and had a long conversation with Von Neumann about calculating machines.[23] Summarizing his discussions, Bhabha wrote the same night to von Neumann:

---

[19] DD Kosambi to Homi Bhabha, dated August 14, 1946, D-2004-00002.
[20] *Ibid.*
[21] *Ibid*.
[22] Minutes of the 13th Meeting of TIFR Council, February 27, 1948, Resolution 8.
[23] HJ Bhabha (New York) to DD Kosambi, January 9, 1948, D-2004-00387.

> I think you also expressed the view that it might be a mistake to put a machine of this sort in an institute where it would run all the time on routine calculations as would be the case if it were put in a statistical institute. It would be preferable to put it in an institute were it would be used only part of the time on the problems of the institute so that other institutions might also have a chance of using it.[24]

Obviously inter-institutional competition had much exercised Bhabha. In his reply, von Neumann agreed with Bhabha's general "philosophy" about the use of high-speed calculating machines that would be available in the future:

> I think it would be very desirable to have the machine run under a system of organization which makes it accessible to many scientific groups and guarantees a wide and varied use.[25]

In the years that followed Bhabha also had discussions with Sir Maurice Wilkes who was the director of the Mathematical Laboratory of the University of Cambridge. Wilkes had successfully worked on a stored program computer the EDSAC (Electronic Delay Storage Automatic Calculator) which began operating from 1949. That same year, Dr. DY Phadke who earlier taught at the Xavier's

[24] HJ Bhabha to John von Neumann, January 9, 1948, D-2004-00475.
[25] John von Neumann to HJ Bhabha, February 3, 1948, D-2004-00475

Technical Institute joined TIFR to lead the newly established Instrument Section. It was Phadke who was the force behind many of the instrumentation initiatives of the Institute – from various electronic circuitry, vacuum tubes to the Institute's accelerator programme. Work on the first digital computer began only after Dr. R. Narasimhan joined the Institute.

When R. Narasimhan joined TIFR in 1954, he had an MSc in Telecommunication Engineering from Madras University, an MS in Electrical Engineering from Caltech and a Ph.D. in Mathematics from Indiana University. Encouraged by the founder, Homi J. Bhabha, Narasimhan and his team started work on a pilot machine in 1954. One of the justifications articulated at that time for TIFR building its own computer was that "Various universities had built or were building their own computers." [26] This was consistent with the foundational vision of the Institute: to become comparable to Princeton or Cambridge.

TIFR was the first Institute in India to build its own computer. It was, however, not the first Indian Institute to possess a computer. Mahanolobis's Institute had acquired an analogue computer in 1950 and later in 1955 acquired a HEC- 2M specially crafted and designed by Professor AD Booth at Birkbeck College, London. The ISI machine was a 16-bit machine, with 16 instructions. It operated in machine code with its drum memory of 1024 words. It used punched cards and gave out punched cards. ISI had purchased the machine for Rs

[26] DY Phadke to the Council, dated April 16, 1962.

200,000.[27] As Narasimhan recalled the ISI machine was "one of a kind, not really a mainstream computer. It had no future."[28] The TIFR machine on the other hand, was based on the von Neumann report.[29]

Narasimhan recalls that the technologically rich atmosphere and the interdisciplinary culture of TIFR at that time were very conducive to his work:

> A very important aspect of the personalities of Bhabha and Sarabhai (that has not been discussed much in accounts of them), was their high technological literacy, not merely in doing science but in a variety of other areas for example, in management and administration, in organizing space in architecture and so on.
>
> Bhabha's appreciation of the crucial importance of technological literacy and a technological culture in doing highly creative work in an institution devoted to fundamental research may be seen reflected in all aspects of the functioning of TIFR. TIFR is a technology-rich place. Productivity of average individuals goes up in technology-rich environment. According to Blackett: "A good

[27] Subroto Bagchi, *DataQuest*, January 1985, pp. 46-47.
[28] Interview with R Narasimhan, May 11, 2005, TIFR Oral History project.
[29] *Ibid.*

> laboratory is one in which even mediocre scientists can do good work.[30]

The pilot model, completed in November 1956, used a Ferrite core memory instead of William's memory, had a capacity of 256 words, word length of 12 bits, a logic scheme that was parallel, asynchronous, fixed point, single address, used paper tape and Teleprinters as output devices and a total power of 10kw.

The construction of the pilot machine proved to be not just the testing ground for ideas in circuit design, logical system design, engineering design and fabrication techniques; it also trained the team, none of whom, apart from Narasimhan, had had any previous experience of using or operating a computer, let alone building one.[31]

Narasimhan's machine was based on the ILIAC – the machine built at the University of Illinois, Urbana where Narasimhan had spent some time. This connection was particularly fruitful because when Narasimhan felt unable to proceed with the control, it was the computer group at Illinois that had made their control logic scheme available to him.[32] The pilot machine was tried out in the restricted space of the Old Yacht Club – the second home of the Institute.

---

[30] R. Narasimhan, "Men, Machines and Ideas: An Autobiographical Essay," *Current Science*, Vol 76, No. 3, February 10, 1999, p. 448.
[31] The team at that point had Minoo Dosabhai, SP Srivastava, MM Farookhi, DS Kamat, BK Basu and KS Kane.
[32] Interview with R Narasimhan, May 4, 2005, TIFR Oral History project.

The second phase of the project focused on building the TIFRAC. The hardware in the central processor of this machine used 2700 Vac tubes, 1700 Geramanium Diodes, 12,500 Resistors. Using a Ferrite core memory , the TIFRAC had a capacity of 2048 words, a memory cycle time of 15μsecs. Its memory cycle time as well as 40 bit word length were both higher than the first generation IBM (IBM 701). The addition and subtraction time was 45μsecs and the Multiplication and Division time was 500μsecs. The TIFRAC used paper tape and a teleprinter and a total power of 20 kw. Once the main computer was assembled, peripheral hardware such as a CRT character display was built using a Memotron tube. Using the same plug-in modules of the TIFRAC, a magnetic tape backup storage was developed and added later.

The main computer was ready in 1959 and installed in the new building in 1960 (See Appendix 1). As Narasimhan recalled the machine was not commissioned until the move to the new building because of the lack of adequate air conditioned space.[33] In the following year, Narasimhan built the subroutine library and trained programmers who would be able to assist the users.

The TIFRAC was named TIFR automatic calculator by Prime Minister Nehru in 1962. The machine ran from 1960 to 1964. It was used by research scientists from the Bhabha Atomic Research Centre, Trombay, the Crystallography group of Madras University and the Cosmic Ray Group of TIFR

for data analysis. By 1964, the TIFRAC operated in two shifts every day as scientists from government laboratories, educational institutes and private organizations from all over India used it for their computational needs thus translating into action the Bhabha and von Neumann's "philosophy" of the use of computers. The larger international networks therefore also influenced the way in which scientific work would be carried out in the Institute. This perhaps was the Institute's singular difference with other institutions in Calcutta that also had computers in the early 1960s. The idea of sharing computer facilities with other institutions and making TIFRAC available as a nation-wide facility was also part of the mind-set of the citizen-scientist – scientific equipment were meant to be shared as they provided the ground for training, their processes had therefore to be disseminated widely.

It was not however, the vision of only one man that sustained this larger vision within the scientific culture at the Institute. The cosmopolitan nature of the city of Bombay where TIFR was located was an equally important factor in making this kind of scientific engagement possible.

Bombay and the impact of cosmopolitanism

For Nissim Ezekiel, a poet of twentieth century Bombay, the city "burnt like a passion." "Deprived of seasons, blessed with rains" this "barbaric" city with its "million purgatorial lanes," symbolized the poverty and deprivation of post-War urban spaces. And yet, the very diversity of population of Bombay where

[33] Interview with R Narasimhan, May 11, 2005, TIFR Oral History project.

"many-tongued" men toiled for "words and crumbs" seemed to possess the power to reorient and realign the narrowness of regional identities and reshape and transform it into a cosmopolitan urban identity. For Ezekiel and Mulk Raj Anand who spent their working lives in this city which was the most modern among Indian cities, the rush of humanity in Bombay represented an energy that made possible a new form of engagement that enabled one to abandon the provincial and embrace a larger cosmopolitan sense of belonging.

In wartime Bombay, this cosmopolitanism was not confined to the mingling of Indian groups alone. The city had witnessed the arrival of a group of Jewish refugees from Austria and Germany over a period of time; among them were Walter Langhammer and Emmanuel Schlesinger, Austrian citizens who had left Europe following the rise of Nazism, and Rudolph and Albrecht von Leyden, who had arrived in the mid-thirties and had become British citizens. Walter Langhammer, an artist at the Vienna Academy had joined the Times of India as its first art director in 1939. Rudolph von Leyden had also joined same newspaper as its art critic shortly afterwards. Langhammer went on to support young painters from Bombay encouraging them to paint in a "new" distinctive style that marked them out from the academic painters of Bombay. While Rudolph Von Leyden, through his columns, espoused the cause of the young modernists artists, thus fortifying their position; as Krishen Khanna would put it many years later, "our gain was incalculable."[34] The young progressive artists of

[34] Krishen Khanna, "To Rudolph von Leyden: A Letter out of Season," in Anil Bhatti and Johannes H. Voigt, *Jewish Exile in India, 1933-1945*, Manohar, Delhi, 1999, p. 187.

Bombay in the 1940s gathered at his *atelier*, among them, K.H. Ara, F.N. Souza, M.F. Husain, Sadanand Bakre. Raza and Gade. This group founded the Progressive Artists Group (PAG) in 1947.

Writing a manifesto for the group in 1948, Francis Newton Souza wrote: "Today we paint with absolute freedom for content and technique, almost anarchic." Souza's anarchism and the freedom he advocated were both international in character and stood in sharp contrast to what they perceived as the "narrow grid of nationalism" and the sentimentalism that expressed itself in the Bengal School for example. The influence of Langhammer and the art critic Rudi von Leyden revealed itself in the typically "modernist" concern with the human condition and the style of early twentieth century modernist art. The group thus placed itself directly within a cosmopolitan modernity, even though they were not unified by one single aesthetic. In their work they attempted to balance nationalism with internationalism and exemplify the relationship between urban and rural India. The PAG summarily denounced the painting of Rabindranath Tagore for being self-obsessive and introverted, Amrita Sher-Gil for being too much of a hybrid and Jamini Roy for being lacking in sophistication. Apart from the six founding members, the artists associated with the PAG included most of the significant artists working in Bombay in the 1950s. Associated with the group were V.S. Gaitonde, Krishen Khanna, Akbar Padamsee, Tyeb Mehta, Ram Kumar and Bal Chabda.

Their undeniable talent, their professionalism, and their intense dedication to their art was first spotted by novelist and art critic, Mulk Raj Anand who at the opening of their first exhibition in 1948 spoke about the urgency of providing a platform for a new voice. Homi Bhabha, a connoisseur of the European modern masters was perhaps as attracted to this new voice which also exemplified internationalism and a spirit of freedom.[35] With the permission of the Prime Minister, Jawaharlal Nehru, Bhabha began spending 1% of the Institute's annual budget on purchasing works of art.[36] As a result the Institute today houses a very significant collection of Modern Indian art.

Bhabha's interest in art and his proximity and friendship with the Laghammers, Rudi von Leyden, Karl Khadelwala and Kekoo Gandhy as well as the support he received from his companion Mrs Phiroza Wadia, enabled him to develop the art collection of the Institute. As Kekoo Gandhy recollects:

> We had previews for Homi Bhabha, which is why the Tata Institute of Fundamental Research (TIFR) has the best private collection of the 1940s art. The contagion spread among our set from Langhammer and Leyden to Homi Bhabha and Farookh Mulla, PRO of the Tatas. They were all patrons of the Chemould shop.[37]

[35] Gita Chadha and Vidya Kamat, "A Scientist's patronage of art: Homi Bhabha's art collection", *Humanscape*, IX: viii, August 2002.
[36] Chintamani Deshmukh, *Homi Jehngir Bhabha*, Delhi: National Book Trust, 2005, P. 61.
[37] Kekoo Gandhy, "The Beginnings of the Art Movement" (as told to his granddaughter Anisha Imhasly, *Seminar: The City of Dreams – A Symposium on the many facets of Bombay*, # 528, 2003.

The Institute's art collection began in February 1952 with the purchase of a painting similar in style to early European post-impressionism by G.M. Hazarnis titled 'The Window'. That same year, Krishnaji Howlaji Ara had won the Gold Medal of the Bombay Art Society. It is hardly surprising, therefore, that the second painting purchased by the Institute should be Ara's water colour, "Window Light." This marked the beginning Ara's special relationship with the Institute which persisted long after the founder's death in 1966.

By 1961, the Institute's art collection included most of the Progressive Artists from Bombay – F.N. Souza, M.F. Husain, Sadanand Bakre. Raza, Gade, Gaitonde to name only a few; as well as a whole range of Modern Indian artists such as Hebbar, Badri Narayan, A.M. Davierwala, Shiavix Chavda and Laxman Pai. Apart from that early works of Ganesh Pyne and K.G. Subramanium were also bought during Bhabha's time. Nor was the collection confined only to Indian artists. In 1954 Bhabha purchased one of Jacob Epstein's bronze heads of Einstein for the extravagant sum of Rs 3818.72. Like his other purchases of art this too attracted much criticism and objections from government auditors.[38]

[38] Six months after his death, at the fiftieth meeting of the TIFR Council which included among others JRD Tata, MGK Menon and Vikram Sarabhai, a letter from Marlborough Fine Arts Limited London was discussed. This letter informed the Council that the bronze head of Einstein had sold at Sotheby's for £2100 in July 1964,. The Institute had paid £ 200 for it in 1954. Council Minutes TIFR, June 29, 1966.

Not one to remain inhibited by public opinion that went against his belief in the importance of aesthetics to science, Bhabha launched an ambitious plan to invite Picasso to India to execute a mural for the Institute. Referring to a previously held conversation, he wrote to "the sage" J.D. Bernal, crystallographer and biologist in 1962: "We talked about the possibility of interesting Picasso in this." Aware that he could not possibly pay for the Spanish master, Bhabha offered to pay his fare, house him at the Taj and organize trips to Agra, Ajanta and Ellora and other historic architectural and artistic sites.

Bhabha had met Bernal during his stay in England. Their connection continued even after Bhabha's return to India. Indeed, Bhabha's close associate. P.M.S. Blackett, who was also an advisor to TIFR had aligned himself with "Bernalism" – the "scientists for social responsibility" movement in England, which advocated a combination of science and socialism as the answer to economic and social problems. Bernal was not only close to Pablo Picasso, his flat which was just above his Biomolecular Research Laboratory at Birkbeck college, London had a mural done by Picasso. This was the only mural that Picasso executed in England. Bhabha's plan to invite Picasso to his Institute however, did not work out. What lay behind Bhabha's idea of an inclusive citizenship for immigrant artists and his deep interest in the cosmopolitan aesthetics nurtured by the Bombay Progressives? His keen interest in sharing this with his young colleagues reflect the idea of a different pedagogy through which the sensibilities of the citizen-scientist could be refined. Scientists of Bhabha's institute were being envisaged not only as leaders in an expert-led world but also as

connoisseurs capable of holding conversations with the world. Bhabha's invitation to M.F. Husain to paint the mural at the entrance foyer of his Institute illustrate the dual nature of his laboratory.

Husain's mural "Bharata Bhagya Vidhata"

Unable to get Picasso, Bhabha invited a number of artists from Bombay in September 1962 to attend a meeting to discuss the mural. A telegram was sent to N.S. Bendre in Baroda to attend the same meeting. Finally, in October 1962, the Institute invited twelve modern Indian artists to submit preliminary designs for a mural for the wall inside the entrance hall of the new building. The artists were required to submit a design for a mural for the entrance hall 45' long and 9' wide. As the invitation letter from N.R. Puthran, the Registrar of the Institute put it:

> The mural is intended to be a tribute to Indian art, and a stimulus the aesthetic sensibility of the many young scientists who pass through the building.[39]

The Institute had set aside Rs 15,000 for the finished mural. The preliminary sketch was to be 9' 8" and 2' wide, and the artist would be paid Rs 800 for it. The invitation also clarified that apart from the public announcement that invited artists to submit designs, the Institute was inviting several artists. The nine artists who responded to Bhabha's invitation and to the advertisement

[39] TIFR Archives, D-2004-01014

were K.H. Ara, N.S. Bendre, Satish Gujral, K.K. Hebbar, M.F. Husain, B. Prabha, Badri Narayan, G.M. Solegaonkar and R.D. Raval.

The senior-most among contemporary Indian artists, Jamini Roy was also invited to contribute. Roy's painting titled "Krishna and Balarama" was purchased in 1963. Since Roy's piece is similar in size to the preliminary sketches for the mural, it has led to the speculation that Bhabha rejected this piece for the mural as it was not "modernist enough."[40] Archival evidence, however, suggests otherwise. Jamini Roy's reinvention of the Kalighat idiom in his paintings had made him one of the most significant artists of the twentieth century; when Bhabha wrote to him personally in October 1962, it was in full awareness of his distinctive artistic reputation:

> In view of the eminent position you occupy among the artists of today and the fact that you are so to speak the doyen of contemporary artists in India, … it is clearly understood that your design will not be considered for competition with the rest, but as a work of art which we would treasure as part of the art collection of the Institute.

Roy was also accorded special respect for being the senior-most among the invited artists and paid Rs 1000 for his piece. Reflecting a vision of an inclusive

[40] Gita Chadha and Vidya Kamat, "A Scientist's patronage of art: Homi Bhabha's art collection", *Humanscape*, IX: viii, August 2002.

contemporeity, Bhabha went on express his admiration for Roy's "pioneering and original contributions to Indian painting." Wishing to capture the entire range of Indian modern art that included experiments in Bengal as well as Bombay, Bhabha wrote:

> I may mention in this connection that the Institute has one of the best collections of contemporary Indian art in the country, and the absence of any painting by you is a serious lacuna which we wish to fill. [41]

The mural in the entrance hall, therefore, also became the occasion to add to the Institute's art collection. The final design had to visually crystallize a form that could confront the strength and solidity that the building represented. "We intend," the Registrar's letter had declared, "to survey a wide range of artistic possibilities which are in harmony with the aesthetic concept of our building."

The modernist urbanism of the building demanded an aesthetics that was equal to it. It was the modernist idiom and aesthetics that formed the basis on which the nine artists who had submitted designs for the mural came to be judged. The four member committee that was appointed to assist Bhabha in selecting the mural, was made up of two art critics Mr Karl Khandalavala and Mr Rudi Von Leyden, the eminent mathematician and head of the Institute's school of mathematics, K. Chandrasekharan who was an amateur painter himself and Bhabha's companion, Mrs Phiroza Wadia, who was an art connisseur. Since

Bhabha himself was travelling, the committee shortlisted the entries of R.D. Raval and M.F. Husain. Finally, after Bhabha's return, the paintings were reviewed once more and Husain's piece "Bharat Bhagya Vidhata" was chosen unanimously. After summarizing the views of the committee, in a note dated April 29, 1963, Bhabha wrote: "The consensus of opinion is that the Husain is to be preferred."

Husain's relationship to the Institute was at that point, almost a decade old. Two of his water colours "Yellow Fare Tempura" and "Mother and Child" entered the Institute's collection in February 1954. Five years later, the Institute purchased two oils "Lamp" and "Nritya," and in 1961 added to its collection two more oils "Ragmala" and "Horses." Husain's deft line, considered his strongest element, his use of a range of textures and the richness of his compositions is amply evident in all of these. In what appears as a reversal of the patron-artist relationship Bhabha had sketched the young Husain in January 1961. On April 29, 1963, when summing up his personal reasons for choosing Husain over Raval, Bhabha rationalized:

> ...the Raval, though elegant is more manneristic, and it is possible that it may wear less well with time. The Husain seems to me a more substantial and enduring composition and in view of my knowledge of the artist's finished pictures, I would expect that the full-scale mural will be richer in texture and detail than

[41] TIFR Archives D -2004-01014

> the sketch. In the light of Raval's present style, it is doubtful whether the full scale mural will be any richer in texture or detail than the sketch.[42]

Husain's mural "Bharat Bhagya Vidhaata" which echoed the second line of the Indian national anthem also reflected the artist's commitment to the complex concept of the modern nation. India, as he said on a different occasion, "was never a nation…this is the first time it is struggling to become a nation. It might collapse…the very fact that it is struggling is dangerous and exciting."[43] Husain's composition captured the "historical moment of transition, triumph, celebration and anticipation" of modern post-colonial India. In style it manifests a mingling of Indian and western schools of painting, demonstrating an Expressionistic dynamism and flourish of brushwork alongside the minaturist's traditional usage of line to divide the planes and forms.[44] In many ways it fulfilled Bhabha expectations of post-independence, modern Indian art. In his letter to Maulana Abul Kalam Azad written in 1947, mentioned earlier, he had articulated the hope that: "with its newly achieved freedom, India will become the leading country of Asia and one of the leaders of the world in cultural matters." According to him, excellence in the artistic sphere could be achieved only by the 'creation of new art forms, possibly through a synthesis of the ancient Indian and European traditions in art. Husain's mural not only achieved that synthesis but also

[42] TIFR Archives, D-2004-01014.
[43] Quoted in Haimanti Dutta Roy, M.F. Husain: An Iconoclastic Icon in *Art News and Views*, January 2012, http://www.artnewsnviews.com/view-article.php?article=m-f-husain-an-iconoclastic-icon&iid=29&articleid=804 accessed February 3, 2012.
[44] The Catalogue of the TIFR Art Collection,TIFR Archives.

expressed as Bhabha had hoped new Indian art would do, "the life of modern India which is socially and economically based upon modern science and technology."[45]

Speaking in 2009 about the mural that he executed at TIFR in 1964, Husain recounted the joy of sharing institutional space with the scientists.

> At TIFR, I got a room and my name was there on the door. There were scientist from all over the world, and they had their names on the door – and so did I![46]

Husain also revelled in the fact that he interacted with scientists and that Bhabha often came to watch him paint.

> I could have finished the mural in 2-3 months but do you know how much time I took? I took two years, because I wanted to spend time in TIFR![47]

Almost a decade after he painted the mural, Husain painted a series on art and science one of which he made available to TIFR scientists for their outreach programme publication for school children.[48] Another artist with whom Bhabha built and sustained a long-term relationship was KH Ara. Indeed, Ara's relationship with TIFR continued well after Bhabha's death. In fact, Ara would

[45] TIFR Archives, D-2004-0004.
[46] See the an elaborate excerpt of this interview in Indira Chowdhury and Ananya Dasgupta, *A Masterful Spirit: Homi Bhabha 1909-1966*, Penguin, 2010, p. 234.
[47] *Ibid.*
[48] Interview with Balu Venkataraman, 26.6.2007

preside over a children's art competition for the Department of Atomic Energy on Founder's Day (Bhabha's birthday was designated Founder's Day from 1970 onwards). Ara would not only interact with children, faculty and scientific workers of the DAE, he would also execute a painting before his young audience. He remained very close to the Institute until his death in 1985. Nurturing a relationship between scientists who worked at TIFR and one of the most significant artists of contemporary India demonstrates the way in which the pedagogy for creating artistic taste among Indian scientists worked.

Bhabha's way of world-making in which both artists and scientists participated was remarked on by Mulk Raj Anand in a posthumous letter he wrote to his friend Homi soon after he died in an air crash in 1966:

> "Apart from the stimulus you gave to your colleagues in Science, by long hours of work by constant debate and discussion with the youngest men and women, I remember how you infected them with your enthusiasm for the plastic and pictorial arts. The memorable day when you brought two fellow scientists to lunch with me to argue about George Keyt's pictures will live with me, because this led to the important exhibition of this contemporary avant garde painter of Ceylon in Bombay."[49]

Bhabha's efforts in creating "taste" among a younger generation of scientists articulated the importance he placed on the training of aesthetic sensibilities. Apart from the highly specialized professional knowledge, the scientists at his Institute had to be able to appreciate contemporary art. In this way, the scientist-citizen could therefore find a legitimate place within a wider international community. The world that Bhabha envisioned for his young colleagues had to be close to the world he had known in Cambridge as a young scientist. As I have demonstrated elsewhere, at Cambridge, Bhabah not only performed as part of the Cambridge Musical Society, he designed sets and was photographed by Lettice Ramsey.[50] It was this culture that Bhabha sought to build at his own Institute.

The reasons for modelling his institution on Cambridge are not difficult to guess. One of the consequences of western-educated Indians embracing liberalism was that liberalism rendered India and what was peculiar to India unfamiliar. Creating a science institution of the kind he was acquainted with in Cambridge and Europe was Bhabha's way of recreating on Indian soil what was familiar to him. This attempt was supported and indeed, enabled by the international cosmopolitanism that was peculiar to the Bombay of the 1940s and 1950s. The art collection then, housed, as it was in a science institution was one of the unexpected consequences of Bhabha's quest for the familiar. His search for

[49] Mulk Raj Anand, "In Memoriam", *Marg*, Vol XIX No 2, March 1966.
[50] See Indira Chowdhury and Ananya Dasgupta, *A Masterful Spirit: Homi Bhabha 1909-1966*, Delhi: Penguin, 2010, pp. 28-49.

the familiar, did not however, end there. In fact, it extended to other modes of fashioning his Institute.

Internationalism and architecture for science

Planning and constructing the building for the Institute was another important dimension of designing this scientific space. Unlike many of the large laboratories that came up under S.S. Bhatnagar's leadership in independent India, TIFR started without a permanent building. The land where the present building now stands was acquired only in 1953, almost eight years after the inauguration of the Institute in Kenilworth bungalow on Pedder Road.

"In planning the buildings of the Institute," Bhabha wrote in his Historical Note for Nehru in 1954, "the Council took the view that the latest and the best ideas should be incorporated."[51] Unlike the National Physical Laboratory [See Shiv Viswanathan] which relied on the CSIR and the Central Public Works Department to design and construct its laboratory spaces, TIFR appointed the American firm Messrs Holabird, Root and Burgee as the Designing Architects.

Inviting a "foreign firm" of Architects was not unheard of in India in the 1950s. Nehru had first asked the firm of Mayer, Whittlesey and Glass to design the city of Chandigarh. After the firm pulled out in 1950 the task was handed over to Maxwell Fry and Jane Drew who suggested that Le Corbusier should be the master planner. Le Corbusier, the Swiss architect and one of the founders of the

International Style created Chandigarh, a city that symbolized the tragedy of partition, as India's modern city, thus signalling the arrival of Modernism in Indian architecture. Le Corbusier's city, however, was not the only example of the International style in India. Louis Kahn's design of the Indian Institute of Management in Ahmedabad, used the International style with a variation by admitting local material. Both architects echoed the functionalist and conceptually minimalist aspects of the International style, taking special care to eliminate nonessential decorative elements. They represented the modernist influence on architecture in the India of the 1960s. By contrast, Laurie Baker represented alternative choices, incorporating in his buildings indigenous methods and materials. Bhabha's choice of architecture style and material was, as we shall see, a product of his particular cosmopolitan vision.

Bhabha's reasons for appointing Holabird, Root and Burgee were specifically related to aspects of design. This firm, was appointed because they had the required expertise in laboratory design, having built a laboratory for the US Atomic Energy Commission at Oak Ridge. But they also had "considered experience of tropical building." Bhabha cited the firm's experience in building in South America. However, the South American buildings that the firm had undertaken in Bogota, Venezuela and other cities in South America were hardly "tropical" in style. On the contrary, the Hotel Tequendama in Bogota or the Hotel Maracaibo in Venezuela both built by the firm, attempted to transplant the architectural styles of Europe and America onto non-Western landscapes.

[51] 'Historical Note, p. 13

Moreover, such buildings were part of a prevalent trend that characterized public buildings in Latin America of that period. These buildings were constructed in the international style that became the symbol of capitalism in America; in Latin America, such buildings reflected the cultural ambitions of its elites. The Hotel Tequendama or the Hotel Maracaibo hardly took into account local architectural forms or the available building materials. It is hardly surprising then that the TIFR building designed by Holabird and Root and Burgee expressed a modernity that was similar in scope, with a few important differences.

The designer of the new buildings of the Institute, Helmuth Bartsch was at that point, one of the partners in the Chicago firm, Holabird, Root and Burgee. Trained at the Technische Hochschule Charlotteburg in Berlin, Bartsch was a close friend of Ludwig Mies Van der Rohe, the last Director of Bauhaus who had rather reluctantly left Germany in the wake of the Nazi rise to power and joined the Illinois Institute of Technology, Chicago. Mies was to leave his imprint on several buildings in Chicago. Bartsch too was based in the same city at the firm Holabird and Root from 1926 onwards, becoming a partner in 1956.[52] Bartsch met Bhabha in the course of his travels and finally became the designer for the new building of Bhabha's Institute.[53]

[52] Oral History interview with Werner Buch (b. 1917) interviewed by Ines Dresel dated Chicago Architects Oral History Project, Chicago Art Institute, 2003, p. 42. Accessed on January 15, 2006 at www.artic.edu/aic/libraries/caohp/buch.html

[53] *Oral History of John Augur Holabird* (B. 1920) interviewed by Susan S. Benjamin, Chicago Architects Oral History Project, Chicago Art Institute, 2003. Accessed on January 15, 2006 at www.artic.edu/aic/libraries/caohp/hartray.html

The appointment of a Chicago architect for a construction project in India proved operationally complex. Bartsch would send his drawings to Bombay, which were then executed by a local architect Mr. Kanvinde, hired from the Council for Scientific and Industrial Research. There were inevitable delays and Bhabha noted "with displeasure" on March 4, 1954 that, "work on the new building had not yet started." By the next year, however, the governmental machinery had been set in motion and the finances for the project sanctioned by the Ministry of Finance in April 1955.

Writing a note about the building on the eve of its inauguration by Prime Minister Jawaharlal Nehru on January 15, 1962, Helmuth Bartsch recounted how in designing the building he had "worked with a client rather than for a client." Bartsch found that Bhabha "displayed unending interest and encouragement and constantly added intelligent suggestions and advice." He hoped, in the end, he had designed a building that would "not only fulfil its function but should afford a great deal of enjoyment."[54]

The simple rectilinear form of the TIFR building was horizontally orientated. The repetitive use of metal louvred windows in horizontal bands elaborated a grid; the metal-framed windows were set flush with the exterior walls with no ornamentation. The aluminium louvres kept out the harsh sun that was so typical of coastal regions in India. Bartsch also used floor to ceiling glass

[54] "Note by Helmuth Bartsch," *The Tata Institute of Fundamental Research: Inauguration of New Buildings, Bombay, January 15, 1962.* pp. 56-57.

on the ground floor – in the canteen and foyer. Emphasizing the sustained communication between the architect and scientists, that was used to coordinate function and aesthetics, Bhabha elucidated with some pride that such dialogue had resulted in the architecture of space within the new building becoming an illustration of Le Corbusier's description of a modern building: "A house, for a building is a machine to live and work in." The new buildings of the Institute he felt, would indeed be designed as a "machine, in that sense."[55] Bhabha's admiration of modern architectural forms exemplified in the constructions of Le Courbusier and Mies van der Rohe, emphasized aesthetic unity, often at the cost of social reality.[56]

If the style of the building excluded social reality, elements of nation-building that contributed to its making were always present and acknowledged. The use of aluminium frames in the windows as well as on the glass walls, stood testimony to the Bhabha's efforts at capacity-building within the new nation. Bartsch commented on the fact that 'every item was manufactured in India'. In his inaugural speech Bhabha explained the processes of manufacturing that he hoped had contributed to the Nehruvian project of nation-building through science:

> This building has taken so long to construct because
> we had to do a lot of pioneering in the course of it,

[55] HJB speech at Foundation Stone Laying Ceremony, January 1, 1954. TIFR Archives.
[56] For a discussion of the consequences of modern architecture's choice of aesthetic unity which indicated a choice of the sublime over the social, see Richard Sennett, "Places full of Time: Le Corbusier and Léger in New York," *The Conscience of the Eye: The Design and Social Life of Cities*, New York, Norton, 1990, pp. 169-202.

> pioneering that has resulted in permanent benefit to the country. For example, the aluminium companies in India were induced to extrude special sections for windows and doors in a rustles alloy resistant to corrosion by the warm sea air. The well-known firm, Messrs Godrej and Boyce, imported a costly machine in order t weld and fabricate these windows. There is a whole list of other items now readily available in the Indian market which were produced for the first time.[57]

Although glass walls were a conventional feature of the International style, its use in the TIFR building allowed Bartsch to take special aesthetic advantage of the Arabian Sea that the west façade of the building opened on. "The exterior open gallery," as Bartsch put it, "presents magnificent views of the nearby sea as it appears through various architectural frames." The incorporation of these features acknowledged local topography in a building that exemplified and embodied the high modern style associated with the post-War architecture that developed in America.

The use of glass added the element of "playfulness," which Bartsch intended. The use of cylindrical surfaces in the colonnade area of the building

[57] Homi Bhabha, "Speech at the Inauguration of New Buildings," The Tata Institute of Fundamental Research, Inauguration of New Buildings, Bombay, 1962, P. 37.

and the free standing cantilever staircase that leads to the mezannine library combined elements of the International style with modernist architecture. In Bartsch's words:

> The entrance lobby ... opens by means of a wide corridor to dining and recreational facilities and to various class and lecture rooms on either side. Here rooms which interlock with each other create pleasant vistas which are made more effective by free standing walls of glass or masonry placed inside or outside the supporting columns.[58]

The modern style dominates the interiors as well. The furniture in the lobby on the ground floor and the Faculty Lounge consist of upholstered arm chairs with metal legs. Though mostly manufactured in-house, they replicate examples from the catalogues of American designers. Apart from these, there still exist isolated examples of moulded chairs that were introduced after World War II in Europe and America, such as the Eero Saarinen fibreglass Tulip chair, now displayed as part of Bhabha's office in the Museum area.

The design of the building represented a certain choice of environment. The building is centrally air-conditioned; this and the use of glass, seals off the interior of the building from the natural elements outside. In this way, the technology that operated in the interiors of skyscapers in Chicago and New York

was implanted in India and basically served the same purpose: "to isolate the interior from the outside, even though everything outside was visible."[59] This combination of visibility and seclusion was further intensified by the geographical location of TIFR at "Land's End" – at the tip of one of the arms of Bombay, opening out on the Arabian Sea. From the West Canteen one might see Bhabha's Amoeba garden – a Kite swoops down on the lawn, even as gardeners in green uniform mow the lawn. On a clear day one sees the Barringtonia swaying in the breeze; one can catch the subtle undulations on the shiny blue-gray surface of the sea, seagulls flying, and in the distant horizon, the outline of ships. These sights appear as part of a silent tableau, insulated from and unaccompanied by their characteristic sounds. The location of the building inside the Naval Area also isolates it from the everyday hustle and bustle of the city, thus heightening a sense of disengagement with the city to which it belongs.

The building represents a moment of nation-building even as it captures the moment of the high modern in Indian architecture. As a monumental statement, it marks out its difference from other laboratories and public buildings, symbolizing academic exclusiveness and expertise. The authority that the building commands is invoked as much by its inaccessibility to ordinary people as by its isolation from the city.

---

[58] *Ibid*

[59] Richard Sennett, *The Conscience of the Eye: The Design and Social Life of Cities*, New York, Norton, 1992, p. 109.

The Scientist and his global garden

In the course of his last meeting with Homi Bhabha just before he died, Rudi von Leyden the art critic recalled that near his desk stood an enormous drawing board with printed plans and layouts for the gardens and planned afforestation of Trombay.

> By the side of the drawing board were fine illustrated volumes on the gardens of Versailles, on the English Gardens of the 18th century, on Italian, Japanese and Persian Gardens…His detailed knowledge was tremendous. He could describe the essential points of a garden design, whether he had seen it in Vienna, Paris, Rome, Yorkshire or Kyoto…And it was typical of him that he could see the final shape of "his" city only in its complete harmonious integration into the surrounding landscape.[60]

Although he never lived to see the larger than life "industrial Vesailles" that he planned to create at Trombay completed, at the Institute, he experimented with the garden on a smaller scale. The Institute after its inception was housed in rented accommodation, first at Kenilworth, a bungalow on Pedder Road where he himself was born and then at the Old Yacht Club near Apollo Pier, not far from the Gateway of India. The land on the Colaba reclamation site

[60] R. von Leyden, "Dr. Homi Bhabha and the World of Art," *Sciene Reporter*, Vol 3, No 10, October 1966, New Delhi, CSIR, pp. 476-77.

originally belonged to the Indian Navy and was acquired through Nehru's intervention with the in the Ministry of Defence in December 1953.[61] The layout of the garden was planned for this site after that.

Bhabha's love for gardens and plants was legendary. Years later, while releasing the Collected Papers of Homi Bhabha, JRD Tata would confess that though he admired this trait, he used also to tease his friend for being a "master gardener" for "whatever he built had to be beautiful and had to have gardens."[62] The inspiration of the garden that Bhabha designed for his Institute was European. Nor was this surprising, the master-gardener, Shreepad Dwaraknath Vaidya had been initially trained in Horticulture at the Agricultural College, Pune and later, at Versailles. Bhabha, as Vaidya tells us, wanted the TIFR gardens to refresh the spirit and awaken the delight of those who worked inside the building. Vaidya worked very closely with Bhabha's idea of the garden for the new building and finally Vaidya and Bhabha adapted a "French" model for the West Lawn of the Institute.

The gardens of Versailles had come to be almost universally adopted as the model for palatial gardens following the French cultural domination of Europe in the 18th century. On the other hand, the 18th century English garden was created in a style that focussed on the rediscovery of nature. The French "*le jardin paysager*" or the landscape garden adapted elements of the English garden,

[61] Jawaharlal Nehru to HJB dated December 9, 1953 and HJB to JLN dated December 11, 1953, TIFR Archives, D-2004-00474.

recreating in city gardens natural escapes from the monotony of city life. Aware of the way in which the French gardens succeeded in creating the impression of the countryside in the heart of the city, Bhabha harmonized elements of the palatial gardens at Versailles with the landscape garden. The structured geometry of the West Lawn presented a sharp contrast to the chaos that reigned on the streets of the city; for here in the very heart of Bombay, one could be utterly oblivious of the tumultuous stirrings of the city.

Although the gardens at Versailles were something both Bhabha and Vaidya admired greatly, they adapted only elements of it. The Amoeba garden around which exist several stories about Bhabha's perfectionist obsession with form and the crazy paved pathway combined the geometrical trends of Versailles with the idea of a landscape garden. Flanked by the artificial Casurina forest, the the layout of the West Lawn was designed to as to take advantage of the sea-side promenade. The elevation of the building enables the prolongation and extension of vision beyond the garden proper, far into the horizon where the Arabian Sea meets the sky. The East Lawn, on the other hand is a sunken lawn with a single Tabubia tree to one side and a clump of Cacti on the other. As we shall later, the Tabubia growing in solitary splendour in one corner of the lawn, would over time, be cited as a metaphor for Bhabha's policy of building a scientific group around one individual.

[62] Speech by JRD Tata on the Release of Collected Scientific Papers of Homi Bhabha, March 27, 1986, sound recording, TIFR Archives.

Apart from the garden layout, Bhabha's extraordinary interest in plants led him to collect plants from all over the world. He had Felix Bloch send him bulbs for his garden and had the Mexican political leader Emilio Porter Gils send him cacti for the garden at TIFR. Later when Gils became the Mexican ambassador to India, he requested Bhabha for some of the same cacti so he could plant in front of the Mexican Embassy in New Delhi, "to remind him of home." The Barringtonia (also known as Fish Poison tree) on the West Lawn supposedly came from Africa, and the Golden Palm, from the West Indies thus conjuring up an exotic and distant topography that seemed at home in alien soil. The transnational and transcultural character of the garden effectively reflected the internationalism of the building. The exotic plants transplanted in the Institute's garden incorporated a larger world and could perhaps, be seen as an effective metaphor for the Institute's internationalist aspirations.

Despite his love for trees, Bhabha never asked visitors to his Institute to participate in ceremonial tree-planting which would become a customary feature of VIP visits to government institutions in India. Nehru, a frequent visitor to the Institute and to the AEET, was never invited to plant trees in Trombay or Colaba.[63] Perhaps, this is not so surprising, given the fact that the Institute made place for its buildings by undertaking planned transplantation of the many full-grown trees on the site. S.D. Vaidya recollects the very first tree transplant he

[63] Joseph John, "Bhabha, The Friend of Trees," *Bharat Jyoti*, May 1, 1966, Tata CENTRAL Archives, DTT-TIFR-PC 25, Box 194. The same article recounts the only ceremonial tree planting Bhabha participated in on the occasion of his fiftieth birthday, organized by the employee of the Atomic Energy Commission. His mother Meherbai Bhabha planted a conifer inside the premises of Kenilworth. "Even that

undertook at Bhabha's request. The Rain Tree outside Kenilworth was to be felled because Pedder Road was to become a wider road. Vaidya was hesitant at first because of the expense involved.

> I said it is a very expensive thing; in India, we would not normally spend thousands of rupees for transplanting a tree, nobody would believe that. But he [Bhabha] said, "No, if you think you can do it, I want you to tell me, 'I can do it'."
>
> I was staying in Kenilworth, so I immediately said we can transplant it inside Kenilworth. Then he [Bhabha] asked me the details, "How we will take it inside?" So I told him it can be lifted by crane, and the crane can put it inside, and we will straightaway transplant it.
>
> On such a large scale, such a big tree was never transplanted by anybody in India.... They would say, "there are thousands of trees, plant another one and it will come up!" But they didn't have the idea that a tree of that size could be transplanted.[64]

Transplanting full-grown trees became the standard practice at the Institute. Over the years, the TIFR complex and the housing colony became home to a number of full grown trees that were transplanted under Bhabha's wishes

---

was on the strict understanding that no photographs would be taken and no board hung to mark his birthplace."

[64] Oral history interview with S.D. Vaidya April 3, 2004, TIFR Archives.

and instructions. The first instance of such transplantation within the new complex of the Institute was the shifting of a *Mimusops hexandra* in August 1962, from Napean Sea Road, Malabar Hills to the car park area by the side of the auditorium. The following year, a *baobab* tree was uprooted and shifted to the Institute premises from Marol-Maroshi road because it was about to be felled as part of road widening plans. This practice remained a part of the Institute's horticultural practice even after the founder's death. As the Chairman of the Council of an Institute that took pride in being a trendsetter, JRD Tata too supported and encouraged this particular practice. In 1970 a massive baobab, about eighteen feet in circumference was transplanted it from Napean Sea Road. Excavating a tree of this size took nearly three days, with TIFR gardening staff working in two shifts and JRD Tata himself looking in on the operation. Finally, the tree was moved with the help of three cranes and balanced on two trailers, it journeyed for a full day to its destination inside the housing colony, where it still stands.[65]

Vaidya's account testifies the manifestations of not only a sense of mission in undertaking pioneering work, but also the pride of participating in a rare project initiated by a revered leader. Like the collection of paintings and the modernist architecture of the building, creating the gardens of the Institute was also an attempt to recreate what Bhabha was familiar with. Formal gardens that existed elsewhere and which had famously fostered "green thoughts in a green shade" were ideal for nurturing creativity. In structuring the formally laid-out

[65] Oral history interview with S.D. Vaidya April 3, 2004, TIFR Archives.

garden and its tall and full-grown trees, and the crazy-paved pathway that lead to the seaside promenade, Bhabha sought to cultivate an ethos where scientists could discuss their work, or refresh themselves after a busy day at the laboratory. The gardens at TIFR sustained an environment would that would work like a cultural cement to hold together the scientific groups of the Institute.

On comportment and appropriate forms of behaviour

The utopian dimensions of Bhabha's project can hardly be ignored. The sea-facing arid land with its make-shift army barracks that had housed prisoners of war had been transformed into a modern building that overlooked lush lawns, a casuarinas forest and on trees from all over the world. In his speech at the inauguration of the buildings, Bhabha had expressed the hope that the completion of the building will enable the staff to "concentrate without distraction on the aims for which this Institute was established, namely, the furthering of scientific knowledge."[66] But what the founder left unsaid in his inaugural speech was that the modernity of the setting of the Institute also demanded modern forms of behaviour from the staff. The aesthetics of the building demanded maintenance not only by staff employed for the purpose (the Institute still has a Cosmetic Maintenance Section entrusted with this task) but every member had to vigilant towards preserving the quality of the building and its cleanliness.

[66] HJ Bhabha speech at inauguration of new buildings, *The Tata Institute of Fundamental Research: Inaguration of New Buildings, Bombay, January 15,* 1962, Bombay, TIFR, p. 47.

For Bhabha, the modern architecture of the building and the layout of its gardens represented a desire for transformation of the local and the regional into the international. The building, as far as he could see, could have existed anywhere in the world. Once again, echoing liberalism's need to create familiar spaces that existed elsewhere, Bhabha wrote in 1961 that the building corresponded to international standards and therefore, he expected that:

> Each member of the staff should have a sense of personal pride in these buildings, which have been given for his use, and it is his duty to take personal interest in their proper maintenance and to see that he himself uses them in such a way as to maintain their quality and cleanliness so as not to cause inconvenience to others. Certain normal and elementary good manners with regard to the use of the buildings and fixtures and furniture in them must be observed. A member who sees another not using the buildings properly should draw his attention to the proper conduct in such matters. If any person continues to misbehave, the matter should be reported to his superior.[67]

[67] RM Lala *The Heart Beat of a Trust: The Story of the Sir Dorabji Tata Trust,first 1984 New Delhi: TataMcGraw Hill*, 1998, p. 108.

In the same office order he reminded the members of staff that they should follow the strictest norms of cleanliness as they worked inside the building:

> Feet should be wiped on a mat before entering the building, and marks from dirty hands should not be left on the walls. Lavatories should be used properly and kept spotlessly clean.[68]

While the tone of the order was certainly peremptory, Bhabha also never hesitated to show his appreciation when any of the lower-level staff had demonstrated his devotion to the sanitary principles he had laid out. Patrick Bragranza, also known as Patrick "Shiner" for the dedication with which he polished the brass panels of the elevators, joined the Institute in 1965 and soon afterwards was praised by Bhabha himself for his work. "Good work, Patrick," Braganza recalls the founder telling him. A remark he treasures to this day.[69]

Apart from cleanliness, the members of the Institute were also expected to conform to western mores and style that the Institute adopted. The new buildings had a Common Room (since renamed the Faculty Lounge) where the Faculty gathered for lunch on Wednesdays. The formal visits by dignitaries to the Institute often became the occasion for circulating instructions about a dress

[68] *Ibid.*, p. 108.
[69] Personal interview with Patrick Bragranza, 13.1.2004.

code. Thus on April 7, 1964, the day before the visit of Admiral Karmarkar, Bhabha circulated the following instructions:

> It is desirable that in these Faculty lunches a certain minimum formality should be observed in the dress, even when no guests are expected, as there may be occasion to bring in a guest unexpectedly. It seems to be that an appropriate dress for the occasion would be lounge suit, or bundgalla, or bush coat and trousers. If a shirt is worn, so should a tie invariably, even if the coat has been dispensed with on less formal occasions. On more formal occasions the dress should invariably be lounge suit or bundgalla."

The adaptation of traditions and practices of Cambridge and Princeton at Bhabha's Institute remained unquestioned, though often belligerently debated. Thus in 1962, K. Chandrasekharan protested against the Institute's decision to stop free tea before a colloquium: "Though I don't care tea, I do care for academic tradition."[70] Bhabha responded by citing the mode of payment adopted at the Cavendish:

> ...it does not seem to me to be an intrinsic part of academic tradition that tea should be free. At the colloquia in the Cavendish Laboratory at the time of Rutherford and later, and in the and in the theoretical

> physics colloquia run by Fowler, and later others, tea is always served before a meeting, and each person taking a cup of tea put two pence in the tray.[71]

Chandrasekharan's immediate and sharp response was to point out that the essential aim of such practices was to build an atmosphere that was conducive to scientific life:

> Rutherford has been dead for many years, and the description of the Cambridge tradition given by the Director is rather incomplete, since even food is free for Fellows at Cambridge. We are not a university, and the comparison with Cambridge does not seem quite right. The Institute for Advanced Study at Princeton, and several similar Institutes in the US have had tea served in their Common Room every day of the week free of charge. This has helped to build an atmosphere, which even Dirac would, I am sure, recognize. If this is impossible to secure, in a building of our size, I would give it all up.[72]

[70] TIFR Canteen file.
[71] TIFR Canteen file.
[72] TIFR Canteen file.

Underlying these fierce outbursts and elaborations of traditions fostered by scientific institutions abroad was the idea that traditions were a necessary part of institution-building. The models for emulation always remained elsewhere.

As JV Kotwal, the Secretary to the Physics Faculty and later, Deputy Registrar confirms, Bhabha wished the members of his Institute to give up their inherent home-grown habits and adopt new ones:

> At the Colloquium tea, one person poured [his] tea out on the saucer and Bhabha said, 'Gentleman, a saucer is meant for holding the cup and not for drinking tea.[73]

If ways of conducting oneself remained an important concern, it was imperative to also dress properly. Given the liberal ethos of the place, it would have been unimaginable to enforce a dress code. However, Bhabha did make clear his dislike for the Indian kurta-pyjama or the provincial style of wearing shirts over trousers. He also ordered that ties be worn during Nikolai Bulganin and Nikita Khruschev's visit to the Institute in 1956.[74] The continual emphasis on forms of conduct and ways of presenting oneself, emanated out of the need to define practices that would imprint identity on the Institute that Bhabha had started.

[73] Oral history with JV Kotwal by Indira Chowdhury, dated October 31, 2003.
[74] Robert Anderson, *Building Scientific Institutions in India: Saha and* Bhabha, Montreal: McGill University, Occasional Paper Centre for Developing Area Studies, p. 73.

Conclusion

If the utopian ideals of Bhatnagar with which we began our journey saw science as existing without national boundaries, Bhabha's institute which attempted to mirror that utopian ideal focussed on erasing all signs of the regional and the provincial. Though the social mores adopted at the Institute were more in tune with the customs of Cambridge or Princeton, these practices were not exact replicas but a local version of institutional practices from elsewhere.[75] The Institute's West Canteen for example, attempted and perfected over time, a variety of hybrid culinary experiments with locally available vegetables: examples of these are the Karela Hotpot [the bitter gourd hotpot] and sautéed Dudhi [The sautéed calabash]. But the West Canteen did impose the use of fork and knife on all users, a practice which continues till today.

It would be inaccurate to identify all these practices as signifying an imitative milieu, for forms of comportment, ways of dressing and feeding oneself became part of the scientific institution's civilising process in which local practices and ways of being were put aside and temporarily forgotten. The social mores adopted at the Institute, I suggest, should be viewed as part of a cultural pedagogy that prepared its members for participation in global networks that scientific work demanded. If the scientists at Bhabha's institute were capable of holding their own in scientific conversations with the first world, they would not

[75] Apart from this, Institutional folklore claims that Bhabha would often depute people to instruct people to not to squat on the WC and use it like an Indian-style toilet, he would also keep a check on whether the WC was being used correctly – footprints on the seat were reported. Apart from that the toilets were equipped with toilet paper and the local practice of keeping water in the toilet for ablutions ignored. This practice continues till date.

be found lacking in adopting to what came to seen as “international” cultural mores. The laboratory thus encapsulated its own double – the invisible cultural workshop which performed an equally significant pedagogic function.