

**SCIENTIFIC RESEARCH AS A SPIRITUAL MISSION: A SOCIAL HISTORY OF
THE MADURAI JESUITS AND THEIR SCIENTIFIC PRACTICE IN
INDEPENDENT INDIA**

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SCIENCE, TECHNOLOGY AND SOCIETY STUDIES

BY

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Abbreviations

AINH	Anglade Institute of Natural History
ASTRA	Application of Science and Technology for Rural Areas
AT	Appropriate Technology
BA	Bachelor of Arts
BMS	Baptist Missionary Society
BSI	Botanical Survey of India
Bt	<i>Bacillus thuringiensis</i>
CART	Council for Advancement of Rural Technology
CBCI	Catholic Bishops Conference of India
CHAI	Church History Association of India
CMS	Church Missionary Society
COSIST	Committee On Strengthening of Infrastructure for Science and Technology
CSE	Centre for Science and Environment
CSI	Church of South India
CSIR	Council of Scientific and Industrial Research
DBT	Department of Biotechnology
Dec.	Decree
DNA	Deoxyribonucleic Acid
DST	Department of Science and Technology
EPA	Environmental Protection Agency
ERI	Entomological Research Institute
FDA	Federal Drug Administration
GC	General Congregation
GM	Genetically Modified
GMO	Genetically Modified Organism
IAPT	International Association of Plant Taxonomy
ICMR	Indian Council for Medical Research
IPM	Integrated Pest Management
IUCN	International Union for Conservation of Nature and Natural Resources
JCI	Jesuit Conference of India
JCSA	Jesuit Conference of South Asia

KSSP	Kerala Sasthra Sahithya Parishad
LED	Light-Emitting Diode
LMS	London Missionary Society
M. Sc.	Master of Science
MEP	Missions Etrangères de Paris (Paris Foreign Missions)
MoEF	Ministry of Environment and Forests
MS	Master of Science
NBTB	National Biotechnology Board
NCEPC	National Committee on Environmental Planning and Coordination
NCST	National Committee for Science and Technology
NEAC	National Environmental Awareness Campaign
NGO	Non-Governmental Organization
NPOP	National Programme for Organic Production
PCF	Province Coordinator for Formation
PHCC	Palni Hills Conservation Council
PhD	Doctor of Philosophy
RHT	Rapinat Herbarium Trichy
SHC	Sacred Heart College
SIRO	Scientific and Industrial Research Organization
SJ	Society of Jesus
SJES	Social Justice and Ecology Secretariat
SJS	Social Justice Secretariat
STS	Science Technology and Society Studies
TIFAC	Technology Information Forecasting and Assessment Council
TPC	Threatened Plants Committee
UG	Undergraduate
UGC	University Grants Commission
UK	United Kingdom
UNIDO	United Nations Industrial Development Organization
VOYCE	Vattakanal Organization for Youth Community and Environment
VRO	Village Reconstruction Organization

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(1) Introduction

1.1 Prologue

After his ordination as a Jesuit priest in 1980, VS Manickam (1944-2012) began his ministry as a preacher in the Catholic Charismatic Movement.¹ Manickam became a sought after preacher over the next few years and was fairly convinced that preaching was his primary mission. However, Manickam was also a trained botanist with a PhD; his doctoral research in the cytology of south Indian ferns was acclaimed by international botanists (Benniamin & Fraser-Jenkins, 2012). But Manickam decided to give up all plans of pursuing a career in research and intended to continue his charismatic preaching. His Jesuit superiors thought otherwise. He was instructed to put an end to his charismatic ministry and focus on teaching and research. Eminent botanist and fellow Jesuit KM Matthew (1930-2044), who first encouraged Manickam to take up research on ferns, also admonished him for “straying away from [his] true vocation, that is scientific research”. Manickam later wrote that he felt “deep anguish and mental agony” for being asked to give up preaching but nevertheless resumed research in obedience to his superiors (Manickam, 1993). Over the next decade, Manickam explored the Western Ghats region in Tamil Nadu, published extensively on the cytology and taxonomy of ferns in the region, and guided many young PhD scholars during this period. He also established a Centre for Biodiversity and Biotechnology at St. Xavier’s College (Palayamkottai, India) in 1987, much before “biodiversity” became a buzzword. In 1993, Manickam declared:

“In the days following my ordination I had a rather narrow view of spirituality i.e. to be spiritual means to spend a lot of time praying, Bible reading and preaching a lot of retreats. But now, through my scientific research I understand that for me to be spiritual means to explore God’s creation and reveal his power and wisdom embedded therein... I am filled with a sense of satisfaction and joy to see that, in spite of my occasional wavering in the scientific vocation, I have accepted God’s will and guidance revealed through my superiors and well-wishers... Another reason for my ecstasy is the discovery of eleven species [of ferns]... and eight new species [of other flora]” (Manickam, 1993, pp. 21–22).

¹ On the Catholic Charismatic Renewal Movement, see (Csordas, 2007; Hocken, 2004)

Manickam's spiritual quest navigated several paths: the pursuit of a PhD as a Jesuit scholastic² in the 1970s, as a charismatic preacher in the 1980s, and finally as a reputed botanist in the 1990s. His self-discovery of spirituality not being restricted to "praying, Bible reading" but also "exploring God's creation" through scientific research is emblematic of the oxymoron that is the "Jesuit priest-scientist".³ Yet, this paradox related to the scientific practice and how it is manifested in the missionary spirituality of the twentieth century Jesuit priest-scientist has received very little attention among historians, even though early modern Jesuit science has been explored significantly. This thesis is an attempt to correct this vacuum by exploring the scientific activity of Jesuit priests in independent India. Specifically, I explore the varieties of science practised by the Jesuits of the Madurai Province, since the formation of the province in 1952.⁴

1.2 Re-positioning the historiography of Jesuit science in independent India

In 1892, the 24th Superior General of the Society of Jesus, Luis Martín Garcia (1846-1906), initiated a program to present the history of the Order to the world, thus inaugurating Jesuit historiography (Harris, 1988, p. viii). Following Martin's direction, a number of Jesuits were commissioned to write histories of the various Jesuit assistancies resulting in the first volumes of the *Monumenta Historica Societatis Jesu* by the end of the nineteenth century. These volumes and later historiographical contributions produced by the Jesuits until the mid-twentieth century were scholarly but largely apologetic. Eventually, these volumes would provide the motivation for later historical scholarship on the Jesuits, including those by non-Jesuits (O'Malley, 2013c).

The historiography of Jesuit science gained importance in the 1970s when historians began to investigate the role of the Catholic Church in the so-called Scientific Revolution of early modern Europe (e.g., Shapin, 1996). Others began to explore Jesuit contributions to the birth

² In the Society of Jesus, the term scholastic "includes those Jesuits in formation who have not yet completed future studies in anticipation of ordination to the priesthood... [a scholastic is] a vowed Jesuit who progresses through philosophy studies, regency, and theology studies to ordination as a priest" (Maczkiewicz, 2017).

³ In this thesis, I do not make any specific distinction between a Jesuit scientist and a Jesuit priest-scientist. Hence, I use these terms interchangeably because the Jesuits I spoke to for this research also used these terms interchangeably.

⁴ A "Province" is the basic organizational unit in the Society of Jesus, by which Jesuit communities and their works were organized geographically. Each Province in turn belongs to an "Assistancy" (Howell, 2017b). As of 2019, there are nineteen provinces in India, each of which belongs to the South Asian Assistancy (*Provinces and Regions*, n.d.).

of the modern scientific disciplines around the same period. Both these approaches were situated either in the background of conflict or complementarity between science and religion (to which I will return later) with neither seeking to examine Jesuit science on its own terms. It was only in the early 1980s when a series of seminal studies contributed to a re-evaluation of Jesuit science (e.g., Ashworth, Jr., 1986; Heilbron, 1979; Wallace, 2014). These new perspectives on Jesuit science in the 17th and 18th centuries have helped to re-examine the influence and participation of Jesuits in the scientific tradition of those periods without caricaturing them merely as defenders of Catholic dogma or opponents of scientific progress (Rabin, 2017).

Despite the lasting significance of these works, the primary aim of these explorations was to study aspects of Jesuit science *only* during the Scientific Revolution in Europe. This has caused serious limitations in the explorations of Jesuit scientific activity during other historical periods and in other geographies. These limitations have been exacerbated by other accounts that only celebrate “Jesuit firsts” in science or those which attempt to counter the “legend” that the Catholics were/are anti-science (e.g., O’Connell, 1956; Walsh, 1908). This historiographical trend began to change towards the end of the 20th century when historians began to reconsider the development of science in the non-West. This development contributed to a re-evaluation of Jesuit science in Asia and the Americas. For instance, Andrés I. Prieto (2011) showed that the study of nature by Jesuits working in the South American missions during the 16th and 17th centuries was “intimately linked to their missionary endeavours”, which was “the salvation of natives’ souls”. Prieto argued that the South American Jesuit naturalists defined themselves foremost as missionaries unlike the Jesuits in European colleges who saw themselves as natural philosophers or mathematicians. Qiong Zhang (2015) analyzed the cultural encounters between the European Jesuits and Chinese intellectuals in late imperial China, and argued that both collaborated as “active producers of scientific knowledge in an intercultural and interactive context”. The volume edited by Luís Saraiva and Catherine Jami demonstrated that the scientific activity of the early modern Jesuits in East Asia was not restricted to China but was also influential in Japan, Korea and Vietnam (Saraiva & Jami, 2008).

On Jesuit science in India, Dhruv Raina (2014) argued that the French Jesuits were perhaps the first “Indologists” to study the astronomical and mathematical knowledge systems practised in south Asia during the 17th and 18th centuries. In this account, Raina even suggests

that the Jesuits thus inaugurated the earliest “historical inquiry into ancient Indian astronomy”. In arguing thus, Raina revises the historical accounts of others like Virender Nath Sharma (1982) and SN Sen (1966) who seemed to suggest that the Jesuits’ scientific activity in India was “peculiarly barren and abortive”. Eric Forbes (1982) has also demonstrated that the Raja of Amber, Sawai Jai Singh, had requested the Jesuits in India to make astronomical observations for him—for he believed that the Jesuits with their European instruments could help in yielding better results. Recent understanding of early modern Jesuit science (in India) has gained considerably from such studies. Yet, this reawakening has not inspired sufficient historical investigations into recent Jesuit science, that is, the history of Jesuit science since the Restoration of the Order in 1773 (more about the Restoration in Chapter (3)).

The historian and philosopher Job Kozhamthadam (also a Jesuit priest) observes that the limited number of books available on Jesuit science deal with a few specific contributions of the Jesuits in a handful of scientific disciplines (Kozhamthadam, 2007a). This includes somewhat “whiggish” celebrations of Jesuit inventions and discoveries which could be informative in learning about Jesuit “firsts” or “near-firsts” in a particular scientific discipline (e.g., Bishop, 2005). But these accounts offer only a fragmented picture of Jesuit involvement in science besides committing the mistake of equating early modern “natural philosophy” with present day “science” (Dear, 2005, p. 392). The Jesuit scholar Agustín Udías (2015a) tried to undo this by presenting the first full-length exploration of the history of Jesuit science before Suppression and after Restoration of the Order. However, Udías (2015a) himself acknowledges that he has only used “broad brushstrokes” and presented only a “representative” history of Jesuit science (p. vii). Other significant accounts of recent Jesuit science include Udías’ (2011) account of Jesuit observatories around the world, Carl-Henry Geschwind’s (1998) analysis of American Jesuits’ involvement in 20th century seismology and the account of the first Jesuit scientific journal in 20th century Portugal written by Francisco Malta Romeiras and Henrique Leitão (Romeiras & Leitão, 2016).

Despite this variety of studies in the history of Jesuit science, there is still very little research on Jesuit science in 20th century India. Udías (2016) also notes that the modern biological sciences in India are ripe for historical research on Jesuit scientific activity in India. Raina (2014) also remarks that recent Jesuit science has only been explored in the context of Jesuit educational institutions in modern India or as an inventory of Jesuit contributions to the

modern sciences (p. 259). There is thus scope to do justice to the diversity of Jesuit scientific activity in independent India.

Raina is among the few who have explored the considerable variety of “Jesuit colonial science” in India, that is, the scientific activity of Jesuits supported by the Portuguese colonial empire. He argues that “Jesuit colonial science” was “spread across a canvas that extended from stellar and planetary astronomy, to anthropology and ethnography and natural history” (Raina, 2014, p. 269). He challenges the traditionalist perspective that portrays Jesuit colonial science as “boringly homogeneous and restricted to the Jesuit religious project alone, but even that project... was marked by an inner diversity” (Raina, 2014, p. 270). Majority of scholars, Raina suggests, have paid attention to the missionary goals of the Jesuits but failed to engage with “the different modes and forms of Jesuit engagements with non-Western knowledge forms and cultural practices” (Raina, 2014, p. 271).

While agreeing with Raina that the diversity of Jesuit colonial science in India still remains relatively unexplored, I think that there is also a case for exploring the relationship between the missionary endeavours of the Jesuits and their scientific activities in *post* colonial India. I will argue in this thesis, that the changing context of the Jesuits’ missionary spirituality had lasting significance for the evolution of their scientific and cultural projects in independent India. In other words, I will seek to explore the characteristics of what could be called “Jesuit postcolonial science” - Jesuit scientific activity in independent India. I will attempt to show that there is much to learn about the diversity of Jesuit science in independent India, by engaging with the literature on the history of Indian Christianity and relating it to the literature on the history of Indian science. I also offer a “science studies turn” to this exploration by situating my research in the context of science-society relations, as practised by the Jesuits of the Madurai Province.

Some accounts of Jesuit scientific activity in the Madurai Province have been described by the Jesuits themselves (Ignacimuthu, 2016; Jadav, 2018; Terrasa, 2010). These accounts are often celebratory in nature, suggesting that science was one of several other fields to which the Jesuits contributed to and excelled in. They do not usually evaluate the quality of Jesuit science or how it contributed to the Jesuit missionary and cultural enterprise in the country. Further, these descriptive accounts do not critically engage with the “science-as-progress” discourse and unquestioningly accept the narrative that “more science” is the solution for all

forms of social injustice. However, this characterization of science has been contested by a section of the Jesuits themselves, especially in parts of Africa and south and south-east Asia. Jesuit historians in India have also warned against perpetuating the discourse that European Jesuits contributed to the cultural and so-called civilizing uplift of the indigenous peoples (De Souza, 1988; De Souza & Borges, 1992; Nirmal, 1988). Cognizant of these diverse perspectives, the purpose of this thesis is not to uplift the Jesuits beyond their historical significance but to suggest that the history of Jesuit science in independent India needs to be considered separately from its colonial avatar.

Accordingly, a series of questions could be posed regarding Jesuit postcolonial science in India. Was Jesuit science in independent India restricted to science education? Were the Indian Jesuits of the Madurai Province less “scientific” and less illustrious than their European predecessors? Was Jesuit scientific activity pursued only to defend Catholic dogma and to promote evangelization in India? How did the evolving science policy and practice in independent India influence Jesuit scientific activity? How did the Jesuits involved in science respond, first, to the institutionalization of science by the state and later, to the commodification of science under the patent regime? In short, this thesis attempts to present a picture of Jesuit scientific activity in independent India through the dual prism of the history of Indian science and the history of Indian Christianity. This study uses the seminal figures of three Jesuits involved in the practice of science in the Madurai Province, so as to interrogate the nature and evolution of Jesuit science in independent India. In doing so, I attempt to show the emergence of a distinct Jesuit scientific culture (not necessarily homogeneous) in independent India. By using Jesuit scientists as case studies, I show that Jesuit science in modern India emerged as a multi-layered array of missionary, intellectual and cultural activities, motivated by “apostolic spirituality” and the socio-political settings of the Madurai Jesuits. In the next section I outline the research methodology I employ to explore my thesis.

1.3 Studying Jesuit science in India: Research design and methodology

This study seeks to contribute to the understanding of how Jesuit scientific activity in independent India evolved into a distinct scientific tradition of the Jesuits – a tradition which I argue is quite different from the scientific engagements of the Jesuits in colonial India. I illustrate this using the case of the Jesuit scientists belonging to the (undivided) Madurai

Jesuit Province, one of the oldest and historically significant mission stations established by the Jesuits in south India.⁵

The Jesuits in peninsular India have a multi-layered history from the time they arrived in Portuguese Goa (on the west coast of India) in the 16th century, to the time they established the first Indian novitiate in Nagapattinam (in south India) to train native Jesuits in the nineteenth century. In addition to undergoing centuries of transition in colonial India, the emerging socio-political and religious context in independent India led to an entirely different culture of Jesuit scientific activity in the Madurai Province. These factors had significant implications for the Jesuit men of science working across India. In this thesis, I provide an account of how the dual context of doing science and practising Christianity in postcolonial India, led to the re-orientation of Jesuit spirituality and the Jesuit mission in India. This in turn, I will show, resulted in the Jesuits promoting a (cautiously) techno-optimistic vision of social progress in the country. This thesis will respond to the following three questions in order to understand the emergence of Jesuit scientific research as an integral part of their spiritual mission in independent India:

1. How have the Madurai Jesuits engaged with science in postcolonial India? And how was this engagement different from the engagement of the Jesuits in colonial India?
2. What role did spirituality play in the re-imagination of scientific work as a missionary activity among the Madurai Jesuits of postcolonial India?
3. How did the Madurai Jesuit scientists respond to the broader socio-political context of science and technology in postcolonial India?

I answer the above guiding questions employing a combination of contemporary and retrospective analyses, by tracing the spiritual-scientific journeys of a few Jesuit men of science in the Madurai Province. I employ different methodological strategies in tracing these journeys; these include archival research, qualitative interviews, document analysis and to a lesser extent, participant observation.

⁵ In December 2019, the Jesuit Madurai Province was bifurcated into two separate Jesuit provinces – Chennai and Madurai (see, Jesuit Roman Curia, 2020)

1.3.1 The research site: Madurai Jesuit Province, post 1952

This thesis focuses on the scientific activity of the Jesuits of (undivided) Madurai Province in independent India.⁶ As of 2019, there were nineteen Provinces under which the Jesuits have divided their missionary activities in India, of which Madurai was the first to be established as a self-administered Province in independent India.⁷ The present day Madurai Province took shape when Jesuits from the French Province of Lyons established the New Madura Mission in 1837 (I explore this history in greater detail in Chapter (3)).⁸ The New Madura Mission became significant for housing the first scholasticate (institute for training Jesuits) in India. In 1895, this institute was re-born as the Sacred Heart College which not only trained Jesuit scholastics from the Indian subcontinent but also those from Europe. While the European Jesuits who worked in the Bombay and Calcutta Provinces were also involved in or promoted scientific activities, it was the Sacred Heart College that firmly established the scientific tradition among the native Jesuits in India. Eventually, this tradition would lead to several Indian Jesuits specializing and taking up scientific research in independent India. Further, Jesuits from or trained in the Madurai Province would be among the first native Indian Jesuits to obtain doctoral degrees in science. Therefore, the New Madura Mission and its successor, the Madurai Province, can for all purposes be considered to have laid the foundations for the Jesuit scientific tradition in independent India.

As of 2019, Madurai Province had the largest number of Jesuits working in India. Historically, Madurai also appears to have had the highest number of Jesuits working as full-time science educators and/or researchers in Jesuit colleges (Ignacimuthu, 1998). Further, the Madurai Province is also home to some of the oldest research centres dedicated to scientific research in the country. For these multiple reasons, exploring scientific activity in Madurai Province can provide insights into the larger picture of the history and evolution of Jesuit postcolonial science in India. Hence, I chose to study scientific activity of the Madurai Jesuits for my research project.

⁶ Any reference to “Madurai Province” in this chapter and the rest of the thesis refers to the “undivided” Madurai Province, the reason being that the data for this thesis was collected before the bifurcation of the Madurai Province in 2019.

⁷ See (Jesuit Conference of South Asia [JCSA], 2020) for list of Jesuit provinces and regions in South Asia.

⁸ In Jesuit parlance, a “Mission” is a mission station to which Jesuit missionaries are sent from the “Province”. While the province is headed by a “Provincial”, the mission is coordinated by a “Mission Superior”. The mission can be either inland or foreign.

The choice of a specific group of Madurai Jesuits for exploration in this study was influenced by several factors. First, guided by the postcolonial historiography of Indian Christianity, I was keen to incorporate the narratives of Indian-born Jesuits. This arises from the need to address the gap in historical accounts of missionary science “from below”. Besides, there are several accounts of European Jesuit scientists who have worked in India but practically none about Indian Jesuit scientists. Secondly, I chose to describe Jesuits who pioneered scientific activity in the Madurai Province in various forms. For instance, Lourdu Yeddanapalli established the research infrastructure in Loyola College, KM Matthew established research centres for taxonomy and conservation, and Ignacimuthu was among the prominent few to register patents and trademarks for scientific innovations. I also chose cases which could help describe the development of the Jesuit sociotechnical imaginary over the period from the 1950s to the 2010s (more about this in Chapter (8)). For instance, a study of Yeddanapalli would cover the period of Jesuit science in Madurai from the 1950s to 1970s; KM Matthew from 1970s to 1990s; and Ignacimuthu from 1990s to 2010s. The case of Joseph D’Souza is helpful to describe how not all the efforts of the Jesuit scientists ended “successfully”. Yet, this case also adds to the broader diversity of how Jesuit scientific activity evolved in the Madurai Province - and in India.

1.3.2 The research design: a mixed methods approach to social history

This thesis interrogates the nature and evolution of Jesuit science in independent India. It does this by presenting a social history of Jesuit scientific activity through the dual prism of the history of Indian science and the history of Indian Christianity. I do this by exploring the micro-histories of a few Jesuit scientists and their science activities in the Madurai Province.

As I described briefly earlier, I employ different methodological strategies to narrate the micro-histories of Jesuit scientists in Madurai Province. I use these strategies to collect biographical material (both of individuals and of institutions) in order to study the social context of how Jesuit scientific activity evolved in independent India. The focus is not so much on individual biographical accounts but on the broader significance of these micro-histories as a whole towards understanding the social history of Jesuit science (for e.g., Nilsen & Brannen, 2010). Each of these individual accounts is therefore studied using different methods (mostly qualitative but also quantitative) as I will explain in each chapter. Together, these accounts will help to interpret the social context under which Jesuit science evolved among the Madurai Jesuits in independent India.

There are other reasons for using a ‘mixed methods’ approach to study Jesuit postcolonial science in India. Despite the elite status of Jesuits in the western world, they do not enjoy the same status in India - at least since independence. Sources of historical information about the Jesuits in independent India are not readily available, partly because of reasons intrinsic to the Society of Jesus. As per archival rules of the Jesuits, the archives of the provinces and of individual Jesuits are available for research only up to 1958.⁹ Researchers may request access to specific documents but not entire collections. In my case, I was granted special permission by the Jesuit Superior General in Rome to access Fr. Joseph Vincent D’Souza’s 1980 report on the Secretariat for Jesuit Scientists. I also obtained a report of a Jesuit conference on appropriate technology from the Jesuit Historical Institute in Kenya. Additional documents were obtained from digitized archives of the Institute for Advanced Jesuit Studies in Boston, USA. So I had to obtain fragments of information through multiple sources in order to construct an extended narrative of Jesuit science in independent India.

Within India, I visited several Jesuit institutions to obtain relevant information. First, I visited the Madurai Jesuit Province Archives at Sacred Heart College, Shembaganur (Tamil Nadu) in November 2017. There, I was able to access several documents relevant to the research questions, from the period after Indian independence. In May 2018, I visited the Goa Jesuit Province Archives in Panjim (Goa) where I was granted almost complete access to the personal file of Fr. Joseph Vincent D’Souza who spent several years working as a science educator and researcher in the Madurai Province. While in Goa, I also visited the Xavier Centre for Historical Research which (among other things) also has material relevant to Jesuit scientists like Fr. Jean Fernand Caius who began their careers in the New Madura Mission before settling down in the Bombay Province. Additionally, I accessed college annual reports, annual letters, periodicals and internal documents related to Jesuit administration from the libraries in Loyola College (Chennai), Satya Nilayam Research Institute (Chennai) and the Papal Seminary (Pune).

Secondly, I visited the Entomological Research Institute in Loyola College (Chennai) in May 2017 and August 2018, the Rapinat Herbarium in St. Joseph’s College (Trichy) in May 2017 and the Anglade Institute of Natural History in Sacred Heart College (Shembaganur) in

⁹ According to the rules of the Director of the Archives of the House of the Superior General of the Jesuits (see, *Archivum Romanum Societatis Iesu*, n.d.)

November 2017. Besides repeatedly interviewing multiple Jesuits (scientists and others) and their lay colleagues during these visits, I was also provided access to several documents related to these Jesuit research centres. In addition, I also attended a three-day environmental awareness program for college students at the Anglade Institute in November 2017. Besides being the oldest “student” in this program, the occasion granted me an opportunity to understand the context in which Fr. KM Matthew and his protégés carried out one of the most extensive taxonomic projects to be executed by a private research foundation in independent India. Further, participation in this awareness program also helped me to understand the ongoing work of the Jesuits in environmental conservation and research.

Thirdly, this study builds on semi-structured qualitative interviews conducted with several informants in Madurai and elsewhere in India. This included interviewing Jesuit scientists, Jesuit provincials and other superiors, Jesuit spiritual directors, lay colleagues of Jesuit scientists, Jesuit archivists and historians, and (non-Jesuit) historians of Jesuit science. The interviews with the Jesuit scientists in Madurai Province were conducted on multiple occasions. These interviews were recorded, transcribed and analyzed. When required, follow-up questions were sent by email to the respondents to seek clarifications. I also participated in several seminars and workshops organized by the Jesuits in relation to their scientific work. At these events, I was able to conduct informal interviews with scientists from other Catholic religious orders (both male and female, from India and beyond) with relevant insights being noted down for further research. I also attended a seminar on “The Bible and the origins of modern science” offered by a Jesuit philosopher and historian of science to Jesuit scholastics at the Satya Nilayam Research Institute.

Finally, I studied the scientific publications of the Jesuit men of science belonging to the Madurai Province. Most of these publications were available online and hence could be obtained rather easily. The publications which are only available in print were accessed from Jesuit colleges or purchased when necessary.

1.4 Chapter summaries

In **Chapter 2**, I provide a review of the literature to establish the background of my thesis. I begin by presenting an overview of the different trajectories of science and technology in independent India, where I highlight themes used in postcolonial science studies. I then briefly discuss the historiography of Christianity in postcolonial India by emphasizing the

changing perspectives from the Eurocentric histories of the past to the social histories of Indian Christian peoples which emerged during the 1970s. I then discuss the three key themes I adopt to lay out my ideas in this thesis: (1) the social history of science and religion, where I discuss the histories of “conflict” and “complexity” and also how STS is largely silent on these themes; (2) the practice of missionary science which provides a useful template to bridge the history of Christian missions (in the global South), the history of science and STS – which is helpful in taking forward the agenda of my thesis; and (3) the method of scientific biography which while illuminating the micro-context of individuals/institutions, also helps to elaborate the macro-context of how science was practised in a particular historical context or social situation.

Chapter 3 is a brief historical account of the founding of the Society of Jesus and their many missionary encounters in colonial south India. I describe how the Jesuits came to establish the Madura Mission in colonial India and later the Madurai Province in independent India. I also discuss the Jesuits’ engagements with science which was necessitated by their foray into higher education. In this context, I also explain how the training of Jesuits for the priesthood at the Sacred Heart College of the Madurai Province, included a substantial dose of training in the natural sciences. It was this historical context, I will argue, that helped establish the Jesuits of the Madurai Province as the forerunners of missionary science in independent India.

In **Chapter 4**, I present an overview of the spiritual tradition of the Jesuits while linking it to the “affective turn” in the social studies of science. I also explain the evolution of Jesuit spirituality in post-modern times. Importantly, I explore the similarities between the affective spirituality of the Jesuits and the principles of positive psychology. With this background, I then provide a narrative account of how Jesuit priest-scientists try to understand their scientific work in the light of their spirituality. Using concepts in positive psychology (notably, the concept of *flow*) and data based on my interviews with Jesuit scientists, I describe how Jesuit scientists find *spiritual consolation* in undertaking scientific work as a distinct kind of missionary activity. I also elaborate how these Jesuit scientists try to navigate the journey of doing “high impact” science in postcolonial India while staying obedient to the rules outlined in the *Constitutions* of the Society of Jesus.

Chapter 5 presents an account of the Secretariat of the Jesuit Scientists of the Indian Assistancy. It also sets the stage for understanding how the “scientific apostolate” came into existence under the leadership of the then Jesuit Superior General Pedro Arrupe. Further, I discuss the journey of the first Secretary of the Secretariat – Joseph Vincent D’Souza – and the many ups and downs in his attempt to lead the first network of Jesuit priest-scientists in India. Based on archival information, I situate the biography of this collective of Jesuit priest-scientists in the dual historical context of people’s science movements in India and the re-orientation of the Jesuit mission towards social justice in the postcolonial era. Importantly, I explain how the renewed Jesuit mission to practise a “faith that does justice” both (strangely) helped as well as discouraged the collective scientific activity of the Jesuit priest-scientists.

In **Chapter 6**, I provide an account of the scientific accomplishments of the Jesuit priest and botanist, KM Matthew, who remains one of the pioneers of plant taxonomy in south India. I discuss how his botanical pursuits were inspired by his Jesuit teachers during his training for priesthood and how he was encouraged to pursue higher education, thanks to the changes in outlook on Jesuit formation in independent India. This chapter also serves as a “success story” of how a Jesuit priest-scientist developed a twin research establishment – the Rapinat Herbarium (Trichy) and the Anglade Institute of Natural History (Shembaganur) – while managing the boundaries of this establishment with many “social worlds”. I explain that Matthew’s self-fashioning as a “botanist-environmentalist” was made possible because of his Jesuit roots. I also argue that his Jesuit identity played an important role in stabilizing his research establishment and also helped re-orient the Jesuit mission to include a focus on ecological justice as well.

Chapter 7 describes the story of how an agenda for scientific research came to be established at the Loyola College in Chennai, thanks to the efforts of the Jesuit priest and chemist Lourdu Yeddanapalli and the layman zoologist TN Ananthakrishnan. I provide an institutional biography of the Entomological Research Institute (ERI) which Ananthakrishnan founded in the 1960s. I then describe the influence of Arrupe (notably through his visits to Jesuit colleges in the Madurai Province in the 1970s and early 80s) in shifting the agenda from materialistic progress to social justice. With this focus, I examine if the Arrupean agenda for scientific research was fulfilled at ERI. I do this by exploring the work of Ananthakrishnan’s successor, the Jesuit priest and entomologist, Ignacimuthu Savarimuthu. This I do by analyzing the scientific publications authored by Ignacimuthu and his colleagues at ERI, and checking if

the scientific activities at ERI sought to get “undone science” done. The concept of “undone science” has often been used in STS to examine if research for social change or social impact is pursued by scientists and research organizations. I suggest that the Arrupean agenda for scientific research is an agenda to get “undone science” done and thus explore if ERI’s work does fulfil the Arrupean agenda for undone science.

Finally in **Chapter 8**, I describe that the many trajectories of Jesuit scientific activity in the Madurai Province in independent India suggest the emergence of a unique Jesuit scientific culture. Drawing from Sheila Jasanoff’s concept of sociotechnical imaginaries and based on the accounts of Jesuit science in this thesis, I suggest that the Jesuit encounter with science and technology in independent India, contributed to the birth of a distinct collective imagination around what doing science means for the Christian missionary. I argue that this imaginary provided some unique characteristics to Jesuit science in postcolonial India, which are quite different from the features of Jesuit science in colonial India. I conclude finally by describing how the encounter between science and religion offers an exciting arena for understanding how sociotechnical progress is imagined by different groups of people. I submit that studying the historical and cultural contexts of religious groups like the Jesuits in the Madurai Province will encourage the exploration of how other religious communities perceive and act towards realizing visions of sociotechnical progress.

(2) Establishing the Background

2.1 Introduction

This research builds on two relatively recent developments in the history of science which have provided fresh opportunities of engaging with science, technology and society studies. The first has been the identification of the Christian mission station as a “knowledge making space” where “new knowledge, including that provided by local informants was collected, assembled, exchanged and developed” by missionaries (Endfield, 2011). The second development has been the rising interest in the history of the Society of Jesus, leading to the launch of new field of study known as Jesuit studies (Maryks & Wright, 2014). The coming together of these two themes has created a new avenue for studying narratives of missionary science produced by the interplay of society, culture and scientific knowledge. It was based on these two developments that I moved back and forth between the data collection and analysis for my study. Further, this engagement with missionary science in the context of writing micro-histories of Jesuit scientific activity is also informed by the revival of biographies in the history of science.

In this chapter, I locate the background of my thesis by first presenting a brief overview of the evolution of science and technology in independent India, where I draw primarily from themes used in postcolonial science studies. I then discuss the historiography of Christianity in postcolonial India which has witnessed radical shifts from the Eurocentric mission histories to social histories of the Christian peoples, largely due to the rise of subaltern studies in the 1970s. I then discuss the three conceptual themes that I use in this thesis: social history of science and religion, scientific biography and missionary science.

2.2 Trajectories of science in postcolonial India

The starting point for this thesis is the overlap between history of science and science studies with religion (Christianity in India) as an important frame of exploration. It is now generally acknowledged that the narrative of the globalization of science is predominantly Euro-American and hence there is a need to pay greater attention to the development of science in the global South. Science studies in the global South could be said to fall under two broad themes: (1) the uneven integration of the formerly colonized world into the global scientific order; and (2) the institutionalization of science on a national basis (Dumoulin Kervran et al., 2018, p. 6). Historians of Indian science have explored in particular the relations between

colonial science and Indian knowledge systems, the development of sciences during the Indian Freedom Movement, and trends in present-day science (e.g., G. Prakash, 1999; Raina, 2017; K. Raj, 2007).

From its philosophical origins during the European Renaissance science took an “academic” form by 1900, funded largely by government but also by private contributions, through universities and other public institutes (Gibbons et al., 1994; Choi, 2009). One of the social norms governing “academic science” was the consideration that the outputs of scientific research be treated as “public knowledge”. Society was expected to gain from “objective” knowledge produced by scientists, as scientists were assumed to be immune to commercial, political and other external interests (Ziman, 1996a). After the Second World War, there were dramatic shifts in world power with the United States manifesting itself as the lone superpower followed by the firm opinion that science and technology were fundamental to national development (Escobar, 1995). Long before Jawaharlal Nehru (1889-1964) became the Prime Minister of independent India he declared: “It was science alone that could solve these problems of hunger and poverty, of insanitation and illiteracy, of superstition and the deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people” (as cited in Arnold, 2013). After becoming the Prime Minister, he prioritized science and technology in planning for India’s development, saying: “My interest largely consists in trying to make the Indian people and even the Government of India conscious of scientific work and the necessity for it” (as cited in Arnold, 2013). Accordingly, Nehru set up a massive scientific establishment with eminent Indian scientists leading the different scientific bodies which reported directly to the Prime Minister.

The view of “science for development” changed significantly by the 1950s and science became oriented more towards “short-term, commercial and applied outcomes”. Unlike the previous era where scientists received patronage for pursuing their individual areas of interest “post-academic” scientists were paid to produce goods and services in a competitive market economy (Hooker, 2003). Meanwhile in India, the optimism that people expressed for “Nehruvian science” began to fade in the 1960s, because the institutions Nehru built had failed to deliver on his promise of eradicating poverty. Further, there was the realization that technological transfer from the West was perpetuating dependency among the nations of the developing world (Esteva, 1992). This disappointment with the scientific establishment was compounded by a growing criticism of the development process itself. This criticism peaked

in the 1970s when Nehru's daughter and succeeding Prime Minister, Indira Gandhi (1917-1984), effectively imposed an autocracy by declaring a domestic emergency. A spectrum of localized social movements ensued in different parts of the country resulting in a new (but short-lived) government headed by the Janata Party—a new party which grew out of a massive grassroots movement headed by the Gandhian-Socialist leader, Jayaprakash Narayan (1902-1979) (Krishna, 1996).

The surge of grassroots movements in 1970s India also had its impact on scientists and educators. Scientists who were earlier influenced by “Nehruvian science” - which focused on building a top-heavy scientific establishment—began to engage with the idea of a “people's science” which emphasized rural development from the bottom-up (Krishna, 2017; Visvanathan, 2006). This shift towards an “alternative science” gained traction from two sources: a return to the Gandhian ideal of “science for villages” and the idea of “appropriate technology” promoted by EF Schumacher (S. Prasad, 2015; Bakker, 1990). Scientists and science educators began to speak of “science for social change” and formed regional groups to promote “science for social revolution” in different parts of the country (Jaffry et al., 1983; Vaidyanathan et al., 1979).

In the 1980s, relations between public science and private profit shifted radically with the broad global movement towards neoliberalism. The neoliberal turn transformed science and technology into commodities that could be traded in the markets (Lave et al., 2010, p. 3). As a result, the development of science shifted from the state to the market and individuals. By then, science (and technology) had taken root as the core of industrial innovation (Powell & Snellman, 2004). The most significant outcome of this development was the notion that economic wealth is best created through “the production, distribution and use of knowledge and information” – that is, in a knowledge-based economy or simply, a “knowledge economy” (Godin, 2006).

Scientific research in the knowledge economy became commercialized, with research being managed by a mix of academic, government and industrial interests (Nowotny et al., 2003). Essentially, the knowledge economy resulted in “public knowledge” being transformed into “intellectual property” (Ziman, 1996b). With this understanding of knowledge as a commodity for economic growth stabilizing in the developed world, developing countries like India were eager to follow similar models for growth (R. Prasad, 2004). Recent

government policy in India has focused on strengthening knowledge-based industries such as pharmaceuticals, information and communication technology, and internet based services. The Science, Technology and Innovation Policy of 2013 and the Technology Vision 2035 have both emphasized a greater role for private investment in the scientific research infrastructure of the country (Technology Information Forecasting and Assessment Council [TIFAC], 2017). Successive governments have been keen to provide an appropriate intellectual property rights ecosystem to “convert knowledge into wealth and/or value” (Department of Science and Technology [DST], 2013). This changing context of science policy in India and the revolution initiated by postcolonial studies has triggered fresh perspectives on the role played by different actors in the constitution of modern science in the country.

Anderson (2002) notes that postcolonial studies in STS do not simply celebrate the end of colonialism but also suggest new ways to study “the changing political economies of capitalism and science, the mutual reorganization of the global and the local, the increasing transnational traffic of people, practices, technologies, and contemporary contests over ‘intellectual property’” (p. 643). This critical mode of examining science and technology has led to the framing of new questions like: why some groups of actors gain more from science than others, and why some areas of scientific research are preferred over others (Frickel et al., 2010). One of the critical developments in the re-framing of questions in STS is the consideration of justice as an explicit area of research enquiry (Mamo & Fishman, 2013). The call for justice in postcolonial STS has created a space for thinking about this “anonymous crowd” who are not often considered in STS literature. STS scholars have begun to look towards these “invisible” organizations and institutions to respond to the needs of humans and non-humans (Reardon, 2013). Still, religious institutions and bodies continue to be off limits in these explorations. It is here that we need to turn our lens towards the history of science in understanding the role of invisible actors, including those in religious institutions. In this thesis, I draw upon Raina who writes that the role of Jesuits in the development of modern science in India has been underplayed due to a fixation on the supposed antagonism between science and religion (Raina, 1999). It is in this context that I attempt to explore a social history of the Jesuits’ scientific activity in independent India.

I submit that studying Jesuit science in postcolonial India is important because it could contribute to understanding the plurality of actors and how these actors’ influenced the

diverse trajectories of science in independent India. As we noted briefly earlier, the practice of science changed radically in India (and elsewhere in the world) from the mid-1950s to the mid-1970s. These changes were marked by the rise of institutions, the multiplication of public experts, the emergence of social movements and the rise of science studies (Agar, 2008). The long 1960s also marked a crucial period in the history of the Jesuits globally and also in India. The election of a liberal minded Jesuit, Pedro Arrupe (1907-1991), as the Superior General along with changes ushered in the Catholic Church through the Second Vatican Council (more on this Council in Chapter (5)) promoted new perspectives in how Jesuits responded to the crises within and outside Catholic society (Alberigo & Sherry, 2006; Steinfels, 1991). The influence of the social movements in the secular world also had its impact on the Jesuits and there was a call to renew their mission according to the signs of the times. This resulted in the social justice orientation of their mission which also had an influence of their scientific practice (as we shall see in Chapter (5)). But first, I present an overview of how Catholic Christianity in India began to develop a distinct character after Indian independence.

2.3 Writing Postcolonial Histories of Christianity in India

Until Indian independence, historical scholarship on Christianity in India was focused largely on two dominant themes: (1) foreign missionaries and their processes of conversion; and (2) the influence of the colonial enterprise on the missions. A limited third theme tried to present an apologetic account of the impact of missionary activities by providing an inventory of their educational, healthcare and social outreach programs across the country. Much less was written on the experiences and initiatives of Indian Christians (Sarkar, 2002). Beginning in the 1970s, a number of new historical perspectives began to emerge among historians of Indian Christianity. Chief among these was the nationalistic perspective where historians and theologians began to turn the lens towards the Indian contribution to Christianity. Besides turning the focus away from the Eurocentric perspective on the foreign missionaries the nationalistic perspective situated the history of Christianity in India as an intrinsic part of the social history of the Indian people. The initial fruits of this perspective were focused on a few Indian Christian heroes (Oommen, 2003, p. 213). But a re-appraisal of this perspective, complemented by the “history from below” approach of the New Historians, pioneered several people-centric histories of Christianity in India (Oommen, 2003, p. 215; Burke, 2001). The postcolonial critique also helped to situate European missionaries not as key actors but as co-actors in the social history of Indian Christians and to present contextual

histories of Indian Christianity (Oommen, 2003, p. 218). Related developments in feminist historiography also influenced the literature, though historical writing on feminist perspectives of Christianity in India is yet to gain momentum (e.g., Dempsey, 2001; Taneti, 2013; S. Thomas, 2018). Finally, the impact of subaltern studies helped in critiquing the prevailing elitist historiography of Christianity in India and by producing socio-cultural histories of Dalit and Tribal Christians in India (e.g., Oddie, 1975; C. M. Bauman, 2008b; Mosse, 2012). These trends in the historiography of Indian Christianity were also an outcome of a broader shift in the writing of global Christianity, that which rejected the theory of Christian expansionism from the West. Specifically, it called into question the so-called “civilizing mission of the white man” as a “divine commission”. This critique, Cyril Powles (1984) suggests, also contributed to the realization that it was meaningless to write of a homogeneous global history of Christianity in the Third World. One could only speak of Christianity in specific contexts such as that of colonial or postcolonial South India (Powles, 1984).

Despite these developments, there continues to be a dearth of research on 20th century Christianity, particularly on histories outside Europe and North America. However, there is a small group of historians calling for nuanced explorations of specific groups of Christians in particular times and places in the global South. For instance, Hartmut Lehmann (2002) argues for a closer investigation into the psychological aspects of religion by looking into how religion (in this case, Christianity) operates in individual lives under emerging social, political and cultural conditions. He recommends two avenues for this exploration: biographies and microhistories. In India, the Church History Association of India (CHAI) was a leading player in initiating this historiographical trend of writing a revisionist history of Christianity in India, beginning in the 1970s. However, even into the 1990s, the CHAI collective realized that writing a social history of Christianity in India can be daunting, particularly with the diminishing missionary archives after Indian independence (Webster, 2008). The turn to the social sciences, particularly sociology and anthropology, has offered an opportunity to explore histories of Christianity from a “new perspective”. This “social turn” has offered an opportunity to understand the nuances of a church congregation or a religious order in a particular geography—like that of the Jesuits of the Madurai Province. One further interesting turn in the history of Christianity is to situate it in the context of the history of science. This has been exemplified in recent studies on the history of science and religion, as we will explore in the next section.

2.4 The historiography of science and religion

Often, historians of science study past ideas from the perspective of the present; for example, they are motivated by the idea of progress which they understand to be exemplified in the present-day scientific advances. This presentist view suggested that priority should be accorded to examining the internal development of scientific ideas and exclude external factors, chief among them religion (D. B. Wilson, 2000, p. 2). On the other hand, the nineteenth-century scholars Andrew Dickson White (1832–1918) and John William Draper (1811–82) considered that religion is an external factor which impedes the progress of science. They initiated the thesis that science and religion are at perennial “conflict” with each other (Draper, 1874; A. D. White, 1896).

It was Herbert Butterfield who contended that the past should be explored on its own terms, rather than reading the present into the past. Further, he argued against dividing the world into friends and enemies of progress—science being one of the former and religion being a proponent of the latter (Butterfield, 1931). He suggested that useful historical insights can be obtained only if historians stop seeing scientists of the past as similar to those of the modern era. Butterfield presented a far more nuanced role for religion suggesting that it should not be seen as opposed or separate from science. Rather, the relationship of religion to science should be described only based on the available evidence (Butterfield, 1949). Another historian, Alexandre Koyré (1957) argued that the pioneers of the Scientific Revolution were also the same men who discussed philosophy and theology, such as Johannes Kepler (1571–1630) and Isaac Newton (1642–1727). On a similar note, Thomas Kuhn (1957) described how philosophical and religious perspectives were as fundamental to the early modern astronomers as were their scientific views. By the 1980s and 90s, historians were expected to avoid the “retrospective fallacy” of considering the past as fixed in place while the future was seen as unformed and fluid. Further, the insights provided by the social constructionist school helped to re-cast religion as only one among many social factors that affect the production of scientific knowledge. So neither religion nor science are considered the focal points of analysis, rather other elements such as power relationships and social structures began to take priority in contemporary historical scholarship (Berger & Luckmann, 1991; Weldon, 2000).

Arguing that “conflict” was only one of several kinds of science-religion relations, Ian Barbour (1966) outlined a fourfold typology on the relationship between science and religion: that of conflict, integration, dialogue and independence. The conflict view, as we noted

previously, considers that science and religion cannot be reconciled because their distinctive identities and features are incompatible (Stenmark, 2010). Historians today agree that the conflict model is no longer tenable because it is not supported by historical record—there is no simple pattern in the historical relations between science and religion. Peter Harrison (2010) suggests that celebrated cases of “conflict”, such as the condemnation of Galileo by the Catholic Church are atypical in the history of science because they arose out of local considerations such as disagreement between theories rather than due to universal conflict between the social institutions of science and religion (p. 4). John Hedley Brooke (2014) submitted that “scholarship in the history of science has revealed so extraordinarily rich and complex a relationship between science and religion... [that the] real lesson turns out to be the complexity” and initiated what is now being referred to as the “complexity” thesis (p. 6).

Acknowledging the complex relations between religion and science has contributed to an increase in the consideration of religious phenomena in historical analysis, while guarding against attributing undue agency to religious commitments. For instance, the intellectual historian Sarah Shorthall (2016) suggests that attending to the claims of religious actors need not imply a direct endorsement of their claims. Rather, scholars should illuminate how these claims function by translating them to the language of social and political processes (Shortall, 2016). This has led scholars of various disciplines to “bring back” religion into the scholarly discourse. For example, development studies scholars urge that if religion is “brought back in” to policy research, it can improve “our understanding of challenging development issues” (Deneulin & Rakodi, 2011). Sociologists of religion have shown how public (mis)understandings of science can prejudice the idea that some religious communities “pose a threat to the West” (Jones et al., 2019). Further, science educators suggest that teaching about the relation between science and religion can help students to learn science better (Reiss, 2010).

However, religion is yet to make a significant impact in Science, Technology and Society Studies (STS). Even though research on the development of science has happened at the crossroads between the history of science and STS, there has been little progress on analysing the religious worlds of scientific actors within the discipline of science studies. One possible reason is perhaps the disconnect between historians of science and STS scholars. For instance, Lorraine Daston (2009) claims that science studies has become less historical than before. She suggests that even though both disciplines gave up the language of winners and

losers in science they both adopted estrangement towards contemporary science. Daston further submits that science that is explored by the historians looks very different from that studied by STS scholars. On the other hand, Sheila Jasanoff (2000) suggests that the lack of consensus between historians and STS scholars arises from historians' scepticism of STS scholars' preoccupation with constructivism. She submits that science studies are also historically grounded and offer critical exploration of the relations of science with society (Jasanoff, 2000). Together with the historian of science Peter Dear, Jasanoff contends that historians and STS could collaborate in bringing forward the neglected voices that have contributed to the history of science (Dear & Jasanoff, 2010). It is with this perspective that I approach the exploration of Jesuits to be an important but silenced voice in the history of science as a social institution in India.

Exploring the role of religious actors like the Jesuits provides space for incorporating social constructivist approaches in considering alternative representations of social actors who otherwise remain silent in STS literature (e.g., Lestar & Böhm, 2020). For sure, this is not to idealize the role of spirituality and religion within science studies. Rather, it is to encourage attempts to understand human behaviour and explore how individuals and communities bring about change - for better or for worse. For instance, Bruno Latour feels that it is pertinent to ask why religious people do what they do, and Wenell asks why religious adherents might sometimes have more stimuli to act more ethically than others (Latour, 2005, p. 235; Wenell, 2016 as cited in; Lestar & Böhm, 2020). So, considering the interaction between science and religion in the social studies of science could help in exploring the institution of science in a new light and to re-position narratives of scientific progress as historically contingent. Again, this requires guarding against the simplistic suggestion that religion contributes to science. Rather the question that needs to be posed is: what did the pursuit of science and technology mean to people (religiously minded or otherwise) and what were the historical conditions of time and place that facilitated that pursuit?¹⁰ One area which has contributed to a healthy exploration of the role of religious actors in the history of science is the emerging sub-discipline of missionary science. I introduce this academic field briefly in the next section.

¹⁰ For example, see the discussion on the exchange of knowledge by missionaries in (Delbourgo, 2019)

2.5 Contemporary missionary science and postcolonial Christian mission

David N. Livingstone (2005) writes that “[to] speak of scientific inquiry and the missionary enterprise is already to invite censure” (p. 50). The sustained effort to promote the narrative of conflict between science and religion has made it difficult for the contemporary lay public to conceive that missionaries could indeed be involved in scientific activity. However, historians have demonstrated that as the European empires spread in the 16th and 17th centuries, science and Christianity grew together through mutually beneficial connections (e.g., Lindberg & Numbers, 1986; Harrison, 2010). Caricatures of missionaries as unscientific and prejudiced have been corrected as historians of science and historians of Christianity began to unravel the active role played by missionaries in cultivating science in distant lands.

Broadly construed, missionary science is a term used to describe the “cultivation and spread of science by Christian missionaries” (Stenhouse, 2020, p. 90). Missionary science was far from homogeneous; it was a situated practice depending on the places the missionaries visited. The scientific practices of the missionaries were constituted through their experiences in specific spaces, both cultural and physical (D. N. Livingstone, 2005, p. 51). Specifically, a number of historians have shown that much of missionary science emerged through a close alliance between colonial imperialism and missionary zeal (e.g., Etherington, 2005; O. White & Daughton, 2012; H. M. Carey, 2011). This historical interaction between science and Christian mission in the non-Western world could help to re-examine the history of science and its relation with religion.

In the sixteenth century, the Jesuits became perhaps the earliest missionaries to create international networks for scientific exchange between the Old and the New Worlds (Harris, 1996a, 2005). In the eighteenth century, the Protestants in Europe used a broad spectrum of scientific as well as spiritual resources, from “host as well as home cultures”, to spread the missionary message in the European colonies (Stenhouse, 2020, p. 91). Beginning in the nineteenth century, the Canadians and the North Americans also began to engage in missionary activities in different parts of the world. But this expansion in the spread of missionaries was nevertheless related to the imperial expansion (Endfield, 2011, p. 204).

Travel narratives were among the earliest accounts of ‘expeditionary science’ narratives produced by the missionaries. Sujit Sivasundaram (2005) describes how the missionaries of

the London Missionary Society (LMS) became active practitioners of geographic knowledges in the Pacific. The case of the prominent missionary geographer David Livingstone (1813-1873) is also distinct because his missionary travels were sponsored by the Royal Geographic Society. His celebrated account of *Missionary Travels and Researches in South Africa* (1857) made scientific work respectable among missionaries (J. D. Livingstone, 2013).

Often, the missionaries prepared for the vagaries in climate of their mission stations by recording details of hostile climates, which in turn served as data for use by future missionaries. For example, British missionaries stationed in central southern Africa during the 19th century provided detailed accounts of climate variability in the Kalahari region. Further, these accounts suggest that the British missionaries associated drought and other climate variations with the ‘moral degradation’ of the local populations. As an act of ideological control, these missionaries introduced irrigation technologies to “morally redeem” the local people (Endfield & Nash, 2007). Other scholars have shown that the records of various missionaries not only helped to develop climatic chronologies but also contributed to early thinking around environmental conservation (Grove, 1989).

Among the other “missionary sciences”, the linguistic explorations were also important. David Maxwell (2016) notes how missionaries recorded linguistic data in pre-colonial Luba Kingdom of 19th century central Africa to not only proselytize but also to consolidate the ethnicity of Luba Christians. The missionaries also worked with the local populations to learn the native languages and created grammars, dictionaries and Bibles to help in the evangelizing missions. In their missionary encounters with the Yoruba (in present day Nigeria), Christian missionaries often ended up using vocabulary introduced by the Muslims to introduce Christian concepts. For instance, the Anglican missionary Samuel Adjai Crowther used a Yoruba term meaning ‘Muslim cleric’ to designate a priest throughout his Yoruba translation of the Bible (Landau, 2005 as cited in, Stenhouse, 2020). Indeed, the appropriation of local knowledges by Christian missionaries was often used to promote imperialism to a large extent in Africa (Grunder, 1995). Yet as Endfield (2011) observes, local peoples were not just passive recipients of colonial/missionary science. The mission station served as a site of interactive exchange between the missionaries and the indigenous people (p. 211). This was also often the case with missionary science in India.

One of the leading Lutheran Pietists, August Hermann Francke (1663–1727) collaborated with Gottfried Leibniz (1646-1716), the Enlightenment polymath, to establish the Halle Orphanage in Germany, a centre to train missionaries using a scientifically oriented and practically useful curriculum (Whitmer, 2015). Missionaries trained at Halle led the first Protestant mission to India, where they contributed to the transmission of European science into south India beginning in the late eighteenth century. Two south Indians educated by the Pietists from Halle—King Serfoji II (1777-1832) and Vedanayakam Sastri (1774-1864) – were enthusiastic about synthesizing European and Indian systems of science and education (Peterson, 2003). In northern India, Sivasundaram (2007) shows how the ‘Serampore Trio’ of Baptist missionaries—William Carey, William Ward and Joshua Marshman—practised a form of ‘constructive Orientalism’ by introducing a dialogue between traditions of ‘Sanskrit science’ with colonial European science, albeit with the intention that the dialogue would lead to conversion. Carey, a self-taught botanist, employed colonial botany to help Indians affected by famine. He also established a private botanical garden and the Agriculture and Horticultural Society, which became a key link in the worldwide network of botanical exchange (Sivasundaram, 2007).

The Jesuits, however, were arguably the earliest among the ‘missionary scientists’ in India, dabbling in anthropology, linguistics, astronomy and geography (e.g., Sen, 1982; Sharma, 1982; Restif-Filliozat, 2019; Clooney, 1990; Amaladass, 2017). Anthony Montserrate’s journeys across northern India in 1580 contributed to a series of latitudinal observations which eventually helped draft perhaps the first map of the Indian subcontinent (McFarland, 1939). In the early eighteenth century, the French Jesuit Pons and Boudier were invited by the *Raja* (King) of Amber, Sawai Jai Singh, to collaborate with the astronomers in his court (Forbes, 1982). Besides, the Jesuits in China and India were in contact with astronomers in Paris, including the eminent astronomer and mathematician Jean-Dominique Cassini (1625-1712), thus participating in a global network to map the earth (Raina, 1999).

The rise of antagonism towards Western Christianity and the emergence of modern scientific disciplines in the early twentieth century led to a gradual disparagement of “non-professionals” in science. As missionaries seldom had professional training in the sciences their work became an easy target for professionalizing scientists (Stenhouse, 2020, pp. 105–106). This along with the implied memory of mission as a colonial imposition brought the missionaries under closer scrutiny by mid-twentieth century. Some have therefore suggested

that missionary science should thus be delegated to a marginal status in the history of science (Endfield, 2011, p. 213). However, the postcolonial revision of “mission” as a generic theological term could be put to use in the critical appraisal of missionary science today (e.g., Behera, 2019).

In the sixteenth century, the term “mission” was understood by the Catholic Church as preaching, baptizing and serving the baptized (O’Malley, 1994). In the 18th century, Protestant missionaries theorized ‘mission’ as an obligation of Christians to convert the “heathen” (W. Carey, 1792 as cited in, Behera, 2019). In the postcolonial context, the term evoked memories of colonialism and paternalism among the Christians of newly independent states. Thus there were calls to even put on hold all foreign missionary activity in the global South (e.g., G. H. Anderson, 1974; Lourdasamy, 1987). For example, the Jesuits in independent India sought to downplay the historical alliance between European imperialism and Jesuits missions of the 16th and 17th centuries especially after accusations of “forced conversions” began to emerge soon after independence (C. M. Bauman, 2008a). In the postcolonial world, there was a growing recognition that the Catholic Church as also the Protestant churches should move away from being Eurocentric and evolve into a truly “world church” (Rahner, 1979). Accordingly, Joy Thomas (1997) notes that Christian mission today has shifted from one of “conquest” to “dialogue”. Therefore, contemporary mission demands respect for other faiths and differing viewpoints, so that it can respond to the human situations and collaborate with all those working towards the “integral development and liberation of people” (J. Thomas, 1997).

Likewise, the Indian Jesuit Michael Amaladoss (1988) notes that mission in the third millennium cannot be seen as being Christian versus non-Christian. He argues that Christianity can no longer claim to have the blueprint for salvation but should promote counter-cultural missionaries who are involved in and work for the people of the world. Missionaries should no longer be restricted to working with Christian institutions but focus on reforming the economic, industrial and technical structures which can improve the quality of life of all people, Christian and non-Christian alike (Amaladoss, 1988). This, I will show later in the thesis, is one of the trajectories in which missionary science evolved among the Madurai Jesuits in independent India.

The narrative of how missionaries engaged with changing cultures of science and technology is of increasing interest to historians because of significant shifts in how the missionaries have responded to the scientific revolution of the 15th century, the industrial revolution of the 18th century, Darwinism of the 19th century, and the biotechnological revolution of the 20th century (Sivasundaram, 2010). Further, the nature of missionary science differed significantly across the globe. On the one hand, the Jesuit geologist and palaeontologist Teilhard de Chardin attempted to (controversially) bridge science and theology by presenting a Christological perspective of Darwinian evolution (Chardin, 1965; Grumett, 2007). On the other hand, north American fundamentalists have attempted to create their own brands of creation science and flood geology in the 20th century (e.g., Numbers, 2006). Questions about the centrality of Christ and the “salvation of souls” arise in these multiple versions of contemporary missionary science, and argue for the increasing importance of an engagement with the history of recent science. This thesis will be an attempt to highlight one such instantiation of missionary science: the re-invention of Jesuit scientific activity as a postcolonial missionary activity which aims to dialogue with people and policy rather than as a tactic for “conversion of the heathen”. I do this by drawing from biographies of some Indian Jesuit priest-scientists, to seek an understanding of the larger social, cultural and political interplay between Jesuit missionary spirituality and their scientific activity in independent India. In the next section, I explain why I adopt the method of scientific biography to explore these questions.

2.6 Exploring scientific communities through biographies

Until the 1970s, the history of science was “a history of white men in Europe... written by white men in Europe” (Poskett, 2018, p. 26). Besides, these histories were often presented as biographies of “superhero celebrities” - great men (seldom were histories of women written about) and their great ideas. The arrival of social history challenged historians of science to also write about the “ordinary scientists” who are generally excluded from “big picture” narratives (Nye, 2006, p. 323). The so-called ‘New History’, which originated in the 1970s, challenged the status quo because the ‘New Historians’ felt that the existing chronological narrative was restricting the types of historical questions and explanations possible to provide an overall historical account (de Vries, 2017). It was argued that the descriptive narrative of the ‘antiquarian’ historians was useful to answer the ‘what’ and the ‘how’ questions but not the ‘why’ questions (Stone, 1979, pp. 4–5).

The revival of the historical narrative under the 'New History' was based on the foundation that reality is socially or culturally constructed. The 'New History' suggested that social forces shape virtually every human activity, including the history of science (Burke, 2001, p. 3). As a result, historians of science also began to enquire into "the cultural resources of scientific theory and the social construction of scientific knowledge" (Nye, 2006, p. 324). Scientific biographies, under the influence of the social sciences, began to be oriented with not just description but of analysis; of not just celebrating the stories of great scientists but also the failed ones; not just to narrate Whiggish accounts of scientific progress but to shed light on the workings of past society and culture (Stone, 1979, p. 19).

Thomas Söderqvist (2006) describes the scientific biography as a method for writing the contextual history of science. He refers to the historian of science Thomas Hankins who viewed the biography as a kind of "microcosm" that could illuminate the history of science at the macro-context (Hankins, 1979). Söderqvist (2006) suggests that the scientific biography provides "a smart way to get under the skin of a whole historical period or situation" and thus contributes to a socially and culturally informed history of science (p. 106). Mary Jo Nye (2006) writes that biographies help in achieving the "historical aim of interpreting the changing character of scientific practice, as well as the specific character of individual scientists" (p. 329).

Some historians have considered the similarities between biographies and another subgenre - the microhistory (Lepore, 2001). Microhistories, developed by Carlo Ginzburg and Giovanni Levi, offered a method to turn the lens on "exceptional normal" individuals rather than "ordinary people". This advanced the aim of testing macro-scale theories thus contributing a critical narrative of the marginal figures and their historical context. Microhistory is based on "the reduction of the scale of observation, on a microscopic analysis and an intensive study of the documentary material" in the belief that such a microscopic observation will reveal previously unobserved factors (Levi, 2001, p. 99). On this reduced scale, microhistories could help historians to understand relationships between belief, values and their representations on one side and social affiliations on the other (Ginzburg, 1993, p. 22).

Closely related to biography and microhistory, is the historiographical method known as prosopography, which also gained prominence through the rise of social history. Prosopography is the study of biographical detail about individuals in aggregate, by exploring

the connections between individuals in a group, where the group members share one or more characteristics (Keats-Rohan, 2007, pp. 140–141). Prosopography differs from biography in that the former is not interested in the unique but the average. The details of the individual are only important to gather information about the collective. The objective of prosopography is to analyse the group by examining the interplay between different variables so as to understand historical processes (Verboven et al., 2007). Some historians distinguish between two kinds of prosopographies: collective biographies of groups (small groups of, say, fewer than a hundred individuals) and statistical studies of populations (larger groups of thousands of individuals) (Clark, 2003, p. 237). The most well known of prosopographies in the history of science is Robert K Merton's statistically based collective biography of British scientists in *Science, Technology, and Puritanism in Seventeenth Century England* (1938), where he described the reasons why science emerged so strongly in 17th century England. According to his analysis, it was Puritanism that lent a supportive structure to scientific activities of that place and time. He also showed that the scientists he explored were influenced by the practical concerns of the day (Cole, 2004). Merton's account gained interest among historians as social history began to obviate Whiggish accounts in the history of science (Clark, 2003, p. 239).

According to Lewis Pyenson (1977), prosopography signifies any study that uses collective biography, though some historians object to that description (e.g., Keats-Rohan, 2007, p. 143). Moving beyond definitional issues, Pyenson (1977) presented a case for using the prosopographical method to go beyond the study of scientific elites (p. 158). Rather, he argued for historians to explore themes related to the “little men and women” in science who continue to remain marginal in the history of science (Pyenson, 1977, p. 179). Others have also argued for prosopographies to explore “less visible and anonymous streams of incremental innovation” including those by failed and less successful scientists (MacLeod & Nuvolari, 2006, p. 774). This view also emphasizes the role of “small nonconformist groups of institutions” that have contributed to the emergence of novel paradigms (MacLeod & Nuvolari, 2006, p. 774). Rather than perpetuate the heroic conceptions of scientific and technological change, the social turn in the history of science suggests the need to highlight the “anonymous crowd” from the back of the stage (MacLeod & Nuvolari, 2006, p. 776).

Coming to Jesuit science, Steven J Harris (1988) presented the first major prosopography of Jesuit science till now. Moving beyond the science-religion conflict thesis, he studied the

scientific publications of Jesuits in the 17th and 18th centuries. Starting from this quantitative analysis, Harris proposed that the Jesuits' scientific activity was inspired by an ideology modelled on "apostolic spirituality". His study thus helped to articulate the web of ties that bound the Jesuits together (Harris, 1989). Harris' findings are still relevant to understand the spiritual roots of Jesuit science. But these themes need to be re-explored in the varied context of science and Christianity today, as well as the contemporary context of Jesuit mission. This is the underlying motivation for me to pursue the biographies of some Jesuit priest-scientists to understand their orientation and contributions (significant or otherwise) so as to situate their scientific activity in a meaningful context. I also draw from Peter Harrison who suggests that studying the personal dimensions of a scientist's religious and scientific activities can help in understanding the relationship between science and religion (Harrison, 2006 as cited in, Cantor, 2019). Söderqvist (2006, p. 108) also suggests that biographies can help in comprehending the origin and construction of scientific results with reference to socio-psychological circumstances such as motivations, feelings and personal experiences.

Having reviewed the literature relevant to understanding the background of this thesis, I now provide a historical overview of the Jesuits in the next chapter. I begin from the origins of the Jesuits and their arrival in the Indian subcontinent in the 16th century, their struggles in maintaining their status within the Catholic Church during the 18th century, the reinvention of their missionary work in 19th century British India and subsequent reorientation of their mission in independent India.

(3) From Madura Mission to Madurai Province: Four centuries of the Jesuits in south India

3.1 Introduction

In the year 1492, the Catholic monarchs of Spain, Ferdinand and Isabella expelled the Muslims and the Jews from the Spanish territories and unified the regions into a Catholic stronghold. In the same year, Ferdinand and Isabella authorized Christopher Columbus, an Italian, to lead an expedition towards the so-called New World. Columbus was accompanied by Catholic missionaries patronized by Spain, who initiated the spread of Christianity in Central and Latin America (Cunningham, 2009, pp. 180–181; Nirenberg, 2009). A few years later, the Portuguese began their explorations into the New World when Vasco da Gama's fleet reached the southern coast of India in 1498. Competition over colonial domains and ecclesiastical rights ensued; Spain and Portugal fought over who should take control of the new lands. But the Catholic Church in Rome, in a series of papal bulls¹¹ between 1418 and 1481, had already granted the Portuguese Crown exclusive rights to not only establish Catholic missions in large parts of Africa, Asia and Brazil but also to make ecclesiastical appointments and to engage in trade with the native peoples. Under this system of privileges called the *Padroado Real*, the Franciscans and later the Dominicans began to arrive in India to establish the Portuguese missions. By 1510, the Portuguese established the *Estado da India* with Goa as the capital of Portuguese East India (Frykenberg, 2008c, pp. 126–127). The advent of Portuguese rule in India led to the arrival of several monks and missionaries. But the most influential of all missionaries in India would be those belonging to the Society of Jesus, known better as the Jesuits.

3.2 The founding of the Society of Jesus

Íñigo Lopez de Loyola was born in the Basque region of Spain around 1491. In his youth, he served in the Spanish courts and was keen to advance his career as a courtier but was wounded in a battle in 1521. During a long and painful period of recovery, Íñigo found himself reading and reflecting upon the lives of the Catholic saints.¹² Eventually, he decided to go to Jerusalem as a wandering mystic. As a pilgrim, he began to write about his spiritual experiences and preached to the local people. He was suspected of being a heretic because he

¹¹ A papal bull is a kind of an official document issued by the Pope to make specific proclamations.

¹² In the Catholic tradition, “the formally canonized saints are Christians who lived with such virtue, through real communion with Christ, that their lives radiated purity and sanctity to an exceptional degree, and usually with a significant impact on many people” (Ford & Ford, 2010).

promoted his personal form of spirituality without any formal authorization from the Catholic Church and so was briefly imprisoned under the Spanish Inquisition.¹³ Íñigo realized that he had to equip himself with an ecclesiastical degree (training in theology and philosophy) if he truly wanted “to help souls” and began his higher studies at the age of 37. In 1528, he enrolled himself at the university in Paris where he began to call himself “Ignatius” after a martyred saint of the early Catholic Church. He soon won the admiration of fellow students at the university. Ignatius and his group of friends decided to form themselves into a religious order of Catholic priests in 1539 with Ignatius drafting an initial rule for the Order called the *Formula of the Institute*. In 1540, Pope Paul III approved the *Formula* and the Society of Jesus was born. Ignatius was elected the first Superior General of the Jesuits in 1541 (O’Malley, 1993).

Even before the Jesuits were formally approved in 1540, the Portuguese ambassador to the Papal Court was impressed by their fervour and requested that the Jesuits be sent as missionaries to the “East Indian possessions of Portugal”. After a series of diplomatic exchanges, one of Ignatius’ early companions, Francis Xavier (1506-1552) was selected to go to India - along with a fleet of five Portuguese ships (Schurhammer, 1928). Xavier arrived at Goa in 1542 and initiated the chapter of Jesuit missionary activity and Roman Catholicism in India. Indeed, forms of early Eastern Christianity had existed in parts of south India for centuries.¹⁴ But it was only after the Portuguese conquest of Goa that Western Christendom began to shape Christianity in India.

3.3 The birth of the Madura Mission

From Goa, Francis Xavier gradually moved towards present day Tamil Nadu converting thousands of people in the fishing villages along present-day Tuticorin (Schurhammer, 1928, pp. 96–103). More Jesuits began to arrive in India; there were 349 Jesuits working in different missions around India by 1584 (Frykenberg, 2008c, p. 129). In Tamil Nadu, Xavier was succeeded by other Jesuits such as the Italian Antonio Criminali (1520–1549) and the Portuguese Henrique Henriques (1520-1600) who led the missionary activities in the coastal regions of Tamil Nadu. By 1600, twenty Jesuits were working along the “Fishery Coast” of Tuticorin (Fernando, 2016).

¹³ The Spanish Inquisition was an institution established to combat heresy but also served to consolidate power under the Catholic monarchs of the newly unified Spanish kingdom (Kamen, 2014).

¹⁴ According to one tradition, the apostle Thomas arrived in southern India and evangelized around AD 50. Evidence of formal Christian life in south India has been recorded from AD 345, see (Frykenberg, 2008d).

In 1605, Robert de Nobili (1577–1656), an Italian Jesuit arrived in Goa with fourteen other young Jesuits (Cronin, 1959, p. 24). The same year, the Jesuits established the second Indian province after Goa, the Malabar Province in the south with Cochin as its headquarters (Cronin, 1959, pp. 30–32). Nobili was directed to report to the Provincial of the Malabar Province, Alberto Laerzio, who instructed Nobili to join other Jesuits and convert people in the interior regions around Madurai (Cronin, 1959, p. 36). Unlike in the coastal regions, the Jesuits had much less success in securing converts in the interior parts of south India. Nobili then began his (in)famous experiment of presenting himself as a “Roman Brahmin”. Dressed in the attire of a Brahmin *sanyasi* (hermit) he learned the local languages—Tamil, Telugu and Sanskrit—and preached an adapted form of Christianity. He allowed the converts to retain their Tamil names and to continue their social customs. Nobili’s approach was frowned upon by his Jesuit companions in Madurai as well as the Catholic hierarchy in Rome. He was eventually allowed to follow his adapted form of evangelization though the success of his methods continued to be debated (Clooney, 1990; Županov, 1999). The important point however is that Nobili’s efforts led to the establishment of Madurai as an important mission station of the Jesuits – the Madura Mission¹⁵. Robert de Nobili was followed by others like John de Brito [Britto] (1647–1693) and Constanzo Giuseppe Beschi [Constantine Joseph Beschi] (1680–1747) who preached an Indianized form of Roman Catholicism to convert the local people in the Madura Mission (Bayly, 1990; S. J. Raj & Dempsey, 2002).

While the Madura Jesuits were adapting Christianity to secure more converts, the Jesuits in Northern India used their skills in astronomy and geography to try and gain conversions. Despite winning the respect and patronage of both Hindu and Muslim rulers in the north, the Jesuits were unable to gain as many converts in the northern parts of India. For example, the Jesuits attempted to, but were unsuccessful in, converting the Mughals to Christianity (Du Jarric, 2005; MacLagan, 1932). The Madura Jesuits appear to have been more active in art and culture than in the sciences. For instance, Beschi is often credited with bringing about a renaissance in Tamil literature. He composed several Tamil poems and wrote a grammar for the common use of Tamil. In recognition of Beschi’s contributions to Tamil language and literature the Government of Tamil Nadu erected a statue in his honour in the city of Madras

¹⁵ The colonial term ‘Madura’ was used to describe the Jesuit mission while the term ‘Madurai’ was used to refer to the city. When the mission station was upgraded to the status of a Jesuit Province in 1952, it was named the Madurai Province.

(Chennai) in 1968 (Muthiah, 2008, p. 242). He also represented Mary (the mother of Jesus) as a Tamil woman dressed in a sari, a statue of which continues to be preserved in the village of Elakurichi today.¹⁶

3.4 Global Suppression of the Jesuit Order

Meanwhile, the rising numbers and influence of the Jesuits across Europe and in the colonies of Portugal and Spain led to a series of public attacks on the Jesuits by their ideological enemies. Specifically, the rulers of Spain, Portugal and France held the Jesuits responsible for sparking political unrest against the monarchy (Burson & Wright, 2015; Worcester, 2015). Portugal became the first to suppress the Jesuits in 1759. Jesuits working in Portugal and its colonies were arrested while Jesuit properties were confiscated. Most of the Jesuit missionaries in Goa were taken back to Portugal and imprisoned. Meanwhile in southern India, Portuguese influence had decreased considerably with the arrival of the English and the French (see, Karashima, 2014; Pearson, 1988). Meanwhile, Pope Clement XIV ordered the global suppression of the Society of Jesus in 1773. However, the Jesuits of the Madura Mission were allowed to remain in the region even though they could no longer call themselves “Jesuits”. Interestingly, the Jesuits were not suppressed in Russia because the Empress Catherine the Great refused to promulgate the papal decree of Jesuit suppression. So the Jesuits continued to operate from Russia, even ordaining new priests after the Suppression (Inglot, 2015).

In 1776, the French monarchy in agreement with the Church in Rome entrusted the Missions Etrangères de Paris (MEP) with the responsibility of taking over the Malabar Province and the Madura Mission from the Jesuits. The former Jesuits of the Malabar Province (eight of them) were allowed to remain independent but were expected to collaborate with the MEP (Pavone, 2014, pp. 334–335). It would only be in 1837, after the Restoration of the Society of Jesus in 1814, that the Jesuits would return to re-establish the “New” Madura Mission.

3.5 Restoration and the return of the Jesuits to Madura

After the Jesuits were suppressed, the Catholic Church itself had to endure a series of epochal events that challenged its temporal authority considerably. Significantly, the French Revolution of 1789 ushered a period of ‘de-Christianization’ which resulted in the separation of Church and State (Tackett, 2006). The Napoleonic era that followed the French Revolution

¹⁶ For details of the statue and the church where it is housed, see <http://www.adaikalamadha.org/>

did not help either; Rome was occupied by Napoleon and Pope Pius VII was forced to live in exile (Desan, 2006).

In 1801, Pius VII offered hope to the Jesuits in exile when he formally recognized the existence of the Society of Jesus in the Russian Empire. The end of the Napoleonic Wars and the restoration of the Bourbon rulers to the French monarchy helped restore some of the lost influence of the Catholic Church. On his release from captivity, Pius VII returned to Rome in 1814 and formalized the Restoration of the Society of Jesus universally across the world (Wright, 2008). However, the Church in Rome had to encounter fresh challenges with the expansion of Protestantism in the British Empire, including in south Asia (S. Brown, 2006, pp. 592–593).

In the early 17th century, the British arrived in India under the auspices of the English East India Company. By mid-seventeenth century, the Company had established itself in the port city of Madras (present day Chennai in Tamil Nadu) and other ports in India. Soon enough, British interests shifted from trade to conquest of Indian territory and began to wage wars or negotiate treaties with the Indian rulers and the other colonial powers in India. By the end of the 18th century, the Company had managed to eliminate their last remaining adversary in south India, Tipu Sultan. The Portuguese and the French were reduced to small pockets of coastal India (see, Bryant, 2013; Karashima, 2014). The British territories of southern India were consolidated under the directly ruled Madras Presidency (which comprised parts of present day Odisha, Andhra Pradesh and Tamil Nadu) and the protectorate domains (or princely states) (Thurston, 1913).

The arrival of the British in India coincided with an extended period of dispute between the Church in Rome and the Portuguese Crown. In 1622, the Pope had established the *Sacra Congregatio de Propaganda Fide* (“Sacred Congregation for the Propagation of the Faith”) because it was felt that the Portuguese were only pursuing the cause of colonial domination rather than spreading the Gospel of Christ. In fact, one of the reasons for Nobili to preach an Indianized Catholicism was because the natives saw the Portuguese and their Christian converts as “crude, meat-eating, alcohol-drinking, and sexually promiscuous European[s]” (Frykenberg, 2008a, p. 347). Despite its shrinking power in India, Portugal continued to demand its rights under the *Padroado* and refused to entertain non-Portuguese missionaries in India (Frykenberg, 2008a, p. 348). In the early 18th century, *Propaganda* found it useful to

secure the support of English East India Company to establish its control over the Portuguese; the English on the other hand were happy to rid India of other European powers (Frykenberg, 2008a, p. 349). In the midst of these disputes Catholic Christianity was paralysed and Catholic institutions remained unattended to until the end of the 18th century. In 1813, the Company passed the Charter Renewal Act which officially allowed missionary activities within Company-ruled territories. Soon enough, an Anglican Bishopric was established in Calcutta; other evangelical societies such as the Baptist Missionary Society (BMS), the London Missionary Society (LMS) and the Church Missionary Society (CMS) soon departed for India (P. Carson, 2012).

The spread of the Protestant missionaries in southern India was rapid and widespread; the Catholic priests of the MEP who had replaced the Jesuits after their suppression could not match the Protestants' collective efforts in evangelization. Catholics began to embrace Protestant Christianity because the Protestant missionaries were better organized and more equipped to look after the native Christians' welfare. When the Jesuits were restored in 1814, the MEP and its representatives in India requested the Church in Rome to restore the Madura Mission to the Restored Jesuits (Pavone, 2014, p. 344). The new Superior General of the Jesuits, Jan Roothan and the new Pope Gregory XVI collaborated to have Jesuits sent to India. The first mission of the Restored Jesuits was established in Calcutta only to have a short-lived existence (Ballhatchet, 1978). Eventually, attention turned towards south India and the Jesuit Province of Lyons in France was asked to take over responsibility for the Madura Mission from the MEP. In 1837, four Jesuits from France arrived to take over the mission from the MEP (Pavone, 2014, p. 342; Pujo, 1977). The Jesuits retained the name of "Madura" for the new mission so as to imply a continuity with the previous mission (see, Strickland, 1852). But as we will see, the "New" Madura Mission was quite distinct from the Old Mission, both in its missionary character as well as in its objectives. Most significantly, the return of the Jesuits to India initiated a focus on Catholic education. Before exploring the Jesuit educational enterprise in the New Madura Mission I first provide an overview of the characteristics of Jesuit education as expressed by Ignatius and the early Jesuits.

3.6 Jesuit education and the need for native clergy

When Ignatius was elected the first Superior General of the Jesuits in 1541 he was also entrusted with the responsibility of drawing up the formal rules for the Order. Accordingly, Ignatius began to draft the *Constitutions of the Society of Jesus* and continued working on the

Constitutions until his death in 1556. Ignatius was aided in this effort by the first Secretary of the Society Juan de Polanco (1517–1576) (O’Leary, 2017). Meanwhile, the Humanistic tradition (of Erasmus) had been firmly established in the schools and universities across Renaissance Europe (O’Malley, 2000, 2013b). Ignatius and his first companions had in fact been products of the Humanistic education at Paris. So when the people of Messina (in present day Italy) invited the Jesuits to open a school in 1547 the Jesuits followed a pedagogical approach that was modelled on the Humanistic tradition. Initially, Ignatius saw the Messina school as a means to fund the Jesuit missionary endeavours and to recruit young candidates to join the Jesuits. But the success of this first school led the Jesuits to consider education as one of their key missionary activities. By the time of Ignatius’ death, the Jesuits had established over thirty schools not only in Europe but as far away as Mexico. By the end of the sixteenth century, the Jesuits had schools in Macau, Japan and India (O’Malley, 2013a). The distinctiveness of the Jesuits as (arguably) the first Catholic Order of teachers also won for them the papal assignment of managing the *Collegio Romano* (Roman College), the principal institution for clergy formation in Rome. Under the Jesuits, the curriculum at the *Collegio Romano* included not only philosophy and theology but also subjects like astronomy. The college also boasted several influential Jesuit faculty including the creator of the Gregorian calendar, Christopher Clavius (1538–1612), the polymath Athanasius Kircher (1601–80) and the astronomer Christopher Grienberger (1561–1636) (Gavin, 2017).

As the number of Jesuit schools and colleges increased there were also disagreements over what topics should be taught in these institutions—especially to conform to Catholic doctrine. After decades of deliberations the Jesuit plan of studies known as the *Ratio studiorum* (Plan of Studies) was formally codified in 1599. The *Ratio* continued to remain in effect until 1773 when the Order was suppressed. In 1832, Superior General Roothan attempted to revise the *Ratio* for the changed context of the Restored Society but his plan did not proceed as envisioned. Yet, the *Ratio* continued to influence Jesuit education until mid-twentieth century, especially in the formation of the Jesuits themselves (Keenan, 2017).

When the French Jesuits re-established the New Madura Mission in 1837, the context was quite different from that of the Old Mission. First of all, the Old Mission was patronized by the Portuguese Crown while the New Mission was supported by the Jesuit Province of Lyons (and later, Toulouse) in France. There was no direct colonial involvement in the administration of the New Madura Mission and all ecclesiastical matters were decided in

consultation with the papal representatives in India (Frykenberg, 2005, p. 480; Strickland, 1852, p. 71). Besides, the Old Mission was originally meant as an extension of the Malabar Province while the new mission was supervised independently by the French Jesuits. The territory of the New Mission was also different now that the ecclesiastical authorities had redrawn some of the administrative boundaries of the Catholic populations in South India. In fact, the size of the New Madura Mission was only half the size of the Old Mission (Matthew, 1998c). Further, the headquarters of the New Mission was now at the temple town of Tiruchirapalli (Trichinopoly or Trichy). Most importantly, the Restored Jesuits had to negotiate the evolving British policy towards missionaries since the centre of action had now shifted from Portuguese Goa to British Madras.

Even though most restrictions against missionaries were withdrawn by the East India Company in 1833 the British policy towards Catholic missionaries was far from uniform. The British supported the papal authorities in Goa where it wanted to rid Portuguese influence while they sided with the Portuguese in Madras to counter the influence of the French (Ballhatchet, 1993). The early 19th century also saw the rapid expansion of Protestant missions in India with Protestant educational efforts spreading widely in southern India (Frykenberg, 1986, 2008b; Heredia, 1995). This caused the French Jesuits to also initiate efforts to stem the growing Protestant influence over the Catholics in south India. So the missionary orientation of the New Mission shifted from “evangelization of the heathen” to “renewing the faith of the converted”. But the number of French Jesuits available in the mission was far too small to work to achieve this goal.

Within two years of the initial four Jesuits’ arrival in Madura, five more arrived from France. The Provincial of Lyons appealed for more volunteers and sixty four Jesuits arrived within the next ten years (Le Guen, 1938, p. 8; Mullens, 1854, p. 136). The Mission Superior Joseph Bertrand (1801-1884) sought more Jesuits from Europe but the Superior General Roothan had other plans. In 1842, Roothan wrote to Bertrand that “Europe will not be able to recruit in sufficient numbers; you are to be able to recruit yourselves on the spot. I do hope after some time you will have a Noviciate” (as cited in M. X. Miranda, 1982, p. 52). Eventually, the Jesuits established the St. Joseph’s College at Negapatam (Nagapatinam) in 1845. The college was primarily an educational institution for training Catholic boys but it also served the auxiliary purpose of recruiting members to the Jesuit order. The college was later shifted to Trichy in 1883 (Saverinayakam, 1945).

Earlier in the 19th century, the British officers Robert Wight (1796-1872) and R. H. Beddome (1830-1911) explored the region around Kodaikanal known as the Palni Hills (spelt “Pulney” by the British) and provided the earliest botanical accounts of the area (Matthew, 1962). In 1852, Fr. St. Cyr, a French Jesuit visited the Palni Hills, arriving at the village of Shembaganur situated about 200 km from Trichy. Like other Europeans in India, the French Jesuits wished to establish a sanatorium in the hills, as a respite from the heat of the plains. This was because several of the French Jesuits who first arrived in Tamil Nadu in 1837 died from cholera and other tropical diseases. Nine Jesuits had died by 1843 and twenty five more died by 1855. The Jesuits had already established a few ‘sanatoria’ at Kodaikanal but Fr. St. Cyr found Shembaganur suitable for the long term goal of establishing a formation house for the Jesuits (Le Guen, 1938; “Madura Mission in 1843,” 1943, pp. 216–217). Earlier a novitiate was established at Dindigul (also near Trichy) but the European Jesuits found the cooler environs of Shembaganur better suited for training young Jesuit candidates (Ugarte, 1995). Roothan’s desire for an Indian novitiate was fulfilled in 1895 when the Jesuits established the Sacred Heart College (SHC) at Shembaganur. SHC served as the centre of Jesuit formation in India for nearly a century. It served as a formation house for three stages of Jesuit formation: novitiate, juniorate and philosophate (details about these stages in the next section). After successfully completing these three stages, the Jesuit scholastic proceeded to the next stage of training in theology (theologiate) in Kurseong (near Darjeeling in northern India) (Ugarte, 1995).

3.7 Jesuit formation and the Sacred Heart College

The formation of the Jesuits was and continues to be one of the most demanding and the longest among the religious orders in the Catholic Church. A Jesuit candidate to the priesthood would spend around fourteen years in training before becoming a fully professed Jesuit priest.¹⁷ The aspirant to the Order would apply to the Provincial of a particular Province, who would consider his candidature based on his basic qualifications and the goals of the Jesuit mission. After an initial assessment, the candidate would be admitted to the novitiate for two years. The novitiate was essentially an apprenticeship where the novice could experience the culture, ideals and rules of the Jesuit way of life. Ignatius referred to this

¹⁷ The Jesuit Constitutions describe four categories of Jesuits: novices, approved scholastics, formed coadjutors, and the professed members. The professed members (or priests) are the principal members who make four vows, while the coadjutors (or brothers) make only three. The professed members are usually accorded greater responsibilities and privileges in the Society (Chase, 2017).

period as the time of “experiences and probations” - for it was not only the novice who was scrutinizing himself but also his superiors, who would test his aptitude and rigour for the Jesuit life. The experiences also included making a month-long retreat based on the *Spiritual Exercises* of Ignatius (Ignatius & Ganss, 1970, pp. 95–96). Once the master of novices approved the candidate’s completion of the two-year novitiate the novice made the *simple* vows that he vows to join the Society and continue the formation.¹⁸

The novitiate is followed by the *Juniorate* where the candidate (now called a *scholastic*) completes two years of training in the humanities. Then, the scholastic pursues a three-year course in philosophy. This is followed by a two-three year *regency* where the scholastic is assigned a particular work assignment that serves as a practical experience of working in the real world. The next stage in Jesuit formation is usually a four-year course in theology. Since most of these courses are taught by the Jesuits themselves the candidate’s progress is monitored throughout the period of study. After successful completion of the formation, the scholastic is ordained as a Jesuit priest. But his formation continues for another period of *tertianship* where the now ordained Jesuit repeats the spiritual training (based on the *Spiritual Exercises*) that he underwent in the novitiate. Only after completing the tertianship is he formally accepted into the Society of Jesus when he makes the *solemn* vows of poverty, chastity and obedience (Orobator, 2017). As we noted in the previous section, SHC at Shembaganur served as one of the most important centres for Jesuit formation in the Restored Society.

Though the Jesuits of Restored Society acknowledged the antiquated status of the *Ratio Studiorum* Jesuit formation at Shembaganur followed its “spirit”. For instance, the scholastics learned Latin, Greek, English and a regional language in the Juniorate. While following “the spirit of the *Ratio*”, the Jesuits began to recognize the importance of the emerging scientific disciplines. For instance, the 23rd General Congregation¹⁹ of 1883 had laid special emphasis on the study of natural sciences, even permitting the scholastic an additional year for “special

¹⁸ At the end of the novitiate, the Jesuit takes *simple* or *first* vows of poverty, chastity, obedience and thus becomes a *scholastic* with the intention to complete the Jesuit formation in its entirety and eventually join the Society of Jesus. On the other hand, the *solemn* or *final* vows taken after tertianship solemnize the individual’s acceptance into the Society of Jesus. For a brief summary of the different vows, see (Martin, 2009).

¹⁹ A General Congregation (GC) is an assembly of Jesuit representatives from around the world. When convened, a GC serves as the highest authority of the Society and makes decisions that are binding on Jesuits everywhere (Corkery, 2017).

studies” in the sciences or humanities (M. X. Miranda, 1982, p. 268). Besides, the study of physics, chemistry, botany, zoology and astronomy were part of the regular philosophy curriculum at Shembaganur. The cosmopolitan nature of the College also helped to reinforce high academic standards on the campus: by 1945, scholastics from more than a dozen countries (including India) were studying at Shembaganur (Gathier, 1945, p. 63).

3.8 Training in the sciences at Shembaganur

In 1844, the British Government of the Madras Presidency announced that those educated in English would be accorded preference for recruitment in the Government services. The aim of education (particularly in the Madras Presidency) was to gain employment in the Government. The result was that a number of English schools and colleges were opened across the districts (Frykenberg, 2008b; Saththianadhan, 1894). It was in this scenario that the Jesuits set up their first college in the New Madura Mission at Nagapatinam in 1844. For some years, the Jesuits followed the method of the *Ratio* for teaching Europeans and Indians at the College. In 1857, the University of Madras was incorporated under the British, along with the Universities of Calcutta and Bombay respectively. The Jesuits decided to get St. Joseph’s College affiliated to the University of Madras, which they did in 1866. It helped that the method of the *Ratio* had to only be slightly modified to fulfil the requirements of the Bachelor of Arts degree of the University. The B.A. degree required the graduate to be skilled in language, history, mathematics, philosophy along with an optional subject, the choice of which included natural philosophy and physical sciences (Saththianadhan, 1894, p. 58). The curricular requirements of the B.A. degree were very similar to the plan of studies at Shembaganur. So in 1895, the Jesuits secured a licentiate in teaching for the philosophy program; this meant that the Jesuit scholastic was awarded the B.A. degree from the University of Madras when he successfully completed the philosophy course at Shembaganur (T. Mathias, 1945). The developments at Sacred Heart College along with the growing reputation of St. Joseph’s College encouraged the Madura Jesuits to seek more accomplished Jesuits from Europe to train students at both the colleges (M. X. Miranda, 1982, p. 269). Some of these Jesuits began to train the scholastics in the sciences.

As early as 1898, Mallat (died 1922) was brought in as a Professor of Science at Shembaganur. He increased the number of hours dedicated to the study of the sciences and insisted that each scholastic be provided with a complete set of science textbooks (Gathier, 1945, p. 10). In 1904, Emile Gombert (1886-1948) replaced Mallat; he became one of many

Jesuits to maintain a collection of orchid paintings (“Fr Emile Gombert (1886-1948),” 1948; Matthew, 1988b, p. 250). In 1910, he was re-assigned to teach physics and later botany at St. Joseph’s. The arrival of Louis Anglade (1873-1953) in 1911 initiated a new phase of scientific activity at Shembaganur. He encouraged the scholastics to spend their recreation for “useful scientific or cultural purposes, such as dissecting animals, mounting skeletons, preparing butterflies, identifying and cataloguing the flora and fauna of the Pulneys” (Gathier, 1945, pp. 76–77). Anglade himself spent hours studying and preparing an illustrated flora of the Palni Hills. He also contributed an anthropological report of dolmens found in the hills (Anglade & Newton, 1928). Under Anglade’s direction, the Jesuits set up a museum of natural history on the Shembaganur campus, which soon became a tourist attraction (Ugarte, 1963). Anglade encouraged several Jesuits to pursue studies in the sciences. Among his students was Alfred Rapinat (1892-1959) who was responsible for establishing a separate department for botany studies at St. Joseph’s College (Matthew, 1992, p. 2).

Along with Jesuits professors in the natural sciences, a number of Jesuits were also involved in the teaching of physical sciences at St. Joseph’s College (Savariraj, 1988). In the meantime, the Madura Jesuits set up more educational institutions and established St. Xavier’s College in Palayamkottai (1923) and Loyola College in Chennai (1925). Also during in the 1920s, the Madura Jesuits had to face a new development—Mohandas Gandhi’s movement for Indian *swaraj* (self-rule).

3.9 The Madura Jesuits and Indian independence

When the Jesuits worked as missionaries in the Old Madura Mission, the Church in Rome was as powerful as any of the other European monarchies. But the Jesuits of the New Mission worked when the Church had lost almost all its temporal power and colonial patronage. By early 20th century, Catholic conservatism was being challenged and the leadership of Rome was contested even by members within the Church (O’Connell, 1994). As a result, the Madura Jesuits had to rely on whatever local support they could get to continue their activities, including from the Protestant British. While the British in India did not provide any preferential treatment to Catholics, the Jesuits were able to fund some of their educational institutions by accessing financial grants from the University of Madras. For example, Francis Bertram, the first principal of Loyola College in Chennai was more successful in accessing grants from the Government of the Madras Presidency than from Catholic benefactors abroad (Froehly, 1940). So while the Jesuits did not actively support British

colonialism they certainly did not engage in any fundamental criticism of British rule in India. On the other hand, the Indian students educated at Jesuit colleges were often recruited by the British government services (according to Annual Reports of Loyola College in the late 1930s and early 1940s).

During the 1930s, religious bigotry was on the rise in parts of India. The Madura Jesuits became anxious if the *swaraj* movement could also lead to persecutions of the Christians (“Shembaganur Diary,” 1934). So when Gandhi’s statements against missionary conversions became public, the Jesuits conveyed their fears to Rajendra Prasad (1884-1963), then President of the Indian National Congress (which represented the Indian nationalist movement against British rule). Prasad reassured them that Gandhi’s private views were not binding and did not amount to a ban on conversions. The Jesuits on the other hand declared that Pope Benedict XV had formally promoted the training of native clergy as early as 1919 and that the Church in Rome would not interfere in domestic political matters (“St. Joseph’s College Diary,” 1936). Besides, some Jesuits in other Indian provinces had even made efforts to “Indianize” Christianity. P. Johanns, a Jesuit in Calcutta, published a series of articles titled *To Christ Through The Vedanta*. This was one of the earliest efforts (by the Restored Jesuits in India) to make the Church more Indian in its representation and theological understanding.²⁰ By the 1940s, Protestants and Catholics alike desired to shed the prevailing “European” image of Christianity in India and took steps to demonstrate that a Christian could also be patriotic. Institutionally, the Catholic Bishops Conference of India (CBCI) was formed in 1944 to present a united front for Catholics in India. One of the founding members of the CBCI was a Jesuit bishop from the Madura Mission (Mallampalli, 2006, p. 428). Meanwhile, the Protestant churches came together to form a united Church of South India (CSI) in 1947, a significant step that brought together the Anglicans, Methodists, Presbyterians and other Protestant churches in India (Mallampalli, 2006, p. 426).

The number of native Indians training to become Jesuits was also on the rise steadily. Across India, the proportion of native Indians among all the Jesuits in India had increased from 25% in 1914 to 54% in 1937 (M. X. Miranda, 1982, p. 319). In 1929, the Madura Mission was raised to the status of a vice-province; in 1946, for the first time, an Indian—Humbert Pinto—was chosen to be its superior (Rosario, 1982). Between 1923 and 1946, the number of

²⁰ The series was published between 1922 and 1934 in the *Light of the East*, a journal started by the Belgian Jesuits in Calcutta.

Indian Jesuits more than doubled from 34 to 69 while non-Indian Jesuits decreased from 116 to 105. The number of Indian scholastics also increased from 30 to 85 in this period whereas the non-Indian scholastics reduced considerably from 35 to 3 (*The Jesuit Madura Vice-Province*, 1946). In 1952, five years after India gained independence from the British, Madura was raised to the status of an independent province - the Province of Madurai. As an autonomous Province, Madurai would have both financial and administrative independence without relying on the French Jesuits. However, several European missionaries remained in Madurai to continue serving in the Jesuit institutions. Later, additional responsibilities were given to the Madurai Province when its territories were expanded to include the Telugu speaking regions of south India in 1954 and the Malayalam speaking regions in 1956 (Jesuit Roman Curia, 2020).

By retaining the name of “Madurai” for the new province the Jesuits emphasized their historical links with the early Jesuit missionaries of the region. Despite the emphasis on continuity, the birth of the Madurai Province was also a response to the changing social and political context in India. It was also advantageous to the Madurai Jesuits to take decisions relevant to the local needs without waiting for approval from elsewhere. This did not mean that the Madurai Jesuits had severed all ties with the Vatican or the Jesuit headquarters in Rome; the Province was very much part of the Jesuit Conference of India—an association of all the Jesuit provinces and missions in India. As a separate province though, the Jesuits could re-examine their missionary strategies and institutional structures as demanded by the evolving social and cultural context of the region. It was in the context of independent India and of the newly created Jesuit province that Jesuit scientific activity would become significantly different from that of the erstwhile Madura Mission. As we will see in the coming chapters, Jesuit science was reinvented in modern India due to a plurality of external and internal factors.

This chapter offered a brief history of the Society of Jesus and the missionary endeavours of Jesuits in south India, highlighting the educational ministry and the priestly formation of the Jesuits in the Madurai Province. In the next chapter, I provide an overview of the spiritual formation of the Jesuits while describing how this formation shaped the scientific practice of the Jesuit men of science in independent India.

(4) “Finding God in all things”: The Spiritual – Scientific Lives of Jesuit scientists

4.1 Introduction

Bertrand Russell described the scientist as a “genuine man of science” who is characterized by a “disinterested intellectual curiosity” (as cited in Koppman et al., 2015, p. 31).²¹ According to Russell, the ideal scientist is motivated entirely by a methodical curiosity and detached from all emotion and passion. This characterization gained further traction with Robert K. Merton’s image of the ideal scientist whose commitment to science is governed only by a set of social norms devoid of any personal interest (Merton, 1942/1973). However, a survey of scientists’ autobiographies, both past and present, reveals a frequent mention of emotions such as wonder, joy, fear and passion (e.g., Wolpert & Richards, 1997; Barbalet, 2002, p. 134). Merton himself suggested that the stability of science as a social institution was assured by “an *emotionally* [emphasis added] toned complex of rules, prescriptions, mores, beliefs, values and presuppositions which are held to be binding on the scientist” which he called the “ethos of science” (Merton, 1938/1973, p. 258). In the 1970s, sociologists also demonstrated that emotional commitment is not only integral to scientific research but could enhance the quality of the scientist’s work (Mitroff, 1974).

In recent times, there has been an increase in research on the role of emotions in science in the history and sociology of science (e.g., Dror et al., 2016; Bowler, 2005). This has arguably been a result of the “affective turn” across the spectrum of the natural and social sciences (Leys, 2011). The affective turn has also extended into STS studies. For instance, researchers in STS have tried to interpret how feelings are embodied in scientists’ lives and their practice (e.g., Fitzgerald, 2013). Others have explored the role of emotions in how scientific research is judged by lay people and how scientists respond emotionally to “failed” experiments (Drummond & Fischhoff, 2020; Timmermans, 2011). Such accounts suggest that scientific practice is “sustained, strengthened, and understood” through emotional entanglements (Fitzgerald, 2013, p. 149).

²¹ Since men alone are accepted as members of the Jesuit order, I will mostly refer to scientists in the masculine form in this thesis. I do this with the awareness that there are issues of gender in the field of science which need to be addressed on an urgent basis.

In his *Science as Vocation* lecture, Max Weber described the emotional commitment of the scientist as arising from “an inner devotion” to a “vocation” (Weber, 1958, p. 115). Others described science as a “charismatic” activity – that it is “of divine origin” - “because, through it, a man seems to or is thought to come into contact with what is essential in the universe” (Gustin, 1973, p. 1124). More recently, the physicist Stephen Hawking suggested that the goal of human existence was to gain “a complete understanding of the events around us, and of our own existence” (Hawking, 1988, p. 169). The historian David Noble argued that technology is charismatic because it helps humans to restore the “image-likeness of man to God” (Noble, 1997, pp. 15–17). According to this “charismatic” description of science, the passion to understand human existence and to even become like God, serve as key motivations for scientists. We also often witness religious language being employed to describe contemporary scientists’ passion to pursue science (e.g., Singler, 2017). Perhaps it is because science and religion, as social institutions, are both seen as spheres of “passions, motivations, and desires, which drive all humans seeking after the truth” even though members of these institutions do not (apparently) always agree with each other (Tanzella-Nitti, 2012). But historians and sociologists have shown that the emotions stirred by religious/spiritual beliefs have been significant in motivating scientific pursuits (e.g., Ecklund, 2020; Lehner, 2016; Richardson, 2002). This has been particularly true of Jesuit scientists.

Since the founding of the Society of Jesus in 1540, the Jesuit engagement with science has been acknowledged and documented by various scholars. The historian Steven J. Harris identified the basis of Jesuit scientific interest in the Order’s “apostolic spirituality” as developed by the founder of the Jesuits, Ignatius of Loyola (Harris, 1989). Ignatius was one of several 16th century Spanish mystics who belonged to what was known as the “golden age” of Christian spirituality (Howells, 2013). Along with others like Teresa of Avila (1515-1582), Francisco de Osuna (c.1497-c.1540) and John of the Cross (1542-1591), Ignatius established (what we today refer to as) an “affective turn” in the practice of Christian spirituality, advocating a greater function for emotions in the Christian’s spiritual life (Carrera, 2007; Kracher, 2016).²² The impact of Ignatius’ “affective spirituality” has remained in vogue for

²² For the purpose of this chapter, I do not attempt to theorize feelings or emotions, nor do I prefer one over the other. I refer to either feelings or emotions depending on how the Jesuits referred to them in their documents. Further, Kracher (2016) notes that “our modern concept of emotions tends to flatten out and

nearly five centuries. Ignatius' most important work *The Spiritual Exercises* along with the *Constitutions of the Society of Jesus* continue to be the foundational documents for training the Jesuits.

Throughout the history of the Jesuits, the emphasis on feelings in Jesuit spirituality²³ has played a role in the Jesuits' attempts to bridge the sacred and the secular worlds. The 17th century Jesuit mathematician Christopher Clavius (1538-1612) declared that "the mathematical disciplines... delight in, and honour truth" (as cited in, Smolarski, 2002). By underscoring the feeling of "delight" in unravelling the "truth", Clavius convinced his Jesuit colleagues to include mathematics in the *Ratio Studiorum* (Smolarski, 2002, p. 450). Almost four centuries later, the Jesuit palaeontologist Teilhard de Chardin (1881-1955) described a "certain feeling of spiritual presence and energy" when he observed the cyclotrons in action at the Radiation Laboratory in Berkeley (Chardin, 1970, p. 350). He even declared that "[t]here is less difference than people think between Research and Adoration [of God]" (as cited in T. M. King, 2005, p. 21). How were Jesuits like Clavius and Teilhard convinced that scientific work is but an extension of their spirituality? What was the role of feelings in mediating this entanglement between Jesuit spirituality and their scientific practice? This chapter seeks to answer some of these questions in the context of the spirituality of Jesuit scientists in late twentieth century India.

4.2 Method

I begin this chapter with a brief history of Jesuit spirituality followed by a discussion on the *Spiritual Exercises* of Ignatius of Loyola and its key concepts of consolation and desolation. I then elaborate how these two concepts are understood by contemporary Jesuits and how this contemporary understanding has led Jesuit scientists to consider their scientific activity as equivalent to a spiritual practice. The chapter then describes how postmodern influences on prayer and spirituality have also influenced Jesuit spirituality in general. Specifically, I employ the framework of positive psychology to understand the practice of spirituality

lump together phenomena that were traditionally regarded as distinct by classical philosophers and early Christian writers. A range of more or less distinct phenomena known in Latin as *passiones*, *motus animae*, *libidines*, etc. spread across a semantic map covering what we call emotions, feelings, moods, or desires to varying degrees. And each of these were seen by different authors as positive, negative, or ambiguous in various ways" (p. 257).

²³ The terms "Ignatian spirituality" and "Jesuit spirituality" have often been used interchangeably in literature. Likewise, I do not make any specific distinctions between the two. But Barry and Doherty (2002) observe that "Jesuit spirituality can be considered a subset of Ignatian spirituality... it is the spirituality not of one man, but of a religious order in the Roman Catholic Church" (pp. 3–4).

among Jesuit scientists in India. Notably, I explore the similarities between the psychological concept of flow and the Ignatian concept of consolation.

The central part of the chapter draws upon interviews with five different Jesuit scientists, three of whom are from the Madurai Province. I interviewed these Jesuits on different occasions between 2017 and 2019. Each interview lasted 90-120 minutes with follow-up questions asked over email. Based on these interviews and using sociological concepts on religious experience, I try to understand Jesuit spiritual training and their lived spirituality in the specific context of Jesuit scientists. I relate these narratives to the literature on positive psychology and argue that these Jesuit scientists were indeed able to create flow in the scientific work. This in turn, I suggest, gave them the spiritual consolation that Ignatius spoke of. It was by creating flow in their scientific practice, I will argue, that they were able to find spiritual fulfilment as Jesuits.

4.3 The role of feelings in Jesuit spirituality

Any attempt to satisfactorily define the terms “religion” and “spirituality” will prove futile because these terms mean different things to different people in the post-modern world (e.g., Asad, 1993; Bruce, 2011; A. S. King, 1996). But working definitions can be useful as signposts without limiting the many ways of understanding these terms. Since this chapter concerns Christian spirituality in general and Jesuit spirituality in particular, I use working definitions provided by scholars in Christian studies. By religion, I use Sandra Schneiders’ (2003) brief description of religion as an “institutionalized formulation of a particular spiritual tradition” (p. 169). I use David Perrin’s more elaborate definition of spirituality because this chapter is focused on spirituality:

“Spirituality refers to a fundamental capacity in human beings. It is expressed within human experience before people identify that experience with a particular religious or spiritual set of beliefs, rituals, or ethics. Spirituality, as an innate human characteristic, involves the capacity for self-transcendence: being meaningfully involved in, and personally committed to, the world beyond an individual’s personal boundaries. This meaningful involvement and commitment shapes the way people live and allows them to integrate their lives. Spirituality can be clearly identified and studied in human events and written texts, or other forms of expression, such as art and music, desires and

motivations. Spirituality is also an academic discipline. Using interdisciplinary methods, the dynamics of the spiritual dimension of life can be analyzed” (Perrin, 2007, p. 20).

I will not attempt to detail the various elements of spirituality explored above, but it is important to note that this definition clarifies what spirituality entails. Spirituality is:

1. a lived reality in the life of an individual, which
2. is identified with human events and activities, and so
3. it involves interaction with the material world
4. spirituality may or may not be identified with a particular set of religious beliefs, but
5. it seeks self-transcendence, where self-transcendence indicates orientation towards an “ultimate value” which could mean “life itself, personal or social well-being, the good of the earth, justice for all people, or union with God” (Schneiders, 2003, p. 167).

For the purpose of this chapter we understand the relation between religion and spirituality as follows: that the integration of spirituality in human life is made possible for many people through participation in organized religion. We also recognize that post-modernity has made it possible for people to pursue idiosyncratic forms of spirituality, including what has come to be known as “non-religious spirituality” (e.g., Houtman & Aupers, 2007). We will return to post-modern forms of spirituality shortly.

Belonging to the Catholic religious tradition of early modern Europe, Ignatius developed the *Spiritual Exercises* as a series of “exercises” or resources for a person (called the director) who helps another to develop his or her spiritual life as a Christian (Schneiders, 2007, p. 16). In the Jesuit context, the director is usually the master of Jesuit novices.²⁴ The *Spiritual Exercises* are structured as a program drawn over four “weeks” with the director providing a set of exercises to the participants every “week”.²⁵ The director explains the goals of the different exercises/reflections each week and what the novice should expect to gain

²⁴ While the Exercises were developed for the use of all Christians (and later, even non-Christians), the *Spiritual Exercises* form the foundation of a man’s training to become a professed member of the Society of Jesus.

²⁵ A “week” does not necessarily last for seven days in the *Spiritual Exercises*. It refers to the period over which a specific set of exercises and reflections may be appropriately completed by the exercitant, subject to the satisfaction of the director.

spiritually at the end of each exercise. The affective aspect of the Exercises relates to the need for the novice to identify the “interior movements” (i.e. feelings) within himself. According to the Exercises, proper identification of feelings triggered within the novice will help to discern if and how he can lead a life as a Jesuit in the service of God.²⁶

One of the key sections in the Exercises is the *Rules for the Discernment of Spirits* which elaborate how the Jesuit should pay attention to his feelings (see, Boyle, 1983; Buckley, 1973; Futrell, 1970). The Jesuit theologian Michael J Buckley (1973) contends that these rules allow the Jesuit to live a practice-oriented spirituality “without reducing it to magic and superstition, rationalism and enlightenment, or sentimentality and enthusiasm” (p. 20). George Earle (1977) describes these rules as the “antennae” for discerning the meaning of events in the individual’s life and to “make sense of them” (p. 125). The Jesuits are expected to internalize these rules and use them to discern the source of their feelings—whether they are from God or from the “enemy”.²⁷ The Jesuit will then be (hopefully) able to direct those feelings towards meaningful action “for the greater glory of God”.

It is within these rules for discernment that Ignatius introduces two concepts to elaborate the role of feelings in spirituality: spiritual *consolation* and spiritual *desolation* (Ignatius & Ganss, 1992).²⁸ Ignatius explains what consolation is, with some examples:

“By [this kind of] consolation I mean that which occurs when some interior motion is caused within the soul through which it comes to be inflamed with love of its Creator and Lord. As a result it can love no created thing on the face of the earth in itself, but only in the Creator of them all.

...under the word consolation I include every increase of faith, hope, and charity, and every interior joy which calls and attracts one toward heavenly things and to the

²⁶ Again, we are not interested in theoretical debates regarding feelings and emotions. But we proceed with the knowledge that they mean different things in different times. For instance, Carrera (2007, p. 236) notes that the word “emotion” did not exist in sixteenth-century Spain. She notes that Ignatius of Loyola “used the [Spanish] phrase ‘*afecciones desordenadas*’ in the sense of disorderly passions or affects”.

²⁷ According to Ignatius, the mortal “enemy” of human nature is Lucifer, a name for the Devil in the Christian tradition (Ignatius & Ganss, 1992, p. 65).

²⁸ Henceforth in this chapter, the specific paragraph number of the Exercises and the page on which it appears will be referenced in the 1992 edition (Ignatius & Ganss, 1992) of the *Spiritual Exercises*.

salvation of one's soul, by bringing it tranquillity and peace in its Creator and Lord" (Ignatius & Ganss, 1992, sec. 316, p. 122).

Simply put, consolation is "every interior joy" which motivates the Jesuit towards thoughts and activities that brings with it "tranquillity and peace in its Creator and Lord". It is also manifested in the increase of positive feelings associated with "faith, hope and charity". On the other hand, desolation is the opposite of consolation. Ignatius explains desolation as follows:

"By [this kind of] desolation I mean everything which is contrary to what was described in the Third Rule; for example, obtuseness of soul, turmoil within it, an impulsive motion toward low and earthly things, or disquiet from various agitations and temptations. These move one toward lack of faith and leave one without hope and without love. One is completely listless, tepid, and unhappy, and feels separated from our Creator and Lord" (Ignatius & Ganss, 1992, sec. 317, p. 122).

It is important to note that Jesuits do not equate consolation and desolation with affective states of pleasure and pain; they highlight that consolation can come only from "the Creator" and desolation comes from the "enemy".²⁹ It is this emphasis on the supernatural that prevents the Jesuits from reducing their spirituality to a secular psychological tool.³⁰ While Jesuits emphasise the "divine" orientation of the Exercises, they encourage a critical (including historical) engagement with the Exercises so as to gain further profit from Jesuit spirituality (Endean, 1995).

Systematic research into the origins of the *Spiritual Exercises* began at the turn of the 20th century (Sluhovsky, 2016). Directors of the Exercises began to delve deeper into the "original experience, language, directives and intentions of Ignatius" (Haight, 1987, p. 1). Based on historical analysis of the origins of the *Spiritual Exercises*, Jesuits began to realize that Ignatius' attitude to prayer was radically flexible (Kinerk, 1985, p. 3). Ignatius' nuanced

²⁹ There has been some discussion among Jesuits on whether consolation always results in an increase of a "pleasant, delightful or peaceful feeling". Ignatius also suggests that desolation, though unpleasant, can help the Jesuit re-orient his life to achieve consolation. For the sake of this chapter, I follow the dominant view that spiritual consolation almost always involves pleasant feelings (e.g., McDermott, 2018).

³⁰ "Consolation and desolation, then, must be critically distinguished both from Freud's description of instinctual satisfaction... As motives, then, for prayer, neither is posited except in its orientation towards God" (Buckley, 1973, p. 29).

approach to prayer was revealed in the texts of his most trusted colleague, Jerónimo Nadal (1507-1580). Nadal identified Ignatius' spirituality in two key expressions: "finding God in all things" and "contemplation in action" (Endean, 2001, p. 69). While the first expression appears in the section of the Exercises called the *Contemplation to Attain Love*, the second exemplifies Ignatius' invitation "to find God not just in prayer but in action" (Endean, 2001, p. 70). The implication of these expressions for Jesuit spirituality was broadly described as follows:

"The Ignatian tradition invites us to find God in all things... *We cannot limit God's presence to the 'religious bits'* [emphasis added]: to what happens in church, to times of prayer, to the celebration of the sacraments. God's presence is manifested in our encounters with other people, in our relationships, in the inner stirring of our hearts, in art and music and nature, in our times of leisure, in our pain and struggles, *in the events of our daily lives* [emphasis added]" (McParland, 2017, pp. 42–43).

Based on this re-discovery of Ignatius' teachings on prayer and action, 20th century Jesuits began to consider the possibility that the spiritual life (of a Jesuit) could not only be restricted to specific periods of prayerful activity. They further found that Ignatius also equated intellectual activity with prayer. In 1547, some Jesuit scholastics at Coimbra were concerned that the Jesuit priestly formation had an intense study regime but not sufficient periods for prayer. But Ignatius insisted that studies are as important as prayer. He wrote:

"...do not imagine that during this interval of studies you are not being useful to your neighbour... While studies do not leave you time, for long prayers, the time can be made up for by desires when a person turns all his activities into a continual prayer by undertaking them solely for the service of God" (Ignatius, 1547/1996).

Ignatius seems to suggest that a Jesuit should not only be spiritually oriented towards prayer but also capable of converting "all his activities into a continual prayer". The Jesuit should be able to perceive all human activities as opportunities to find God and to serve others. This formed the crux of "apostolic" spirituality.³¹ Ignatius' approach to "find God in all things"

³¹ By apostolic spirituality, Ganss writes that "Ignatius intended a new form of apostolic living which would be spent largely in mingling with men in hospitals, villages and cities., hence he devised his 'experiences'

offered a pathway for Jesuits to engage in activities which may not be conventionally understood as circumstances of prayer (Lonsdale, 1987). One such activity is scientific research. While Jesuits have actively contributed to the sciences since the founding of the Order, I attempt to show that the Jesuit priest-scientists in 20th century India began to perceive their scientific practice as a distinct form of Jesuit spirituality. But first, we explore how the rules of Jesuit spirituality could be considered very similar to the principles of positive psychology.

4.4 Jesuit spirituality, post-modernism and positive psychology

Ignatius' suggestions on how Jesuits ought to find God in all things were detailed in the sixteenth century. With foresight, he added the caveat that Jesuit superiors should adapt his broad guidelines "keeping in mind persons, places, times, and other circumstances" (Ignatius & Padberg, 1996, para. 352). Based on this suggestion, the Jesuits of the 20th century chose to "respond to God in the language of everyday events" of the post-modern, post-colonial world (Futrell, 1970, p. 49). It was during the 1960s, when religion started becoming "de-regulated and de-traditionalized" that believers began to pick and choose what traditions they wanted to believe in (Tomalin, 2016, p. 20). This emergence of "post-modern religion" and "alternative spiritualities" had some effect on the Jesuit approach to spirituality too.

The rise of post-modern religion in the 1960s also had its effects on the universal Catholic Church. During the Second Vatican Council (henceforth referred to as Vatican II), the Catholic hierarchy announced that Christians could indeed learn from other spiritual traditions (subject to certain conditions) (Vatican II Council, 1965b, sec. 18). The Jesuits on their part began to explore Ignatius' spirituality through the vantage point of other cultural traditions, including Hinduism and Buddhism (De Mello, 1978/2007; O'Hanlon, 1978). Though hailing from the pre-Vatican II era, Teilhard de Chardin's idea of a "materialistic spirituality" gained popularity after the posthumous publication of his writings in the 1960s. Chardin's view that "Scientific research... for all its claim to be positivist, is coloured and haloed—or irresistibly animated... by a mystical hope" offered a new approach to science-as-spirituality (Chardin, 1965, p. 22). These views encouraged other Jesuit scientists to reflect on their work as a form of spirituality. For instance, the Indian Jesuit and plant taxonomist KM

for his novices which would be an apprenticeship in such living out (of the religious life) in the world" (Ignatius & Ganss, 1970, p. 96, FN 7).

Matthew shared that Teilhard de Chardin became for him “the model of the Jesuit and of the man of science” (more on KM Matthew in Chapter (6)) (A. J. Miranda, 2004, p. 69).

Jesuits in India also began to recognize postmodernism as an opportunity for spiritual growth.³² Besides, the 1970s marked a new phase in Jesuit history as they renewed their apostolic mission of a “faith that does justice” which emphasized social justice rather than evangelization (as we will see in Chapters (5) and (7)). Consequently, a series of Indo-Ignatian *Satsang* (sacred gathering) meetings were organized by the Indian Jesuits “to relate and integrate Indian and Ignatian spiritualities in the context of India today” (Irudayaraj, 1975, p. 98). Bridging post-modern religion and social justice, the *Satsang* declared that “if we do not focus on the most urgent socio-economic problems, our efforts at fashioning an Indian spirituality would prove archaic, unrealistic and irrelevant” (Irudayaraj, 1975, p. 105). For sure, Jesuit spirituality continued to be rooted in the Christian understanding of God and was predisposed to Catholic teaching. But in practice, their spirituality perhaps ceased to be purely doctrinal and became rather a “method... to consider the meaning of the relationship between God and humanity” (Muldoon, 2005, p. 97).

In addition to learning from other spiritual traditions and social contexts, the Jesuits also began to consider Ignatius’ spirituality as an “introspective, analytical and psychological” tool for personal growth (McNally, 1965, p. 38). The Vatican had earlier approved the use of psychological techniques to understand the emotional reasons behind priestly vocations.³³ This marked an affective turn in priestly formation paving the way for the integration of Jesuit spirituality and social justice with social psychology (e.g., Martín-Baró et al., 1996). Accordingly, the Jesuits in India advocated the “judicious use of Indian *sadhanas* (disciplined practices) like yoga and zen and of modern psychology” for the formation of Jesuits (South Asian Assistancy, 1991, p. 142). The Jesuits have since combined diverse spiritual traditions and psychological tools in Jesuit formation since the 1960s. More recently, Jesuits have also found resonance between their spirituality and one of the latest branches of psychology: the

³² By claiming that Jesuits engaged with postmodernism, I suggest that they began to question the prevailing grand narratives of Catholic spirituality. For instance, a Nigerian Jesuit writes: “a postmodernist approach expands our understanding and stimulates a fresh and radical interpretation of the service of faith and the promotion of justice” (Orobator, 2008). For a more general discussion on postmodernism, see (Lyotard, 1984).

³³ The Second Vatican Council indicated that “no opportune aids are to be overlooked [in training priests] which modern Psychological and sociological research has brought to light” (Vatican II Council, 1965a, sec. 2). On the Vatican’s love-hate relation with psychoanalysis, see (Foschi et al., 2018).

academic field of *positive psychology* founded by Martin E. P. Seligman and Mihaly Csikszentmihalyi (Seligman & Csikszentmihalyi, 2000).

Seligman & Csikszentmihalyi (2000) describe the field of positive psychology as a “science of positive subjective experience, positive individual traits, and positive institutions... to improve [the] quality of life” (p. 5). They also suggest that positive psychologists aspire “to understand and build the factors that allow individuals, communities, and societies to flourish”. Jesuits submit that this goal is common to Ignatius’ spirituality, even though positive psychology is secular in its approach in promoting human flourishing. They argue that there is a close affinity between the Jesuit principle of *consolation* and the concept of *flow* in positive psychology (Zagano & Gillespie, 2006).

Csikszentmihalyi (1975) first described *flow* to denote “the holistic sensation present when we act with total involvement” (p. 43). He explained that flow is a state in which an individual is completely absorbed in an activity because that individual finds the activity intrinsically rewarding (M. Csikszentmihalyi, 2014). He suggested that flow is characterized by the merging of action and awareness, most often observed in sports. He later described that the flow experience could be observed in any activity where “a person is actively engaged in some form of clearly specified interaction with the environment” (M. Csikszentmihalyi, 1975, p. 43). Additionally, he identified that flow most often happens in activities with “clearly established rules for action” (M. Csikszentmihalyi, 1975, p. 45). Based on these findings, flow researchers were able to identify similarities between experiences labelled as “religious” and the characteristics of flow. But what counts as a religious experience for a Jesuit?

Early scholars like William James (1917) and Rudolf Otto (1923) described religious experiences as spontaneous and rapturous. Contemporary scholars do not restrict religious/spiritual experience to such dramatic events. Alistair Hardy (1979) described religious experience as “a continuing feeling of transcendental reality or of a divine presence” and extended it to “seemingly more ordinary but deeply felt experiences” (as cited in Yamane, 2000). Others have described spirituality as “not simply [a] spontaneous experience.. but a conscious and deliberate way of living” (Schneiders, 2007, p. 16). As for the Jesuits, we noted earlier that Ignatius did not identify spirituality with acts of prayer alone but in any action that was oriented towards God – it was for him a “way of living”. All that

mattered to Ignatius was that the Jesuit should find spiritual consolation – the feeling of interior joy - in his daily activities. In the language of positive psychology, Ignatius’ affective spirituality encourages Jesuits to find flow in all their missionary activities. So a religious experience for the Jesuit would (ideally) be any everyday experience – sacred or secular – which produces in him interior joy.

The positive psychologist Isabella Csikszentmihalyi (1988) suggested that the Society of Jesus has created a “system of all-embracing rules” which provides “an optimal set of conditions by which young men could live the entirety of their lives as a single flow experience” (p. 232). It was this institutional setup, she argued, that enabled Jesuits to excel in a diversity of activities including the arts and sciences. Besides the Society’s institutional rules, she identified the spirituality based on Ignatius’ *Spiritual Exercises* as another reason for the flow experience of the Jesuits. She explained that:

“the exercises are structured in such a way that the participant knows what goals he is to achieve, how to go about achieving them, and whether he is on the path toward his goal – in short, the steps are there for the process of achieving a religious flow experience” (I. Csikszentmihalyi, 1988, p. 236).

Isabella Csikszentmihalyi suggests that Jesuits experience flow throughout their lives because the impact of the *Spiritual Exercises* continues beyond their novitiate training. The fully formed Jesuit continues to rely on the rules of the Exercises “as a source of spiritual and moral reinforcement” to evaluate and orient his missionary goals (I. Csikszentmihalyi, 1988, p. 237). In the language of Ignatius, the Jesuits continually discern their apostolic activities to find spiritual consolation even in the face of adversity.

Based on Isabella’s observations, Zagano and Gillespie (2006) suggest that “Ignatian disciplines may enhance the possibility of ‘flow’-like experiences” (p. 54). The significant difference between the concept of consolation and flow is that consolation is believed by Jesuits to be a direct effect of God’s action on the individual. On the other hand, flow is described as an emotional state which can be developed by the individual through appropriate training. Yet, some Jesuits declare that the affinities between flow and spiritual consolation cannot be discounted. The Jesuit Nicholas Austin (2014) suggests that

“consolation can be thought of as a specific kind of flow experience in which a person comes alive in activity because of a positive connection to God and the things of God. Not all experiences of flow are consolations, but *all consolations are experiences of flow*; and *the experience of flow in an activity may be an initial indication that God’s Spirit is at work* [emphasis added]” (p. 29).

The above observation on the similarities between flow and spiritual consolation offers an opportunity to explore contemporary Jesuits’ understanding of science-as-spirituality. I use these inputs from positive psychology to comprehend how scientific activity is understood as a spiritual practice by the Jesuit and how it provides spiritual consolation to him. In the remainder of this chapter, I delve into the lived spiritualities of five Indian Jesuit priest-scientists. These five individuals belong to the same Jesuit order, but their individual life trajectories are uniquely different. I explore their retrospective accounts of how their Jesuit spiritual formation and how significant life events shaped each Jesuit’s personal understanding of science-as-spirituality. I will try to show that the spirituality of Jesuit scientific practice emerges from how these Jesuits created flow in their work, which in turn led to their finding spiritual consolation through their scientific work. But first, I offer a note on my exploratory method.

Katz (1983) has argued that any kind of religious experience is mediated by the social, biographical and situational context of the individual (as cited in Schlamm, 1992). Drawing upon this insight, Straus (1981) argued for a distinction between *experiencing* and *interpreting* - because the one having the religious experience can only interpret her/his experience through the “socioculturally constructed categories” available to that individual (p. 58). For this reason, Yamane (2000) says that we cannot directly study *experiencing* - that is, the religious experience in real time (p. 174). Rather, we can only study *interpreting* - that is, the retrospective accounts of how a religious experience was made meaningful to the individual. Sociologists of religion find these narrative accounts useful to understand how people interpret their religious/spiritual experience (e.g., Griffin, 2000). The narrative account offers a useful tool to examine how groups of people (such as Jesuit priest-scientists) interpret their occupations, their daily experiences and their interactions with the material world, as manifestations of their spirituality.

Among the five Jesuits considered in this account (see **Table 4-1**), three began their Jesuit training during the 1960s when new methods of Jesuit formation were being explored in India.³⁴ Of the remaining Jesuits, one joined as a novice in the 1990s and the other in the 2000s. The diversity of these Jesuits will help us to appreciate the unique ways in which each Jesuit understands his scientific work as a form of spirituality. Drawing from Yamane's observations, I try to make sense of the spirituality of these Jesuits while being aware that the narratives drawn from these interviews may offer only "limited portraits". But to my knowledge, this is the first account of this kind where the spirituality of Jesuit priest-scientists is explored in the context of post-colonial India. Further, this is also likely the first account which employs the framework of positive psychology to understand the nature of spirituality embraced by Indian Jesuit scientists. And so, I believe this narrative offers a significant perspective to explore how scientific practice becomes a form of spirituality for these Indian Jesuit priest-scientists.

Name ³⁵	No. of years as Jesuit Priest ³⁶	Research specialization	Significant achievements
Ivan Sequeira	~ 40	Biotechnology, Biopesticides and Ethnopharmacology	Authored more than five hundred journal articles, has patented products, nominated member of international scientific societies
Valan Benjamin	~ 40	Biochemistry, biophysics, electronics, ethnomedicine and livelihoods	Established an independent research organization authorized as SIRO by the Government of India; created a multidisciplinary research program creating scores of international scholars in biosciences and related fields
Jerome Bosco	~ 50	Taxonomy and Plant Systematics	Author of multi-volume flora of peninsular India; awarded a national award for contributions to environmental research
Matthew Paul	~ 10	Biopesticides, Integrated Pest Management, and Insect Molecular Analysis	Patent holder of natural bio-pesticide, nominated member of international scientific societies
Rex Arulnathan	~ 3	Nanomaterials, Photo-electro chemistry, degradation of environmental pollutants	Among the first Jesuits to do PhD in nanotechnology, published peer-reviewed journal papers even before beginning PhD research

Table 4-1: Summary of Jesuit scientists interviewed

³⁴ For a report of the changes that were put forward in the mission and governance of Indian Jesuits in the late 1960s and early 1970s, see (Indian Social Institute, 1969).

³⁵ All names are pseudonyms.

³⁶ Usually, Jesuits refer to the total period they spent as a Jesuit, beginning from the day they make their simple/first vows as a novice. Generally, Jesuits spend a minimum of thirteen years in formation before they are ordained priests. So those who have completed forty years as a Jesuit priest in 2020 would have usually spent more than half a century in the Society of Jesus beginning as a novice.

4.5 “Touched by Jesus”: The call to the priesthood

Ivan Sequeira is a 72 year old Jesuit priest-scientist, who from an early age felt that he had an experience of a transcendent God:

“When I was younger... I used to have very close contact with Jesus, I used to pray much also... I was touched by whatever Jesus did... I read the Bible particularly the New Testament so many times... [I read about] all that Jesus worked [sic] and all... so I thought that this is the best mission, where I could preach to people, communicate the word of God and bring them closer to Jesus”.³⁷

Sequeira speaks of “close contact” and being “touched” by Jesus through the devotional practices he learnt from his traditionally Catholic family in south India. Be it the prayers he learnt to recite or the passages he read in the Bible; these traditional prayerful practices led him to believe that the best possible “mission” was “to go like... [a] wandering priest to preach Jesus to the world”.

The Jesuit Philip McParland (2017) describes devotional practices such as vocal prayer, church practices and reading the Bible as “religious bits” (p. 43). Another Jesuit, Francis Hezel (2015) notes that candidates for the priesthood almost always come from families where such religious practices were considered important (p. 5). So these “religious bits” cannot be discounted as empty religious practices. As the Jesuit scholar Nicholas Austin suggests, Jesuits like Sequeira encounter some kind of religious flow experience in the devotional activities they practised during their childhood. These could have suggested “an initial indication that God’s Spirit is at work” (Austin, 2014, pp. 29–30). This initial flow may have enthused Sequeira with the emotional motivation to become a priest later. However, the motivation is not the same for all Jesuits – as in the case of Rex Arulnathan, a 38 year old Jesuit who was ordained in 2017.

Even though Arulnathan was born in a Catholic family, he admitted to me that his faith as a teenager was more of an obligation. He was not an active participant in the regular Catholic devotions and used to stand outside the church during Sunday mass. However, the untimely

³⁷ Ivan Sequeira (pseudonym), interview by author, May 15, 2017.

death of his sister (elder to him by a year) who wanted to become a nun herself, triggered Arulnathan's desire to become a priest. He described the feeling when his sister died:

“[It] was very painful... [I] remember... I cried so much... when my sister died... I don't know why... [but] that was the moment I felt that I should do what she wanted to become... I [decided] to become a priest... I would fulfil what my sister always wanted to become”.³⁸

Arulnathan was very close to his sister. Her death at the age of fourteen made him feel lonely, he said, as his other siblings were much elder to him. Richard D. Logan (1988) explored how people could have flow-like experiences even in the midst of solitary ordeals. He analyzed the experiences of people who spent long periods in confinement and observed that these people re-invented their interactions with their environment so as to create a coping mechanism that led to flow (Logan, 1988, p. 173). Though not in confinement, Arulnathan did experience a “solitary” ordeal when his sister died. Extending Logan's analysis, it appears that Arulnathan's desire to become a priest was perhaps how he managed to cope with the death of his sister. While he did not call it this, it seems that the loss of his sister was a kind of spiritual desolation.

According to Ignatius, desolation could also offer a means to turn to God. Desolation could be a way “to test... how far we will extend ourselves in the service and praise of God” or a possibility to gain “a true recognition and understanding... that all these are a gift and grace from God our Lord” (Ignatius & Ganss, 1992, sec. 322, pp. 123-124). Indeed, it would be difficult to consider the loss of a loved one as a “gift”, but Ignatius suggests that any form of prayerful reflection should enable the exercitant to gain an awareness of self and consider “where I am going [in life] and for what [purpose]” (Ignatius & Ganss, 1992, sec. 239, p. 96). Logan also describes how those who endured ordeals stopped perceiving themselves as victims; they even spoke of the “freedom” to create and experience meaning in the midst of their trials (Logan, 1988, p. 175). It would appear that they began to think of their ordeal as a “gift” in the Ignatian sense of the term. Arulnathan also told me that his sister's death was the reason for his vocation, which in turn encouraged him to seek a closer relationship with God once he joined the Jesuits as a novice.

³⁸ Rex Arulnathan (pseudonym), interview by author, June 5, 2019.

Matthew Paul is a 45 year old Jesuit priest-scientist whose journey to become a priest also began with “pain”. Paul had initially decided to become a diocesan priest.³⁹ But Paul did not have the certificates to sufficiently prove his Catholic family background. The Rector of the diocesan seminary did not permit him to join the seminary on account of these certificates.⁴⁰ Paul described how he left the seminary in tears and returned to his village. But instead of going home he went directly to the church in his village. He described what happened there:

“I entered the church, nobody was there... I was literally crying... I was talking to Jesus... with pain I was telling him [what] happened... Around 3’O clock [in the afternoon], one old nun came, she touched my back and said ‘Why are you crying?’ I said I wanted to become [a] priest [but the Rector said] I am not worthy... then she said ‘If God is for you, if God calls you, nobody can deny your call’. That was a beautiful.. consoling word... The next day, the parish priest called me [and introduced me to a] Jesuit deacon [who] gave me the address of [the Jesuit] novitiate. So I went [to] the camp... we had [a] short interview, they (the Jesuits) asked [me about] my desire, my family situation.. [and] they said ‘You are selected’... [I felt an] enormous amount of joy and gratitude to God... [Later] I reflected who was that old nun... [who] came from the convent [at] 3’O clock [when] she had no business to come normally... who had sent that old nun to come to church and tell me?... I experienced it as God’s call through a person’s word”.⁴¹

Paul suggests that the nun’s words of encouragement indicated “God’s call” to him, which was eventually fulfilled by his selection to the Jesuit novitiate. He saw the nun’s words as an almost supernatural call, very different from how Arulnathan understood his vocation. But both felt an internal urge to find meaning in their lives throughout the priesthood.

³⁹ A diocesan or secular priest is a Catholic priest who is ordained into the service of the members of a diocese (a church administrative region) and reports to the Bishop of that diocese. On the other hand, a religious priest such as a Jesuit or a Franciscan, is ordained into the service of a religious order and reports to the superiors of that order (see, Boudinhon, 1912).

⁴⁰ From time to time, the Vatican issues guidelines regarding the suitability of admitting candidates to the priesthood. Part of the screening process also includes the submission of appropriate documents related to family background, etc. (e.g., Congregation for Divine Worship and the Discipline of the Sacraments, 1997).

⁴¹ Matthew Paul (pseudonym), interview by author, August 20, 2018.

Emmons (2003) suggests that a close association between personal goals and their accompanying thoughts and emotions is necessary for a “a happy, fulfilling, and meaningful life” (p. 106). In the Christian spiritual tradition, the goal of the mystics (such as Ignatius) to lead a meaningful life usually involved a variety of practices including contemplative prayer and service to one’s neighbour (N. C. Howard et al., 2018, p. 309). Emmons describes such goals to find meaning in mystical practices as a *spiritual striving*. This kind of striving is also a personal goal but oriented around the sacred and the holy. Spiritual striving is “concerned with ultimate purpose, ethics, commitment to a higher power, and a seeking of the divine in daily experience” (Emmons, 2003, p. 112). This description aligns closely with Perrins’ working definition of spirituality I introduced earlier.

The accounts of the Jesuits mentioned here reveal that the men who entered the Society of Jesus were ordinary youth but had a spiritual striving as Emmons suggests. Irrespective of the nature of the events that led to their becoming Jesuits, each of the priests I interviewed seemed to believe that the priesthood was a kind of “divine calling”. Personal goals played a crucial role in motivating them during the initial stages. Yet, their personal goals were also driven by a sense of transcending the self and seeking to be united with a divine reality (Emmons, 2000, p. 10). After they entered the Order, their lived spiritualities would begin to take a distinctly Jesuit shape during their spiritual training in the novitiate.

4.6 “Learning to pray”: The experience of Jesuit spirituality in the novitiate

The novitiate is an important milestone in the spiritual life of a Jesuit, for it is the place he decides if he is cut out for the Jesuit life. The novitiate is also where the Jesuit gets his first and most intense experience of Jesuit spirituality, through a month long retreat based on the Spiritual Exercises. The novitiate basically establishes the foundations for the whole of a Jesuit’s spiritual life. However, there was no illusion that the Exercises would automatically transform the Jesuit permanently. Jesuit spiritual directors suggest that it could take months or even years to evaluate the ‘transformative power’ of the novitiate experience on a Jesuit’s life (Lukács, 2019, p. 5). The novitiate was essentially a time for “preparing and disposing [the novice’s] soul” (Ignatius & Ganss, 1992, sec. 1, p. 21). This disposition becomes important for the novice to gain access to a uniquely Jesuit kind of spiritual experience.

According to Straus (1981), when an individual gains membership to a religiously or spiritually oriented social group, s/he becomes increasingly disposed towards having spiritual experiences specific to that social group. These kinds of experiences are considered desirable or natural in that social context (Straus, 1981, p. 61). For example, the Jesuit novice is expected to shed tears and repent for his sins during the initial stages of his month long retreat (Ignatius & Ganss, 1992, sec. 55, p. 43). If the novice is unable to repent then the director urges the exercitant to change his penance until “God our Lord... grants each one the grace to understand what is suitable for him” (Ignatius & Ganss, 1992, sec. 89, p. 51). Therefore, the novitiate predisposes the novice to orient his personal goals within the broader Jesuit social context. Often, this has given rise to the understanding that membership in the Society of Jesus demands a military regime with no room for individuality. Yet, the *Spiritual Exercises* do not demand adherence to a uniform spirituality – the purpose is rather for the novice to enter into a personal and intimate relationship with God (however one understands “God”) (Nelson, 2009, p. 448). The novice is encouraged to integrate himself into the work of the Society of Jesus by paying attention and understanding himself better vis-a-vis the Jesuits. This signifies a progression of the Jesuit novice by looking beyond his personal goals, for instance, the goals of the Jesuit scientists I mentioned earlier. János Lukács, a Jesuit novice master explains the two-fold transformation expected during the novitiate training:

“The first one, a spiritual process that cultivates considerable self-awareness, can be experienced within an unfolding one-to-one relationship with God. The second process cannot develop in similar seclusion, since it implies engagement in interpersonal relationships and integration into the body of the Society. Thus, while the first process takes about thirty days to accomplish, the second—Jesuit formation—can take as many as ten or more years” (Lukács, 2019, pp. 5–6).

Lukács confirms what I described earlier – that the spiritual formation of the Jesuits is a continuous process which does not end with the novitiate. However, the Jesuit *Constitutions* also discuss at length the conditions for creating a suitable environment for training the novice: to provide “a space where growth can take place” and to promote “greater spiritual progress” among the novices (Lukács, 2019, p. 11).⁴² These rules are what Isabella Csikszentmihalyi argued as enabling the novice to have a “direct experience... of... Christ”

⁴² For the related rules in the *Constitutions*, see (Ignatius & Padberg, 1996, pp. 107–131).

(I. Csikszentmihalyi, 1988, p. 237). Arulnathan describes how the novitiate enabled him to “experience God” in his life:

“... only when I went to novitiate... there was lot of guidance... they (the Jesuit fathers) told [me] if you genuinely... want to serve [God] then you need to grow in your prayer life [and] depend more on God... they [helped me] identify some of the incidents where God was touching [me] and I was not aware... they were trying to help me to see... how he (God) guides... how he intervenes in life... It made me to grow more confident in God”.

As mentioned earlier, one of the functions of the Exercises is to help the novice build a personal relationship with God. More specifically though, the Exercises are structured to help the novice review his views about God based on his personal experience (Nelson, 2009, p. 449). He is encouraged to be aware of the God-experience in his life through the daily events which offered him consolation. Arulnathan grew in his self-awareness of God in his life and he also developed a more practical – even unconventional – approach to prayer. Now that he was an ordained priest, Arulnathan’s method of prayer and approach to God became uniquely personal. He told me:

“Now... suppose I want to go out somewhere... I just simply sit on the bike... I go... say a prayer... People will expect me to say a Rosary⁴³ but I don’t.... When I am going on the bike I’ll go on [and] say a prayer... I feel that’s how my prayer is... [even] sitting fifteen [to] twenty minutes daily in the chapel... I find that is more nourishing than spending more time... As a priest, that’s what I feel now, but in the formation... so much time was given [to learn and] becoming aware how God was intervening... always, some incidents are happening... connected through God and how he is intervening... [when] I am able to look [at the experience] like that, then there is more strength in that [experience] I felt. That’s how I started to cherish [my spirituality]. Otherwise, I was not an extraordinary spiritual person... I was quite [a] normal person”.

The manner in which Arulnathan explains his spirituality defies the dramatic elements usually associated with spiritual experiences, as described in the social psychology of religion. Yet, it

⁴³ The Rosary is a Catholic devotional practice which involves repetitive prayer using a string of beads.

is this predisposition that motivates the Jesuit commitment to “find God in all things”. Besides, these rules are “psychologically sound” as Isabella suggests, for creating the environment to ensure that the Jesuits find flow in all their missionary activities. In describing the predisposition towards a specifically religious experience Straus (1981) also highlights the role of the spiritual guide who helps the individual to properly understand the experience. Indeed, these guides offer direction “from the perspective of the social group sponsoring a particular manifestation of religious experience” (Straus, 1981, p. 62). The 69 year old Jesuit, Valan Benjamin, describes that it was his novice master at the novitiate who helped him to stay secure in his calling to be a Jesuit. He says:

“There was this thing [during the novitiate when] I went into a lot of, like, scruples. At one point of time, I had to ask myself ‘Should I stay [in the Society of Jesus]?’... My novice master, hats off! That time with all those things (scruples), I would go almost two to three times a day, knock on his door and he used to say ‘What’s happening?’ and I would you know [tell him]... the patience with which he saw me through that, I have been to the edge and back”.⁴⁴

Benjamin also credits his novice master for providing the freedom to experiment with his spirituality and even when he was about to begin his undergraduate studies. As he continued to speak about the impact his novice master had on his life, he was almost in tears as he expressed his gratitude:

“The way this novice master of mine has formed [*at this point he sheds a tear*] me in that sense... when I reflect on it, I am eternally grateful. So, even in my novitiate I would go to him for permissions. It was part of the requirement, anything you had to do... you had to get permission. So I would knock on the door... and as I opened it, he saw me and I said, ‘Father, I want...’, before I completed ‘I want...’ he would say ‘Yes’. I’d say ‘But father...’ [and] he would say ‘Yes... whatever you want’... [he] gave me such a sense of the trust that he placed in me...”

Benjamin joined the novitiate in the 1960s while Arulnathan did in the 2000s. Despite the almost half a century gap between the formation of the two, both express gratitude to their

⁴⁴ Valan Benjamin (pseudonym), interview by author, February 10, 2018.

novice masters – that is, their novitiate training which grounded them in the Ignatian spiritual tradition. With the help of their novice masters and other spiritual guides, they were able to discern how their ordinary life experiences indicated the presence of a God who was calling them to serve him. Benjamin told me:

“I was literally led from one school to the other all the way [to the novitiate]... this whole thing of vocation was pretty much confirmed... for me, that is why ‘God writes straight with crooked lines’... is [a] key... orientation in my life... including this whole thing of becoming a scientist”.

The spiritual formation of Benjamin and the other priest-scientists I interviewed would play a greater role once they were assigned to particular apostolate⁴⁵. The lessons these Jesuits learned from the practice of the *Spiritual Exercises* would play a crucial role in helping them orient their spirituality as they embarked on scientific careers.

4.7 Navigating the inner conflict: From priest to priest-scientist

By the end of the novitiate, the novices who decide to continue with their Jesuit training would formalize it by declaring their first vows. However, the novitiate is only the first of many stages in their Jesuit training which also includes their college studies (as briefly discussed in Section 3.7). In fact, the real challenges for the Jesuit – spiritual or otherwise – begin only *after* the novitiate. After the novitiate and the juniorate, the Jesuits-in-training (now called *scholastics*) are instructed to begin college studies in disciplines instructed by their superiors. The superior’s choice of studies for the scholastic may not always coincide with the latter’s personal interests. It is important for us to consider how the assignment of a scholastic to a particular academic discipline would play a role in how the scholastic grappled with his spiritual development. In the case of the Jesuit priest-scientists I interviewed, their college studies in science would also signify the starting point for their understanding of science as a form of spirituality.

Jerome Bosco, a 74 year old Jesuit was asked to do his studies in botany and was ready to become a professor of botany. But research would become his primary assignment thanks to

⁴⁵ Apostolate indicates the broad field of work that a Jesuit is sent to work in. The word has its origin in the Greek “apostolos”, meaning an apostle – one who is sent on mission (Howell, 2017a).

the intervention of his mentor, another Jesuit botanist. Bosco described how he entered the field of botanical research:

“That seed, that spark [to pursue botanical research] I did not choose, in the sense, it was not an inspiration within... [It] was flashed across by my mentor... One day, he proposed to me ‘Why not we do together some areas of botanical research? I had taken one line, you take another level of research in the same line’... so we formed a sort of team”.⁴⁶

Bosco also explained that this was how Jesuits were usually assigned to a particular apostolate during and up to the 1960s. He had joined the novitiate prior to the 1960s and the role of the superiors was paramount in assigning the Jesuits to a mission. Bosco told me:

“It was more [the] superiors who assigned [the scholastics to an apostolate]. Of course, they asked you... what is your liking [etc], but it was a routine procedure... [They decide that] this person goes for school education, this person goes for college education, another fellow goes for pastoral work. So these were the three broad areas... we just towed the line”.

While Bosco indicates that it was the superiors and mentors who decided a scholastic’s line of work, he also indicates that he understood why this was the practice followed by the Jesuits. He says:

“They (the superiors) see the mind of [the scholastics]... the superiors judge [a particular scholastic] to be good in this [particular field, based on] the way we communicate, in the way we perform... as [a] graduate, I was always standing in the top, so naturally they said we need such a person for the college... to become a professor... later [I was] hand-picked [by my] mentor”.

Bosco described how dialogue and openness to the scholastic’s views gained prominence after the 1970s. The “post-modern” Jesuit scholastics had greater freedom to discuss and even suggest what assignments they preferred. Matthew Paul who joined in the 1990s, describes

⁴⁶ Jerome Bosco (pseudonym), interview by author, May 24, 2017.

the scenario when he was asked to take up the sciences after he completed his juniorate training.

“When I made.. [the] one month retreat... [There was] lot of inner joy, inner conversion... [and a] desire which was more powerful... to serve the people... to preach... to heal... [So] I wanted to become a doctor... and heal the people... free of cost... in the name of Jesus. [But the Society] said ‘No, we don’t have that type of mission’... After my Juniorate, my Provincial and PCF (Province Coordinator for Formation)... told me ‘We want you to study science’.... I was not much interested... to study and to become a scientist... that was not my desire...”

That Paul could even express his inclination to study medicine indicates the shift in trends in Jesuit formation during the 1990s. He was also able to express his feeling that it was not really his desire. The case with Arulnathan, who joined in the 2000s, is different. He excelled in several activities and was unable to decide what apostolate he was destined for. He told me:

“When I was finishing my novitiate, I was very much interested [in] music... I took the basic sciences [in college]... I was actively involved in the student activities and [I was elected a] student leader in the third year... then I said I must do social work... [After graduation] I went for my philosophy [training], then I slowly started to settle down in my mind... I felt there are many other things... forces coming to... maybe they are trying to distract me... that was... the awareness... given by [my] spiritual father, ‘When you are in novitiate you had this, when you were doing your UG you had this thought, when you are finishing you had [another thought]. See, you are elated when people started to recognize you, but deep down what was happening?’ He was trying to tell me, ‘You are studying well, you are doing studies well. See, that is the thread that you need to follow. These (others’ recognition) are small highlights that are coming up. [But] when you want go and you want to miss the thread, then you will miss the mark’.... that made me [decide], yes, what he said is true... he made me aware of it... then when I came for my Master’s... they asked me to ... continue my studies in Physics”.

Arulnathan’s account describes how his decision to study higher studies in physics was very much a result of a spiritual search. His “spiritual father” helped him to reflect on the spiritual

impact of various life experiences. Thanks to this assistance, Arulnathan claims that he was able to understand the distinction between “forces” that were “trying to distract” him and what was happening “deep down” within him. These terms are general descriptions of Ignatian discernment which are elaborated in the *Spiritual Exercises*. These rules encourage the Jesuit to follow “the thread” as Arulnathan states, or else the Jesuit will miss his “mark”.

From Arulnathan’s description, we note that it was his spiritual father who helped him discern his specific apostolate in the field of higher education. The process of Jesuit discernment is often described as a process of “sifting through” of experiences. Using this process, the Jesuit seeks to understand “God’s call” that comes through “each new moment of life, each new concrete situation” rather than dramatic, out of the world experiences (Futrell, 1970, p. 49). Besides helping the novice to confirm his vocation for the Jesuit priesthood, the process of discernment helps the Jesuit to respond to each concrete situation in life and decide the kind of apostolic missions that are appropriate for a given time and place. Significantly, the discernment process involves the “gathering of evidence” – to collect “all the necessary knowledge and information for prayerful reflection” as we observed in the case of Arulnathan (Futrell, 1970, p. 61). The individual Jesuit is aided in this process by the larger Jesuit community so as to assign the Jesuit to a particular missionary apostolate.

Usually, the Jesuit Provincial leads a process of “communal discernment” to help identify the choice of a particular mission for each Jesuit scholastic. The Provincial, supported by other senior Jesuits in the Province, assigns the Jesuit novice to a particular apostolate depending on his aptitude and the circumstantial requirement. This was the case with Bosco and Paul. As in the case of Paul, some Jesuits may hesitate to embrace their appointments at first. But through personal discernment as well as with the help of others in the Jesuit community, the individual seeks to understand his assignment as part of his divine calling.⁴⁷ Paul explains how he came to terms with his Provincial’s suggestion that he take up studies in science:

“I do not know why they (the superiors) had [that] desire... why they wanted to educate me in microbiology... maybe [because] I got good marks [in high school]... [or because] microbiology was a new field in 1997... nobody [among the Jesuits] was a microbiologist [then]... maybe... God [had] a plan... [He] called me in the womb of

⁴⁷ For a discussion on how Jesuit obedience has evolved from the 1970s to today, see (Knight, 1974; Schnoor, 2019).

my... mother... maybe in the womb of the novitiate... they (the Jesuits) had a dream [for] my life... that time I did not understand why they asked me to study microbiology... [But] once I received [the assignment] I believed [that] it is God who has given me this mission through the Society of Jesus”.

Like Arulnathan did, Paul also discerned his call to study science by “sifting through” his life experiences. He saw his personal experiences in the light of the needs of the Society and was convinced that his ability to study well could fulfil the need for a Jesuit trained in the life sciences. Importantly, Paul was spiritually consoled because he considered that it was God’s plan for him to study science and to become a scientist. He told me again:

“Where I was not qualified in the field of science... and where I [had] no inner desire to become a scientist... God was constantly forming me through my own Society of Jesus... becoming a scientist [was] God’s plan [for me] through the Society”.

Paul’s judgement of his call to become a scientist is made solely from the perspective of the social group – the Jesuits – which enabled him to dispose himself to the contemporary needs of the Society. Bosco and Arulnathan also understood their assignments as manifestations of God’s call in their respective lives. Witten (1993) suggests that people belonging to a particular social group are more inclined to experience a religious experience commonly experienced in that group (as cited in Yamane, 2000). This appears to be the case among the Jesuits. Unlike evangelical Christians, the Jesuits do not expect dramatic experiences but try to find God in their daily experiences - including in their apostolic appointments. Indeed, fulfilling the Provincial’s orders is also expected of the Jesuit under the vow of obedience, but it is through discernment that the scholastic is even able to accept this order as “God’s plan” and find personal meaning in that plan. Discerning and accepting the superior’s choice of college studies signifies an important step in the Jesuit’s understanding of his scientific work as a manifestation of his spiritual life.

Most often, the Jesuits who excel in their studies are the ones assigned a career in science; so was the case with Valan Benjamin. Unlike the others who reluctantly accepted science Benjamin was himself interested in science. He was encouraged by his Provincial to obtain a Master’s degree in electronics and was made Director of an Electronics Centre in a Jesuit college in western India (the centre later became an independent department of electronics).

However, a new set of government regulations mandated that he get an additional degree before doing his PhD. These circumstances, along with the needs of that Province, led the Provincial to decide that Benjamin should do his MS and PhD in biochemistry from a university in the United States. While Benjamin was at home with science, he had minimal training in biology and was not ready to face this challenge. He described to me the turmoil he felt as a PhD researcher in the US:

“When I landed there [in the university], all the advanced courses were going on. Here’s a chap (meaning himself) coming with physics [background]... [who graduated] five years earlier... [So] within the first month I was totally lost. I used to go to the class... that was a molecular biology course... I used to take down notes... any where there is an English [word] you know ‘and they said this’ and anything technical huge blanks. Fortunately, there was a priest from my province [in the same university]... till today he is my spiritual director... [there was] tremendous affinity between the two of us... He had also helped me to get my admission... I told him [about my troubles in class] He said, ‘Man, this is going nowhere!’... [So] we went out to the city, bought one tape recorder... every day I used to record [the lecture] go home... for [a] one hour lecture I would spend three hours to transcribe... I got through the course... I went ahead completed my PhD... I also got the President’s medallion [of the university]... I ended up working on an enzyme that till date has not been classified”.

Benjamin had no choice but to pursue a PhD in biochemistry and so he accepted it given the circumstances. But he had the help of a spiritual guide who also provided practical advice and helped him get through his early difficulties. While Benjamin’s experience may not qualify as a particularly “religious” experience, Benjamin’s experience of committing himself to a missionary assignment is a particularly Ignatian response to personal ordeals. Ignatius’ instruction that Jesuits make all their activities into “a continual prayer” appears to have been the mantra for Benjamin. According to Jesuit spirituality, finding God in studies or in research is not merely seen as a way to be effective or productive in research but as a spiritual practice in itself. The philosopher Simone Weil (1973) expressed this sentiment when she declared that the “key to a Christian conception of studies is the realization that prayer consists of attention” (p. 105). Paraphrasing Weil’s statement, Nicholas Austin (2014) suggested that “when studies are done with the right intention and attention, we are on the threshold of prayer itself” (p. 33). Matthew Paul also followed a similar trajectory when he

was asked to continue his PhD studies after he completed his Master's with several awards to his credit. He said:

“Once again... I saw God's Providence through the Society... [the] type of responsibility [to do a PhD, and] that type of acceptance [by my superiors] gave me [a] lot of energy to get involved in the [PhD] work, and whatever I do [*sic*] I used to offer to God... and I used to have a hidden intention... I used to offer my work for the good health of somebody or... some suffering people... with full speed I used to work... because [I believed that] when I am very successful [or] fruitful in the work [then] God will heal the person. [In that manner] I used to connect with my work and God”.

Paul repeatedly speaks of God's plan for his life as a Jesuit and how he ‘connected’ his scientific research as a prayerful intention for the good of people known to him. This attempt to find meaning in one's work by associating it to one's relationship with the world has been explored in positive psychology. Nakamura and Csikszentmihalyi (2003) examined this in the context of artists and scientists. They described the notion of *vital engagement* in an activity, by which people actively form goals, invest their attention selectively and construct the meaning of their experience – with the result that their relationship with the environment is at once enjoyable and meaningful (pp. 83-84). Through vital engagement in an activity, the individual achieves personal goals through his/her interaction with the world. Of course, this notion does not make any mention of the sacred or a transcendental God, but Matthew Paul's personal goal was to relate to God through whatever means available to him. So he found vital engagement in his PhD research by “connecting” it with his prayerful petitions to God. As a result, Paul found himself becoming,

“...more responsible and... involved in the research... to choose a topic [where] I had a passion to serve the Society [of Jesus] and the world at large through scientific research... Within two and a half years, I submitted my thesis [on how] to prepare an alternative source to chemical pesticide(s)”.

We can now begin to get a sense of how the spiritual training of the Jesuit priest can help him to seek spiritual consolation in his scientific work through vital engagement in his work. Nakamura and Csikszentmihalyi also explain that one of the characteristics of vital engagement among highly successful scientists is that they constantly focus their attention on

their research. We have already identified attention as a key element of Ignatian spirituality. We also noted how Matthew Paul and Valan Benjamin paid increased attention to their research despite other distractions. Others like the Nobel Prize winning chemist, Linus Pauling, describe a similar kind of attention to their work. Pauling was known to have said: “I don’t think that I’m smarter than a lot of other people working in science, but perhaps I think more about the [research] problems”. Pauling describes paying adequate attention to his research and so his work “was not compulsive or burdensome, but engrossing and enjoyable” (Nakamura & Csikszentmihalyi, 2003, p. 85). The kind of vital engagement that Pauling describes in relation to his chemistry research also appears to be present in the Jesuit priest-scientists I interviewed, with the attentive distinctness that their engagement was socioculturally and historically constituted by their belonging to the Society of Jesus.

Nakamura and Csikszentmihalyi (2003) explain that vital engagement is characterized by experiences of flow and by (felt) meaning (p. 87). We have earlier seen that the feeling of spiritual consolation described in Jesuit spirituality is similar to the state of flow described in positive psychology. The experiences of the Jesuit priest-scientists I interviewed seem to suggest that they gained spiritual consolation by creating specific experiences of flow through vital engagement in their research. Indeed, they did this by discerning their experiences in the light of their spiritual formation and by “sanctifying” their work in a distinctly Jesuit manner. However, the challenge to these Jesuits was to continue to experience spiritual consolation (and flow) in their scientific practice.

4.8 Sustaining spiritual consolation in scientific activity

All the Jesuit scientists I interviewed for this chapter excelled in their respective fields. From the time they began their PhD research they published in renowned journals, received national and international awards, secured patents, marketed products and even had species of insects named after them! But almost all of them acknowledged that their scientific careers were not endlessly spiritually consoling – they did not experience flow throughout their scientific practice. They did manage to *enter* into a state of flow at the onset of their scientific careers but they had to put in additional effort to *sustain* the state of flow throughout a lifetime of scientific practice. And this they did by delving deeper into their personal spiritualities.

As pointed earlier, the *Spiritual Exercises* do provide a broad structure for the Jesuits to experience continued flow in their apostolic activities. Ignatius explains that the Jesuit can experience spiritual consolation (also) by learning to channel his “inordinate” feelings and distractions. He indicated that the very purpose of the *Spiritual Exercises* is “to order one’s life without reaching a decision, through some disordered affection” (Ignatius & Ganss, 1992, sec. 21, p. 31). This appears similar to Csikszentmihalyi’s suggestion that “[t]he addition of spurious motivational elements to a flow activity make it also more vulnerable to intrusions from ‘outside reality’” (M. Csikszentmihalyi, 1975, p. 48). By “spurious motivations”, he was referring to money, fame, victory, etc. which distract the individual from experiencing joy in the activity. Likewise, Ignatius admonished those Jesuits who are restless because of external factors: “You can change residence, superiors, and brethren; but unless you change your interior person, you will never do well”. Ignatius urges the distracted Jesuit “to change the interior man and recall him to God’s service” (Ignatius, 1555/1996). In an indirect way, both Ignatius and Csikszentmihalyi suggest that for people to experience flow/consolation in their activities, they should ensure that “potentially intruding stimuli must be kept out of attention” (M. Csikszentmihalyi, 1975, p. 47). The spiritual training along with the assistance of the spiritual fathers helped the Jesuits to be aware of “disordered affection” and keep “spurious motivations” out of their attention. Valan Benjamin described to me a period when he was doing particularly well in his PhD research in the US, but still experienced a disturbance “inside” of him:

“The first paper of my PhD work [was published] in the number one journal of biosciences... but the curious thing was, inside of me, all that time there is a struggle... I was looking at all this... spectrophotometer, centrifuge, cold room... perfectly at home, no? With my PhD. But all the time [I was] asking [*pauses to reflect*] what is the meaning [of all this research]?... I wanted to serve missions, yes, but second option is [to] serve the poor, you know? What do I do with serving [these] machines [in the laboratory]?”

Benjamin was trained and ordained a Jesuit when Arrupe was Superior General. In the post-colonial world of the 1960s and 70s, the Jesuits under Arrupe began to rethink their evangelizing mission in favour of an emancipatory mission: a mission that would promote social justice among the marginalized and oppressed peoples (explored further in Chapter (5)). Benjamin was likely aware of the rising need for Jesuits to contribute to improving the life and dignity of the poor in India - this was also emphasized in a 1978 report on Jesuit

formation in India (Inculturation Commission, 1978). Benjamin was perhaps drawn towards working with the poor rather than doing research in a lab. Matthew Paul spoke of a similar inner conflict in the 1990s. Like Benjamin, Paul explained that these “inner criticisms” came at a time when he was doing exceedingly well in his PhD research:

“I had a strong desire... after joining the Society [to] fight for rights of the poor and the suffering [but] now I am in [a laboratory] with insects... handling larvae... all the time [within] four walls... when my [Jesuit] friends are going... and meeting people and preaching... [I asked myself] am I going in the right track?... that was the greater challenge that I found even after becoming a priest... Is it really God’s mission or am I doing somebody’s mission [*sic*]?”

By the 1990s, the Indian Jesuits had firmly established social justice as their core mission. They also announced that all Jesuits in India were to manifest their spirituality through “involvement in the struggles and hopes of our people” (South Asian Assistancy, 1991, p. 70). Their missionary involvement, the Jesuits announced, should bring about “visible change in the existing oppressive and unjust structures” (South Asian Assistancy, 1991, p. 122). So it is understandable why Paul was conflicted if his scientific contributions were adding any value to the social justice mission of the Jesuits. Like Benjamin and Paul, other Jesuit priest-scientists outside India have also raised similar questions (e.g., Funes, 2007).

In this context, Nakamura and Csikszentmihalyi suggest that people could experience flow *only* if they felt that their capacities were being fully utilized. Further, there should be “clarity about one’s immediate goals... continuous and unambiguous feedback about the progress that one is making as the activity unfolds; and finally, perceived opportunities for action that stretch one’s existing capacities” (Nakamura & Csikszentmihalyi, 2003, p. 89). A mismatch in any of these parameters could lead to anxiety or boredom for the person. In Jesuit terms, this would lead to spiritual desolation. Benjamin, Paul and other Jesuits desired to contribute to social justice but they were not directly involved in that mission. This led to an anxiety and also a lack of spiritual fulfilment in their work. Ignatius himself was believed to have warned that too much intellectual activity without purpose could cause emotional distress (Austin, 2014, p. 2).

However, we also noted how Ignatius urged the Jesuits to try and “make all their activities into a continual prayer”. Following Ignatius’ advice, Matthew Paul had earlier tried to offer his research as a form of prayer but he later became anxious because of his inner conflicts. Ignatius’ colleague Nadal offered a way out of this distress. Nadal argued that any apostolic activity could become an act of prayer *only* if it had the potential to “arouse a great thirst for helping the neighbour [for] devotion without that desire would be a dangerous thing in the Society [of Jesus], even though good in itself” (as cited in Kinerk, 1985, p. 6). Nadal spoke of the need of “returning often to prayer and of realising a circular movement passing from prayer to action and from action back to prayer”. Peter-Hans Kolvenbach, who succeeded Arrupe as Superior General, suggested the importance of Nadal’s action-prayer circle in the spiritual life of the Jesuits. He says:

“Keeping the image of the cycle, one might say that, in the spiritual progression of the apostolic life, the circle ceaselessly contracts until the two components—prayer and action—mutually penetrate in a harmony by which our human activity becomes the activity of God within us” (as cited in Coghlan, 2004, p. 100).

Nadal and Kolvenbach referred to all kinds of apostolic activities. So the Jesuit priest-scientist could also feel consoled that his contribution to scientific knowledge had the potential to become “the activity of God within us”. The Jesuit priest-scientist is encouraged to effectively make his work as a form of prayer by contributing to the common good. This circle of prayer-action helped clarify the mission of the Jesuit priest-scientists I interviewed – for they found ways to create flow in their scientific research and experience the spiritual consolation to continue with their mission. Matthew Paul explained how he was convinced of his mission as a scientist:

“I found [through] my own understanding of spirituality... [through an] understanding of my life on earth, [that] it is not... what work I do... but... for what I am doing, in what way it helps people and the entire universe... so that way [I] used to find meaning in my service... when I open to the [Holy] Spirit, when I see God's elements [in my work]... and when I started involving myself [and] work hard, I [was able to] find God's providence [in my research]”.

Jerome Bosco claimed that the Society of Jesus encourages the Jesuit scientist to find meaning in his work by emphasizing what Nadal suggested: that any activity that serves others becomes a devotional activity and thus becomes a form of prayer:

“Society of Jesus [tells the Jesuit scientist] ‘Come on do it! Not for your glory... not for the glory of the Society of Jesus... you are revealing your knowledge, your own perspective, your own spirituality, that is the way our, I mean, absorption into science began, because of the spirituality’”.

At this point, it might be useful to consider the humanistic definition of spirituality offered by Elkins et al. This definition, though articulating a “secular” approach to spirituality, still refers to experience that arises from an “awareness of transcendence”. According to Elkins et al (1988),

“Spirituality... is a way of being and experiencing that comes through awareness of a transcendent dimension and that is characterized by certain identifiable values in regard to self, others, nature, life, and whatever one considers to be the Ultimate” (p. 10).

Beginning with Ignatius, the Jesuits have tried to find the Christian God in whatever apostolic activity they were engaged in. Jerome Bosco also tries to argue something similar. He suggested that the Jesuit engagement in science is not for personal glory or for the glory of the Jesuit collective, but is a form of expressing their spirituality by relating to the transcendental God. Elkins et al (1988) also argue that a sense of transcendence is key to spirituality, even for the non-religious. The humanist may understand transcendence in different ways: as a primal bond with the rest of the humanity or as “an art” to develop the capacity for a heightened awareness of ourselves (Emmons, 2000, p. 10). Secular scientists and humanistic psychologists may also refer to transcendence as an “extension of the conscious self into the regions of the unconscious or Greater Self”. In other words, it represents an ability to connect with something beyond what can be seen or perceived (Nolan, 2011, p. 58).

Indeed, some scientists have argued that the success of science as an institution depends on the emotional commitment to pursuing “transcendental truth” (Charlton, 2009). For these scientists, the “transcendental” implies “a value that is ideal and ultimate”. They also claim

“real science” thrived only among those scientists and communities who aimed towards this ideal (Ziman, 2000). Enlightenment-era scientists like Kepler and Galileo believed that unravelling this truth would help understand God better. Later, even non-believing scientists like Albert Einstein and Richard Feynman were motivated by a similar ideal of seeking the truth about the world. The Nobel Prize winning scientist Peter Medawar suggested that one of the ways to become a successful scientist is to study “important problems” of general use to humankind, because a scientist is a “seeker after truth” (Thagard, 2005, pp. 165–166). The Nobel Prize winning Spanish biologist Ramon y Cajal also indicated that “a devotion to truth” is key to the scientist (Thagard, 2005, p. 163). Other “outlandish” scientists, like members of the Fundamental Fysiks Group, tried to understand the “big picture” by dabbling with mysticism and still contributed to breakthroughs in the field of quantum information science (Kaiser, 2012). An emotional commitment to the transcendental truth seems to have had positive effects on scientists’ contributions. Nakamura and Csikszentmihalyi (2003) suggest that this aspect of doing science for the sake of finding the truth or a greater purpose by transcending the self helps to enter into flow (p. 86).

In the case of the Jesuits, the desire to focus on God and to go beyond their “disordered affections” seems to have helped them enter into flow. The attention to the transcendent – even in scientific work – appears to have motivated Jesuits to look beyond their internal dilemmas and orient themselves to their “divine calling”. For the Jesuits, all human activities are to be considered as opportunities for finding and serving God because the Jesuit is merely an instrument in God’s hands (Ignatius & Ganss, 1970, secs. 813–814, p. 332). So the Jesuit (including the Jesuit scientist) is expected to find God in all kinds of activities and consider all activities as prayerful. One of Ignatius’ companions, Ribadeneira (1527-1611) described how Ignatius made God his focus in all the things he contemplated and did. He writes:

“...he [Ignatius] desired that all in the Society accustom themselves always to find the presence of God in everything and that they learn to raise their hearts not only in private prayer but also in all of their occupations, carrying them out and offering them in such a way that they would feel no less devotion in action than in meditation. And he used to say that this method of prayer is very profitable for all and especially for those who are much engaged in exterior things of the divine service” (as cited in Kinerk, 1985, p. 7).

Ignatius' recommendation to find God in all things, not only in devotional activities but also in occupations and other exterior things, appears to have motivated Jesuit priest-scientists to get over their internal conflicts and find God in their scientific activity. It is this "method of prayer" that Valan Benjamin says helped him to get over his interior struggle between doing science and serving the poor:

"If you take the sacrament of living in God's hands, you will not die of worry... at the end of the day you are anchored [in God]... one day, after I was doing my work [when] this whole thing of the poor [and the meaning of my research] was bothering me... and I came up with this idea of using biosciences for poverty alleviation... it is our [Jesuit] DNA... we will not rest until our mission is achieved... when I got back [to India]... the [Jesuit] community was also doing some kind of thinking of what to do, and one of the lacuna in the college setup then, was we had no research component. So see, you know? Synergies! *[he smiles]* I have not manipulated them... I just got my training [and] they saw this guy *[referring to himself]* with this kind of achievement *[a PhD and the university medal]* and so they [eventually] gave me a whole building [to do research]... the goal [of the research centre] was this... whatever we do and any research we encourage, we want ultimately the product of that research to benefit the poor".

Benjamin expresses a variety of elements here. He describes his life as a "sacrament" because he lived "in God's hands". So he felt that God would take care of using Benjamin's talents in science for the greater good. He is convinced that it was because he "anchored" his scientific research in his spirituality that his work was eventually used by his Jesuit colleagues for poverty alleviation. His life's work then became appropriate for the "transcendental" purpose - in line with the humanistic definition of spirituality as well as Ignatius' expectation of Jesuits. As a consequence, Benjamin was able to create a flow experience in his scientific work, even though there was initially a sense of anxiety about how his capacities would eventually be used in the cause of social justice. His decision to "live in God's hands" – he believes – helped him to visualize an appropriate activity (the research centre) which integrated his two concerns: serving the poor and doing science. Eventually, he believes that "God writes straight in crooked lines" because his Jesuit superiors assigned the kind of work which was vitally engaging for him. The research centre was thus an opportunity for him to create sustained flow and ensure that his work remained fulfilling for himself and for the

broader Jesuit mission. This provided the spiritual consolation he desired and made his scientific work a continuing act of prayer.

4.9 “To save souls”: Fulfilling the Jesuit mission through science-as-spirituality

So far, I have attempted to show how the Jesuits I interviewed, initially took up scientific research out of obedience to their Jesuit superiors. They accepted their assignments as the will of God for their lives but had to face interior anxiety because of dilemmas between their personal interests and the assignments given to them. I described how these priest-scientists dealt with these internal dilemmas by “sanctifying” their scientific work using Ignatian rules of discernment and the guidance of their spiritual directors. Eventually, they were able to develop their spirituality so as to situate their scientific research within the context of their spiritual lives. Importantly, I observed that the Jesuit’s attention to find God in all things, including his scientific research, helped him to transcend his personal challenges and eventually engage in his research as a form of prayer in itself.

In terms of emotions, Emmons describes the striving to associate personal goals with service to others as *generativity strivings*. These goals “involve creating, giving of oneself to others, and having an influence on future generations” (Emmons, 2003, p. 111). This kind of striving can be found in anyone who has “a concern for guiding and promoting the next generation” and can be realized through activities such as “parenting... teaching, mentoring, counselling, leadership, and generating products that... contribute positively to the next generation” (Emmons, 2003, p. 111). Zagano and Gillespie (2006) suggest that this kind of emotional striving, which is described in positive psychology, also overlaps with Ignatian spirituality. They argue that both are similar because they seek “to help the individual find a higher purpose and meaning outside the self” (Zagano & Gillespie, 2006, p. 52). It is pertinent to interrogate this claim in the context of Jesuit scientific activity.

Ignatius first began his search for spirituality as an itinerant in Jerusalem. Successive turn of events led him to believe that “in order to be able to help souls” he should first educate himself and went to Paris to study the humanistic disciplines (Austin, 2014, p. 2). He later outlined in the *Constitutions* that “The end of the learning which is acquired in this Society is with God’s favour to help the souls of its own members and those of their neighbours” (Ignatius & Ganss, 1970, sec. 351, p. 187). Ignatius, being a Catholic of his time, understood

“helping souls” in the context of evangelization. According to Ignatius, education or scientific research ought to be pursued if it gained people for the Catholic cause. But in the post-modern context, Arrupe declared that “to judge the success of missionary work purely on the basis of conversion statistics” is a “misguided tendency” (Arrupe, 1966, p. 6). Further, Jesuits today understand the concept of the soul very differently. The Jesuit psychologist WW Meissner (2008) argued that when references to “my soul” today refers to “myself as a personal agent, but it [the soul] is only a constitutive part of my total self as a human person” (p. 330). So the Ignatian goal to “save souls” takes on a different meaning for contemporary Jesuits. When I asked Ivan Sequeira what “saving souls” meant for him as a Jesuit priest-scientist today, he told me:

“Today, we don’t talk any more about saving souls... [in the past] it was a motto... [In] today’s interpretation [we talk about] what we can do to make people’s lives better, people coming close to God in whichever way, by emancipation... by knowledge, by driving away ignorance... all these will become part of the work that we do to the so-called [mission of] saving the souls”.

According to Sequeira, saving souls today fundamentally means making people’s lives better. Arrupe called upon Jesuits to become men “for whom all experience of God is action for others and all action for others is such that it reveals to them the Father and draws them closer to Him in affection and commitment” (Arrupe, 1979a). As long as the Jesuit’s work is directed towards “action for others” it attains the status of a mission fulfilled. Like Arrupe, Sequeira also does not feel any need to convert people but he feels that the Jesuit priest-scientist could “bring them closer to God” through the impacts of his scientific research. We observed earlier that Jesuit spirituality in post-colonial India involved a series of radical changes by which the Jesuits re-invented their approach to God, and also explored new ways in which they could serve people more effectively. Jesuit priest-scientists, like Sequeira notes, have also re-visited the notions of how doing science reflects the broader Jesuit mission and also how it brings spiritual consolation to their personal selves.

When I posed the question of “saving souls” to Matthew Paul he replied that a Jesuit engages in any apostolic mission for “the greater glory of God” - be it preaching or doing science. Given this disposition, Paul was not too concerned about doctrinal intricacies regarding “the soul”. According to him, the soul is “interconnected with body and mind”. He explained what

he meant by this and how it was reflected in his scientific research: “It’s [not as if] for soul you help this part, for body you help this [part], [on the other hand] soul, mind, body are interconnected... I find God in all things and all things in God”. Paul echoed the Ignatian maxim of “finding God in all things” and thus sought to serve God in the ways available to him, primarily through his scientific practice. What he said next highlights how saving souls, for him, is more inclusive than just about saving human beings:

“...so when I see the poor farmers are struggling because of [the effects of] chemical pesticides, when I see [that] the soil [and] water gets polluted because of chemicals, when I see the top soil [which] consists of 2.5 billion bacteria, and lakhs of single cell organisms... and the top soil that is a home of those microbes [and how] once they use the chemicals on the top soil, those microbes are destroyed and killed, the fertility of the soil is destroyed... so I find [that I have to] not only [think about] serving the souls of [the] human person[s] but [also] save the microbes [and] macrobes”.

Here, Paul seems to exemplify the Ignatian insight of “finding God in all things” – an insight which he said he developed an affinity to during his theological studies. By the time he completed his priestly training he was convinced that “everything comes from God [and] everything goes back to God”. This trait was demonstrated by Ignatius himself. Ribadeneira recalled how Ignatius practised finding God in places where others would not venture:

“We frequently saw him [Ignatius] taking the occasion of little things to lift his mind to God, who even in the smallest things is great. From seeing a plant, foliage, a leaf, a flower, any fruit, from the consideration of a little worm or any other animal, he raised himself above the heavens and penetrated the deepest thoughts; and from each little thing he drew doctrine and most profitable counsels for instructing in the spiritual life” (as cited in Kinerk, 1985, p. 7).

Like Ignatius who looked for God in plants, flowers and even worms, Paul sought God in microbes and insects. As a consequence of this spiritual insight, Paul was able to create flow in his scientific research, resulting in a scientific breakthrough through which he also found spiritual consolation:

“I started involving [myself] through this scientific research of formulation of a pesticide which is eco-friendly, which is easily available and economically viable, that helps the poor farmers, that helps the plants, that helps the insects, that helps the microbes. So that way, I find helping small microbes [important] because... they [the microbes] are also suffering, because God is there even [*sic*]... so when I do a service for little plants or microbes or insects or a human person, I am doing a service to God”.

Paul’s idea of how he found consolation through his scientific research reveals how contemporary Jesuit priest-scientists try to make spiritual sense of their apostolic assignments. Paul tried to make the best of the assignment that was given to him by “owning” it so that he could enter and sustain flow – and ensure spiritual consolation. Not only did he try to make science beneficial to poor farmers, he also sought God in the microbes and the insects. He reveals a kind of mystical awareness of God when he claims that “when I do a service for [the] plants or microbes or insects or human persons, I am doing a service to God”. Indeed, this kind of transcendental union with non-humans is not exclusive to Jesuit scientists.

The evolutionary biologist Edward O. Wilson (2007) coined the term *biophilia* which he described as “the innate tendency [of humans] to affiliate with life and lifelike processes” (as cited in Schutz, 2019, p. 805). Though a non-believer, Wilson presents biophilia as a kind of transcendent force for ethical action. He describes that this tendency to affiliate with life is so crucial that “our existence, depends on this propensity, our spirit is woven from it, hope rises on its currents” (E. O. Wilson, 1984; as cited in Larson & Ruse, 2017, pp. 272–273). Wilson’s reference to the “spirit” seems to resonate with the idea of a transcendental reality. In fact, Wilson used biophilia to engage with religious bodies and encouraged them to get involved in environmental conservation. Wilson’s affective description of the interconnectedness of life resonates with other natural scientists too. Koppman et al (2015) suggest that the emotional attachment of scientists to the subject of their research is common in the natural sciences (p. 29). Evelyn Fox Keller’s account of the Nobel Prize winning biologist Barbara McClintock (1902-1992) is symbolic of this affective entanglement in the natural sciences. Like Matthew Paul who felt anguish for the microbes that died as an effect of chemical pesticides, McClintock described a distinct “feeling for the organism”. She spoke of a personal relationship with the plant:

“I start with the seedling, and I don’t want to leave it. I don’t feel I really know the story if I don’t watch the plant all the way along. So I know every plant in the field. I know them intimately, and I find it a great pleasure to know them” (as cited in Keller, 1983, p. 198).

McClintock’s account of having a personal relationship with plants, and gaining “pleasure” from knowing them is similar to how Jesuit biologists express their affective relationship with their research subjects. Of course, McClintock and Wilson do not mention God like the Jesuits do. But the focus on transcending the self, to contribute to future generations, and to affiliate with life, does offer a parallel to how the Jesuits seek to find God in and through their scientific research.

Parker and Hackett (2014) suggest that an emotional connect with the research subject is not restricted to scientists in the life sciences but is present among other scientists too (p. 551). Arulnathan described to me that his PhD research in nanotechnology began with the desire to bring Jesuits to the limelight. He agrees that nanotechnology research may not immediately appear relevant to the contemporary Jesuit mission of a “faith that does justice”. He told me:

“Many people ask me ‘You are doing nanotechnology?... what is [it] going to do for the poor, how [are the] poor going to be saved?’... What I am trying to do is... I am going to make a small addition to the... big change that is going to come [in sustainable fuel technology] going to be heavily used by the vehicles that are going to come [in the future]”.

Arulnathan’s research appears to contribute to ecological sustainability which has also been a focus of many Jesuits beginning in the 1990s. But what is more interesting however is that Arulnathan’s desire to work on sustainable fuel technology came about through a “leap of faith”. Arulnathan told me that he sought spiritual fulfilment by always seeking to address his faith with reason. He tried to understand “logically what Jesus is telling” in the biblical Gospels. He explained how this reasoning of Jesus’ teachings helped him to stumble upon the idea for his PhD project:

“I always remember John’s gospel... [the] first sign (or miracle) that he (Jesus) made: he converted water into wine... Miraculously, he could do [but] why can’t we do [the

same]? My [research] work is that. I am converting water into alcohols... methanol [and] ethanol... I began my work with something else but I... started to think in that line (Jesus' miracle) and I was happy that I published that water can be converted into methanol and ethanol... water already [has] hydrogen and oxygen... something new [that] is needed to be given is carbon. [I imagined that] Jesus gave carbon [because] our whole bodies are [also made of] carbon... he could give [carbon] with [divine] power. Power is nothing but light, then this kind of thoughts I had... whenever God is... shown [in religious paintings] they'll show in the form of light, then that's how I thought light must be the energy to convert [water into methanol]... so I started to use LED... use the catalyst, give the carbon... and the change has happened”.

Arulnathan's personal goal to contribute “something good and new” through his scientific mission resulted in an attempt to rationalize the biblical story of Jesus converting water to wine (in the Gospel of John 2:1-11). Accordingly, he attempted to relate his spiritual life (faith) with his scientific orientation (reason). The goal to contribute “something new” also has its echoes in Ignatian thought. Ignatius urges that “those who desire to show greater devotion [to Christ] and to distinguish themselves...will not only offer their persons for the labour...but will make offerings of greater worth and moment...” (Ignatius & Ganss, 1992, sec. 97, p. 54). This characteristic feature of the Jesuit response is called *magis*, meaning “the more universal good” and is closely related to the unofficial motto of the Jesuits, “For the Greater Glory of God” (Geger, 2012). Arrupe suggested *magis* as a strategy to continually seek “a more effective manner of service” and to “offer the greatest possible service of God” (Arrupe, 1979b, 1980b). In a similar fashion, Jerome Bosco described the Jesuit priest-scientist as “a fellow who is committed to... science and technology and who is trying to put [sic] something new, according to the charism of St. Ignatius: to be a *magis* person”.

It appears therefore that the Jesuit priest-scientist tries to be innovative not only in the way he does his science but also in the way he relates his scientific work to his spirituality. This constant search for personal meaning has its rise and fall in his attempt to create and stay in the flow experience. Despite his internal struggles the Jesuit continues to “sanctify” his scientific activity in the hope that he will find spiritual consolation in his work.

4.10 Discussion

In a lecture, John Hedley Brooke (2003) mentions how the 17th century English scientist Robert Boyle described himself as a “priest in the temple of nature” and how the 19th century scientist Thomas Chambers argued that there was a “very close affinity between a taste for science, and a taste for sacredness”. Brooke (2003) also refers to the modern physicist Frank Close who says that he does not believe in God “in the conventional sense” but submitted that the specific moment when an experiment confirms a theory was an “eerie and mystical experience”. Many such scientists, both religious and non-religious, have conferred religious/transcendental meaning on to their scientific efforts. But the purpose of this chapter is to show that the case of the Jesuit priest-scientists is very different. I have tried to show that it was not just the moments of discovery that they ascribed to God – it was in their very journey of becoming a Jesuit and later a scientist, that they lived their spirituality. As pointed out by Isabella Csikszentmihalyi, the entire spiritual life of the Jesuits created the structure for them to enter into a religious flow experience, even though the activity they entered into – science – was anything but religious.

Despite the strength of their spiritual training, the Jesuits continue to face the dilemma of reconciling their two identities, that of the priest and the scientist. Across the Catholic world, the crisis of the “hyphenated priest” reached a peak during the 1960s and 70s (e.g., Dodd, 1967; Marsh, 1971). Sharp distinctions were made between the Jesuit pastor and the Jesuit scholar, with several arguments being made for prioritizing the pastoral ministry over the scholarly mission (e.g. Brennan, 1969). This dilemma was also felt in India when a small group of Jesuit scientists began to establish research centres beginning in the 1980s, a few of whom were interviewed for this chapter. I have tried to show that these Jesuit scientists tried to reconcile their two identities through their spiritualities. Further, it was not by a miraculous or dramatic event that they developed this disposition of science-as-spirituality, but through constant engagement with their spiritual selves. The lessons they learnt in the novitiate provided them the tools to prayerfully engage with their scientific work, as I showed in this chapter. So, the Jesuit scientist does not feel he is any different from the Jesuit pastor - his approach to spirituality also follows the spiritual tradition of Ignatius, which is to find God in all things. However, the call of the Jesuit scientist is considered unique (according to the Jesuit scientist) because it adds a different perspective to the Jesuit mission. Jerome Bosco described why the Jesuit scientist has something unique to offer in the context of the Jesuit mission:

“A Jesuit is not here for employment... to be a scientist is a divine vocation in the Society of Jesus... a fellow (meaning a Jesuit) who is committed to... science and technology... [tries] to be a *magis* person... to expand his knowledge... to carry forward the research... he should be a scientist not for eight hours [but for] twenty four hours... he is a scientist whether he is saying mass, whether he is distributing communion, he may be giving a homily... In all this... I am a scientist... people will see there is a difference”.

Bosco suggests that the scientific temperament of the Jesuit scientist is different because his being a scientist is also a divine vocation. Bosco indicates that his identity as a scientist is intrinsic to his Jesuit personality and motivates him towards excellence in research - towards *magis*. But this understanding of a hyphenated “priest-scientist” mission does not come without its consequences as Valan Benjamin confesses:

“[The Jesuit priest-scientist] struggles to relate the soul, the poor, the people of God, the reality of nature... he is not just a priest, a priest stops at the level of the faith... the Jesuit scientist transcends that and therefore he is a priest of the world... the Jesuit scientist-priest is a priest of the cosmos...”.

As we observe above, Benjamin now begins to address his personal dilemmas to the broader “cosmic” scheme of things. We saw earlier that Weber described the urge to understand the workings of the earth and the universe, is what gives science its charismatic nature – an almost “divine” quality. Understanding the workings of the universe in the interest of serving the poor, according to Jerome Bosco, gives Jesuit scientists a “divine mandate” to teach and do research in science. He insists that “this strong conviction that they are doing divine work is... based on the *Spiritual Exercises*... [and] the mantra is ‘seeing God in all things’”. In a similar fashion, Matthew Paul submits that through his research he is able to “find how God is working through natural resources [and] how these natural resources are working for the life of others... they are all... interconnected”. He further describes that exploring these “interconnected” elements in nature and his research has motivated him to pursue *eco-spirituality*. As a result, he brings his scientific expertise to his pastoral vocation to offer retreats and workshops on how to integrate ecological concerns with spirituality. He described that:

“with [the] spiritual resources that we have through St. Ignatius... and [the] Bible... and even our own Indian [and] eastern spirituality... I [try] to connect... and explain how [science] is connected with our life, people are very much enlightened and empowered... [this is how] Jesuit scientists... encounter God in their service”.

As was described earlier, the post-modern Jesuits found new ways to explore their spirituality. Jesuits like Paul found a way to reconcile their science with their spirituality - and later even offered spiritual inputs to others. Arulnathan also spoke of a similar attempt to reconcile his science with his spirituality:

“I love to preach... every time when I go and preach, I feel like giving something new [that] people have not heard... I [have] always wanted to my faith [to be] addressed by my reason... I would like to prove... in the sense, to explain, I would always feel I must explain at the end... this is what it is... logically [why] Jesus spoke like this... now that’s why he came to this conclusion... now, let us go [take] the leap of faith... then it [our faith coupled with reason] is going to do something more beautiful... I would always like to connect like that... If I have not connected, I would not enjoy my sermon... I would not enjoy my preaching”.

Arulnathan shares that he very much enjoys his pastoral responsibilities (like preaching) as much as he does his scientific research. But he likes to integrate the two and so tries to lead his congregation to use reason in matters of faith. It is this integration of his science with his spirituality that he is able to “enjoy” spiritual consolation. For him to remain in flow throughout his identity as a priest-scientist he uses reason in his preaching as much as he would do so in his PhD research. This is his unique way of dealing with any crisis that may arise from issues associated with being a “hyphenated priest”.

We also noted that the common thread that emerges from these varied accounts is that these Jesuit priest-scientists seek to encounter God in all forms of missionary activity. This could be their scientific research in the laboratory, delivering homilies from the pulpit or conducting eco-spiritual retreats. We noted that this diverse orientation has its roots in the Ignatian directive that Jesuits should be “contemplatives in action”. Jerome Bosco called it “a mysticism of service... you are actively in the field but you are actively in prayer also... [it

is] equivalent to remaining alone in the church... and praying”. Benjamin takes it one step further and claims that he can encounter God even in the laboratory. Benjamin used Rudolf Otto’s (1923) language to describe how he experiences God when he enters the laboratory:

“I claim I am a mystique in the science that I have done... my experience is that of a transcendence... it is an experience of materiality going into [the] transcendent... it is this experience of [Rudolf Otto’s] tremendum... a scientist has the privilege... if he does science with that... openness... to have an experience of that (tremendum)... the moment I enter a lab... I have a sense of the tremendum. Is that a sense of the infinity? Is that what you are defining as God?... [What] you are looking for, [it] is there... and I can experience it... that has been [the] wisdom of this Eastern tradition... I know I am aware of it... my awareness and my experience”.

Benjamin describes an emotional state similar to what Boyle expressed in the 17th century, that he is a priest of the cosmos and can experience the presence of God in the material world. Besides, he also attempts to integrate the spiritual tradition of the Eastern religions with his material spirituality, something common to the post-modern Jesuits in India. He also describes in affective terms that he “*can* experience it” even though he cannot specify the nature of the experience.

4.11 Conclusion

I began this chapter with an introduction on how research into the role of emotions in science has shown that feelings and emotion are integral to the work of scientists, even to the extent of improving the quality of their scientific work. Then, I explored the similarities between the role of emotions in the social institutions of science and religion and showed that both seemed to be motivated by the same emotional commitment to uncovering transcendental truth. This was particularly evident in the case of the Jesuit priest-scientists, who were both believers in the Christian God and committed to their engagement with science.

I followed with a discussion on the spirituality of the Jesuits, arguing that the affective spirituality pioneered by Ignatius was responsible for creating a “lived spirituality” by which the Jesuits aspired to “find God in all things” including in their scientific work. I explained that the Ignatian concepts of consolation and desolation are key to understanding how science is also seen as a form of spiritual practice by the Jesuits. Switching focus to the Jesuit priest-

scientists of post-colonial India, I showed that post-modernity offered the Jesuits an opportunity to integrate lessons from psychology and eastern religions. This also paved the way to re-invent their spiritual traditions, which the Jesuit priest-scientists did by considering their scientific practice as a form of action-prayer.

Drawing from positive psychology, I argued that there were several similarities between the concept of flow and the Ignatian concept of consolation. I then used the narratives of five different Indian priest-scientists and showed how they developed their spiritualities across several stages of their Jesuit lives. I tried to show that it was through their spiritual training and how they lived their practice-oriented spirituality, that they were able to create flow in the scientific work. This in turn gave them the spiritual consolation that Ignatius spoke of. It was by creating flow, I argued, that they were able to fulfil their “divine calling” as Jesuit priest-scientists. This chapter has attempted to show how the interplay of emotions and spirituality created a unique structure for the Jesuits to demonstrate their commitment to science. It also goes to show that the role of emotions in science and religion has a lot to offer in terms of understanding how scientists can find meaning in their work and become “seekers after truth”.

Having gained this insight into the lived spirituality of a Jesuit priest-scientist in post-colonial India, my next chapter deals with the attempt of one Jesuit who tried to widen the scope of Jesuit science in the country by organizing a nationwide network of Jesuit scientists.

(5) The making of the Jesuit Scientific Apostolate in India

5.1 Introduction

By the time India gained independence from British rule, the Jesuit colleges of the New Madura Mission had established themselves as those among the leading institutions in south India. But competition with other colleges and strict regulations of the Madras University (to which these colleges were affiliated) demanded that the Jesuits improve their research capabilities. Subsequently, the superiors decided to ensure that their priests were trained adequately in the sciences.⁴⁸ The brightest of Jesuit scholastics were even sent abroad for their doctoral or postdoctoral research in the sciences. This was itself a break with tradition; a Jesuit professor seldom specialized in specific subjects but was encouraged to become a “jack of all trades” (Gathier, 1945, p. 59). A gradual shift was taking place among the Jesuits because of the changing requirements of higher education in independent India. The Jesuits could no longer remain amateur scientists but had to specialize in the modern scientific disciplines if they had to remain at the forefront of university education in the country (“Informal Discussion,” 1950). These changes were also encouraged by the Catholic Church globally under the Second Vatican Council (henceforth referred to as Vatican II).

In *Optatum Totius* (“desired renewal of the whole [church]”), the decree on priestly training, Vatican II suggested that the training of priests be customized according to the needs of the missionary region, rather than follow a centralized scheme of studies originating from Rome (Vatican II Council, 1965a, #13). Besides the usual training in philosophy and theology, the priestly candidates were encouraged to take note of “the more recent progress of the sciences” so as to “be duly prepared for dialogue with men of their time” (Vatican II Council, 1965a, #15). The decree further stipulated that seminarians be trained at “a higher scientific level” in secular academic institutions (Vatican II Council, 1965a, #18). These recommendations (among many others) represented the Catholic Church’s attempt to reorient its approach to science and technology in the latter half of the 20th century (Vatican II Council, 1965c, #4).

It was under this changing context that the global Jesuits took up a renewed effort to strengthen their scientific activity in an increasingly secular world. This chapter explores how

⁴⁸ Jesuits retained many of the teaching posts in their colleges and the Heads of the departments were almost always Jesuits. This policy remained in force for several decades after Indian independence.

this effort emerged in India and how the Jesuits came together to form a common platform for those trained in the sciences. I explore the origins of what was called the “Secretariat of Jesuit Scientists in the Indian Assistancy”, its objectives, its intended activities and its short-lived existence. I examine this episode in Jesuit science in India by focusing on the communications and contributions of its pioneering Secretary, Joseph Vincent D’Souza.

5.2 Method

This chapter employs a biographical approach, adopting an essentially social constructivist approach without focusing on the technical contributions of Joseph Vincent D’Souza. Besides focusing on the biography of Joseph D’Souza, the chapter also presents a biography of the Secretariat of Jesuit Scientists as a scientific collective. The objective of the chapter is to present what kind of an attempt was involved in D’Souza’s efforts to establish a common forum for Jesuit scientists. The chapter will show that D’Souza shared several common features with other Jesuit scientists in being an accomplished individual. However, it was his very Jesuit-ness that led to his being confined within certain ideas of what it meant to engage in science for the poor.

The sources for this chapter are primarily based on information collected in 2018 from the Archives of the Goa Province of the Society of Jesus. This data consisted of written communication between Joseph D’Souza, his provincials, regional superiors as well as two Superior Generals of the Jesuits. Further, information was gathered from Jesuit periodicals and private newsletters of the Jesuits, collected at the Satya Nilayam Research Institute in Chennai, between November 2017 and November 2018. A copy of a rare document was also obtained from the Jesuit Archives in Rome with special permission granted by the present Superior General, Arturo Sosa.

5.3 Vatican II and the Jesuit scientific apostolate

On October 11, 1962, Catholic bishops and cardinals from all over the world gathered in Rome for the opening of the Second Vatican Council (formally called the Second Ecumenical Council of the Vatican). The Council began in 1962 under the pontificate of Pope John XXIII and concluded in 1965 during the pontificate of Pope Paul VI.⁴⁹ Broadly speaking, Vatican II represented the Catholic Church’s attempt to stay relevant in a secular world and forced the Catholic hierarchy to reorient its future course of action, according to “the signs of the times”

⁴⁹ For an overview of the Second Vatican Council, see (Alberigo & Sherry, 2006).

(Vatican II Council, 1965c, #4). Apart from effecting radical changes in the liturgical rites, the role of the clergy, the Church's relationship with nation-states and in raising the status of the Catholic layperson, Vatican II also acknowledged the importance of engaging with previously ignored stakeholders, such as non-Catholics and scientists (Kozhamthadam, 2007b; Paul VI, 1965b).

Months before the closing of Vatican II in 1965, the Jesuit representatives from around the world gathered in Rome for the 31st General Congregation (GC 31) and elected the Spanish-born Pedro Arrupe (1907-1991) to succeed Superior General Jean-Baptiste Janssens (1889-1964) who died when Vatican II was in session. Among other decisions taken at GC 31, the Jesuits issued a separate decree on promoting scholarly research among the Jesuits. "Scientific research", the decree noted, was "one of the most necessary works of the Society (of Jesus)... a very effective apostolate... more suited to the needs of the men of our times... (for) carrying on dialogue with them, including nonbelievers, for establishing confidence in the Church" (GC 31, 1966c, Decree 29 #1). In another decree, the Jesuits also declared that seminarians "should have special training to fit them for the scientific apostolate which is so very important. In fact, the Society should have men with doctoral degrees who become truly eminent in these fields" (GC 31, 1966b, Decree 9 #38).

Jesuit engagement with scientific work had been a constant feature of their collective history (as we noted briefly in Chapters (2) and (3)). But the focus on scholarly research and the "scientific apostolate" in GC 31 suggested that the Jesuits were beginning to envision scientific research as a potentially unique missionary endeavour. Sure enough, Jesuit scientific activity received a thrust in 1968 when Arrupe created a new office of "International Coordinator of Jesuits Working in the Positive Sciences" (Udías, 2015b, p. 221). Subsequently, Jesuit superiors in provinces around the world began to consider the collaboration of Jesuits working in the sciences, at least in the form of meetings of Jesuit research scholars. However, progress was slow to come by because of emerging tensions among the Jesuits, most notably due to the influence of liberation theology in the global South.⁵⁰

⁵⁰ For an overview of liberation theology in the Catholic tradition, see (Boff & Boff, 1987)

During the 1960s, the extent of underdevelopment in recently decolonized countries in Asia, Africa and South America caused considerable discontent among the people, including among Catholic scholars. Several Catholic theologians (particularly from Latin America) resented existing approaches to development, which only seemed to increase the developing world's dependency on countries in North America and Western Europe. Theologians like Gustavo Gutiérrez called for the re-interpretation of *development* and formulated what came to be known as *liberation theology* (Gutiérrez, 1973). They argued that the Catholic Church needed to engage politically with issues of justice to “liberate” the people from dependency and to achieve self-reliance. Gutiérrez inspired the Catholic hierarchy in Latin America to “speak of liberation rather than development” (Thakur, 1996). Despite opposing the politicization of Catholic theology, the Vatican also recognized the Church's need to address social injustice when Pope Paul VI defined *salvation* as “liberation from everything that oppresses the human person” (Paul VI, 1975, #9).

The impact of the liberation theology movement was felt strongly across the developing world well into the 1970s and 80s. While the Jesuits did not initiate the movement they did promote liberation theology actively, especially in South America.⁵¹ In 1972, Arrupe himself declared that Christians are called to be “witnesses to justice” (Arrupe, 1972/1980). It was in this emerging context that the 32nd General Congregation (GC 32) was convened. Taking note of Arrupe's call, the Jesuits at GC 32 decreed that: “The mission of the Society of Jesus today is the service of faith, of which the promotion of justice is an absolute requirement” (GC 32, 1975, Decree 4 #2). Accordingly, Arrupe urged all the Jesuits to ensure that this renewed mission should pervade all the Jesuit apostolates, including their scientific activity.

Despite GC 31's decision to promote science as an apostolic activity, the scientific apostolate was yet to be established by the Jesuits in a significant manner. Now, the “faith that does justice” mission of GC 32 further confounded the scholars among the Jesuits. They sought Arrupe's clarification on how their intellectual work could support the “faith that does justice” mission. In 1976, Arrupe wrote a letter to Jesuit “intellectuals” addressing these issues.⁵² He elaborated that Jesuit scholars could contribute to social justice by engaging in

⁵¹ Prominent Jesuits who promoted liberation theology in South America include Ignacio Ellacuría and Jon Sobrino. The former was murdered along with six other companions for their contributions to social justice (Hassett, 1991; Sobrino, 1978).

⁵² By intellectuals, Arrupe referred to those involved in “science, research, reflection, literature, art” (Arrupe, 1976/1981).

“the difficult and demanding labour of study, required for understanding... the unjust structures of society... and discover ways to modify them”. Arrupe assigned particular importance to those Jesuits working in the sciences because he felt that “the achievements of the exact and natural sciences are often excellent means of helping men to overcome evils and sufferings of all kinds” (Arrupe, 1976/1981).

It is unclear how Arrupe concluded that science offered “excellent means to overcome evils and sufferings”. But he was also a man of science, trained in medicine. He was possibly aware that many scientists in the 1960s and 70s were disillusioned with the weapons race and environmental destruction (e.g. Agar, 2008; Heymann, 2017). Several scientists across the world, including in India, were beginning to rethink the existing paradigm of bureaucrat-led, technology-driven solutions which seldom contributed to social and economic development of the poor (Jaffry et al., 1983; Vaidyanathan et al., 1979). So Arrupe could have believed that science and technology could indeed help in alleviating social evils, if used “appropriately”.

Arrupe’s letter to the intellectuals was received favourably among Jesuit scientists and educators in India – especially in the GC 32 context of pursuing social justice. Subsequently, the Jesuit scientists in India decided to create a common forum and pursue the goals of social justice through the scientific apostolate. But before describing how the Indian Jesuits in science collaborated, I discuss very briefly the alternative viewpoints that emerged in 1970s India, on how to develop “appropriate” science and technology solutions for the poor.

5.4 Alternative science and the appropriate technology movement in India

As we noted in Chapter (2), the first Prime Minister of independent India, Jawaharlal Nehru, was convinced that science and technology were critical for national development and set up a massive scientific establishment (Arnold, 2013; C. N. R. Rao, 2008). Despite significant achievements in establishing scientist-led developmental projects, ordinary people began to feel that scientific research was restricted to ivory towers and that scientists could not contribute appropriate solutions to social problems (A. Rahman, 1980). Further, wars with neighbouring countries, international oil crises, compounded by criticism of the development process added to a general disorientation with the scientific establishment. Social unrest peaked in the 1970s when then Prime Minister Indira Gandhi declared a domestic emergency

and effectively imposed an autocracy. To counter the emergency, several non-violent, grassroots movements emerged in different parts of the country.

This surge of grassroots movements also inspired several scientists in India's scientific establishment to raise pertinent questions regarding the processes adopted for India's "development" (Krishna, 1996; A. Rahman, 1980). For instance, the newly created Department of Science and Technology appointed a committee in 1971 to develop a comprehensive Science and Technology Plan (Ahmad, 1985). This National Committee for Science and Technology (NCST) sought inputs from nearly 2000 scientists and engineers and submitted the plan in 1974. But the plan soon became inactive due to political unrest and was never taken up again. As a result of such bureaucratic hassles, several scientists began to engage with ideas of "alternative science" through which they could better understand the ground realities of what "development" entails (Agarwal, 1979; Krishna, 2017; Visvanathan, 2006). This alternative paradigm gained inspiration from several social movements including the movement to develop appropriate technologies (Bakker, 1990; S. Prasad, 2015).

Earlier in the 1960s, the Gandhian leader Jayaprakash Narayan (1902-1979) invited the British economist EF Schumacher (1911-1977) to India, knowing well that the latter was inspired by Gandhi's views on economics and science (Hooda, 1976). It was in India that Schumacher first presented his ideas under the umbrella term *Intermediate technology* (Schumacher, 1971). Eventually, a plethora of terms came to be associated with Schumacher's *intermediate technology*: appropriate, alternative, soft technologies, etc (Hollick, 1982). But the term *appropriate technology* (AT) gained traction when the United Nations system of international organizations began to promote the idea in the 1970s (Floor, 1979).⁵³ One of the earliest centres dedicated to the promotion of AT in India was established by the Gandhian Institute of Studies (founded by Jayaprakash Narayan) in collaboration with the Intermediate Technology Development Group (founded by Schumacher). This centre was set up at Varanasi in 1972 and was called the Appropriate Technology Development Unit (Hooda, 1976, p. 147).

⁵³ During this time, a working definition of Appropriate Technology was proposed as "technology appropriate to a country's factors of production in that it maximises the use of factors which are locally plentiful and minimises the use of those which are locally scarce" (Miles, 1982, p. 3).

Elsewhere in India, several scientists and science educators formed local grassroots groups to promote “science for social change” in several parts of the country (Jaffry et al., 1983; Vaidyanathan et al., 1979). One of these groups was the Kerala Sasthra Sahithya Parishad (KSSP), formed as early as 1962 in the south Indian state of Kerala (M. A. Rahman, 1979). Soon other voluntary groups emerged in other parts of India and eventually organized an All India Convention of People’s Science Movements in Trivandrum (Kerala) in November 1978. The Convention led to a more coordinated effort to promote “people’s science” with several of the participant groups continuing their work till the present day (Abrol, 2014; R. Varma, 2001). Soon, some of India’s leading educational institutions joined the alternative science bandwagon and set up centres for developing AT for rural development. Prominent among them were ASTRA (Application of Science and Technology for Rural Areas, now called the Centre for Sustainable Technologies) at the Indian Institute of Science, Bangalore (1974) and the Centre for Technological Alternatives for Rural Areas at Indian Institute of Technology, Bombay (1985).

Interest in AT was expressed within the Indian government too. For instance, India played host to the International Forum on Appropriate Industrial Technology organized by UNIDO (United Nations Industrial Development Organization) in 1978. The Sixth Draft Five Year Plan also suggested the use of appropriate technologies for employment generation (ILO & UNIDO, 1980). Later, the Ministry of Rural Development established the Council for Advancement of Rural Technology (CART) to promote appropriate technologies relevant for rural peoples (Subuddhi, 2002). It may be reasonable to assume that appropriate technology became a buzzword among scientists in India of the 1970s and 80s. Meanwhile, the emphasis on rural development and poverty alleviation was also becoming a priority area for the Indian Jesuits because of the emerging social justice mission.

As noted previously in Section 5.3 , the Jesuits at GC 32 had resolved to integrate justice across all their apostolic activities including their academic and intellectual works. This resolution along with the changing political milieu had a significant impact on Jesuit missionary activity in India. Some Jesuit missionaries – like Hermann Bacher and Michael Windey - who were earlier appointed to work in Jesuit colleges, requested permission to work in India’s villages (VRO, n.d.; Ziegler & Henkel, 2014). While these Jesuits were not scientists by training they were among the earliest Jesuits to adopt appropriate technologies for rural reconstruction, such as improved irrigation facilities for agricultural development

(e.g. Lobo, 1992). Eventually, the Jesuits decided to coordinate their scientific research and teaching in the form of a national network of Jesuit scientists. This national effort took shape under the leadership of the Jesuit priest and chemist, Joseph Vincent D’Souza.

5.5 Joseph Vincent D’Souza and the Secretariat of Jesuit Scientists

Joseph Vincent D’Souza⁵⁴ was born in British India on March 10, 1931. He joined the Goa-Poona Province⁵⁵ of the Society of Jesus in June 1954 and was ordained a Jesuit priest in March 1964 (Naik, 2012). His early years as a Jesuit were spent as a college administrator and chaplain. But the growing need for qualified science teachers in Jesuit colleges prompted his superiors to educate him further. D’Souza completed his Master’s degree in Chemistry in 1969, followed by a PhD which he completed in only two years. D’Souza pursued his postdoctoral research at Farbwerke Hoechst, a pharmaceutical firm in Frankfurt, Germany. On his return to India in 1973, D’Souza took up teaching at the Department of Chemistry in St. Xavier’s College, Bombay.

In 1953, the Jesuits of the Madurai Province established their fifth college – the Andhra Loyola College - to cater to the Telugu speaking regions of the erstwhile Madras State. The college was established at Vijayawada in what is now the state of Andhra Pradesh (“Notabilia,” 1954). This college had Jesuits from different provinces teaching in their science departments as the Madurai Province probably did not have qualified Jesuits to teach in the Andhra region.⁵⁶ D’Souza was deputed to work in the Andhra Loyola College because his qualifications seemed to be relevant for the college’s focus on enhancing its research departments. He joined the Department of Chemistry at the college in 1974 and set up a biochemistry laboratory for the staff members to conduct research (T. V. James, 1979). D’Souza’s stay at Vijayawada was to shape the course of his mission as a Jesuit scientist in many ways.

⁵⁴ D’Souza was often referred to as “Joe V” or “Jovie” by his colleagues.

⁵⁵ On July 31, 1993, the Goa Province was established as a separate province following the bifurcation of Goa-Poona Province. For a history of the Goa province in the Restored Society of Jesus, see (W. Mathias, 1940).

⁵⁶ Andhra was a *Region* supported by the Madurai Province until 1988 when it became an independent province (“Province Diary (July 1987 - June 1988),” 1988). In Jesuit convention, a *Region* is headed by a *Regional Superior* who is the equivalent of the Provincial. For a brief description of a Jesuit Region, see (Scully, 2017).

As we observed in Section 5.3 , it was in 1976 that Arrupe invited Jesuit scholars to engage in research that promoted social justice. Encouraged by this letter, the Regional Assistant of India, Casimir Gnanadickam and the Provincial of India, Ambrose D’Mello attempted to bring together Jesuit scientists in the Indian assistancy.⁵⁷ The involvement of the Regional Assistant suggests the personal interest Arrupe had in the matter. A meeting of the Jesuit scientists was held at Bangalore during April 1978. At the end of this meeting, the *Secretariat of Jesuit Scientists in the Indian Assistancy* (henceforth referred to as “the Secretariat”) was established and Joseph V D’Souza was elected its first Secretary.⁵⁸ On becoming Secretary, D’Souza launched a quarterly called *Interact* to report on the activities of the Secretariat to its members.

In October 1979, D’Souza organized a meeting of the Secretariat at Madras (now Chennai) with the agenda of “creating a vision for the Jesuit Scientist”. A set of objectives were drafted for the Secretariat, the primary objective being “to bring together this group of like-minded scientists and Jesuits into a collaborative union” (J. V. D’Souza, 1980a, p. 2). Collaboration between Jesuits had become a point of importance at the recent general congregations. Arrupe also stressed “the importance of collaboration among Jesuits in different disciplines and even of interdisciplinary research” and called for these Jesuits to be “equipped with a gift for synthesis that inclines towards those global, deep and unified solutions demanded by the great human problems” (Arrupe, 1976/1981). In the light of Arrupe’s recommendations, D’Souza suggested that the Secretariat promote collaboration among the Jesuit scientists “at the level of problems, ideals, experience, aspirations, facilities for science advancement, finance and even exchange of men for more relevance in work” (J. V. D’Souza, 1980a, p. 2). The “exchange” of Jesuits between different provinces was already in practice, so as to strengthen Jesuit missionary works in different parts of the country.⁵⁹ D’Souza proposed that the Secretariat actively promote exchange of Jesuit scientists to expand scientific research and collaboration in Jesuit colleges.

⁵⁷ The *Regional Assistant* represents the Assistancy and is part of the Jesuit Curia at Rome. The *Provincial of India* oversees the administration of all the provinces in India. For a brief description of the Jesuit Curia, see (Danieluk, 2017).

⁵⁸ See Editor’s note in (Arrupe, 1981a, p. 127).

⁵⁹ For example, the Jesuit Chemist J. F. Caius (1877-1944) was originally from the Madurai Mission but taught during different periods in two different provinces of India – first at the St. Joseph’s College, Tiruchirapalli and later at the St. Xavier’s College, Bombay (Gense, 1944).

Several “allied” objectives were also identified: the first was to “provide forums for study, reflection and critique”. This objective was to be realized through “(a) All India Meetings, Specialist Scientist Jesuit Meetings, Meetings of other Religious⁶⁰ interested in Scientific Research (b) Think Tank or the guiding influence of the Secretariat (c) A quarterly called INTERACT” (J. V. D’Souza, 1980a, p. 2). The functions of the “Think Tank” were not elaborated - it is possible that the idea of the Think Tank was inspired by GC 31. Decree 29 suggested a “guiding” mechanism for Jesuit scientists to “help superiors with their advice in planning, coordinating, preparing, promoting, and also abandoning scholarly works, in such a way that the effort expended in this apostolate may be directed more efficiently to its end” - the end being the fulfillment of the Jesuit apostolic mission (GC 31, 1966c, Decree 29 #5).

A second allied objective of the Secretariat was to provide the basis for “theological and philosophical interaction with science and its advances” (J. V. D’Souza, 1980a, p. 2). The basis for this objective also goes back to GC 31 when Pope Paul VI gave the Jesuits a mandate “to combat atheism”. The Pope called upon the Jesuits to make “a well-organized and successful campaign” against “the fearful danger of atheism threatening human society”. The pontiff urged the Jesuits “to do research, to gather information of all kinds, to publish material, to hold discussions among themselves, to prepare specialists in the field” in their “campaign” against atheism (Paul VI, 1965a). In response, the Jesuits called upon the “vigorous intellectual efforts of all our (Jesuit) scientists, philosophers and theologians” and for establishing “a continuing cooperation among Jesuit scholars in various disciplines” to fulfill the Pope’s mandate against atheism (GC 31, 1966a, Decree 3 #14).

D’Souza also suggested a plan for the Secretariat to combat atheism. He submitted that one of the reasons for the “growing atheistic environment of our times” and “the confusion that riddles the Church and the Society of Jesus today” was because developments in “theology had not kept pace with the rapid advance of science” (J. V. D’Souza, 1980a, p. 1). As a counter measure, D’Souza proposed and later published articles on the relationship between theology and science in *Interact*. In addition, D’Souza recommended “producing compact books for... theological reflections on science”. Significantly, D’Souza pointed out the need for reflections grounded in the regional (South Asian) context because the existing resources were usually from “foreign sources”. Several Jesuits had already begun to explore

⁶⁰ Both male and female members of Catholic religious orders are often referred simply as “religious” in Catholic circles.

Asian/Indian theologies and the Secretariat could have gained by engaging with these ideas (e.g. Divarkar, 1982). But such ideas do not find a mention in D'Souza's report.

The third allied objective of the Secretariat was "to influence all (Jesuit?) schools and colleges to integrate research into their teaching programmes" (J. V. D'Souza, 1980a, p. 3). D'Souza opined that research in Jesuit institutions "become part and parcel of the educative efforts of the nation and of national development, especially of rural India" (J. V. D'Souza, 1980a, p. 3). Further, he suggested that "research and education for development" demanded "an appropriate science, methodology and research... with an appropriate feedback from the poorer sections in order that they can spell out their own research problems" (J. V. D'Souza, 1980a, p. 6). It is not clear if D'Souza refers to the appropriate technology movement here. But as we will see later, D'Souza and other Jesuit scientists were aware of the movement in India. In fact, AT would attain singular importance in D'Souza's vision for the Secretariat as well as his individual scientific practice.

The final allied objective was "to make Superiors aware of the problems of Jesuit scientists and to obtain a better deal for them and their work" because it was "felt that not sufficient representation was being given to the need and aspirations of (Jesuit) Scientists" (J. V. D'Souza, 1980a, p. 1,3). Indeed, D'Souza was trying to emphasize what GC 31 had decreed: "Superiors... are to take care that those applied to work in the scholarly disciplines give themselves primarily to the work of research, study, and writing" (GC 31, 1966c, Decree 29 #4). D'Souza invited the Superiors to "use the Secretariat... by encouraging their men into more challenging fields of study... by encouraging cooperation and exchange of men between Provinces, Institutions and Laboratories... and by encouraging our Institutions to make research an essential component of the (Jesuit) educational process" (J. V. D'Souza, 1980a, p. 9). The objectives of the Secretariat and the plans that D'Souza had for the Secretariat were initially well received by other Jesuit scientists across India. In the next section, I explore the extent to which the Secretariat succeeded initially.

5.6 The rise of the Jesuit Scientists' Secretariat

D'Souza was quick to share his plans with Superior General Arrupe and sent a report of the Secretariat's activities in 1980. Arrupe (1981a) was apparently pleased with the report and replied that the Secretariat was "one of the most successful efforts in the whole Society to bring Jesuit Scientists together". Arrupe also agreed with D'Souza's emphasis on India's

national development, highlighting “the need for Indian Jesuits to reflect more on Indian problems”. He further assured D’Souza that he “shall convey to the Superiors your desire for greater support (to the Secretariat)”. Encouraged by Arrupe’s response and the interest shown by his fellow Jesuit scientists, D’Souza took up the cause of the Secretariat in earnest.

In the meantime, D’Souza submitted a proposal to the Indian Institute of Technology – Madras (IIT-M) to pursue research at the IIT-M premises for three months.⁶¹ This step seems to have originated from D’Souza’s interest in expanding his research; he also felt that the facilities available at Vijayawada were not favourable for expanding the work of the Secretariat. In March 1980, D’Souza’s proposal was accepted and he moved to Madras (Almeida, 1980a, 1980b). The “headquarters” of the Secretariat also shifted from Vijayawada to Madras along with D’Souza. But his stay at IIT-M did not end in three months; it lasted two years, thanks to his research and administrative capacities which IIT-M made use of.

Concurrent to his stay at IIT-M, D’Souza began to compile a list of Indian Jesuits with postgraduate degrees in science. By early 1981, he published the “directory” of Indian Jesuit scientists (J. V. D’Souza, 1981b). D’Souza was keen to build upon the initial momentum of the Secretariat. But he was also aware that collaboration had only been “achieved in a euphoric sentiment but has not been achieved in practice” (J. V. D’Souza, 1980a, p. 2). So he prepared a draft set of guidelines for the members of the Secretariat, based on the objectives listed in the 1980 report (J. V. D’Souza, 1981a). Further, he organized regular meetings with Jesuit scientists of different provinces in addition to the all India meetings of Jesuit scientists.⁶² By way of administration, D’Souza reported to the superiors of the Madurai Province since he stayed in Madras, which came under the jurisdiction of Madurai Jesuits. But it was the Provincial of his mother province (Goa-Poona), Leslie J Almeida, who provided the greatest support for strengthening the work of the Secretariat.

Despite being the region where the Jesuits first landed in 16th century India, the Goa-Poona Province did not have any Jesuit college of its own. Leslie Almeida seems to have counted on D’Souza to take the lead and develop the educational apostolate in the province. He encouraged D’Souza to “carry on doing research, especially that type which will be of benefit

⁶¹ The details of what research D’Souza carried out at IIT-M are currently unavailable.

⁶² In a letter to his Provincial, D’Souza reports of several meetings with Jesuit scientists of different provinces in the year 1982 alone (J. V. D’Souza, 1982b).

to our country and particularly to the poor” (Almeida, 1980c). Later, Almeida suggested that D’Souza work out the feasibility of “short courses in various practical skills for college students and for the benefit of the masses” and that “others in the (Goa-Poona) Province, trained in natural sciences, would be interested in collaborating (with D’Souza)”. While D’Souza sought to establish an independent “Institute” for this purpose, Almeida suggested that they “start on a modest scale and, gradually, through experiment and trial and error, build up the work” (Almeida, 1981a).

While paying heed to Almeida’s suggestions D’Souza suddenly seems to have taken an interest in AT, the reasons for which are not very clear presently. He requested Almeida to use the surplus from his research stipend at IIT-M, for AT related research. Almeida was surprised at D’Souza’s new found interest but approved of his request anyway (Almeida, 1981b). D’Souza hoped also to inspire his fellow Jesuit scientists to work on AT related projects. In an invitation to fellow Jesuits he sought their opinions on how “can we as a group make appropriate research data percolate or available to the common man in the villages” (J. V. D’Souza, 1982a). D’Souza wondered if an “Appropriate Technology Laboratory” could help demonstrate “advances in the field of AT... and are seen by missionaries, villagers, educators so that these [*sic*] can put AT into practice in their own areas” (J. V. D’Souza, 1982a). Over a period of five years (1981-85), D’Souza maintained a steady focus on AT in his communication to members of the Secretariat. In preparation for a meeting of Jesuit scientists in January 1985, D’Souza wrote that “immediate cooperation is sought... in submitting to the Group secretary any examples of appropriate technology which one may have been impressed by in his life” (J. V. D’Souza, 1984b). While D’Souza’s interest in AT was evident, it appears that he did not receive too many encouraging replies to his requests. In the same invitation to the 1985 meeting, he made known his disappointment that many were not responding to his communications (J. V. D’Souza, 1984b).

While D’Souza was trying to encourage the members of the Secretariat to get involved in AT, Almeida was more keen to involve younger Jesuits from Goa in the scientific apostolate. Along with D’Souza, he organized meetings of Goa-Poona Jesuit “men of science” in December 1981 and May 1982. Almeida also assigned three Jesuits from the Province to participate in future meetings of the Secretariat (Almeida, 1981b, 1982). In addition, Almeida requested D’Souza to mentor Jesuit scholastics who had shown a preference for scientific research. D’Souza (1982c) replied enthusiastically that this “is why we need a house for this

apostolate where like-minded and oriented Jesuits can inspire one another”. D’Souza even suggested that prospective candidates be sent to IIT Madras where he could mentor them though this does not seem to have happened in reality.

By August 1982, D’Souza’s research project at IIT Madras neared completion. After consulting with Almeida, D’Souza decided to return to Goa and continue his activities in his mother province (J. V. D’Souza, 1982d). On his return to Goa, D’Souza was asked to join a team of Jesuits working at the Social Centre in Ahmednagar, Maharashtra. The Social Centre, started by Hermann Bacher in 1966 was one of the earliest Jesuit organizations to work with the poor and the marginalized villagers of Maharashtra (Lobo, 1992). The Centre was also involved in poverty alleviation and livelihoods promotion by employing scientific methods of improving agricultural yield and irrigation systems.

In October 1983, D’Souza proposed to initiate what he called a “Science for the Poor” project that involved a combination of community mobilization, AT and pastoral care for the adivasi (tribal) villagers (J. V. D’Souza, 1983). While his project was still being considered by his superiors, D’Souza was assigned to the Extension Centre of the Social Centre in a village called Pravarnagar in the state of Maharashtra. He began his project in this village while also assisting the Parish Priest of the local Catholic Church in his pastoral work (Almeida, 1984). Being a scholar in chemistry, D’Souza also joined the Department of Chemistry at Ahmednagar College where he was able to conduct research as well as guide doctoral students. He was also in charge of coordinating the National Service Scheme (NSS) in the college (Koyipuram, 1984). In addition to these activities, he continued leading the Secretariat of Jesuit Scientists and edited *Interact*, single-handedly. But the multiple responsibilities and its associated stress began to take a toll on his health.⁶³ In the meantime, D’Souza began to feel disappointed that other members of the Secretariat (including his colleagues in the Goa-Poona province) were not as excited about his vision for Jesuit science in India. This was compounded with the strain of managing the Secretariat alone without any secretarial help.

⁶³ Almeida’s successor as Provincial, Matthew Lederle was concerned about D’Souza’s health and noted that D’Souza “had several times a blackout” (Lederle, 1985). He was also known to suffer from chronic asthma, as his peers noted on the 50th anniversary of his ordination (“Fr. Joseph Vincent D’Souza, 28.06.2004,” 2004).

In November 1984, Joseph D’Souza invited the members of the Secretariat to a meeting in January 1985. On the one hand, D’Souza expressed happiness that “the Jesuits in Science Group [has reached] its sixth year of corporate existence, [and] every member who has contributed in a positive manner can feel a justifiable pride”. But he also shared his disappointment, writing that “members who continue to keep a low profile are requested to play a more active role in helping the Group function more effectively” (J. V. D’Souza, 1984b). It is not clear if D’Souza had already decided to step down as Secretary of the Secretariat at this meeting. But in a separate 1984 letter to Arrupe’s successor, Peter Hans-Kolvenbach, D’Souza wrote about his plans for expanding the “Science for the Poor” project of the Social Centre and his desire to “have a team of scientists and social workers as consultants in community at Pravaranagar – so as to reflect constantly upon our social and scientific work” (J. V. D’Souza, 1984a). The absence of any reference to the Secretariat of Jesuit Scientists perhaps indicates his loss of interest and growing preference for his personal project. In the same letter, D’Souza wrote that he had “now become a scientist with a mission... to develop in the people a scientific outlook of inventiveness, decision and action” suggesting that he would prefer to work with lay people than with fellow Jesuit scientists. A couple of months after the January 1985 meeting of the Secretariat, a formal announcement was made that “Fr. Cecil Saldanha (Karnataka) is the new Secretary of Jesuits in Science in succession to Fr. Joe V D’Souza who pioneered the Secretariat” (“Announcements,” 1985).⁶⁴

Very little is known about the activities of the Secretariat after D’Souza stepped down. In fact, not much seems to have been achieved by the Secretariat in terms of substantive scientific collaboration or contribution. Individual Jesuit scientists continued to bring laurels to the Society and to their respective colleges, but there seems to be no account of a unified project as envisioned by D’Souza.

After stepping down as Secretary, D’Souza was appointed as the Director of the Centre for Studies on Rural Development (CSR D), a non-Jesuit run Christian institute in Ahmednagar (“Jesuit Heads Protestant Centre,” 1986). He continued his teaching and research at the Ahmednagar College until his retirement in 1991 (Jacob, 1991). One of his last projects on AT was for the Government of India’s Council of Scientific and Industrial Research (CSIR)

⁶⁴ Cecil Saldanha (1926-2002) was an eminent botanist from the Jesuit Karnataka Province. However, there seems to have been little recorded about his role as Secretary of the Jesuit Scientists’ Secretariat (Lumnesh Swaroop Kumar, personal communication, June 13, 2019).

on developing a membrane technology to treat water for drinking purposes (Sareen, 1991). After his retirement, D'Souza devoted himself to pastoral activities – which included an “experiment on an apostolic mendicant community” on the Western coast of the state of Maharashtra. From 1991 till 2004, D'Souza served as a Parish Priest in some of the fishing villages on the coast (Naik, 2012). Interestingly, it was not his work as Secretary of the Scientists' Secretariat but as Parish Priest in rural Maharashtra that earned him the greatest recognition and respect.

5.7 Understanding the demise of the Secretariat

Joseph D'Souza's interest in leading the Secretariat was driven by his belief that he had a “specific Jesuit mission as a Priest and Scientist”. He was also convinced that the Secretariat would help the broader Jesuit community “to promote scientific endeavours in a possibly unified goal”, the goal being to bring “science closer to religion and the people”. But he was unable to sustain the initial momentum and realized early on that the Secretariat was “a difficult apostolate” for the Jesuit mission (J. V. D'Souza, 1980a). A number of reasons could be attributed to how the Secretariat turned out the way it did, despite the legacy of Jesuit science in India.

Deterministic views on appropriate technology

One of the main reasons for the Secretariat failing to become a mainstream apostolic activity of the Indian Jesuits, was D'Souza's insistence on making AT the focus of the Secretariat. Despite his good intentions, D'Souza seems to have been oblivious to the diversity of opinions on AT – even the Jesuits were not convinced on what constituted the “appropriateness” of appropriate technology.

D'Souza's promotion of AT was based on the then contemporary understanding that it was “a total development package for the solution of a community development problem” (Dunn, 1978, p. 5). His provincial Almeida also agreed to support D'Souza's interest in appropriate technology because he felt that the Jesuits should “keep on searching for better solutions to bring science and the fruits of technology to the masses and marginalized” (Almeida, 1981b). Yet, D'Souza appears to have considered AT as a panacea even though Almeida himself wondered if “intermediate technology... propagates the ‘status quo’ and keeps the poor nations poor!” (Almeida, 1981b).

At this point, it may be useful to consider what D'Souza's contemporary and AT pioneer in India, Amulya KN Reddy (1930-2006) thought of AT and its relevance for the Indian context. Amulya KN Reddy was an electrochemist and rural energy pioneer who set up a cell for Application of Science & Technology to Rural Areas (ASTRA) at the Indian Institute of Science, Bangalore in 1974 (Sreekumar & Sant, 2006). Reddy acknowledged the critics of AT and insisted that proponents of AT should answer the "crucial question... whether any proposed technology is oriented towards the villages or the cities, whether it will reduce or increase the inequalities prevalent in Indian Society" (Reddy, 1975, p. 334). It was for this reason Reddy preferred to call these technologies "inequality-reduction technologies" to emphasize the key objective behind his research. Meanwhile, D'Souza was more keen on trying to establish a research institute than identifying a group of Jesuits to collaborate and develop technologies that served the Jesuit mission as advised by his provincial, Almeida.

D'Souza perceived AT to be a techno-centric solution to the problems faced by Indian masses. As a result, he was more focused on working with Jesuits who had PhDs in science rather than collaborating with Jesuits in social work. It also appears that D'Souza considered the scientific apostolate to be in direct contention with the social apostolate. He expressed disappointment at this "growing trend of identifying the social apostolate with the apostolate of a (Jesuit) priest" and sought to demonstrate "the intellectual and scientific apostolate as a full fledged charism, very typical of the Society of Jesus" (J. V. D'Souza, 1982a). Other Jesuits of the time might have even agreed with him, but D'Souza was unable to go beyond his scientism and considered those in the social apostolate to not be adequately trained like those in the sciences. Further, he organized meetings only for those with PhDs and postgraduate degrees in science which might have sidelined those Jesuits with a scientific outlook but not necessarily as qualified as D'Souza was.

For sure, D'Souza was not against the renewed Jesuit mission for social justice. But he was keen on strengthening the rural focus of the Secretariat *exclusively* through the implementation of AT. In his 1980 report to Arrupe, D'Souza submitted that Jesuit scientists "had a very important role to play in the service of faith and promotion of justice" (J. V. D'Souza, 1980a, p. 1). He argued that "creating a scientific attitude among the poor can lead to removal of unequal social structures and (promote) greater human dignity" (J. V. D'Souza, 1980a, p. 6). Coming from the pre-Vatican II era, however, he did have reservations about the so-called "marxist" tools of analysis used in liberation theology and its influence on Jesuit

formation. He felt that “the trend is gradually veering towards an anti-intellectual marxist type of philosophy and theology. This can be detrimental to the work of the Secretariate [sic]” (J. V. D’Souza, 1980a, p. 9).⁶⁵ For this reason, D’Souza insisted that the Jesuit scholastics be trained to reason and approach social problems scientifically. He suggested that members of the Secretariat “discuss with those in formation... with a stress on training to a scientific mentality”. Accordingly, D’Souza tried to impress upon the Superiors that there was a “need to support persons, especially the younger Jesuits who opt for or aspire to this (scientific) apostolate” (J. V. D’Souza, 1982a).

D’Souza’s excessive importance on training Jesuits in the sciences suggests that he considered the effective implementation of AT to be the prerogative of scientists alone. He seems to have believed that scientists would have been able to solve all social evils without any help from others. On the other hand, his contemporaries like Amulya Reddy were aware that AT also required institutional changes necessary to foster social change (Muralidharan, 1987). In fact, it was this kind of social impact that D’Souza’s Jesuit colleagues were working for at the Social Centre, even though they were not formally trained as scientists. Amulya Reddy also emphasized the importance of social processes in rural development and insisted that appropriate technological designs required the inputs of social scientists if they had to adequately identify the “felt needs” of the people (Reddy, 1979, p. 108). However, D’Souza does not seem to have thought along these lines.

Finally, D’Souza considered that his being a Jesuit implied that he should work *only* with other Jesuit scientists. He was either not aware of parallel developments in AT or he was not interested in collaborating with non-Jesuits. For instance, when D’Souza was pursuing research at IIT-M, contemporaries like CV Seshadri (1930-1995) were conducting field level research in AT, very close to the IIT-M campus (C. V. Seshadri, 1985). But D’Souza does not seem to have been aware of this. Similarly, when D’Souza moved to Ahmednagar to work at the Social Centre, others in Maharashtra were developing appropriate technologies for rural development (Unesco, 1981). But D’Souza did not collaborate with them.

⁶⁵ The promotion of liberation theology by the Jesuits was frowned upon by both Pope Paul VI and his successor John Paul II. Arrupe did not encourage marxism among the Jesuits, but he did engage with the philosophy, see (Arrupe, 1980a; Gilbert, 1982; Hofmann, 1973).

Indeed, it would be unfair to blame D'Souza alone for these shortcomings – it was part of the Jesuit psyche to not collaborate with non-Jesuits then. Collaboration with non-Jesuits in apostolic activities was not prohibited but required special approval from superiors (GC 32, 1975, Decree 4 #78-80). Even other Catholic religious working in similar activities felt that the Jesuits had a “superiority complex” and “look down on... other religious (priests and nuns)” (Indian Social Institute, 1969, pp. 49–51). It was not until a decade later (in 1995) that collaboration with “non-Jesuit works” was encouraged widely (GC 34, 1995, Decree 13 #14-15). It remains to be seen how open Jesuits are to the idea of collaborating with other priests, nuns and lay people in realizing their social justice mission today.

It could be reasonably surmised that the Secretariat under D'Souza could have been more successful if he had been open to collaborating with other AT pioneers in India. Besides, if he had worked with social scientists (even those among the Jesuits) he could have appreciated that AT was only an instrument and not a panacea to all social evils. Finally, if he had accommodated the diverse interests of other Indian Jesuit scientists, the other members of the Secretariat could also have taken a greater interest in promoting the Jesuit scientific apostolate. However, there were also reasons beyond D'Souza's control that led to the Secretariat being pushed into oblivion.

Different Jesuits, different provinces, different priorities

Earlier in this chapter, it was noted that D'Souza's provincial Leslie Almeida took special interest in the scientific apostolate and encouraged other Jesuits in the province to participate in related activities. But this enthusiasm does not appear to have been shared by all the other provincials. In his 1980 report to Arrupe, D'Souza observed that all Indian provinces were represented in the Secretariat “except Gujarat, Darjeeling, Madhya Pradesh and Calcutta” (J. V. D'Souza, 1980a, p. 4). This is curious because Gujarat and Calcutta were home to some of the leading Jesuit colleges in India. In fact, the Jesuits of the Calcutta province were responsible for some of India's oldest contributions to science in India.⁶⁶ Yet, there was minimal or no participation from Jesuit scientists of the province. The reasons for the non-representation from these provinces is not known. D'Souza was however grateful to Almeida's efforts to promote the scientific apostolate in the Goa-Poona province and wrote of

⁶⁶ For example, the Belgian Jesuit Eugene Lafont (1837-1908) had helped Mahendralal Sircar (1833-1904) establish the Indian Association for Cultivation of Science (IACS) in Calcutta in 1876 (Biswas, 1994).

his “hope (that) other Provincials take up the cues (and promote the Secretariat)” (J. V. D’Souza, 1982b).

When the Secretariat was first established in 1978, D’Souza reported to the Regional Superior of the Andhra Region of the Madurai Province – because he was teaching chemistry at the Andhra Loyola College in Vijayawada (as we noted in Section 5.5). The Regional Superior, US Paul, was generally happy with D’Souza’s teaching and administrative capabilities. Paul wrote to Almeida that D’Souza had “acquitted himself well in the hostel” and “had organized extra courses outside class hours”. However, the Superior also observed that D’Souza was not entirely at ease in Vijayawada and felt that “he cannot work in Vijayawada unless he had a couple of Jesuit research scholars” (U. S. Paul, 1979). This seems to have risen from D’Souza’s desire to make Andhra Loyola the hub of Jesuit scientific activity in India. D’Souza was keen that Jesuit scholars from other provinces be deputed to Andhra Loyola College as there was also a need for Jesuits trained in the sciences. But Paul was not entirely in favour of such an arrangement and expected D’Souza to work with the existing staff in the college.

D’Souza probably assumed that those at the Andhra Loyola College would welcome his being appointed in charge of the Secretariat, but they thought otherwise. The administrators of Loyola College (Rector and Principal) felt that “they were not consulted (by D’Souza) about it (the Secretariat)” (U. S. Paul, 1980). Besides, they were concerned that D’Souza’s role as Secretary would conflict with his research and teaching in the College. On the other hand, D’Souza felt that the administrators in Andhra did not quite understand his work or appreciate the activities of the Secretariat. Even though the Principal G. Francis “felt it would be good for Jovie if he remained with us.. (but) it would be a pity if he left us especially for the research lab which he established” (U. S. Paul, 1979).⁶⁷ But in his view, D’Souza saw the Secretariat as integral to his work as a Jesuit priest-scientist and did not want to “function at less than his capacity” without the Secretariat (U. S. Paul, 1980). It was under this scenario that D’Souza proceeded to IIT-M in March 1980 hoping that he would be free to pursue both his research as well as lead the Secretariat from Madras.

⁶⁷ Joseph V D’Souza was often referred to as “Joe V” or “Jovie”.

D'Souza moved from Vijayawada to Madras in a fit of disappointment but Almeida continued to encourage D'Souza in his work. However, the provincial cautioned D'Souza that he would “find it difficult to do any serious research as well as look after *Interact* (the Secretariat)” (Almeida, 1980b). Besides, Almeida's views on the scientific apostolate were very different from D'Souza's. Almeida was more concerned about encouraging Goa-Poona Jesuits to take up science, but D'Souza had grander plans for the entire Indian assistancy. Almeida suggested that D'Souza mentor “those talented in natural and physical sciences in our Province [to] come together as a group to brain-storm ways... for the benefit of the masses” (Almeida, 1980b). D'Souza responded positively and they together organized a meeting of Goa-Poona Jesuits in science in January 1981. But the response appears to have been not very encouraging. Almeida proposed that D'Souza organize a second meeting in May 1982. But D'Souza replied: “They will not come if I invite them... unless you write to them, personally” (J. V. D'Souza, 1982c). Generally, there appears to have been an opinion that the scientific apostolate was a fledgling ministry and so younger Jesuits preferred to engage in established works like teaching and social work. As a result, there were very few takers from among the Jesuits to join D'Souza and actively participate in the Secretariat. Further, D'Souza was not ready to reconcile with Almeida's plan to focus only on the single province of Goa-Poona.

Individual accomplishments galore but no common orientation

In 1982, D'Souza reviewed three years' of the Secretariat's existence. He wrote to the members that “(each) Jesuit scientist is a specialised unit and works with his own confined ambit. It is naturally impossible to expect [*sic*] cooperation in his field of specialisation” and so “trying to channel one's work into a common project... has had little success” (J. V. D'Souza, 1982a). The nature of Jesuit scientific activity in India then could not have been closer to the truth.

In the early 1980s, prominent Jesuit scientists were busy with significant research projects, often involving field work and collaboration with government agencies.⁶⁸ While these Jesuit scientists made a mark as pioneers in their respective fields they were not oriented towards a “common project” as D'Souza desired. Indeed, D'Souza could have encouraged them to work on their areas of interest but he was only keen on developing AT as a “main thrust” of the Secretariat. The other Jesuits did not share his interest in AT which was understandable;

⁶⁸ For example, some of the Jesuit scientists referred to in the other chapters of this thesis were not very active in the Secretariat.

not all of them were technologists and quite a few of them were experts in the biological sciences. Ironically, Jesuits' enthusiasm for AT began much later after D'Souza stepped down as Secretary.⁶⁹

Unlike the Jesuit scientists in colleges who had dedicated budgets for their research projects, the Secretariat did not have adequate funds because it was not attached to a specific institution. D'Souza had to rely on the Goa-Poona Province or the Provincial of India to support the Secretariat, at times even sending urgent telegrams to refund his expenses (e.g. J. V. D'Souza, 1979). While inviting his fellow Jesuit scientists to a meeting in 1982, he wrote that "costs are running high, it is proposed that the Secretariat bear only cost of board and lodge.. all else should be borne by the participants" (J. V. D'Souza, 1982a). For sure, other Jesuits would have had the same financial challenges in their respective individual projects but D'Souza had to coordinate a national network without a common funding source. Consequently, the idea of a common Jesuit research project remained a distant dream for D'Souza, even several years after its founding.

Alternately, D'Souza hoped for greater cooperation with other Jesuit bodies such as the Jesuit Educational Association (JEA). In fact, his fellow Jesuit chemist, John Misquitta was in charge of the JEA when D'Souza was in charge of the Secretariat. But D'Souza did not realize that the JEA had a more robust structure with a full-time secretary and an advisory board with representatives from all the Indian provinces.⁷⁰ D'Souza was only a part-time secretary without specific points of contact in other provinces. Indeed this was the case with other Jesuit groups such as those of Jesuit artists and Jesuit pastors, whose success depended either on the commitment of the group members or the organizational abilities of the founder/coordinators. As a result, new units like the Scientists' Secretariat did not attain the status or gain the attention as registered bodies like the JEA.

Crises in the Society of Jesus and its implications

As was pointed out earlier, GC 32 created a renewed mission on social justice among the Jesuits. As a result, Coordinators for Social Action (CSA) were appointed in each province in India to try and assist the different Jesuit apostolates implement the "faith that does justice"

⁶⁹ For example, the Department of Rural Development Science in the Jesuit Arul Anandar College, Karumathur (Tamil Nadu) organized programmes on the 'Use of appropriate technology' and 'Energy and Agricultural Development' in March 1988 ("Taking the University to Villages," 1988).

⁷⁰ JEA had a corpus fund built since its inception (Jerry Rosario, personal communication, 21 July 2019).

mission. Accordingly, the CSAs developed several plans to realize this mission: “non-formal education geared to self-employment”, “courses for Priests and others interested in the promotion of Social Justice”, exposure programmes for Jesuit scholastics to “acquire a deeper experience” of life in the villages, constitution of “Peace and Justice Councils” in parishes, etc (“Meeting of the Coordinators of Social Action of the Southern Region with the Province Representatives,” 1976). It was at the same time that D’Souza impressed upon the superiors to “use” the Scientists’ Secretariat and to take it “far more seriously”. However, the heightened focus on the social apostolate pushed other emerging ones like the Scientists’ Secretariat into the background.

Another setback for the Secretariat was when Superior General Arrupe was paralyzed by a stroke in 1981. This came about when Pope John Paul II had already taken a tough stand against liberation theology and its proponents. The Pope was also of the opinion that the Jesuits under Arrupe had promoted liberation theology among Catholics, which he perhaps considered was the one of the reasons for the falling number of Catholics and increasing number of priestly departures. Indeed, nearly ten thousand Jesuits had quit the order since Arrupe became Superior General.⁷¹ In the face of these crises, John Paul II forbade the Jesuits from convening a GC and from electing a successor to Arrupe. On the other hand, he appointed two Italian Jesuits of his own choice as papal delegates in 1981, to try and stem the continuing influence of Arrupe on the Jesuits (Steinfels, 1991).

This move had a destabilizing effect on the Jesuits, with some of them even protesting against the Papal decision. However, the damage had been done and several of the Jesuit “novelties” slowed down over the next two years. Even though D’Souza’s secretariat was not one of the more radical of Jesuit activities, most Indian Jesuits were focused on only maintaining the status quo. The Jesuit scientists in India were content with maintaining their existing activities – supervising their departments and carrying out their respective research projects. By the time John Paul II allowed the Jesuits to elect Peter Hans Kolvenbach as Superior General in 1983 D’Souza himself had lost interest in the Secretariat and moved on to other activities. Notably, D’Souza had started his “Science for the Poor” project which had a localized focus and did not require the nationwide collaboration of other Jesuit scientists.

⁷¹ Departures among Catholic priests (and not only the Jesuits) were triggered by several factors, including the radical changes implemented by Vatican II (see for e.g., Cozzens, 2000).

5.8 Discussion and conclusion

Even after his term as Secretary of the Jesuit Scientists' Secretariat ended in 1985, D'Souza was keen that the work started by him and encouraged by Arrupe should continue. D'Souza wrote to Superior General Kolvenbach: "I feel... I may be of help to you in understanding other Jesuit scientists" and described some of the institutional difficulties faced by him and other Jesuit scientists in pursuing the scientific apostolate (J. V. D'Souza, 1985). His foremost suggestion was that as a Jesuit scientist, he must be "entrusted with a single responsibility... as educationist and scientist... (so that he) should be fully engrossed with science" (J. V. D'Souza, 1985). This perhaps indicated his grievance that he was never able to devote the time he wanted for strengthening the Secretariat, because of his teaching and pastoral responsibilities. But he also pledged his commitment to the Jesuit principle of obedience, "fully agreeing with the spiritual principle that they also serve who stand and wait" even though he declared that "as a scientist I am committed to the truth as revealed by God in nature" (J. V. D'Souza, 1985).

Another important reason that D'Souza did not pursue the Secretariat beyond 1984 was he identified himself foremost as a Jesuit priest, and only then a scientist, just like his Provincial reminded him. "Although you should aim at being a first-rate scientist", Almeida wrote to him, "your primary vocation as a Jesuit priest must be kept foremost in mind, implying that you should help provide the humanistic and faith-dimension to your work and in contacts with those in the scientific world" (Almeida, 1980b). As an obedient Jesuit, D'Souza prayerfully discerned his vocation as a priest-scientist, spent time on prayer, and commemorated the 25th year of his priesthood in the historic Bom Jesu cathedral in Goa (J. V. D'Souza, 1980b, 1988a). For better or for worse, he was a committed Jesuit who obeyed the recommendations of his Superiors, even though he often pointed that he should be given duties that befitted his "specific Jesuit mission as priest and scientist" (J. V. D'Souza, 1988b).

The phenomenon of Jesuit scientists coming together as a collective is not unique to India. Jesuits in the United States and in Europe had established formal associations to coordinate their scientific activities and pursue common objectives. For instance, Geschwind (1998) has discussed the collective effort of American Jesuits in seismology and demonstrated that different Jesuits had different reasons to engage in seismology in the United States. He notes that the Jesuit seismologist Frederick L Odenbach (1857-1933) promoted Jesuit involvement in seismography because the move could gain publicity and acclaim for Jesuit colleges within

American society. However, he resisted efforts of fellow Jesuits to join a national seismographic network promoted by the US government. Geschwind (1998) also notes that personal jealousy between Jesuit seismologists could also have led to the short life of the Jesuit Seismological Service. Later, however James B. Macelwane (1883-1956) rekindled Jesuit interest in seismology and set up the Jesuit Seismological Association in 1925. This association had greater success and established the Jesuits as authorities of seismology in the country.

Another instance of successful collaboration of Jesuit scientists in the United States was the American Association of Jesuit Scientists, established in 1922. It had a successful run for more than four decades with a membership of more than 250 members in the 1950s (Udías, 2015b, p. 220). Interestingly however, the Association fell apart in the late 1960s even as Arrupe set up the scientific apostolate. One important reason could be that Jesuits in America were not as favourable to Arrupe's views on liberation theology. Likewise, a group of Jesuit scientists in Europe formed a group in 1989 that continued to be in existence until 2009 (Udías, 2015b, p. 221). What is common to these groups is that they were meant largely as a forum for discussion among peers and to offer moral support to one another. These groups were not primarily intended to pursue common research projects.

It is apparent then, that Jesuit scientific activity had different reasons for its existence in different places and at different times in history. Feingold (2003) observed that in early modern Europe, "the Society (of Jesus) unambiguously enjoined the members to consider secular studies only as a means to an end" (p. 9). While the same appears true of Indian Jesuits in the 20th century, the case of Joseph D'Souza and the Secretariat demonstrates that the conditions to secure those "means" were not often favourable to all Jesuits. Negotiations with local superiors and fellow Jesuits complicated by personal interests and community priorities made it difficult to pursue a common agenda for Jesuit science. This is not to suggest that Jesuit superiors censored all scientific activity; it only shows that the scientific work of Indian Jesuits in the 20th century was very different from those in early modern Europe or colonial India. Unlike their 17th century counterparts who practised science to gain the patronage of kings and rulers, the Jesuits scientists in independent India had to come together for social justice and rural development. This shift in Jesuit scientific activity was also linked to the impact of an evolving Catholic Church responding to loss of its power in a secular world.

In a broader context, the story of Joseph D'Souza and his fellow Jesuit scientists demonstrates that the portrayal of "the Jesuit scientist" as a monolithic entity does not hold true even though the documents of the Society of Jesus presents the Order as a united front. In reality, the richness of the Society is revealed in the diversity of Jesuit personalities. As Harris (1996b) notes, the history of Jesuit science requires "unearthing and expansion of 'minor' figures of the Jesuit persuasion" using "accounts of cultural embeddedness" (p. 283). D'Souza's attempt at fostering collaboration among Indian Jesuit scientists is one such "minor" account. This chapter helped to establish the background of how the Jesuits had quite diverse perspectives on how to pursue science and for what purposes, even though they generally agreed on pursuing science as a missionary activity. Besides, this account of the Jesuit Scientists' Secretariat also reveals a hitherto unknown chapter in the history of the people's science movement in India.

(6) Bridging botany and conservation: Reinventing the Jesuit mission through a boundary organization

6.1 Introduction

In 1950, Koyapillil Mathai Matthew (1930-2004) graduated with a degree in Botany from St. Joseph's College in Trichy, the oldest among the Jesuit colleges in the Madurai Province (see Section 3.6). Hailing from an agricultural household in the erstwhile princely state of Travancore (now Kerala), Matthew informed his family that he had decided to join the Jesuits after his graduation (K. M. Thomas, 2004). He proceeded to Sacred Heart College (SHC), the all India Jesuit formation house in the hill town of Shembaganur.

At SHC, Matthew came under the tutelage of several Jesuit professors who were also amateur scientists. As we noted in Section 3.8 , Jesuits like Anglade, Rapinat and others established a legacy for botany as an intellectual discipline among Jesuit scholastics. Under their influence, Matthew became one of the first Indian Jesuits to pursue doctoral studies in botany. When Matthew was ordained in 1967, he joined the staff of St. Joseph's and established the Rapinat Herbarium (c.1967) followed by the Anglade Institute of Natural History (c.1981) in honour of two Jesuit pioneers of botany in the Madurai Province (Matthew, 1996).

This chapter describes how this “two-station botanical-environmental establishment” – the Rapinat Herbarium along with the Anglade Institute – together took the form of a boundary organization. A boundary organization is one that straddles the apparent boundary between two (or more) relatively different “social worlds” but facilitates collaboration between them (Guston, 2001). Research on boundary organizations have analysed social structures, government systems and scientific innovations—so-called *social worlds* - that shaped the rise of these organizations. But very little is known about the *inner worlds* - the identities, thoughts and beliefs, which are often at the core of societal action.

In this chapter, I describe the multiple actors and influences that forged the emergence of Rapinat Herbarium and Anglade Institute (RHT-AINH) together as a boundary

organization.⁷² I also describe how Matthew's Jesuit identity played an important role in establishing and stabilizing the organization.

6.2 Method

I begin this chapter by briefly reviewing how boundary organizations have been described in the literature, specifically in describing boundary work between environmental policy and scientific research. Next I present the different phases in KM Matthew's life as a Jesuit and situate his career as a "botanist-environmentalist" within the multi-historical context of Indian botany, the Madurai Jesuits and environmental politics in independent India. Then, I present the evolution of RHT-AINH as a boundary organization and the challenges that emerged in responding to the different stakeholders. In particular, I describe how Matthew developed an environmental awareness program as a boundary object that helped stabilize the boundaries between plant taxonomy, conservation research and environmental politics. Finally, I argue that this boundary object was eventually used to fulfil Matthew's personal mission as a Jesuit.

The data for this chapter is drawn primarily from Matthew's writings: these include scientific, theological and general articles. Matthew published close to a hundred articles in peer-reviewed (national and international) journals. Supported by a small team, he also published two multi-volume *Flora*⁷³, which described the plant diversity over almost the entire state of Tamil Nadu. This chapter draws from these scientific writings as well as Matthew's writings in Jesuit periodicals and other newsletters.

6.3 Extending religion and ecology to boundary organization theory: a review

From boundary work to boundary organizations

Gieryn (1983) first described "boundary work" as a self-preservation strategy employed by scientists to demarcate science from "non-science". He defined boundary work as "their attribution of selected characteristics to the institution of science... for purposes of constructing a social boundary that distinguishes some intellectual activities as 'non-science'" (Gieryn, 1983, p. 782). Drawing from examples as diverse as 19th century Victorian England

⁷² Since Matthew referred to them as "twin institutions" and a "happy coupling of two units", I refer to both RHT and AINH together as a single boundary organization: RHT-AINH (Matthew, 1996, p. 32).

⁷³ In this chapter, I distinguish between "Flora" (a published compilation of plant descriptions) and "flora" (plants in general) by capitalizing the former.

and 20th century United States, Gieryn described how the boundaries of science keep changing depending on the goals of the boundary work involved. He therefore surmised that descriptions of science as “distinctively truthful, useful, objective or rational may best be analyzed as ideologies” as described by specific individuals or professional communities (Gieryn, 1983, p. 793).

Jasanoff (1994) described the policy-related applications of boundary work by studying how scientists and politicians collaborate to frame regulations for environmental policy. She examined the role of advisory committees of the Environmental Protection Agency (EPA) and the Federal Drug Administration (FDA) in the United States. Her analysis showed that such expert advisory systems accommodate various boundaries between politics and scientific knowledge, and hence decision making regarding policies could often be more political than “scientific”. Her work has demonstrated that understanding these boundaries between science and politics may be useful for effective policy planning and regulations, especially in the case of environmental policy.

Star and Griesemer (1989) described *boundary objects* as a concept to describe abstract or concrete objects which “inhabit several intersecting social worlds... and satisfy the informational requirements of each of them” (p. 393). Star and Griesemer explained how different social worlds intersected at a natural history museum, through boundary objects such as fossils of birds and mammals. These objects were of interest to members from different social worlds – amateurs, professionals, philanthropists, administrators, the public and even the fossilised animals. These boundary objects are “plastic enough” to be adapted to the needs of different social actors while being “robust enough” to maintain a common identity for the actors who employ these objects (Star & Griesemer, 1989, p. 393). Thus, boundary objects help in aligning the shared goals of the participating actors so that “everybody has satisfying work to perform in each [social] world” (Star & Griesemer, 1989, p. 409).

Guston (1999) explained how an entire organization can become a boundary object when it sits on the boundary between different social actors, manages tensions between different social actors and also implements its organizational objectives. He described how boundaries between science and politics may be stabilized by what he calls “boundary organizations”. A

“boundary organization” facilitates communication between two (or more) sets of actors by fulfilling three characteristics: (1) it provides the space and opportunity to create and use boundary objects; (2) it involves the participation of actors from either side of the boundary, as well as mediating professionals; and (3) it exists at the frontier of two distinct social worlds while being accountable to both (Guston, 1999, p. 93). **Table 6-1** provides an overview of the concepts of boundary work, boundary object and boundary organization.

Concept	Application in STS	Reference
Boundary work	Helps resolve tensions and achieve mutual understanding between actors who do not share same knowledge systems (say, science/religion or science/politics).	Gieryn (1983), Jasanoff (1994)
Boundary object	Helps participants in different social worlds use the same abstract/concrete objects to satisfy shared goals while also satisfying the requirements of each social world	Star and Griesemer (1989)
Boundary organization	Facilitates the opportunity to create and use boundary objects while maintaining accountability to groups of actors belonging to two (or more) social worlds	Guston (1999)

Table 6-1: Boundary concepts in STS

Boundary organizations and environmentalism

The concept of boundary organizations has frequently been used to analyse institutions working on environmental policy and research (Agrawala et al., 2001; Jasanoff, 1997; Miller, 2001). The “activist” role of boundary organizations in what has been called the “environmental justice” movement in the US has also been described (Frickel, 2004). Eden (2010) suggested that environmental boundary organizations not only reconfigure their boundaries with different social worlds but also create “hybrid spaces” to further their agendas for environmental action. Parker and Crona (2012) argued that university-based boundary organizations occupy such “hybrid spaces” because they have multiple constituents who are not clearly defined as belonging to public spheres of either “science” or “politics”. They recommended the adoption of a *stakeholder perspective* to analyse the ability of each stakeholder to influence the activities of the boundary organization. This perspective could help to analyse tensions arising from competing demands of the stakeholders and pay attention to the process of boundary management which requires continuous negotiation among the stakeholders. Tomblin (2013) described the boundary work of the White Mountain Apaches (Native Americans) as a dynamic process that hybridized Apache traditions with Western traditions to protect their “eco-cultural” resources from “Euro-American” interests.

Tomblin's case study on boundary management incorporated insights from STS and environmental history. Other case studies have drawn lessons from science policy (Klerkx & Leeuwis, 2008; Swedlow, 2007), organizational studies (O'Mahony & Bechky, 2008) and international relations (Orsini et al., 2017).

Boundary organizations and religious environmentalism

While not employing boundary organization theory, scholars of religious studies have also described boundary work between religion and ecology in environmental policy and research (e.g. Deane-Drummond, 2006). Theologians and religious studies scholars' attempts to understand how religious communities and organizations engage in environmental action has led to a description of what is now called *religious environmentalism* (e.g. Tomalin, 2016; Gosling, 2001).

While a definition of the term is still emerging, Gottlieb (2017) mentions that two aspects are central to religious environmentalism: "the belief that non-human Nature has value, moral standing, and spiritual significance" (p. 439), and the concern that "our treatment of Nature both shapes and reflects our moral connections to other people" (p. 440). However, Emma Tomalin (2016) cautions that such a description relies upon a particular understanding of nature/environment and of religion. She argues that this discourse is based on the "modern" understanding that nature is valuable in itself – an understanding that began in the environmentalist concerns of the 1960s (p. 11). She suggests that religious traditions may or may not support "environmentalist mode of thinking" which is dependent on their particular social and historical contexts. Much earlier, Guha (1989) argued in a similar vein against the reading of Western, environmentalist insights into Asian/indigenous religious practices. Despite its critiques, the "religious environmentalist" discourse has helped to create a renewed role for religion in the public sphere and has shifted the focus of religious movements from "a doctrinal-centred approach to a problem-centred approach" (Tomalin, 2016, p. 30).

Studies in religion and the environment have emphasized the role of religion/spirituality⁷⁴ in promoting environmental sustainability (e.g. Koehrsen, 2015; Lestar & Böhm, 2020). While these studies argue that the religious/spiritual beliefs of these actors prompted their environmental action, they do not explain what kind of boundary tensions are faced by these

⁷⁴ For a brief contextual discussion on religion/spirituality, see Section (1)4.3 of this thesis.

actors and how they manage those tensions in the public sphere. One such tension that is often quoted in studies of religion and ecology was the thesis put forward by Lynn White (1967): that the anthropocentric emphasis of Western Christianity was/is the fundamental reason for the present ecological crisis. Indeed, many Christian theologians took immediate offence to White's thesis. Gradually however, some mainstream churches and theologians attempted to shed their anthropocentric focus and began to incorporate environmental themes in their missionary agenda (Williamson, 1987).

Among Catholics, the Passionist priest Thomas Berry (1988) developed an ecological branch of theology and suggested that all beings – human and non-human - are connected to each other because they are all members of the “earth community”. He was one of the earliest Catholic scholars to argue that the environmental crisis was fundamentally a spiritual crisis. In the lines of Berry, others began to employ a theological basis for understanding relations between God, humanity and the environment (Kearns, 2007). This included the liberation theologian and Franciscan priest Leonardo Boff (1997), who observed that the poor and marginalized communities were oppressed not only by political and economic systems but also by the ecological crisis. Later, the environmentalist and Columban priest Sean McDonagh (2010) argued that Catholics should also integrate ecological sound practices in their pastoral ministry.

Scholars of religious studies and other theologians often employ a historical or theological perspective to explore how organizations with religious roots can reconcile social justice and environmental action (e.g. Cox Hall, 2018; S. M. Taylor, 2009). They also suggest the utility of exploring the “inner worlds” of such efforts – inner worlds meaning “emotions, thoughts, identities and beliefs” (Ives et al., 2020). However, the theory of boundary organizations has seldom been used to study those instances where religious communities or organizations have engaged in environmentalism. This chapter attempts to introduce boundary organization theory for “religious” contexts. I describe how Matthew's Jesuit identity played a part in establishing a boundary organization and how this organization managed the boundaries between various social worlds.

6.4 Matthew's many trajectories: from economic botany to environmental conservation

6.4.1 Encounters with Jesuit amateurs and economic botany, 1950-67

The pursuit of botany in British India was intrinsically connected to the pursuit of commerce.⁷⁵ By 1820, natural history collecting went hand in hand with the East India Company's efforts at expanding its political economy (Ratcliff, 2016). In 1841, the Royal Botanic Gardens at Kew in the United Kingdom were made into an institution of the British state. The Kew Gardens were tasked with coordinating the network of "the many gardens in the British colonies and dependencies, such as Calcutta, Bombay, Saharanpore, the Mauritius, Sidney, and Trinidad, whose utility is wasted for want of unity and central direction" (Bean, 1908; as cited in Brockway, 1979, p. 452). Subsequently, British officers were often instructed to collect botanical specimens for the collections of the Kew Gardens. In 1890, the Botanical Survey of India was established to explore Indian flora and to coordinate botanical research across the Indian Empire (Gupta, 1959). An "Indian Officer" was posted at Kew to assist the Survey and other botanic collectors in India to identify and catalogue plant specimens based on their usage (Gupta, 1959; Hastings, 1986).

As described in Section 3.6, the training of Jesuits at Shembaganur followed the model of Renaissance humanism—an esoteric mix of sciences and humanities (Gathier, 1945). Botany was also included in the curriculum as early as the 1900s (Matthew, 1988b). The teaching of botany (mostly) followed the European scheme of classifying, describing and identifying plants based on their usage—a discipline which came to be known as "economic botany".⁷⁶ As we noted in Section 3.8, the arrival of Louis Anglade at Shembaganur around this time made a significant impact for Jesuit training in the sciences.

As an amateur biologist, Anglade identified and made 1910 portraits of plants of the Palni hills while his Jesuit colleague Emile Gombert (1866-1948) made 114 orchid portraits (Matthew, 1999b, p. 132). Significantly, this was done before the 1915 publication of the earliest floristic account of the region, *The Flora of the Nilgiri and Pulney Hill-Tops* by Philip

⁷⁵ For instance, the first Botanic Garden in British India was founded by Lt. Col. Robert Kyd in 1787, who declared that the intention was "not for the purpose of collecting rare plants as things of curiosity... but for establishing a stock for disseminating such articles as may prove beneficial... and which ultimately may tend to the extension of the national commerce and riches" (Heywood, 1983).

⁷⁶ *Economic botany* is defined as "the study of the identification, properties, uses, and distribution of economic plants... [which are] those plants utilized either directly or indirectly for the benefit of Man" (Wickens, 1990, p. 14).

Furley Fyson (1877-1947). Incidentally, Fyson corresponded with Gombert (c. 1906) and sought the latter's help in identifying plant specimens of the region (Matthew, 1999b, p. 132). On the other hand, the Jesuits consulted officers at the Calcutta Gardens and the Kew Gardens to identify the flora they collected. So the Jesuit amateurs corresponded often with the botanists employed by the British regime. Understandably though, these Jesuits did not pursue botanical research in a "professional" manner as they were primarily involved in the formation of the Jesuit novices and scholastics. Further, archival records at Shembaganur show that proceeds from duplicate specimens sold to Kew were used for "non-scientific" purposes – such as the construction of a local church. Hence, botanical research served diverse purposes for the Jesuits (Matthew, 1988b, p. 251).

Like other Indian botanists of that time, the Jesuits at SHC were indifferent to the imperialism that drove colonial botany.⁷⁷ For all purposes, the Jesuit pursuit of economic botany was not very different from other botanists' engagement with economic botany. The Jesuits learned all they could from the British experiments to plant exotic species in their colonies, and later introduced exotic species like eucalyptus and cinchona on a large scale in SHC to drain the marshy soil around the campus (Le Guen, 1945, p. 30).

Meanwhile, Jesuits from other parts of Europe also pursued botany at other missionary stations in colonial India. The Spanish Jesuit Hermegild Santapau (1903-1970) was trained in botany, had worked for two years at Kew and taught botany at St. Xavier's College in Bombay. Santapau came to be recognized as one of the leading botanists in British India. He published widely in the *Journal of Bombay Natural History Society* and became one of its editors in 1948. After the Botanical Survey of India (BSI) was reorganized in 1952, Santapau became its Chief Botanist in 1954 (Bole, 1970). It was around this time (in 1950) that KM Matthew graduated in botany from St. Joseph's, Trichy and joined the Jesuits as a novice at Shembaganur.

When Matthew joined SHC, Anglade had already retired from active teaching. But other Jesuit professors continued to engage with and teach the natural sciences to the young Jesuits-in-training. One of them was Emile Ugarte (1903-1990) who organized the anthropological

⁷⁷ The Jesuits' response to the call for Indian self-rule was complicated. While most Jesuits remained disinterested in the Indian nationalist movement, some Jesuit missionaries were vocally supportive of the right of Indians to rule India. For a nuanced account of Indian Catholics' response to Indian nationalism, see (John, 2011).

and natural history collections at SHC. Matthew assisted Ugarte in preparing a 203-page inventory of the plant collections (Ugarte, 1963). Meanwhile, the Jesuits of the Madura Mission were keen on improving the quality of research and teaching in their colleges. Efforts were also underway to upgrade the botany department at St. Joseph's in Trichy (Matthew, 1988b, pp. 261–262). Matthew was perhaps considered a potential professor in botany by his superiors. So after he completed his regency training (see Section 3.7 for an overview of Jesuit formation) Matthew was sent to pursue M. Sc. (Botany) at St. Joseph's College in 1957 (Matthew, 1998b, p. 25).

After India became an independent nation, the native Indian Government continued to post a liaison officer at Kew, since it was considered that “the benefit that Indian Botany would derive by this arrangement is considerable” (Gupta, 1959, p. 18). Such “arrangements” were useful in endeavours such as the publication of the encyclopaedic *Wealth of India*. This series was published between 1948-1976 to document the “economically important Raw Materials as well as the Industrial Products of India” by “drawing out an elaborate list of useful plants, animals and minerals occurring in this country... in consultation with the Royal Botanic Gardens, Kew, England, the Botanical Survey of India and other authoritative institutions” (Ramachandran, 1997). So when Matthew resumed his botanical studies in 1958, he (like other Indian botanists of his time) continued to engage with colonial/economic botany. For instance, Matthew's first peer-reviewed journal article provided an enumeration and distribution of the vegetation on the slopes of Kodaikanal hills. In what follows, Matthew's description of his work sheds light on his bias towards economic botany:

“Such data (abundance and distribution of the plant) I consider of importance, particularly when it is a question of plants that may have some *economic importance* [emphasis added], medicinal or otherwise; this detailed information may materially reduce expenses, should it become necessary at any later time to collect the plant for *commercial exploitation* [emphasis added]” (Matthew, 1959, p. 387).

On completion of his M.Sc., Matthew began his doctoral research at St. Xavier's College in Bombay under the guidance of Santapau, who by then had become Director of BSI. Matthew chose as his doctoral subject the *Exotic Flora of Kodaikanal* – not surprising since he had spent nearly a decade studying the vegetation of the region. As noted earlier, Indian botany

was still in the shadow of its colonial legacy. Hence, Matthew mentioned in his doctoral thesis:

“Great tribute is due to the efforts of the European settlers who have made Kodaikanal the beautiful place it is by introducing so many species from different parts of the world. The only criticism is in the case of the Wattle tree, which has displaced large tracts of the indigenous vegetation and at the present rate, will nearly exterminate it in a few decades” (Matthew, 1969, p. 6).

We note above that Matthew credits the Europeans with making Kodaikanal “beautiful”. He also observed that among the places “where the exotic species are particularly noticeable... the Campus of Sacred Heart College, Shembaganur, has the maximum number of species” (Matthew, 1969, p. 6). But he also observes that one exotic species – the Wattle – had displaced and was likely to exterminate other indigenous species. Much later, Matthew would describe the disastrous consequences of exotic species on indigenous vegetation (as we would see later in this chapter). During his doctoral studies however, he conformed to the prevailing trends in economic botany.

Matthew completed his doctoral research in only two years. In 1962, he proceeded to St. Mary’s College at Kurseong (in the northern part of India) for his theological studies. Housed within the Darjeeling Hills, Kurseong was another “botanist’s paradise” and Matthew continued his taxonomic research (Matthew, 1998b, p. 25). He published a study of vegetation in the region, to understand “their abundance, distribution and possibility of *commercial exploitation* [emphasis added]”, yet again reinforcing his preference for economic botany then (Matthew, 1966, p. 158). After Matthew was ordained as a Jesuit priest in 1967 he was asked to join as a staff member of the botany department at St. Joseph’s College.

6.4.2 Post-doctoral research and the Rapinat Herbarium 1968-74

Soon after joining St. Joseph’s College, Matthew re-organized its plant collections and established the Rapinat Herbarium⁷⁸ in honour of the pioneer of botanical studies at the college (“News and Notes,” 1974, p. 887). During those days, Indian botany witnessed a

⁷⁸ A herbarium is “a collection of preserved plants stored, catalogued and arranged systematically for study by both professional taxonomists (scientists who name and identify plants), botanists and amateurs” (Royal Botanic Garden Edinburgh, n.d.).

growing rift between those involved in classical botany and those exploring the modern methods in botanical research. Plant taxonomy, the classical science of identifying, describing and classifying plants, was considered by some to be a “dead subject” (Subramanayam & Nayar, 1971). Teachers and students alike shunned the subject because they believed that career prospects were limited in the field of plant taxonomy. While plant taxonomists advocated the usefulness of their discipline, the emergence of “modern” subjects such as cytology, bio-systematics and molecular biology seemed to suggest that “the days of the ‘herbarium botanists’ are over” (Subramanyam & Sreemadhavan, 1970, p. 210). In St. Joseph’s College too, Matthew’s enthusiasm for plant taxonomy was not shared by his departmental colleagues. His Jesuit peers also had second thoughts about the utility of taxonomical research at St. Joseph’s (Matthew, 1992, p. vi). However, the Jesuit Provincial Douglas Gordon encouraged Matthew to re-orient his priorities, explore other opportunities in taxonomy and permitted him to continue his post-doctoral research abroad (Matthew, 1998b, p. 25).

From 1971 to 1974, Matthew conducted taxonomic research with experts at the Kew Gardens in the UK and the Rijksherbarium in the Netherlands, gaining a Master’s in Advanced Plant Taxonomy from Kew in the process. He was also awarded a fellowship by the Dutch Government. In the Netherlands, he collaborated in the publication of a monograph becoming the only Indian contributor to the collection (Matthew, 1974, 1976). His accomplishments got him nominated for membership to the Linnean Society in 1972 (“Proceedings Of The Linnean Society Of London 1971-72,” 1972, p. 327). More importantly, he was able to return to St. Joseph’s College with additional qualifications and a creative agenda to make plant taxonomy relevant for the needs of the students as well as that of the country.

Matthew returned to St. Joseph’s College in 1974 with laboratory tools, publications and scientific journals - all of which occupied 23 crates (Matthew, 1998b, p. 26). He registered the herbarium with the International Association of Plant Taxonomy (IAPT), which assigned the acronym ‘RHT’ to Rapinat Herbarium Trichy. By making RHT a globally recognized entity with autonomy, he was able to work independent of the botany department (staying clear of his dissenting colleagues). He outlined two objectives for promoting taxonomy at RHT:

“1) Teaching—to incorporate modern developments in taxonomy into the graduate and postgraduate curricula; 2) Research—to prepare a modern regional flora for the area. The latter, besides providing a badly needed handbook for general use and for training taxonomists, will help to identify regional taxonomic problems and thereby prepare the way for monographic work so urgently needed in Indian botany today” (“News and Notes,” 1974, p. 887).

The objectives he outlined for RHT would become relevant for the coming changes in Indian botany, thanks to the rise of the environmentalist movement in the country.

6.4.3 Rise of environmentalism in India

During the 1960s, the publication of Rachel Carson’s *Silent Spring* (1962/2012) triggered widespread public concern regarding the destruction of the environment. A plurality of voices, local and global, began to converge towards developing an “environmental agenda”. In 1972, the United Nations organized the first international conference on the human environment at Stockholm, Sweden. Then Prime Minister of India, Indira Gandhi attended the Stockholm Conference, declaring that the Indian government was committed to protecting the environment but that the first priority was on improving the conditions of the Indian people (Ravi Rajan, 2014). After the Stockholm Conference, Indira Gandhi established a National Committee on Environmental Planning and Coordination (NCEPC). In 1976, the Constitution of India was amended to declare that: “The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country” (as cited in Dwivedi, 1997).

Besides the beginning of an environmental policy in India the 1970s also saw ordinary citizens demanding government action on environmental issues for the first time. The Chipko *Andolan* (Movement) and the Silent Valley Movement drew the participation of not only the affected rural masses but also urban scientists (Guha, 2000; Isaac et al., 1997). Scientists began to explore alternative science and people’s science movements, as we noted in Section 5.4 . Eminent botanists like Janaki Ammal played a part in the Government’s decision to shelve the Silent Valley Hydroelectric Project (Damodaran, 2013, p. 300). Other botanists articulated the role for plant taxonomists and conservations to work together for environmental conservation (Subramanayam & Nayar, 1971, p. 149).

It is not clear how and when Matthew became influenced by the environmentalist movement in India. But it is likely that he was aware of significant changes in the environment at Kodaikanal during his doctoral research. For instance, Matthew noted in 1965, that “(exotic) plants became so well naturalized and spread that at present some of the exotic species are among the most prominent members of the vegetation” (Matthew, 1965, p. 56). Later in 1970, Matthew published an article on the flowering patterns of a group of shrubs found on the Palni Hills—the *Strobilanthes kunthianus*. Popularly known in Tamil (the regional language) as *kurinji malar* or “flower of the hills”, *Strobilanthes* refers to an endemic group of shrubs that was observed to flower profusely at regular intervals of three to 14 years. The flowers of these shrubs were mentioned in Tamil literary classics. Members of the local tribes used to recall milestones in their lives based on the flowering they had witnessed during those milestones. This was because the *kurinji* variety that was endemic to the Palni Hills, was observed to bloom copiously only once in twelve years. While they did attract the attention of the early colonial explorers these flowers were considered an obstacle to the forestry schemes of the British and were systematically eradicated. Matthew had first observed their flowering in 1958 as a Jesuit scholastic and later in 1970 after he was ordained. In his article, Matthew recorded some significant changes over the period from 1958 to 1970:

“Formerly when large tracts of land were covered by this plant, the years of flowering attracted numerous swarms of honey bees... The season of dispersal of seeds was reported to have caused mass migration of jungle fowls from the foothills on the Nilgiris. These, however, are a memory of the past, with the area under the plant fast diminishing owing to denudation of virgin land for cultivation. *The flowering of 1958, and more so that of 1970, was conspicuous for the absence of such visitors* [emphasis added]” (Matthew, 1970, p. 503).

To be sure, the above observation was only a passing reference in Matthew’s article. He was more concerned about identifying the ecological and physiological factors that triggered the long intervals in plant flowering. But he did conclude that human activity (such as clearing lands for cultivation) had triggered the changes in flowering patterns of the *Strobilanth*, which in turn led to decrease in the populations of honey bees and jungle fowls in the region. This was perhaps Matthew’s first recorded experience of the effects of human activity on the flora of the Palni Hills. Later in 1975, Matthew along with his Jesuit protégé S Ignacimuthu and another researcher EF Blasco, documented the changes in the ecology of Kodaikanal

from 1950 to 1974. They reported that indiscriminate exploitation of the Palni hills had led to devastating results for Kodaikanal's environment (Matthew et al., 1975).

Matthew's environmental outlook could possibly have also been shaped during his stay at Kew. His fellowship at Kew coincided with the period when the International Union for Conservation of Nature and Natural Resources (IUCN) set up a Threatened Plants Committee (TPC) at Kew (see, Lucas & Synge, 1977). The overall orientation at Kew was gradually drifting away from economic botany to plant taxonomy and the focus of many botanists was shifting towards environmentalism. This was revealed in Matthew's research interests too as he began to update the regional Flora. His ambitious floristic projects were to become turning points with far-reaching consequences for the Jesuits and for botany in the region.

6.4.4 Floristic explorations and emerging environmentalism 1975-84

When Matthew returned to India in 1974 it was already six decades since Fyson published his *Flora of the Nilgiri and Pulney Hill- Tops* (1915). The other regional flora—Gamble and Fischer's *Flora of Presidency of Madras* (1915)—was also published before Indian independence. Besides being outdated, Matthew found other shortcomings in these Flora:

“The two provincial Floras [Fyson's as well as Gamble and Fischer's] were based on scanty collections from the region and therefore inadequate. Gamble's work was done at Kew with relatively few collections, and covered an unwieldy and heterogeneous area... Besides, the descriptions are inadequate, keys unsatisfactory, scientific names outdated, vernacular names seldom given, and data on habitat, distribution, flowering and fruiting scanty” (Matthew, 1978).

After independence, the BSI had only reprinted the colonial Flora but was yet to begin updating those works (Gupta, 1959, p. 25). Matthew decided that updating the regional Flora would be the first major floristic project for RHT. While his long-term plan was to cover the entire state of Tamil Nadu he began by choosing a smaller geographical area – which he termed the *Carnatic* region of Tamil Nadu. Even then, this was an ambitious project for an autonomous, non-governmental research body. “The significance of this choice”, Matthew described, “lies in that the area is small enough to be exhaustively explored by a private foundation in about six years and large enough to be a phytogeographical unit” (Matthew, 1978).

Besides being a pioneering floristic project by a private academic organization in independent India, Matthew saw the project as an opportunity to make botany relevant for teaching and to improve the employability of botany graduates. He also considered the project to be an opportunity to improve collaborations with the government and with botanical agencies in India (Matthew, 1977). Other botanists had also emphasized the value of collaboration between government agencies and educational institutions (Subramanyam & Sreemadhavan, 1970).

In 1975, Matthew launched the *Flora of Tamilnadu Carnatic* project with initial funding from the University Grants Commission (Matthew, 1977, p. 196). Around the same time, Matthew began to observe the social aspects of botanical research, for instance, the tribal lifestyles in the region. He wrote about the “the intimate knowledge of plants possessed by the Malaiyalees (‘hill men’)” (Matthew, 1975, p. 329). For the first time perhaps, Matthew employed these local inhabitants as field assistants for his explorations and acknowledged them in his publications. His changing priorities in taxonomic research became prominent with the publication of the first volume of the Carnatic Flora in 1981. Matthew listed several priorities for botanical research: “food, conservation, forestry, afforestation, plant exploration, ethnobotany, plant phylogeny and geography” (Matthew, 1981, p. v). This set of priorities suggested that Matthew’s focus was shifting away from economic botany towards environmental conservation.

As work on the Carnatic Flora project continued, the team at RHT expanded to include several draftsmen and women, field assistants, supporting staff and research scholars.⁷⁹ While Matthew and his team became busy with the project in the late 1970s India went through a period of political turmoil and governments were overthrown. Indira Gandhi returned as Prime Minister in 1980 and set up the new Department of Environment with the Botanical Survey of India being brought under the authority of this new department. In 1985, a new Ministry of Environment and Forests was created by Indira Gandhi’s successor (and son), Prime Minister Rajiv Gandhi (Dwivedi, 1997).

⁷⁹ Matthew (1983a) included individual pictures of his team members with a brief statement of each member’s contribution to the Flora.

Besides the changes in the Indian polity, the Jesuits were also revising their governance structure and missionary focus in India. As we noted in Section 5.3 Jesuits worldwide renewed their evangelical mission in 1975 to be “the service of faith, of which the promotion of justice is an absolute requirement”. This missionary re-orientation required the Indian Jesuits to “integrate” their missionary and apostolic activities into the context of “the problems and struggles of the people” (Jesuit Conference of India [JCI], 1978). An effect of this directive was the decision to move the Jesuit formation houses to the cities rather than remain isolated in the hills. Subsequently, the Sacred Heart College was shifted from Shembaganur to Madras (now Chennai) in 1980. With the scholastics moving to Madras the Shembaganur campus with its vast infrastructure lay vacant with only a few priests remaining to maintain the campus. Meanwhile, the natural history museum organized by Ugarte and others had by now become a tourist attraction. There was also the risk that the campus could be sold off or be procured by public authorities (Jerry Rosario, personal communication, April 3, 2020). At this point, Matthew suggested to his Jesuit peers that part of the Shembaganur campus could be used as a field station of the Rapinat Herbarium (Matthew, 1988b, p. 256).

The RHT team had in fact used the Shembaganur campus as a field site to collect specimens for the Carnatic Flora project. Matthew considered this as an opportunity to use his research project to also preserve the Jesuit heritage in Kodaikanal. The suggestion received the green light from his Jesuit superiors. In 1981, the Anglade Institute of Natural History (AINH) was established at Shembaganur (Matthew, 1988b, p. 256). This would later become the hotspot of Matthew’s research and advocacy for environmental action (as we will see in the next section).

In 1982, the second volume of the *Flora of Tamilnadu Carnatic* was released. In the introduction to this volume, Matthew described his intention that the Flora be used not only by botanists but also any interested layperson. He wrote:

“[The Flora should] help the interested user to get acquainted with the entire range of flowering plant diversity in the tract. Environmental education, and particularly the *dissemination of the conservational message* [emphasis in original] requires general recognition of plants even by non-specialists” (Matthew, 1982, pp. v–vi).

The second volume was an index of illustrations of plants in the region. To bolster the use of Flora by laypersons, Matthew included the vernacular (Tamil) names of the plants. The third volume was published in 1983 and saw the further sharpening of Matthew's environmentalism through the inclusion of a separate chapter on environmental conservation. He indicated that conservation required an "integral understanding" of all fauna and flora, rather than just "certain well-advertised species of animals only". Using data from his study, Matthew showed that commonly sighted floral species were now difficult to sight. He wrote:

"...species like *Campanula fulgens* Wallich, *Exacum perrottetii* Griseb. and *Satyrium nepalense* D. Don among several others have not been collected for decades, or *Lilium neilgherrense* Wight collected but once during the period of the project... can be explained only by large scale disturbance, even destruction, of the natural habitats" (Matthew, 1983b, p. 106).

In addition to pointing out the species under threat, Matthew argued that conservation would be ineffective unless the daily needs of local inhabitants (living in protected areas) were satisfied. He declared:

"It is idle to speak of conservation of forests until the local people are provided with alternate fuel and fodder. As for fuel, the local people have traditionally depended on the forests for their needs. This did not pose any serious conservational problem till now, but with the explosion of population on the one hand and the decimation of forests, on the other, there is a real environmental crisis" (Matthew, 1983b, p. 105).

Matthew's views echo that of his contemporary, Anil Agrawal (1947-2002) who founded the Centre for Science and Environment (CSE) in 1980. Agrawal had also suggested that conservation of wildlife was directly linked to the preservation of traditional biomass-based rural economies (Dickson, 2002). Matthew would later incorporate these ideas in his efforts to promote environmentalism.

The *Flora of Tamilnadu Carnatic* became a milestone in regional Floras and received favourable reviews from international botanists. Significantly, Matthew's team had already published three volumes of the regional flora even before the Botanical Survey of India published the first volume of the *Flora of Tamil Nadu* in 1983. This success was to be

followed with a second 3-volume compilation in 1999 – *The Flora of Palni Hills*. This distinct achievement covering almost the whole state of Tamil Nadu was acknowledged in the *Guide to Standard Floras of the World*:

“Key contributors since 1947 have been the Botanical Survey of India, which assumed direct control of the Madras Herbarium in 1955 and established there its Southern Circle (BSI-SC), and Fr. K. M. Matthew at St. Joseph’s College in Tiruchirapalli and what had been the Sacred Heart College in Shembaganur in the Palni Hills. The BSI-SC has published an enumeration of the state flora, while Fr. Matthew has continued in the tradition of earlier writers with his series on the flora of the Tamilnadu Carnatic (covering approximately the central third of the state and including the Shevaroyes). Both his works, particularly the recent Excursion flora, will be generally useful in the Tamil Nadu lowlands and lower hills” (Frodin, 2001, p. 754).

That Matthew and his small team of professionals in a private, autonomous organization were able to accomplish as much as a government agency was noted by other botanists like Radcliffe-Smith who observed:

“The rapid production of the Flora... demonstrates what is possible when someone with the knowledge, ability, energy, drive and enthusiasm of Fr Matthew, ably supported by a capable and well-trained research team, grasps the nettle and single-mindedly reaches for the goal which might to others be deemed unattainable” (Radcliffe-Smith, 1985).

By the time the third volume of the *Flora of the Tamilnadu Carnatic* was published, Matthew was now keen on promoting the conservation of the Palni Hills. He became one of several individuals who were concerned about environmental degradation in the region; the others included retired civil servants, environmental activists, educationists, philanthropists and other volunteers. They came together in 1985 to form the Palni Hills Conservation Council (PHCC) of which Matthew was the Founder Vice-President (Viraraghavan, 1986). PHCC would become a key collaborator in the environmental programme at AINH, contributing to the shaping of RHT and AINH as a boundary organization engaged in environmental conservation.

6.5 The evolution of RHT-AINH as a boundary organization 1984-2004

With the establishment of a separate Department of Environment in 1980 it appeared that India would soon bring environmental considerations within the purview of national development. The Department initiated a series of discussions on promoting environmental education and organized an international conference on the topic at New Delhi in 1981 (Misra, 1982). The Department also began to fund environmental awareness programs and seminars (Mathew, 1982).

In 1984, gross negligence at a multi-national industrial corporation led to an environmental catastrophe in Bhopal, leaving thousands dead and thousands more affected for generations (Narain et al., 2014). This disaster led environmentalists to wonder if the Government's response to environmental needs had degenerated into bureaucratic paperwork without enough accomplishments in reality. Among others, Matthew also expressed the worry that Kodaikanal could become another Bhopal if industries in the region were left unmonitored (see, Nath, 2001). The environmentalist in Matthew began to evolve significantly around this time. His concerns for the declining flora in Tamil Nadu, the dwindling numbers of taxonomists and the decimation of the environment by unrestrained industrialization motivated Matthew to think beyond floristic research projects.

Taking advantage of the government scheme to fund environmental awareness programs, he launched a 3-day program for school and college students in 1984 (Matthew, 1986). Matthew may not have conceived of this program as a boundary object but it did eventually cater to the needs of multiple “social worlds”, such as: (1) the Jesuit community which now had a reason to continue maintaining the Shembaganur campus; (2) the Government of India which was keen to support environmental awareness programs for students and the public; and (3) the general public which now had an emerging responsibility towards the environment. Matthew envisioned the program as part of a larger agenda to bridge the gap between his floristic research projects and service to society—what he referred to as the “lab-to-land” vision. Eventually, this “lab-to-land” approach of RHT-AINH led to the development of an integrated programme with multiple components (Matthew, 2003).

When the program was launched in 1984, participants were screened on a “first come first served basis” as participation was free; participants only had to pay for their travel to Shembaganur. A group generally consisted of 45 to 60 participants. Project assistants (usually

research scholars from RHT) were the trainers for the student program. The 3-day program extended from Monday to Wednesday or Thursday to Sunday, with groups coming in almost throughout the year. The first year alone saw over a thousand students and a hundred teachers participating in the program (Matthew, 1986). In 1986, the newly established Ministry of Environment and Forests initiated a National Environmental Awareness Campaign (NEAC) “with the objective of creating environmental awareness at all levels” (Ministry of Environment and Forests [MoEF], 1987, p. 64). The ministry encouraged proposals from educational institutions as well as civil society organizations. Having proved its efficiency in previous programs, RHT-AINH succeeded in receiving additional funds under NEAC.

On the first day of a typical 3-day program, the trainers introduced participants to environmentalism by situating Indian concerns in a global context. For this, Matthew used ideas from the *World Conservation Strategy* report of the International Union for Conservation of Nature and Natural Resources [IUCN] (1980) and CSE’s *State of India’s Environment* (1982). So the program was built upon existing research on environmental action, both global and local. The emphasis of the program was on exposing the participants to the impact of human activity on the environment. Having introduced participants to concepts and data on environmental hazards they were taken to key sites in Kodaikanal for exposure on the second day. This included excursions to predetermined places as Matthew describes:

“...the plateau of Kodaikanal, where some remnants of the primary vegetation of the Western Ghats still exist... [this] alerts the trainees to the large scale destruction that has taken place during recent decades through commercial plantations, agriculture, and other forms of human pressure... [a] second halt serves to introduce the students to commercial plantations (of wattle, eucalyptus, pines, etc.) which constitute perhaps the biggest threat to the indigenous vegetation of the area” (Matthew, 1986, pp. 351–352).

As we can observe, the field trips were largely based on Matthew’s botanical pursuits in the previous several decades. Based on the data available with him, Matthew was able to demonstrate to the participants that human activity had indeed resulted in the loss of several indigenous plant species. He also did not shy from arguing that environmental destruction was mostly a result of human impact. Matthew’s environmentalism was thus informed by his botanical research.

Matthew appears to have believed that environmental conservation was possible only by an appropriately informed and proactive public. He declared that “care for the environment... can be achieved by motivating today’s youth, and not by legislation of which there is enough already” (Matthew, 1986, p. 351). He also wrote that “unless enlightened public opinion becomes active in the manner of the Green Party in Europe, the rest of the Shola [that is, the regional forests] could be decimated and shortly turn barren” (Matthew, 1986, p. 352). Such strong views seemed to suggest that Matthew was fast turning into an activist though he never called himself one. He began referring to himself as a “botanist-environmentalist” and his activities became (slightly) political in the later 1980s, especially in his collaboration with members of PHCC.

Matthew was among the first to suggest that PHCC should assess mercury content of water streams in Kodaikanal to verify if industrial pollution was a reality (see, Whitaker, 1990; Hiddleston, 2010). Besides imparting the environment awareness program, RHT-AINH also assisted in regenerating the regional ecosystem in collaboration with other environmentalists. On the other hand, PHCC members used the *Flora of Palni Hills* to identify endangered species and implement projects to restore those species (Stewart & Balcar, 2003). The Shembaganur campus of AINH also served as the pilot grounds for testing a sewage water treatment project. The plant was installed on the campus by PHCC members while the maintenance and operation were done by project assistants of AINH (Jeyakaran & Charles, 1994). As a result, the activities of RHT-AINH began to expand beyond botanical research and into environmental conservation.

The 3-day program did not remain static either. Matthew continuously updated the program by incorporating lessons learnt from the collaboration with PHCC. For instance, trips to new field sites were included on day two of the program so as to expose the participants to how drinking water was contaminated by tourists, local inhabitants as well as by the industry. On the third day, participants were encouraged to provide feedback on their experience and to develop a potential “action plan” to protect the environment.

Customized programs of different durations were also offered to other groups of stakeholders. For example, a 5-day program was offered for those engaged in environmental research and advocacy with inputs provided by members of PHCC. Additionally, a programme geared

towards villagers was also offered with inputs from faculty from the Gandhigram Rural University in Salem (Tamil Nadu). The program for villagers was oriented to suggest livelihood options for the villagers that did not adversely affect the environment (Kandasamy, 1994). This was also possible through collaboration with other local NGOs that promoted conservation oriented livelihood schemes. For example, AINH worked with an organization called VOYCE (Vattakanal Organization for Youth Community and Environment) to help cultivate the wattle trees (considered as weeds) as fences and use them for firewood instead of using endangered trees from the forests (Stewart & Balcar, 2003, p. 124).⁸⁰ Simultaneously, scholars from RHT-AINH identified species of endangered plants for conservation on a priority basis and achieved some success in *ex situ* conservation (Matthew, 1999a).

Matthew's work was recognized by the Government of Tamil Nadu in 1989 when he was awarded its award for best teacher. The State Government also began to consult him on floristic projects rather than approach BSI, the nodal agency for botanical research. He was invited to author the section on the flora of Trichy district in the official Gazetteer of the district (Matthew, 1998a). That a small independent organization was approached by a government agency instead of approaching BSI was further testimony to the accomplishments of RHT-AINH.

RHT-AINH had slowly shaped itself as a boundary organization straddling botanical research and environmental policy. As a result, the organization was now accountable to multiple stakeholders with diverse expectations. These presented competing demands upon RHT-AINH and created different sets of tensions with implications for its research and environmental action. This was further complicated because the organization was, for all practical purposes, a department within St. Joseph's College. In the next section, we explore the different stakeholders and the resulting boundary tensions.

6.5.1 RHT-AINH and management tensions at the boundaries

In previous sections, I described the historical origins of RHT-AINH and its many activities. In this section, I suggest that RHT-AINH represents a boundary organization because its goal of doing research that served "the needs of the people" required the organization to

⁸⁰ As we noted in Section 6.4.1, Matthew (1969) had earlier recorded that exotic species like wattle were fast replacing native species of plants. His observations helped organizations like VOYCE to preserve the native species.

collaborate with multiple stakeholders. RHT-AINH also satisfies one important criteria of a boundary organization—it created several boundary objects to fulfil the demands of its stakeholders, while also achieving its own goals.

In what follows, I describe the demands of the key stakeholders who influenced the activities of RHT-AINH. Secondly, I describe the boundary management tensions that emerged from these demands. Finally, I detail strategies adopted by Matthew in managing those tensions and meeting the stakeholders’ competing demands.

(a) *The stakeholders*

I follow Parker and Crona’s (2012) approach in using the stakeholder perspective to analyze the relations between an academically oriented boundary organization and its multiple constituents. This perspective also offers a “way to determine each stakeholder’s ability to influence boundary organization activities” (J. Parker & Crona, 2012, p. 265). Parker and Crona used the *stakeholder salience* model of Mitchell et al. (1997) to identify different stakeholders, characterize them and describe their influence on a boundary organization. *Stakeholder salience* provides a way to identify the degree to which each stakeholder’s agenda is prioritized over another. This degree is measured on the basis of the extent to which each stakeholder is seen as powerful (the stakeholder is able to impose its will), legitimate (the stakeholder’s agenda is desirable within a socially constructed system) and urgent (when the relationship with the stakeholder is time-sensitive). The stakeholder salience is considered *low* if only one of the above three attributes is considered relevant, *moderate* if two attributes are thought to exist and *high* if all three are present.⁸¹ Based on this brief outline, I determine the salience of five stakeholders who influenced the activities of RHT-AINH. This is summarized in **Table 6-2**.

(i) *The Jesuit community:*

As an ordained priest of the Catholic Church and a professed member of the Society of Jesus, Matthew was bound by the rules of the Society of Jesus. He was expected to comply with the authority of his superiors, beginning with the Superior General in Rome, followed by the Provincial of the province he belonged to (Madurai Province) and the superior of the local Jesuit community at St. Joseph’s College. In practice, this implied that Matthew could start

⁸¹ Mitchell et al. (1997) also describe different *classes* of stakeholders. I find the construct of stakeholder salience sufficient for the purposes of this chapter and so do not describe a class for each of RHT-AINH’s stakeholders.

and execute a new “apostolic venture” (meaning a specific missionary activity) only with the approval of his superiors (Jesuit Madurai Province, 1982, p. 10). As seen earlier, his Provincial permitted him to pursue post-doctoral research and to use the Shembaganur campus for his environmental awareness program. But, Matthew was expected to submit activity reports, financial audits statements, and also secure permission for travels (Jesuit Madurai Province, 1982, pp. 9–11). Significantly, Matthew had to explain to his superiors that his botanical-environmental activities did indeed fulfil the missionary priorities of the Society of Jesus. In addition, the Rector and Principal of St. Joseph’s College had to be satisfied that RHT-AINH carried out work useful to the college. The Jesuit community thus had the power to re-orient Matthew’s work, within the legitimate norms of the Jesuit constitutions.⁸² Even though the demands of the Jesuits are time-bound, they are relatively non-urgent. The stakeholder salience of the Jesuit community can be identified as “moderate”.

(ii) The policy-making and funding community:

Matthew’s floristic studies and his environmental awareness program were made possible through grants provided by government agencies. In addition, these funds were made possible because of policy measures made by the Ministry of Environment and Forests in general. While Matthew did raise financial resources from other funding agencies and philanthropists (including the Jesuits in Rome), it was the government agencies that enabled access to reserved forests, permission to work at the state herbaria and use relevant information available in government offices. In addition, Matthew was expected to deliver research outputs on time. On the other hand, high-quality and timely delivery of outputs by RHT-AINH were rewarded with further financial assistance.⁸³ Thus, the salience of the policy-making and funding community is “high”.

(iii) The botanist community:

⁸² As part of what could be called a review of individual Jesuits’ performance, the Provincial visits the Jesuits in his province once every year. This *annual visitation* is meant to “examine, evaluate and if necessary reform the religious life and apostolic activities of communities and works”. The Provincial also has the authority to stop an individual Jesuit’s apostolic venture (if it is felt necessary to do so) and the Jesuit is expected to obey the Provincial’s decision (Kolvenbach, 2003, p. 32).

⁸³ For instance, the Department of Science and Technology (Government of India) initially funded the Carnatic Flora project from 1978 to 1982 but later provided an extension for an additional year and a half. This extension helped RHT-AINH release the third volume of the Flora (Matthew, 1982, p. x).

Botanists, both national and international, collaborated with RHT-AINH by providing assistance and access to research networks.⁸⁴ Matthew notes the assistance received from “over 50 international botanists from nearly every part of the world” (Matthew, 1983a, p. xxxv). The botanical community also provided legitimacy to RHT-AINH’s work by reviewing and publicizing the Flora. Regional and international journals provided adequate descriptions of the Rapinat Herbarium and the Anglade Institute, providing global coverage of the organization’s ongoing work and outputs. The *Flora of Tamilnadu Carnatic* and the *Flora of Palni Hills* were mentioned in standard compilations of flora, and thus provided timely recognition. The botanist community also collaborated in a timely manner and hence, the salience of the botanist community is “high”.

(iv) The environmentalist community:

These stakeholders are distinct from the botanists, though some botanists could also be environmentalists. RHT-AINH’s environmental awareness program gained legitimacy because the environmentalists provided multi-disciplinary inputs to participants. This made the program relevant to different groups of participants, with varying levels of literacy and exposure to environmental issues. While these environmentalists did not have the power to influence or impede the organization’s activities, they depended on RHT-AINH to engage and act on local environmental issues in a timely manner. Therefore, the salience of the environmentalist community is “moderate”.

(v) The general public

In many ways, Matthew envisioned the activities of RHT-AINH to fulfil the needs of the general public. He made the Flora accessible to the layperson and developed the environmental program with a view towards informing the youth primarily, and then the villagers, women and others. The purpose of making the public aware of the environment and how they could conserve the natural vegetation gains legitimacy if we consider the environmental needs of the land. Due to the high rate of destruction of the environment, particularly around Kodaikanal, the need to create awareness became urgent as well. Even though the general public did not have direct power to allow or impede the activities of RHT-AINH, the salience is still “high” because the participation of the public was key to generating social impact.

⁸⁴ When Matthew’s team collected the plant specimens, the specimens had to be correctly identified/named by other botanists as a kind of peer review. So he had to consult other botanists from Indian and international herbaria.

Stakeholder type	Characteristics			Saliency Level
	Power	Legitimacy	Urgency	
The Jesuits	+	+	-	Moderate
Policy-makers/ Funders	+	+	+	High
Botanists	+	+	+	High
Environmentalists	-	+	+	Moderate
General public	+	+	+	High

Table 6-2: Stakeholder salience in the boundary work of RHT-AINH

(b) Tensions in boundary management

The demands of RHT-AINH's stakeholders competed in three different ways: (1) fundamental botanical research versus applied research; (2) the dilemmas related to the Jesuit humanistic legacy and the post-colonial needs of social justice; and (3) the demands of the academic system versus policy oriented education. These competing demands contributed to tensions in managing the activities of the boundary organization. Following the approach of Parker and Crona (2012), I outline each tension along with a few illustrative quotes.

(i) Fundamental versus applied research:

This had been one of the primary sources of tension in RHT-AINH's engagement with different stakeholders. On the one hand, the college administration could not appreciate the benefits of plant taxonomy as it was believed that taxonomy cannot help create job opportunities for botany graduates. As we saw in Section 6.4.2, the so-called "modern" botanists relegated herbaria and taxonomic studies to a bygone era. While funders and policy makers did encourage fundamental research as part of the larger environmental agenda, more funding was readily available to the applied and experimental sciences. Matthew was aware of these tensions and reasoned that botanists would need to be more creative in resolving these tensions. He wrote:

"If systematic botany has fallen on evil days... the botanists themselves are largely to blame... university botany has come to be emasculated, unrelated to life and employment and uncreative... systematic botany fared even worse... when people see that massive collections made over decades have not been used creatively, they cannot be accused of prejudice for asking searching questions" (Matthew, 1981, pp. v–vi).

Matthew was also concerned that very little funding was available to taxonomy, even though applied botanical sciences relied on plant taxonomy as an essential first step of any research investigation. He wrote that "fundamental work is not popular in a climate where research is

equated with sophisticated instruments and exotic conveniences” (Matthew, 1988a, p. v) and that “non-Governmental agencies receive only a trickle from the national research grants” (Matthew, 1988a, p. ix).

(ii) Social versus intellectual apostolate:

When Matthew began his teaching and research at St. Joseph’s College, the Jesuits of Madurai had begun to reorient their educational apostolate in the light of the social justice emphasis of GC 32. Matthew was perhaps concerned that research in Jesuit institutions was losing priority in the post-colonial, justice-oriented scheme of the Jesuit mission. He wrote that:

“...we have a very rich heritage... However, since Vatican II and the last two General Congregations, there has been a certain disenchantment with the ‘intellectual apostolate’... anti-intellectualism is dangerous to the Society (of Jesus) and to the Church...” (Matthew, 1988b, p. 263).

Matthew felt that the scientific contributions of the Jesuits were being de-valued in preference to the emerging missionary framework based on social justice. He therefore argued for autonomy to Jesuits in research. He wrote:

“Jesuits (in colleges) should do purposeful research, with complete autonomy, using the available men and resources... The availability of half a dozen Jesuit doctors in botany in the (Madurai) Province... is probably unique in the Society and is a challenge to produce proportionate results” (Matthew, 1988b, p. 262).

Matthew also felt that Jesuit superiors should encourage more Jesuits to get involved in research so that they could contribute to environmental awareness and conservation. He was aggrieved that Jesuits with a proven record in “purposeful research” were not provided resources for their work. On the other hand, Matthew’s advocacy of environmental education in the 1980s triggered some Jesuits to wonder if he was prioritizing environmental rights over human rights. Matthew was himself aware of this dilemma and acknowledged the criticism, saying:

“Ours is a pioneering project and therefore, we should be given the freedom to experiment... no conservation measure will work unless adequate fuel wood and fodder are made available to the villagers... We’ve to note that conservation is not opposed to development. Conservation that ignores the need to development will be ivory tower philosophy, and is bound to fail. So there should be a balance between these two which would be ‘sustainable utilisation of resources’” (as cited in Durairaj, 1987).

In other words, Matthew was not opposed to the social apostolate. He was only concerned that the social justice mandate of the Jesuits should not come about at the expense of the contributions of the Jesuits in science. He therefore tried to balance these tensions through various means, as we shall see shortly.

(iii) *“Ivory tower” orientation versus “purposeful” education:*

Matthew was of the opinion that environmental conservation would remain an academic subject if it was not mainstreamed in the education of the youth as well as in the training of government officials. He suggested that there was “little qualitative improvement since the monumental publications on Indian plants of the colonial days” (Matthew, 1995, p. v). The reasons for this, Matthew argued, was an “ivory tower” orientation among botanists which resulted in “Indian plant taxonomy... undergoing inbreeding, resulting in loss of vitality” (Matthew, 2000). On the other hand, he intended all research at RHT-AINH to be “purposeful”. He wrote:

“A team of overseas volunteers based on [sic] Auroville, Pondicherry, engaged in a local re-afforestation programme, purchased half-a-dozen sets of the *Flora* and has been habitually *using* [emphasis in original] them, there are entire ‘nature’ departments of the State Government, botany departments of Colleges including my own, and even Universities, that have not evinced any interest in the *Flora* in spite of complimentary copies adorning the book shelves...” (Matthew, 1988a, pp. v–vi).

Matthew felt that much academic research was conducted away from the needs of the people. He noted that:

“The root cause of these symptoms is the attitude to scientific research... the ivory tower, ‘five-star culture’ attitude altogether out of touch with the life situation of the people and from the genuine needs of the country” (Matthew, 1995, p. vi).

Matthew felt that the ground realities of the people could be understood better if academics worked together with government officials in responding to the conservation and livelihood needs of the people. He also emphasized that botanists should be oriented towards such requirements in their engagements with government officials, if the latter were expected to make any serious contribution to environmental conservation. Matthew wrote:

“...the urgency in imparting real *education* [emphasis in original] in conservation... should start with the concerned officers... serious in-service training after recruitment alone can equip the staff for any creative contribution... officers who have not caught the message of nature conservation can neither be expected to be deeply committed, much less able to transmit it to others” (Matthew, 1983b, pp. 104–105).

The above tensions outlined with illustrative quotes indicate the different demands which the stakeholders exerted on the boundary activities of RHT-AINH. In the following section, I describe some ways in which Matthew, along with his staff and collaborators, managed these tensions over time.

6.5.2 “Creative” ways of boundary management at RHT-AINH

Managing the tensions on the boundaries between botanical research, environmental conservation and Jesuit mission required Matthew to make strategic decisions regarding the organizational structure, its operations and the kind of collaborations it entered into. This required a dynamic process of negotiation with the various stakeholders. To aid in this process, Matthew developed a number of boundary objects which fulfilled the various stakeholder requirements. The flagship boundary object was the environmental awareness program which Matthew not only adapted for various participants but also used to coordinate mutually beneficial collaborations with the stakeholders. As Matthew insisted, RHT-AINH provided an illustration of the “creative” ways in which botanists could relate botany to the needs of the people and of the environment.

(i) Autonomous, organizational structure within the university:

Right from the start, Matthew visualized RHT not merely as an academic department but to be utilized for public engagement, especially to identify and respond to emerging needs of Indian botany. He was however aware that prevailing academic ethos did not encourage investments in plant taxonomy, either financially or by way of efforts by his departmental

colleagues. Matthew realized that he would be able to steer clear of organizational tensions if RHT became an autonomous entity with the provision to attract its own funds. He wrote:

“...autonomy (is) so vital in steering clear off the countless pitfalls in the quest for excellence in this country. The price I had to pay was that I had to find money all the time... Despite this, I am not prepared to part with autonomy!” (Matthew, 1992, pp. viii–ix)

The provincial of the Madurai Province cooperated with Matthew by providing the required autonomy for RHT to function as an independent entity within St. Joseph’s College. The entire herbarium was moved from the Botany department to a separate building housing the Natural History Museum, but the maintenance costs were still borne by the college. Matthew had to secure the funds for research at RHT on his own. Matthew explains that he did manage to achieve this without depending on the college administration:

“(a) while accepting ad-hoc funding for specific projects, I kept the establishment out of external dependence; (b) by building up an endowment to provide for routine expenses I ensured even domestic autonomy” (Matthew, 1998b, p. 28).

The endowment was built through personal honoraria and proceeds from sales of books, duplicate specimens, etc. Matthew was also entrepreneurial in identifying and securing funds from appropriate organizations, as he believed “that there is money around for good works” (Matthew, 1996, p. 37).

As a result of this independence in project financing, Matthew was also able to determine the criteria for staff recruitment, remuneration and terms of employment. It is worth recording that Matthew always acknowledged his staff – both technical and supporting – in all his publications. Significantly, he dedicated one of his books to the staff and elaborated why:

“Our formidable team (field, processing, draftsmen and technicians, all converging on the scientific) of over 100 persons in the past 15 years, whose team work has realized 75,000 fresh collections, deserves my unqualified appreciation. Their remuneration has been meagre within our shoe-string budget, yet their dedication has not only been total

but also enthusiastic. The least I can do is to dedicate this Manual to these truly magnanimous persons” (Matthew, 1992, p. ix).

Matthew was aware that “only persons with some idealism (to make a life, not merely a livelihood, especially of the consumerist brand) would chose to work” at RHT-AINH (Matthew, 1996, p. 36). As a result, Matthew said, he was able to provide a “climate of work” for the staff and a “culture of science prevailed” at RHT-AINH (Matthew, 1992, p. viii).

This organizational autonomy also helped Matthew establish appropriate collaborations with relevant stakeholders. Significantly, the local Jesuit community pitched in with timely loans when funds were hard to come by—even though the total share of these funds was “less than 10%” of all the funds received by RHT-AINH (Matthew, 1996, p. 37).

In summary, one of the most important decisions that Matthew made in managing the boundary tensions at RHT-AINH, was to seek financial and organizational autonomy. The organization was able to secure funding for its activities while also remaining accountable to two key stakeholders – the Jesuit administration and the policy-making/funding community.

(ii) Alliances for boundary objects

Organizational autonomy was one of the reasons for the successful and timely publication of two sets of regional Flora by RHT-AINH, which helped establish its credibility among botanists and funders. Importantly, the message of conservation was prominent in the publications. When Matthew launched the environmental awareness program in 1984, RHT-AINH’s sphere of influence further widened to include environmentalists and other civil society practitioners. As we noted in Section 6.4.4, Matthew himself helped found the Palni Hills Conservation Council (PHCC). Besides, with the expansion of organizational activities, opportunities for environmental action also increased and opened up additional channels for funding. These options enabled RHT-AINH to develop several boundary objects which satisfied the demands of the different constituents, as listed in **Table 6-3**.

The boundary objects in the form of services provided at RHT, Trichy were complemented by the services provided at the AINH, Shembaganur, as indicated in **Table 6-4**.

Services provided at RHT, Trichy			
S. No	Boundary object	Services provided	Stakeholder served
1	Flora of regional vegetation	Detailed reference for identifying, naming and planning for conservation/propagation and related research activities	Botanists, teachers, students and research organizations
2	Excursion flora	Handy reference for identifying plants	Hobbyists and general users
3	Students' Herbarium	Miniature herbarium as a public utility; shields the research herbarium species from inept handling by non-specialists	Students and teachers of botany
4	Economic botany museum	Display of economic plants	Non-specialists
5	Duplicate specimens	Specimens for international herbaria; ensures Indian flora are accounted for in monographs; ensures preservation of plant specimens at multiple herbaria; additional source of income to RHT	International herbaria, systematic botanists and RHT
6	Library	Wide catalogue of periodicals, books and reprints	Botanists and other researchers
7	Open days	Demonstrate research procedures of herbarium	Students of schools and colleges
8	M. Phil and Ph. D programmes	Research programs in sync with the goals of the organization	Research scholars, Botany department of college and RHT
9	Staff orientation programmes	Demonstration-cum-training to upgrade skills	Teachers of systematic botany
10	Consultancy	Assistance in naming plants, reviewing books, queries...	Multiple, including government agencies

Table 6-3: Boundary objects (services) at RHT

Services provided at AINH, Shembaganur			
S. No	Boundary object	Services provided	Stakeholder served
1	Research in systematic botany	Field site for research scholars	Research scholars of RHT and other institutions
2	Environmental research	Eco-restoration programmes: both in situ and ex situ	Environmentalists (PHCC)
3	Grassroots environmental programme	3-day programme for farmers and villagers on current needs and responsibilities in maintaining balance in peoples' needs and eco-restoration	Farmers, government agencies
4	Leadership environmental programme	5-day programme to provide broader context of environmental work and to meet/collaborate with workers from other organizations	Government officials, NGO leaders, government agencies
5	Students environmental programme	3-day awareness programme for (high-school) students on need for environmental conservation and planning	Students, government agencies

Table 6-4: Boundary objects (services) at AINH

The flagship boundary object was of course the environmental awareness program. As briefly described earlier, Matthew did include political reflections in the training program and informed participants about the effects of unregulated industrialisation and unrestricted deforestation. While Matthew argued against the “politicisation of science”, RHT-AINH’s alliance with PHCC eventually led the organization to engage in political action (Matthew, 1995, p. vi).⁸⁵

PHCC’s annual report of 2000-01 mentions Matthew’s warning that Kodaikanal may become a future Bhopal if the thermometer factory (owned and operated by Hindustan Lever Limited) was allowed to proceed unmonitored (Nath, 2001). Sure enough in 2001, PHCC along with Greenpeace discovered that the industry was selling mercury contaminated glass pieces to a local scrap dealer. The investigation prompted the Tamil Nadu authorities to shut down the company. RHT-AINH invited the same environmentalists from PHCC to provide inputs for the environmental awareness program. In fact, Matthew mentioned the association with PHCC as an active component of the organization’s activities:

⁸⁵ For an overview of different theoretical conceptions of politics in science, see (M. B. Brown, 2015).

“I have been involved with the inception of the Palni Hills Conservation Council (PHCC) in 1985 as the environmental watch-dog, and serving as a Founding Vice-President since... The Green Belt planting, involving decentralized nurseries in the region, and many eco-restoration programmes have had a very positive effect” (Matthew, 1996, p. 32).

The environmental awareness program was adapted according to the needs of different stakeholders. However, Matthew remained disillusioned that the Jesuits did not find the program important enough to be an explicit missionary endeavour. He wrote:

“[The program] is not only for students and teachers. We have already devised courses for villagers (men and women, separately), for Block development officers at the request of a District Collector, and for Sri Lanka repatriates... [But] Catholic (and Jesuit!) participation is negligible” (Matthew, 1988b, p. 263).

In due course of time, Matthew was gradually able to influence the Jesuit missionary goals in favour of environmental conservation. The 3-day program received the attention of the Jesuit headquarters in Rome and was featured twice in the international yearbook of the Jesuits (1992 and 2002), a unique achievement considering his pioneering efforts did not initially conform with the interests of the local Jesuit community (Matthew, 1991, 2001a). Matthew was able to build on the initial recognition when he became one of only four Jesuits worldwide, to represent the Radio Vatican task force at the Global Forum at Rio in 1992 (C. Prakash, 1992). Matthew now had the opportunity to influence the Jesuit authorities in Rome, to utilize the intellectual capital of environmental research and use it in the promotion for its social justice mission. He submitted three proposals to the Jesuit authorities in Rome:

“a) A Jesuit Secretariat for Environment is most timely, in response to the signs of the times, and most pressing. This is not just one more establishment, but an effort to unify the various ongoing developmental and educational ministries under the environmental umbrella.

b) A document from GC 34 on our commitment to the environment, providing both the *raison d'être* and practical orientations, would be most opportune.

c) In practice, each Province should have at least a minimal environmental programme for which suitable personnel should be trained. To begin, an Assistancy-wide initiative can show the way” (Matthew, 1994).

Eventually, all three proposals were received positively. It is not suggested here that Matthew was the sole architect of Jesuit environmentalism but he was one of the few Jesuits who was consulted for drafting an environmental mission agenda for the Jesuits. This joint action resulted in the publication of a working paper on Jesuit environmental agenda in 1999 (Social Justice Secretariat, 1999). In the late 2000s, just as Matthew had desired, the Jesuits officially endorsed the importance of embracing the environmental agenda by renaming the *Social Justice Secretariat* as the *Social Justice and Ecology Secretariat*. Matthew did not live long enough to see this milestone; he passed away in 2004. Before his passing however, in 2001 he was invited by the Provincial of India to conduct an Assistancy Level Programme for Jesuits at Shembaganur (Matthew, 2001b). RHT-AINH’s flagship boundary object had finally won the recognition of the wider Jesuit community.

(iii) “Lab-to-land” philosophy

Two features helped RHT-AINH gain recognition among various stakeholders - the speed at which the Flora were published without sacrificing quality, and the endeavour to spread environmental awareness among thousands of students and others. Significantly, both these offerings were provided either free or at “throwaway” prices. This was because Matthew insisted on what he called a “lab to land” motto: that “our work should benefit our people” (Matthew, 1988b, p. 28). It was perhaps the successful demonstration of this motto that satisfied most of RHT-AINH’s constituents.

One of the steps in realizing this motto was that publications from RHT-AINH were priced to “suit the purse of students or ordinary people” (Matthew, 1996, p. 35). Accordingly, a decision was taken to self-publish the books, with the low prices serving as a useful marketing strategy too. The incredibly low price of the Flora was noticed by botanists of international repute, as one of them notes:

“This is an extremely valuable book. It is the philosophy of the author that such a book should be available to the local people at an affordable price. Most tropical Floras does

[sic] not have this in mind, or it is not possible within the limits of their administration and printing costs...

There is every reason to congratulate the author on another fine floral work. For anyone interested in the tropical Asian flora, the books of Father Matthew are a must. Particularly the present work is outstanding as to the quality and informative value of the drawings. This is good value for money” (Larsen, 1996).

On the other hand, a Jesuit colleague and fellow botanist suggested that the low price of the books may cause them to be valued less:

“It is surprising that this set is offered at such a low price. This is well meant, but unfortunately people tend to judge the worth of anything by its price tag. Granted that low cost is because the books are subsidized. But do we really [need] to subsidize books of such importance” (L. D’Souza, 2000).

Matthew was aware of such “well-meaning queries”; but he maintained the “lab-to-land” philosophy in the environmental awareness programs too, because he felt: “the wider community has a right to be informed of our work, and to profit by it” (Matthew, 1998b, p. 27). Further, the program was also meant for the local inhabitants, and so the program was offered free “because the majority of the trainees cannot pay as they are in a permanent struggle for survival” (Matthew, 2003, p. 77). The only expectation from the trainees was to participate in an evaluation and follow-up because: “They [should] realize that their attending this programme gratis was made possible by the tax-payer who has given them a loan which should be returned in the form of service in their turn” (Matthew, 1998b, p. 31). A number of other services were also provided as per the “lab-to-land” philosophy as Matthew outlined in his reflections:

“...the annual, 2-day “Open Days” for the benefit of colleges and HS (higher secondary) schools of the town (Trichy), during which we demonstrate our research procedures (is) a very popular programme indeed... Besides M.Phil and Ph.D programmes, we also provide staff orientation programmes to keep them abreast of current, international trends” (Matthew, 1998b, p. 27).

Many were curious to know how Matthew was able to subsidize operations and still maintain an organization of international repute. The editor of a magazine wrote about his conversation with Matthew regarding this:

“I had queried the annual cost of running his centres, which seemed so low, considering what he (Matthew) was able to do with it. His reply shows the great humility of the man: ‘Thank you for your generous write-up. Yes, the figure of 21,000 pounds sterling a year is adequate simply because I believe that every penny made available by the taxpayer in the name of conservation should be spent on that and nothing else. Matter of honesty to oneself and others. I always travel by public transport, for instance. So, please be assured that your estimate is correct’” (M. Murphy, 2004).

While Matthew did not acknowledge this explicitly, it is possible that the Jesuits’ preferential option of the poor also played a part in Matthew’s simple way of living and RHT-AINH operations. He appears to have constantly thought of ways to ensure the future of the organization. One of the ways that RHT-AINH received funds was through the sale of duplicate specimens to international herbaria, which he advertised widely. Even as the Carnatic Flora project was in its initial stages, Matthew had already announced that duplicates were available for sale:

“The collections are numbered under the institutional (RHT) series and are made with 5 additional duplicates, primarily for distribution to collaborating scientists and institutions. 10,000 numbers have been collected so far during two years; another 20,000 are to be collected before the completion of the work. Two sets of duplicates will be sold at competent prices, the proceeds of which are to go for establishing research scholarships in the herbarium” (Matthew, 1978).

In response, institutions like Kew and the Smithsonian invested in the duplicates and contributed to RHT-AINH’s continued emphasis on the “lab-to-land” motto. Matthew acknowledged this much later:

“The duplicate specimens are already in international herbaria... making sure that future monographers do take account of Indian material in their researches. And the proceeds

have gone to creating the endowment that would look after the overseas requirement of the library and the herbarium” (Matthew, 1998b, p. 27).

This lab-to-land philosophy was one of the leading reasons how Matthew managed to quell the tensions at the boundaries with RHT-AINH’s different stakeholders.

6.6 Reconciling the botanist-environmentalist with the Jesuit

So far, we have studied the origins of RHT-AINH as a boundary organization, followed by an analysis of its stakeholders and the resulting tensions. We detailed how these tensions were managed through a dynamic process of boundary management which involved the creation of several boundary objects. This investigation lends credence to the argument that boundary organizations are complex “hybrid organizations” and mediate between multiple social worlds, and these worlds need not be restricted to only science and politics. For this reason, Miller (2001) provided a broader definition of boundary organization as “those social arrangements, networks and institutions that increasingly mediate between the institutions of ‘science’ and the institutions of ‘politics’” (p. 482). This re-definition helps identify boundary management as a continuous process of negotiation rather than a singular act in time. As we observed in this chapter, Matthew’s perspectives evolved along with the boundaries of the organization and its associated tensions. As a result, his beliefs - “inner worlds” - changed considerably over the course of his career. Significantly, he began to question the original intentions behind the large scale plantation of exotic flora by his Jesuit superiors in Shembaganur and Kodaikanal. Matthew’s observation of “exotic” species in 1969 was recorded as follows:

“Great tribute is due to the efforts of the European settlers who have made Kodaikanal the beautiful place it is by introducing so many species from different parts of the world” (Matthew, 1969, p. 6).

Three decades later, Matthew made a contrasting observation about these species, calling them “alien”:

“As disastrous as the decimation of the primary vegetation has been the invasion of adventive species... [on] the Palni hills where people from overseas settled since the

mid-19th century and introduced many plants from the temperate countries, the percentage of alien plants now is 20% of the total” (Matthew, 1999a, p. 793).

This contrast in Matthew’s views over a span of three decades has to be seen in the light of the fact that his agenda for research was indeed shaped by the changes he observed—a “scientific” approach, so to speak. Secondly, his views also evolved along with his theological understanding of what constitutes an appropriate Jesuit mission in a world devastated by the environmental crisis. As a result, the emergence of RHT-AINH as a boundary organization also depended on Matthew’s beliefs and convictions. This section briefly discusses how the management of boundaries at RHT-AINH led Matthew to redefine his own identity as a scientist and Jesuit priest, motivating him to reorient the missionary priorities of the Jesuits in the 1990s. To do this, we first need to understand the concept of environmental justice.

Environmental justice as described by Ottinger et al. (2017) is the advocacy against injustice meted out to disempowered communities when these communities are excluded from the decision making process involving the environment they live in. This form of enforcing social justice was also the kind advocated by Indian environmentalists like Anil Agrawal, as we noted in Section 6.4.4. The dominating issue in the environmental justice movement was to enable equitable access to ‘natural resources’. Matthew was also in favour of ensuring equitable human access to natural resources but this alone was not the crux of the agenda of RHT-AINH and its allies like PHCC.

While Matthew did not articulate it explicitly, his research and practice suggest the consideration of non-humans as equally important stakeholders.⁸⁶ RHT-AINH under Matthew’s leadership advocated a form of justice that would reconcile rights of the environment with the rights of the humans (e.g. Shoreman-Ouimet & Kopnina, 2015). For him, environmental justice was the first step in ensuring ecological justice – that is, “justice for nature”. While he was indeed concerned about the “short-term” human interests in terms of rights and access to resources, his long-term goal was the preservation of biodiversity. Matthew tried to facilitate the production of not merely a social order but an “ecological”

⁸⁶ On considering non-humans as stakeholders in conservation, see (Kopnina & Washington, 2020).

order. This, I suggest, was a result of his *religious environmentalism*: Matthew's environmentalism was borne out of his engagement with what has been called *eco-theology*.

As we saw in Section 6.3, ideas promoted by Berry (1999) and McDonagh (2010) were slow to gain the attention of mainstream Catholics. But these ideas did find a place in Matthew's environmental action. Influenced by eco-theology, Matthew wondered if Jesuits had missed the relationship between humans and non-humans in their missionary work. He even argued that the "worst environmental threats to Kodai have arisen from the former Jesuit properties" (Matthew, 1998b, p. 30). He expected his Jesuit colleagues to broaden the mandate of "faith that does justice" so as to include ecology as intrinsic to the Jesuit mission. In other words, he advocated an *ecological justice* and not merely *environmental justice*.⁸⁷ Matthew's version of justice for the environment was not only shaped by his research and advocacy but also by the views of eco-theologians like Berry and McDonagh whom he read. As we noted in Section 6.5.2, the Jesuits in his province were eventually won over by his views – even joining the 3-day environmental program as participants.

Matthew's lifelong discernment and his practice as a Jesuit botanist-environmentalist led him to cautiously critique the Church's "narrow anthropocentric understanding of history" (Matthew, 1999c, p. 138). He encouraged Catholics to engage in interfaith dialogue, to learn from indigenous peoples and to listen to advocates of the environmental movement, whom he called "modern missionaries" (Matthew, 1993a, p. 220). Even though Matthew criticized the Church for its silence on the ecological crisis, he did not quite agree with Lynn White on his thesis that Western Christianity was responsible for the crisis. On the contrary, Matthew laid the blame on what he called the "de-sacralization" triggered by the Renaissance (Matthew, 1999c). He therefore argued for a return to finding divinity in nature, though he did not privilege a Catholic approach for this. However, he adopted the language of the Church and the Jesuits, to frame a contextual theology for regional challenges. He argued for a pastoral program that would encourage the celebration of church sacraments in the context of an eco-theological cosmology, drawing from the works of Thomas Berry. It was in this specific context that he argued that the environmental awareness programme of RHT-AINH was a genuinely pastoral engagement. He saw his work for ecological justice as a missionary

⁸⁷ Some scholars distinguish between *environmental justice* and *ecological justice*. Environmental justice is "a movement advocating the rights and participation of marginalized peoples in environmental concerns". Ecological or eco-justice is "a theological and ethical ideal that harmoniously incorporates both social and ecological concerns" (Bohannon & O'Brien, 2017, p. 164).

activity, though devoid of the labels of the Church. He said that the Church should insert itself into such efforts and not be restricted by its doctrinal limits (Matthew, 1993b).

Matthew's boundary work in environmental education and research was rewarded by the Government of India when he was conferred with the Indira Gandhi Paryavaran Puraskar posthumously in 2004 ("Award for Tiruchi Botanist," 2004). But his missionary success as a Jesuit can be gauged with the number of Madurai Jesuits he trained and who continue his ecological work in different capacities. Notably, VS Manickam developed an environmental awareness programme at St. Xavier's College, Palayamkottai, similar to Matthew's and as successful (Manickam, 1993). S Ignacimuthu, Matthew's co-author of the paper which first described the ecological changes in Kodaikanal, became an expert in agricultural biotechnology and developed biopesticides based on ethno-pharmacological research (Packiam et al., 2012a). Significantly, Matthew found a successor in John Britto to take over the reins of RHT-AINH. In 2019, Britto produced a thoroughly revised and updated version of the Carnatic Flora to cover parts of Tamil Nadu that were not covered in the earlier edition (Britto, 2019).

6.7 Conclusion

This chapter about an environmental boundary organization led by a Jesuit priest and botanist-environmentalist has a number of implications for understanding the theory and practice of boundary organizations. First, it pays attention to the "inner worlds" of the leadership behind the organization and how it can play an important role in shaping the boundary activities in a complex social setting. Secondly, it adds to boundary organization theory by demonstrating the usefulness of stakeholder salience in understanding and responding to the tensions between the various constituents. Thirdly, the study explores the boundary work of environmental boundary organizations in the context of "ecological justice" rather than environmental justice. While the latter is more often described in STS literature, I explored the work of Matthew and RHT-AINH through the use of arguments from religion and ecology. Finally, this chapter offers a way of bridging the disciplines of STS and religious studies which provides a scope for engaging with the less articulated area of "inner worlds" in action for sustainability and conservation.

From the perspective of Jesuit postcolonial science in India, this chapter helped to contrast the approaches of Matthew with that of D'Souza (in the previous chapter). In the next

chapter, I describe the work of another Jesuit scientist who took yet another approach to adapt the Jesuit mission to engage in science particularly in the neoliberal context of 21st century India.

(7) Getting undone science done: Reconciling the Jesuit mission with biopesticide research

7.1 Introduction

The Loyola College in Madras (Chennai) was founded by the Jesuits of Madurai Province in 1925, as a constituent college of the Madras University (Bertram, 1925). Like other Jesuit colleges in the province Loyola College was primarily established as a missionary enterprise even though the college was open to young men of all religions. From the beginning, the college curriculum was based on the framework mandated by the Madras University (Sathianadhan, 1894, p. 57). Soon, the Madras University's increasing emphasis on academic research meant that the Jesuits could no longer remain amateurs as they did at Shembaganur (see Section 5.1) but had to specialize in the sciences if they wanted to differentiate themselves in the field of higher education in the region. Consequently, the Madurai Jesuits began to ensure that their priest-educators received specialized training, with some of them being sent abroad for their higher education.

This chapter begins by describing how a culture of research came to be established at the Loyola College soon after India gained independence. It then examines how this research mandate took a detour after the election of Pedro Arrupe as Superior General and the renewal of the Jesuit mission as one of “faith that does justice” (see Section 5.3). The focus of this chapter is however on the Entomological Research Institute (ERI), one of the leading centres of research at Loyola College. Specifically, the chapter examines how ERI's research agenda evolved as agricultural biotechnology gained traction in 1990s India. I explore how this institute headed by a Jesuit priest-scientist beginning in the 1990s, dealt with the challenge of establishing a research agenda that fulfilled the Jesuit missionary mandate while also seeking to excel in agricultural biotechnology. Using the literature on *undone science*, I attempt to explain how ERI dealt with the dilemma of pursuing scientific research in a mainstream college while also attempting to fulfil the renewed Jesuit mission of a “faith that does justice”.

7.2 Method

This chapter employs an institutional biographical approach (see, Nye, 2015; Shortland & Yeo, 1996). It begins with a brief history of the research enterprise at Loyola College and traces the origins of ERI. This history is situated in the context of how Arrupe envisioned the

purposes of (scientific) research in the light of the Jesuit mission and how this vision impacted the way the Madurai Jesuits perceived the way forward for research in their colleges. The chapter then moves on to explore how ERI revised its agenda in the context of globalized India in the 1990s, especially in taking up research on agricultural biotechnology. It then examines how ERI shifted its research trajectory from transgenic foods to biopesticides research in the early 2000s. I argue that this shift was effected because of the influence of the Jesuit mission on social justice. Then, I describe briefly the STS concept of *undone science* and attempt to show that the ERI research on biopesticides was an exercise in doing undone science. I describe how ERI's research was an important step though not a paradigm shift in getting undone science done. I argue that this step was not only a scholarly accomplishment for ERI but also a missionary endeavour in prioritizing the needs of farmers in south India.

The data for this chapter was collected from multiple sources. First, the Annual Reports of the Loyola College from 1925 to 2018 were referred to. Specifically, the sections on research accomplishments at Loyola College and the departmental reports of ERI were analyzed from the Annual Reports. Second, a substantial set of all the peer-reviewed journal publications authored by the researchers at ERI (numbering a total of 314 articles published from 1993 to 2017) were reviewed to understand the applied research focus of the institute. It was in 1993 that the Madurai Jesuit scientist, Savarimuthu Ignacimuthu, took over the reins of ERI and prioritized research on agricultural biotechnology. And it was in 2017 that he completed 50 years as a Jesuit - thus the years 1993 and 2017 were used as milestones to review the publications. Interviews with the former and present directors of ERI, both Jesuits, were also conducted to understand the Jesuit perspective on research at ERI.

7.3 The making of a research agenda at Loyola College

In the late 1940s, the Loyola College in Chennai planned to establish honours courses in the sciences as mandated by the Madras University ("Informal Discussion," 1950). The Jesuit superiors were keen on training the younger Jesuits in the sciences. This was because the Jesuits traditionally desired that their college departments be headed *only* by Jesuits. Laypersons were nominated as head of departments only if there was no other option available. In 1945, there were two science departments: the Department of Natural Sciences headed by Alfred Rapinat (1892-1959) and the Department of Sciences headed by Lourdu M Yeddanapalli (1904-1970), both of them Jesuits. Rapinat (as we noted in Section 3.8) was

not a specialist trained in botany but he was responsible for establishing the legacy of botany at Jesuit colleges in the region (Coyle, 1960). One of Rapinat's chief contributions to Loyola College was recruiting the young zoologist and (non-Christian) layperson TN Ananthakrishnan (1925-2015) who later founded the Entomological Research Institute. As we will see shortly, it was Yeddanapalli and Ananthakrishnan who paved the way for a culture of research to emerge at Loyola College.⁸⁸

7.3.1 Chemistry for industrial and national development 1948-1970

After completing his master's degree in chemistry, Yeddanapalli pursued his theological studies in Belgium. He was ordained a priest in 1938 in Belgium and then pursued doctoral research in chemistry at the University of Louvain. The outbreak of the Second World War forced him to postpone his doctoral defence. In 1940, he re-located to England from where he was invited to Princeton University. He pursued doctoral research again and was awarded his doctorate at Princeton in 1941. With the war ending in 1945, he returned to Belgium to be awarded his previous doctoral degree. With two doctoral degrees in chemistry, Yeddanapalli returned to Loyola College in October 1945. In 1946, Yeddanapalli was appointed Head of the newly established Department of Chemistry, which was bifurcated from the Department of Sciences (Stanislaus, 1971).

As we noted in Section 5.4, India's first Prime Minister Jawaharlal Nehru was convinced that science and technology were crucial for the nation's development. Yeddanapalli seemed to share similar views on the purposes of scientific research. In 1954, during one of several talks that he delivered for All India Radio (the national broadcaster), Yeddanapalli declared the importance of "scientific research in industry, and the latter's dependence for continued success on knowledge which sustained research alone can secure" (Yeddanapalli, 1954, p. 22). He hailed the development of chemical fertilizers as "one of the greatest triumphs of modern physical and engineering chemistry... [and] for supplying the chemical manure for the growing needs of our expanded agriculture" (Yeddanapalli, 1954, pp. 22–23). In pursuit of the goal to carry out industrial research at Loyola College, Yeddanapalli wrote to his American colleagues requesting scientific equipment, mentioning that "there was an

⁸⁸ It could be argued that other Jesuits like Charles Racine the mathematician also contributed to the scientific enterprise at Loyola College. Racine received many honours including being selected as a Fellow of the Indian National Science Academy in 1949. But Racine's contribution was more to *teaching* mathematics in India than in mathematics research itself. Several of his students went on to become leading mathematicians themselves (see, D. Murphy, 1977; Raghunathan, 2010).

immediate need for scientific knowledge concerning the country's abundant raw materials valuable to its industrial development" (Yeddanapalli, 1956, p. 63). It appeared that Yeddanapalli was keen on developing India's industrial development through chemical research. Accordingly, he conducted research to understand the chemical composition of raw materials available in India so as to provide inputs for industrial use.

Subsequently, Yeddanapalli explained that understanding the constituents of cashew nut shell liquid and turpentine oil could help in "new and better use... of this most valuable raw material of our country" so as to support the manufacture of "a variety of valuable industrial products" (Yeddanapalli, 1954, p. 24). Eventually, Yeddanapalli and his students were able to separate the main constituents of cashew nut shell liquid, isolated them and established their chemical identities (V. J. Paul et al., 1950; V. J. Paul & Yeddanapalli, 1956). This research later contributed to the commercial utilization of the cashew nut shell liquid in producing products such as phenol and anisole. The department also carried out research on the isomerisation of turpentine oil which eventually led to the development of commercially useful raw materials (such as tere-phthalic acid) used for the production of terylene, a polyester fibre (Gnanapragasam, 1971).

Yeddanapalli's emphasis on the place of scientific research for India's industrial development was recognized by the Nehruvian administration. Yeddanapalli's research on polymer chemistry earned him a spot on the Plastics Research Committee of the Council of Scientific and Industrial Research (CSIR) (T. Mathias, 1954, p. 2). When Yeddanapalli was appointed Rector of the college in 1959, his focus on indigenous fundamental research and industrial application became a key priority for Loyola College (Sundaram, 1960). It was under these conditions that the Entomology Research Unit (later, Institute) came into existence on the top floor of the Chemistry building of Loyola College in 1968.

7.3.2 Exploring entomology to aid Indian agriculture 1958-1983

As previously noted, TN Ananthakrishnan joined the staff of Loyola College in 1948. He was neither a Jesuit nor a Catholic, and was recruited on the basis of his exemplary academic record as a graduate student. Under the influence of leading Indian entomologists like TV Ramakrishna (1880-1952) and MS Mani (1908-2003), Ananthakrishnan began to study the taxonomy of thrips (Raman, 2014). Thrips are slender, winged insects that feed on plants.

While some species of thrips are beneficial as pollinators or as predators of other insects, several species of thrips are considered pests of commercial crops.

Soon after joining Loyola College, Ananthakrishnan began studying one particular species of thrips (*Arrhenothrips ramakrishnae*) that was available aplenty on the campus. He studied their feeding behaviour, reproductive biology and population dynamics. He also identified new species of thrips in Madras and described their biology. Gradually, he began to collect and analyse hundreds of Indian thrips, publishing his findings frequently (Raman, 2015).

Ananthakrishnan's work was soon recognized widely. In the early 1960s, Ananthakrishnan became one of the earliest Indian researchers to secure a research grant under the Public Law 480 (PL-480) agreements signed between the governments of United States and India (Raman, 2014).⁸⁹ In 1963, Ananthakrishnan used the PL-480 grant to establish the Entomology Research Unit as an independent research division of the newly formed Zoology Department, of which he was Head. Using the grant, Ananthakrishnan built a team of PhD scholars in entomology and published widely in some of the world's most reputed journals. In 1968, Ananthakrishnan secured another grant and so quit his position as head of the Zoology department to focus completely on entomological research at the new unit he set up (Raman, 2014).

The PL-480 funding came to a close in 1973 but Ananthakrishnan had already built an international reputation as one of the leading entomologists in India. In 1977, he was selected as Director of the Zoological Survey of India, which he accepted after taking a three-year sabbatical from Loyola College. On returning to the college, he secured further funds under the Committee On Strengthening of Infrastructure for Science and Technology (COSIST) program sponsored by the University Grants Commission (UGC) of India. This funding helped Ananthakrishnan establish a separate premises for the research unit, which was re-christened the Entomology Research Institute (ERI) in 1983 (Raman, 2014).

When Ananthakrishnan began research at Loyola College, his research progressed along two separate trajectories: (1) "basic or fundamental aspects" such as taxonomy, structure and

⁸⁹ Different PL-480 agreements were signed by India and the US between 1956 and 1970. These agreements were meant to support India tide over its food shortage crisis and constituted an important component of what later came to be known as the Green Revolution (see, Laxminarayan, 1960; Swamy, 1968).

function of insects; and (2) “applied aspects” around insect control measures and development of breeding techniques for beneficial insects (Ananthakrishnan, 1977). By the time ERI was established as a separate institute Ananthakrishnan began to integrate insect control programmes with techniques to increase food production. One of his peers writes that ERI in the 1980s had “the singular purpose of understanding and explaining the chemical and molecular ecology of insect–plant interactions” (Raman, 2015, p. 1242). As a consequence, research at ERI shifted from the previous priority area of taxonomy of thrips towards understanding the physiology of insects. This changing research trajectory had immense applications for agricultural entomology, notably in areas like integrated pest management (IPM). In 1988, ERI celebrated its silver jubilee (Raman, 2014).

When Yeddanapalli retired from service in 1969, the Principal G. Francis wrote that it was “through the Chemistry department that the spirit of research in our College took root when Father Yeddanapalli started his research” (Francis, 1970, p. 6). In a similar vein, when Ananthakrishnan completed 25 years of service at Loyola College, the Principal referred to him as the “doyen of researchers in Loyola... [who] has instilled the spirit of scholarly research in several of his colleagues and has inspired them to follow in his footsteps” (Kuriakose, 1975, p. 6). The contributions of Yeddanapalli and Ananthakrishnan to research at Loyola do not reveal anything uniquely “Jesuit” in character. Surely, their research contributions were on par or exceeded those of other leading scientists of their time. But there was no distinct “Jesuit” characteristic in their research agenda. However, the focus of research in the college came under different influences during the 1980s even though the impact would not be felt until the 1990s. The reason for this impact was the changing missionary focus of the Jesuits across the world, particularly after the election of Pedro Arrupe as Superior General.

7.3.3 Arrupe and the making of a Jesuit agenda for scientific research

In Chapter (5), we noted that Arrupe was selected to lead the worldwide Society of Jesus in 1966 and that the Jesuits were keen on promoting scholarly research within the Society and its institutions. We also noted that Arrupe established the office of “International Coordinator of Jesuits Working in the Positive Sciences” in 1968, essentially launching a missionary apostolate for science (Section 5.3).

Among other firsts, Arrupe became the first Jesuit Superior General to visit India in 1967. This included a “flying visit” to the Madurai Province (Jesudasan, 1967). At St. Joseph’s College, Trichy, Arrupe declared to his fellow Jesuits that “We have to work in the 20th century. For this we need Jesuits of the 20th century, or rather of the 21st century” (Arrupe, 1967b, p. 88). He also visited Loyola College and addressed the students, saying: “You are the men who are preparing for the 21st century of India. Therefore you have to widen your ideas, your heart, your knowledge, you have to feel yourself as a very good and ideal Indian. For this you must be a man of the wide world” (Arrupe, 1967a, p. 22).

Arrupe appears to have suggested that Jesuits needed to adapt themselves to the changing times, and also broaden their perspectives without being closeted in nationalistic mindsets. This seemed to be in contrast to what Yeddnapalli had strived to do – to promote national interests through research for industrial relevance. In another contrasting perspective, Arrupe offered a critique of materialistic progress saying: “inspite of this tremendous progress of technology and economics, we feel a certain stagnation, a lack of real men”. He said that Jesuit institutions like Loyola College ought to nurture “men of character, men of science, men of principles, men of strong will who follow justice and truth” (Arrupe, 1967a, p. 20).

Arrupe’s views on Jesuit higher education seem to reflect his broader views on the contemporary world order. These views were shaped in part by his experience of surviving the atomic bombing at Hiroshima in 1945, where he was rector and novice master of the Jesuits. The after effects of the bombing seemed to have influenced his attitude to scientific “progress”. In an autobiographical reflection, Arrupe writes that on August 7, 1945 (the day after the Hiroshima bombing) he felt compelled to “contemplate this human tragedy [where] science and technological progress [have been] used to destroy the human race” (Arrupe & Dietsch, 1986b, p. 33). In another essay, he wrote that “the present world order is based neither on justice nor love, but almost always on personal and national interest” (Arrupe, 1975, p. 25). Arrupe was clearly looking for ways to go beyond categories of self and nation, and be “a man of the wide world” as he said to the students at Loyola. It appears then, that Arrupe differed from Yeddnapalli’s focus on pursuing research in national interest alone. In this context, Arrupe seemed to suggest that Jesuits should indeed continue their engagement with science and technology but that this engagement should contribute to values like love and justice rather than broad, materialistic categories such as industrial development. He refers to the examples of radio and television in this context:

“The transistor radio can serve in today’s world as a means of instruction, but it can also be a source of explosive power, more powerful indeed than atomic energy itself, for the latter is blind and subject to man’s control while the former is human and therefore gifted with intelligence and freedom” (Arrupe, 1975, p. 26).

In other words, Arrupe was not anti-science. He was, after all, trained in medicine.⁹⁰ His most distinct views on how Jesuits ought to engage in scholarly research (both sciences and humanities) came in the form of his 1976 “letter on the intellectual apostolate” which we explored in some detail in Chapter (5). In this letter, Arrupe (1976/1981) wrote that the Jesuits should be “prepared to undertake the difficult and demanding labor of study, required for understanding... the unjust structures of society... and discover ways to modify them”. He also encouraged Jesuits to pursue interdisciplinary research so as to identify “global, deep and unified solutions demanded by the great human problems” (Arrupe, 1976/1981).⁹¹ In Chapter (5), we also noted how Arrupe’s views on science inspired some Jesuit scientists in India to come together to promote a scientific apostolate in the country, albeit with mixed success.

In 1981, Arrupe returned to India and addressed the staff and students of Loyola College. Perhaps he was aware that Jesuit academics in general were less than enthusiastic to integrate elements of social justice into their education and research.⁹² As if to encourage greater synergy between Jesuit higher education and social justice, Arrupe proposed that the goal of Jesuit educational institutions should be to prepare “men for others”.⁹³ While explaining what this goal demanded, Arrupe said:

“This (goal) requires a rethinking of the contents and relevance of the curricula, especially in the human and social sciences, a renewed emphasis on social

⁹⁰ Arrupe attended medical school for four years but gave up studies to join the Jesuits after a transformational spiritual experience in Lourdes, France (Arrupe & Dietsch, 1986a).

⁹¹ By ‘interdisciplinary research’, Arrupe referred to “the concrete application of different disciplines to the study of questions posed by the local situation... a realistic encounter ought to take place, not only among the several sciences, but also between those who have, for example, an existential acquaintance with the realities of poverty and those who investigate them rather from an intellectual point of view” (Arrupe, 1976/1981).

⁹² For instance, I have referred to Joseph V D’Souza’s and KM Mathew’s reservations on integrating the social apostolate with the intellectual apostolate (in Chapters (5) and (6) of this thesis respectively). In general, there was a kind of identity crises among Jesuit educationists globally on what their mission orientation was to be – pastoral or educational (for e.g., see, Brennan, 1969; Fichter, 1969; Meissner, 1963).

⁹³ In 1973, Arrupe had declared that “the paramount objective of Jesuit education” is the formation of its graduate as a “man [and woman] for others,” a person who would “give himself to others in love—love, which is his definitive and all-embracing dimension, that which gives meaning to all his other dimensions” (Arrupe & Aixala, 1980).

responsibility in human relations, *a reorientation of research in physical or human sciences, with a view to alleviating hunger, disease or penury* [emphasis added]. It implies a greater insertion into the community around, developing a sensitivity to problems affecting your country men, especially the poor and the neglected, combating the causes of injustice existing in society and enshrined at times in socio-economic structures” (Arrupe, 1981b, pp. 15–16).

While the kinds of scientific research promoted by Yeddanapalli and Ananthakrishnan surely put Loyola College on the international stage, one can observe that Arrupe articulated a different agenda for scholarly research. This is not to suggest that Yeddanapalli and others at Loyola College were insensitive to the problems of the poor and the neglected. But their research agendas were likely developed in the laboratories than among the communities. Arrupe urged a focus on community driven research, what we would today refer to as “civil society research” (see, Hess, 2009). It seems that Arrupe wanted Jesuit scientists (and other intellectuals) to move away from the ivory tower, insert themselves “into the community” and take up research that could “alleviate hunger, disease or penury”.

Arrupe was succeeded by Peter Hans Kolvenbach (1928-2016) as Superior General at the 33rd General Congregation (GC 33) in 1983. At GC 33, the Jesuits under Kolvenbach reinforced the “faith that does justice” mandate. The Jesuits also decreed that: “Of great importance among the ministries of the Society are the educational and intellectual apostolates... The opportunities and responsibilities of these apostolates require a change of heart and an openness to human needs around us; they also demand a solid intellectual formation” (GC 33, 1983, Decree 1 #44). It was also here that the Jesuits first comprehensively expressed the “preferential option for the poor” to orient all their missionary activities (GC 33, 1983, Decree 1 #48). The decree further added that “this [preferential] option should find some concrete expression in every Jesuit’s life, in the orientation of our existing apostolic works, and in our choice of new ministries” (GC 33, 1983, Decree 1 #48). It appeared as if it was binding on the Jesuits, including those in scientific research, to orient their activities in accordance with the “preferential option for the poor”.

GC 33’s renewal of the “faith that does justice” mandate and the articulation of the “preferential option for the poor” together appear to have had significant impact on the Madurai Jesuits. They convened a Provincial Assembly in December 1984 to “re-examine

our life and ministries... in order to give meaning and value to our fight for justice and our option for the poor” (“Province Assembly,” 1985, p. 9). The motto of the Assembly was declared as “Towards Liberation, Together with the Poor” (“Province Assembly,” 1985, p. 11). Representatives of the various apostolates such as education (secondary and higher), social, pastoral-spiritual, formation and communication ministries submitted various proposals to implement the renewed Jesuit mission. Significantly, the Madurai Jesuits drafted a comprehensive vision statement on re-orienting their missionary activities, especially in the educational institutions of the province:

“In the context of existing inequalities, injustices and dehumanizing poverty in contemporary society, we are committed to challenge and change these oppressive structures through our colleges towards the integral liberation of man in collaboration with Christians of different denominations, people of other religious and secular movements working with similar vision. Our educational institutions will shape our students into agents of social change preparing them for concerted social action and thus paving the way to mass movements which will bring about the desired liberation” (as cited in “Editorial,” 1987).

The Jesuits in the education apostolate concurred with this vision statement and resolved to transform “their staff and students to live as men for others” (“Province Assembly,” 1985, p. 11). However, the same Jesuit educationists acknowledged the constraints of working under government rules and the grant-in-aid system. But, they agreed (among other things) that “applied research should be directed towards local needs and oriented towards the transformation of society” (“Higher Education,” 1985).

In December 1987, Kolvenbach visited Loyola College during a formal visit to India. While addressing the staff and students, he said that “in our (Jesuit) educational institutions attention must be paid in an explicit way to an education for justice” (Kolvenbach, 1988, p. 5). On the occasion of his visit, the Madurai Jesuits released a monograph titled *Research for Social Change* (Kolvenbach, 1988, p. 6). Clearly, the Arrupean emphasis on social justice began to gradually make its presence in the agenda for scholarly research at Loyola. Paraphrasing the directions of Arrupe from his speeches and the GC decrees on the purposes of Jesuit education, we could summarize the characteristics of a Jesuit agenda for scientific research as follows:

- (1) the purpose of research is to understand the “unjust structures of society” and to “combat the causes of injustice”
- (2) this requires a “greater insertion into the community around” and “an openness to human needs around us”
- (3) accordingly, research in Jesuit institutions should consider “what is relatively most urgent and most needed in different places”
- (4) eventually, the applications of research “should be directed towards local needs and oriented towards the transformation of society”

While articulating a research agenda is relatively simple, implementing it is an entirely different affair. As we already noted, the Jesuits were aware that practising “research for social change” was easier said than done especially in the face of challenges such as securing adequate funds and complying with government regulations. Besides, developing such a research agenda led to tensions among the Jesuits themselves. Even during the 1984 Madurai Provincial Assembly, the Jesuits in the social apostolate argued that “our (Jesuit) institutional structures and restraints did not give scope for social action in our schools and colleges” (“Province Assembly,” 1985, p. 10). A report of the assembly described that “areas of disagreement still remained” between the Jesuits in the different apostolates though each “tried seriously to appreciate the difficulties and constraints under which the other worked” (“Province Assembly,” 1985, p. 11).

Woodhouse et al. (2002) suggest that a growing number of STS scholars are engaging with the question of “how to reconstruct technoscience to promote a more democratic, environmentally sustainable, socially just or otherwise preferable civilization” (pp. 297-298). This normative question appears to be similar to Arrupe’s proposal to the Jesuits involved in scholarly research. While a spectrum of approaches – from activist to academic - are available to tackle this question, one of the choices that all researchers face is: “What topic deserves my attention?” (Woodhouse et al., 2002, p. 303). It is in this context that the problem of *undone science* gains priority in determining the research agendas of those researchers working with civil society organizations and social movements. In the next section, we review the concept of *undone science*, with the goal of relating this to the Jesuit dilemma of deciding what areas of research count as fulfilling the Jesuit mission.

7.4 The problem of getting “undone science” done

David Hess (2007) submits that the process of choosing a research program is “both an intellectual and political investment” (p. 33). For example, young scientists may choose to contribute to a new research topic which could open up new opportunities and bring rewards. However, there is also the risk that the buzz around the new research ideas may die down or there may not be adequate funding for a fledgling research project. Leading scientists on the other hand may prefer to stick to their ongoing research questions, even though the additional rewards may not be too great. Besides these personal dimensions, the decision of the researcher ultimately takes place within the broader context of funding priorities that are established by governments, philanthropic foundations and private corporations. Eventually, some research problems get priority based on the distribution of “power, resources and opportunities” (Frickel et al., 2010, p. 465) while other problems are preempted as “not worth studying” (Hess, 2009, p. 307). Hess (2007) argues that though most researchers “tend to follow the money at an aggregate level” (p. 36), some may opt to “incorporate into their research programs the social-change goals associated with social movements” (pp. 59-60). He suggests that it is this latter kind of social-change orientation that contributes to the development of “alternative pathways” in scientific research.

Hess (2007) refers to the various research projects that arose in 1970s in favour of “people’s science”, such as the appropriate technology movement and the “radical science” movement as examples of such alternative pathways (p. 63). In Section 5.4 , we noted the development of such a trajectory in India. Essentially, these pathways were geared towards developing research programs that could address the needs of the poor, to an extent better than that of the state-led science of the government. So while mainstream research agendas reflect the priorities of “political and economic elites”, the “social change agents” pursue alternative pathways to counteract these elitist biases. Woodhouse et al. (2002) suggest that these social change agents do not merely shift from university to community-based research but “shift toward serving those social interests now relatively disadvantaged in social negotiation” (p. 302). Generally speaking, these agents with alternative research agendas seek to get *undone science* done.

Undone science typically refers to those areas of research that are systematically left unfunded or ignored by political and economic elites. On the other hand, the knowledge produced by pursuing these “undone” areas of research could help social movement

organizations or other civil society organizations to promote social change or confront policies that may be considered harmful to people or the environment (Frickel et al., 2010; Hess, 2009). Examples of community-led projects to get undone science done have been documented with increasing frequency in STS literature, two of which will be described here briefly.

During the 1990s, controversy erupted in the Great Lakes region of North America on account of extensive chemical manufacturing and contamination. Scientists had earlier documented threats to humans and wildlife from toxic, industrial chlorinated pollutants. Based on this evidence, citizen-activists and environmental advocates argued that the chemical industry should explore non-chlorine alternatives. However, the industrial agenda was systematically focused on continued use of chlorine chemistry and not on pursuing the undone science of identifying non-chlorine alternatives. Sustained advocacy by civil society agents managed to phase out the “dirty dozen” chlorinated compounds on the basis of well-documented, toxic characteristics of those compounds. However, thousands of other less studied chlorinated chemicals still remain unregulated and continue to pose risk to humans and the environment – highlighting the continued challenges of getting undone science done (J. L. Howard, 2004 as cited in; Frickel et al., 2010, pp. 448–453).

A second example relates to community-led research against contamination by pesticides in Argentina. The adoption of genetically modified (GM) crops during the 1990s, also introduced the use of a broad-spectrum systemic pesticide (glyphosate). Pesticide use increased exponentially, especially through fumigation. Fumigation is the use of fumes to apply pesticides on a large scale, often resulting in pesticides being sprayed outside the intended areas of application. In the 2000s, communities affected by this harmful exposure came together to demand justice. These communities enrolled legal and scientific experts to record previously under-estimated toxic effects of glyphosate-based pesticides, map the affected localities and motivate affected communities to mobilize for proper regulations on glyphosate usage. The regulatory authorities did not originally restrict the commercialization and usage of these pesticides. However, the communities were able to influence local policy using knowledge produced by the scientists enlisted by the campaign. The production of undone science by the communities convinced local authorities to classify the pesticides as hazardous, even though they were not able to convince the authorities at the national level –

yet another illustration of how getting undone science done is challenging but nevertheless important to deliver social change (Arancibia & Motta, 2019).

These examples suggest that doing undone science serve the broader public interest. Pursuing an undone science agenda can create shifts in research, even open up new areas of research that deserve greater priority. It could be argued that Arrupe's call for Jesuit education to pursue a "reorientation of research... with a view to alleviating hunger, disease or penury" appears to be a call for Jesuits to pursue undone science (Arrupe, 1981b, pp. 15–16). The problem of undone science calls attention to produce knowledge in "scientific research areas of social relevance that are understudied, often because there is no group with both money and interest in them" (Woodhouse et al., 2002, p. 299). Further, Arrupe wrote that Jesuits scholars cannot understand the "unjust structures of society" without undertaking "the difficult and demanding labour of study[ing]" these structures, thus urging them to pursue areas of research relevant for social change (Arrupe, 1976/1981). Likewise, Woodhouse et al. (2002) describe how activist-oriented scholars "analyse situations where they believe commercial concerns are getting disproportionate weight, or where historically privileged groups appear still to be receiving unwarranted treatment... or in product innovation attentive more to the wants of the rich than to the needs of the poor" (p. 304). It appears therefore, that Arrupe's invitation to Jesuit scientists and educators to be "men of science... who follow justice" was essentially a call to pursue research for social change.

Given this call from Arrupe to Jesuit scholars to reorient their research agendas, it is worth exploring how the Jesuit scientists at Loyola College responded to this call. If they did respond positively, how far did they shift from the initial agenda established by pioneers like Yeddapanalli and Ananthakrishnan? In the next section, we examine if and how ERI responded to the demands of a research agenda that was "directed towards local needs and oriented towards the transformation of society", as the Madurai Jesuits resolved in 1984.

7.5 Doing undone science: Biopesticide research at ERI

7.5.1 The biotechnology era under Ignacimuthu

The 1980s ushered in the era of plant biotechnology across the world.⁹⁴ In 1983, the first instance of “*Agrobacterium tumefaciens*-mediated genetic transformation” was demonstrated by international scientists; a bacterial antibiotic resistance gene was transferred into tobacco and the first transgenic plants were produced (Vasil, 2008). In 1982, the Government of India had constituted the National Biotechnology Board (NBTB) under the Ministry of Science and Technology. In 1986, the Indian Government upgraded the NBTB to form the Department of Biotechnology (DBT) under the Ministry of Science and Technology. Soon, other government agencies began to support research programmes in biotechnology (S. R. Rao, 2002).

During the early 1990s in Loyola College, Ananthakrishnan anticipated the role of biotechnology in insect control and organized a workshop on the theme of “Biotechnological approaches to the biological control of insects” (Ananthakrishnan, 1992). For the first time perhaps, ERI began to discuss the prospects of genetically improving plant resistance to pests. By then, Ananthakrishnan had served as Director of ERI for nearly four decades and began looking for his successor. Eventually, the Jesuit authorities appointed the Jesuit priest and researcher of plant biotechnology, Savarimuthu Ignacimuthu (1948-), to lead ERI.

As a Jesuit scholastic, Ignacimuthu was trained by the Jesuit priest and botanist, KM Matthew (see Section 6.4.3). Like other Jesuit botanists of the time Ignacimuthu’s interest in botany took shape during his Jesuit formation at the Sacred Heart College in Shembaganur. He proceeded to graduate in botany and continued his higher studies in the field of plant genetics. He explored the genetic variations of leguminous plants and investigated new breeding techniques to improve their yield.⁹⁵ For his doctoral research, Ignacimuthu examined how ionising radiations could induce mutations and help in the genetic improvement of crops (see, Ignacimuthu & Babu, 1991). After completing his PhD in the 1980s, Ignacimuthu served in various academic positions in Jesuit colleges run by the

⁹⁴ For a brief historical account of the origins of biotechnology, see (Bud, 2009). For the history account of plant biotechnology, see (Buchholz & Collins, 2013; Vasil, 2008).

⁹⁵ His MPhil thesis was on “Investigations on genetical and biochemical variations in *Phaseolus sublobatus* Roxb. (*Leguminosae-Papilionoideae*)” (1981) and his PhD thesis was on “Mutagenic studies in three species of *Vigna* Savi.” (1985), both from the University of Delhi (see, Ignacimuthu & Babu, 1985, 1988).

Madurai Jesuits. Eventually, Ignacimuthu joined ERI as Assistant Director in 1993, became its Director in 1996 and continued his association with the institute for the next two decades.

7.5.2 An overview of research trends at ERI 1993-2017

In 2017, Ignacimuthu celebrated fifty years of joining the Society of Jesus. From 1975, when he published his first article (with KM Matthew) till his golden jubilee as a Jesuit in 2017, Ignacimuthu had authored (and co-authored) more than 430 peer-reviewed journal articles.⁹⁶ He published not only in botany and plant biotechnology, but also in food chemistry, microbiology, medicinal chemistry and ethno-pharmacology. He was nominated a Fellow of international bodies such as the Royal Entomological Society (2007) and Indian academies like the National Academy of Agricultural Sciences (2008). Besides a stint as Principal of Loyola College, Ignacimuthu was also selected by the Government of Tamil Nadu to serve as Vice-Chancellor of two State universities: the Bharathiar University, Coimbatore (2000-2002) and the University of Madras (2002-2003) – perhaps, the only Indian Jesuit to have done so. He also served as Advisor to government bodies such as the Biotechnology Board (Tamil Nadu) and the Tamil Nadu State Planning Commission. Given this list of achievements as a Jesuit scientist it is useful to examine if his stint at ERI contributed in any way to getting undone science done, especially in the manner suggested by Arrupe. A starting point to examine this could be to analyze the topics covered in Ignacimuthu's research articles.

Ignacimuthu published his first article jointly with KM Matthew in 1975 (Matthew et al., 1975). Since our focus is on the research agenda he established at ERI we examine only the articles that Ignacimuthu authored after 1993 when he joined the institute as Assistant Director, and until 2017 when he celebrated his golden jubilee as a Jesuit. The list of his publications was provided to me on request. This list was then filtered for peer-reviewed journal articles that appeared in journals listed on the *Master Journal List of the Web of Science* database (Web of Science Group, n.d.) and the *SCImago Journal Rank Indicator* (SCImago, n.d.). The former database lists more than 21,000 journals covered in the Web of Science Core Collection while the latter lists 34,000 journals contained in the Scopus database (as of 2018). These lists did not cover some major Indian journals like the *Journal of Cytology and Genetics*. Since the intention here is not to perform a scientometric study but

⁹⁶ In October 2020, Ignacimuthu was ranked 872 among 113,961 scientists from all over the world. Based on citation analysis of scientists' journal articles published until 2020, Ignacimuthu was identified as one of the top 1% of the world's leading scientists in biology (Ioannidis et al., 2020).

to get an overall picture of Ignacimuthu’s research priorities as Director of ERI, I proceeded with the journals that were listed only in the *Web of Science* and *Scopus* databases.

The number of journals that Ignacimuthu published in and that were listed in either *Web of Science* or *Scopus* databases came to a total of 134. Articles authored by Ignacimuthu et al that were published in these 134 journals were then downloaded, as long as they were available for access. This resulted in a total of 314 articles that were available for analysis (it should be mentioned that Ignacimuthu was not the sole author of these articles nor was he always the first author). Each of these articles was read individually; the research priority in each article was identified and categorized. In the first iteration, more than ten research categories were identified. As this number was too high for further analysis a second iteration was done and the articles were categorized under three main categories – pest management, plant biotechnology and ethnopharmacology. These categories also align closely with Ignacimuthu’s research interests as mentioned in his CV – biopesticides, biotechnology and ethnopharmacology. The broad areas of research covered in the three categories are listed in **Table 7-1**.

Category	Broad research priorities as identified in the journal articles
Pest Management	Includes research on identifying active principles (molecules or compounds) in naturally occurring plants; and the development of botanical pesticides using principles identified
Plant biotechnology	Includes research on improving crop yields and developing insect/disease resistance using agricultural biotechnologies; and the development of genetically modified crops
Ethno-pharmacology	Includes research on indigenous knowledge systems (here, ethno-botany and ethno-medicine) and using this knowledge for drug discovery
Miscellaneous	Includes research overviews, letters to journal editors, meeting reports and reviews of recent trends

Table 7-1 Research priorities in Ignacimuthu’s articles

In a few cases the articles could not be unambiguously categorized in only one of the three categories as there was an overlap between the categories. For example, research on pest management could also include biotechnologies (e.g. Ramakrishnan et al., 2016). In such cases, the distinction was made using the final intended outcome of each article. If the goal of the article was to develop resistance to a disease caused by a pest then the article was listed under “pest management” even if the methods employed to develop pest resistance included biotechnologies such as genomics analysis. As mentioned earlier, the primary intention is to get a broad overview of the research priorities than to perform a quantitative analysis of the

articles. Based on this approach, each of the articles were categorized under the three main heads with some listed under miscellaneous. The distribution of these articles across the years is shown in **Table 7-2**.

Year	Pest management	Biotechnology	Ethnopharmacology	Misc	Total
1998	0	3	0	0	3
1999	0	2	3	0	5
1999	2	4	1	2	9
2000	5	8	1	1	15
2001	4	4	2	1	11
2002	4	1	1	0	6
2003	1	1	0	0	2
2004	1	1	0	2	4
2005	0	0	2	0	2
2006	2	2	9	1	14
2007	0	2	4	0	6
2008	1	3	8	1	13
2009	2	4	18	1	25
2010	2	3	13	0	18
2011	13	2	13	4	32
2012	18	0	21	3	42
2013	7	1	11	2	21
2014	10	2	24	3	39
2015	7	1	3	3	14
2016	8	3	11	2	24
2017	1	0	8	0	9
Total	88	47	153	26	314

Table 7-2 Distribution of Ignacimuthu's articles by year and research priority

It is worth repeating that the categories indicated in **Table 7-2** are placeholders for broad areas of research. *Ethno-pharmacology* not only includes drug discovery using ethnic knowledge but also includes ethno-botanical research and the validation of ethno-medicine using laboratory methods. The category *plant biotechnology* includes protocols for micro-propagation and regeneration of plants using tissue culture methods, as well as protocols for genetic modification such as agro-bacterium mediated transfer. Likewise, the category *pest*

management includes research on not only integrated pest management (IPM) for use in agriculture but also in controlling insects affecting humans, such as mosquitoes.

As seen from **Table 7-2**, the highest number of articles authored by Ignacimuthu falls under the “ethno-pharmacology” category. However, most of the articles in this category are of an exploratory nature with potential for applications but did not result in the development of specific applications. The next highest number of articles is in “pest management”. A closer look is warranted at the articles published under this category for three reasons. Firstly, Ignacimuthu listed ‘biopesticides’ as his primary area of interest. Secondly, ERI’s research on pest management resulted in patented applications that were marketed for use in the real world such as the development of PONNEEM, a plant oil based biopesticide. Finally, Arrupe insisted that research by Jesuits should have applications in fulfilling the needs of the poor and the neglected. So, an exploration of Ignacimuthu’s research on biopesticides will help us examine if and how this (applied) research fulfils Arrupe’s agenda for “Jesuit” science.

7.5.3 Choosing bio-pesticides over transgenic crops as research priority

As we noted in Section 7.5.1, Ignacimuthu’s early research beginning in the 1980s was largely related to the genetic improvement of crops. In 2002, the Government of India approved the cultivation of transgenic cotton. In less than a decade, India became one of the leading consumers of transgenic crops in the world (Herring, 2015). Ignacimuthu appears to have followed the lead of the Indian government especially because he was a supporter of transgenic crop technology. In 2003, Ignacimuthu wrote in a Jesuit periodical that there appeared to be “little threat to human health through the consumption of GM foods. At the same time we need new methods and concepts... to study the safety of the genetic techniques used in developing GM crops” (Ignacimuthu, 2003, p. 25). Even though many Jesuits in the social apostolate (particularly those in Africa) were opposed to this view, Ignacimuthu continued working with some of the leading scientists in genetic modification technologies.⁹⁷ Ignacimuthu collaborated with the developers of (the controversial) golden rice crop to identify potential uses for transgenic rice in India (Ignacimuthu et al., 2000; Terada et al., 2001). Later, Ignacimuthu developed *in vitro* transgenic millet varieties which were resistant to plant diseases and pests (Ignacimuthu & Ceasar, 2012; Ignacimuthu & Kannan, 2013).

⁹⁷ The magazine of the Jesuit Social Justice Secretariat organized and published a discussion on the pros and cons of GM foods. Jesuits and others from different countries around the world voiced their views on the topic (see, “Debate on GMOs,” 2003).

Despite this progress in transgenic crop research, ERI assigned lesser priority to GM crop research in comparison to its research on bio-pesticides and ethno-pharmacology. What was the reason for this shift in Ignacimuthu's priority for an "undone" research area?

When I interviewed Ignacimuthu in 2017, I asked him how he chose to enter into a particular line of research, considering that he had worked in multiple disciplines over four decades. Ignacimuthu replied: "If you want to be relevant, you should be up to date... Once I started seeing new developments (in my field of research) I entered into that area, contributed... and try to incorporate into our research so that it becomes relevant to the application oriented part of our research" (S. Ignacimuthu, personal communication, 15 May 2017). There appear to be two criteria to Ignacimuthu's choice of a research area: (1) it should be a "new development" in the field of interest to the researcher; and (2) it should be "relevant to the application oriented part of our research". It is my submission that Ignacimuthu's spontaneous response is aligned with what Arrupe proposed in terms of how Jesuits should perform research, as I shall explain subsequently.

In his letter to Jesuit scholars, Arrupe wrote that Jesuits "ought to be especially concerned about *the concrete application* [emphasis added] of different disciplines to the study of questions posed by the local situation" (Arrupe, 1976/1981). The "application" of the research attains significance in Arrupe's words. Similarly, while writing to Joseph D'Souza in 1980 (see Section 5.6), Arrupe indicated that "Concerning the content of the subjects of research, we should be aware of our limitations and therefore develop criteria in the choice of the subjects, like what others are not doing, *what will be of greater service to the poor and neglected* [emphasis added]" (Arrupe, 1981a). For Arrupe, any research becomes relevant as a Jesuit ministry *only* if it could provide relief to "the poor and the neglected".

With Arrupe's idea of "applied research" in mind, I asked Ignacimuthu how he decided if the chosen subject of research was relevant to his identity as a Jesuit priest. He replied: "Whenever we take up any work, we don't go only for theoretical or pure scientific [studies], we always look at the application aspect... that is the way we take up our work". He further explained that whether it was the documentation of ethno-medicinal practices of tribal people or if it was editing the gene of a mosquito, he asked himself if "it [the research output] is going to have socially relevant worth... [that is how] we more or less decide [to pursue] whatever [research area] we take up". So, Ignacimuthu's choice of research depended on

whether the application of the research was socially relevant. But this still does not answer the question how Ignacimuthu decided that doing biopesticides research was *more* socially relevant than pursuing transgenic crop research. In order to explore this we have to understand that despite being a supporter and researcher of transgenic crops Ignacimuthu was convinced that transgenic crop technology was *only one* of several options available to deal with crop pests. He made clear his views on transgenic crops in a letter published in *Current Science*. Along with his colleagues S Seshadri and S Janarthanan, Ignacimuthu writes:

“A conscientious biotechnologist will not agree with the statement given in the article ‘the addition of transgenic crops does not add any new dimensions to the existing scenario in modern agriculture’... Transgenics are a product of artificial selection and hence they cannot fall in line with traditional varieties. No doubt, any scientific advancement needs to be received well, accepted and adopted in the modern system after a thorough scrutiny of impact on mankind. At the same time, the traditional varieties also have their own role to play...

We do need transgenics and research on them has to be encouraged. While it is necessary to clear any doubts on transgenics among the consumer-public, it is also necessary to develop genetically modified crops devoid of gene protection (terminator) technology and selectable markers.

Ultimately one should aim not to leave the human community (i) rely upon one or two crops/varieties for cultivation in the future; (ii) lack self-sufficiency in the fields; (iii) rely upon monopolistic commercialization of essential crops” (S. Seshadri et al., 2000).

It can therefore be seen that Ignacimuthu was cautiously optimistic about GM technology and argued that GM crops were not “in line with traditional varieties”. More importantly, he was against “monopolistic commercialization of essential crops”. Further, Ignacimuthu as well as his colleagues at ERI were also intrigued with “questions posed by the local situation” as Arrupe said Jesuits should. In my interview with him Ignacimuthu said that he was moved by the large number of farmer suicides by consumption of chemical pesticides. In addition, he was also concerned about the effects of chemical pesticides on the environment. This inspired him to consider research on biopesticides, he said. This concern for farmers seems to have

opened up a new line of research, away from those dictated by industrial elites. As a result, Ignacimuthu began exploring a new line of research quite different from his doctoral research on genetic improvement of crops. The orientation towards social-change, as suggested by Arrupe (1976/1981) and Hess (2007), appears to have motivated Ignacimuthu to engage with an undone science project.

Ignacimuthu's colleague and fellow Jesuit S Maria Packiam was one of those students who collaborated with Ignacimuthu in developing the novel biopesticide, PONNEEM, as part of his doctoral research. When I interviewed Maria Packiam on why he chose to pursue research on biopesticides, he had slightly different reasons when compared to Ignacimuthu. While reiterating the primary reason that natural pesticides were safer for farmers, he was also motivated by the benefits to the environment. He said: "the concentration [of PONNEEM] is favourable to plants... it is not toxic to the soil microbes [and] is also easily degradable because [it is] natural" (M. Packiam, personal communication, 20 August 2018). Further, Maria Packiam said that:

"Chemical pesticides... also kills the beneficial insects... soil fertility gets degraded, and the vegetables [and other food crops] collected from the fields where chemicals are applied have toxic elements [in them]... so you may get immediate result [with chemical pesticides] but ultimately it [is] harmful to humans and plants and animals...we can't completely eradicate the harmful insects... [these harmful insects] have always existed... [just] because it (the insects) damage the plant [sic]... we immediately say it is a harmful insect or unwanted insect [but] it is not like that. God has a purpose for creating everything... if we take away their place, our place [will be] taken by those insects".

In other words, both Ignacimuthu and Maria Packiam appear to have been moved by factors that Arrupe considered essential for the Jesuit way of doing research, albeit in slight different ways. Maria Packiam also brings in a theological argument to promote the use of natural pesticides: that God has a role assigned even for the insects. But both of them submit that they were not merely motivated by the need to pursue basic research or to promote "money generating crops", as Maria Packiam called it. Ignacimuthu suggested that he was motivated to make PONNEEM available in the open market for farmers to use. So the product was patented and the marketing rights were sold to a social enterprise. Even in this process,

Ignacimuthu ensured that the impact of the research was made accessible to those who need it the most. He explained:

“Now, companies going in for a profit and so on [*sic*] that is totally unethical... that is how I look at it. For example, we prepared a natural pesticide (called) PONNEEM... many companies were interested to come and take our (PONNEEM) technology... but we identified one company according to our vision... socially relevant... and not simply putting the cost very high, just for profit [*sic*]... so we identified [a] moderate kind of businessman... we see to it that prices are kept... at the minimum... so that farmers don’t suffer... when I distribute something I can say this is the [rule] I would like [the marketing agency] to follow... if you are not interested, we will not market it [through you]” (S. Ignacimuthu, personal communication, 15 May 2017).

In time, thanks to ERI’s efforts to make PONNEEM available at relatively low-cost to farmers in Tamil Nadu (and beyond) the product became the visible face of applied research at ERI because of its social relevance. I suggest that ERI’s biopesticide research fulfils the criteria for getting “undone science” done for two reasons. First of all, ERI took up biopesticide research even as India became one of the leading proponents of transgenic technology – this despite the fact that Ignacimuthu himself was an expert in the technology. Secondly, biopesticides account for just 5% of the total crop protection market in India (Mishra et al., 2015; Sinha, 2012). So ERI decided to pursue a line of research that was *not* driven by economic interests. Rather, the priority was to conduct research that could further the needs of farmers and the environment, as we observed in the statements by Ignacimuthu and Maria Packiam.

ERI’s research on biopesticides could also be considered to have got undone science done because of the alternative pathway it adopted to target two common varieties of crop pests – the American bollworm (*Helicoverpa armigera*) and the Asian armyworm (*Spodoptera litura*). These were the same major pests which were cited as reasons for the introduction of transgenic cotton in India (see “Box 3” in Tuli et al., 2009, p. 324). As can be seen from **Table 7-3**, the number of articles (62) that ERI researchers published on dealing with pests (crop pests and vector-carrying mosquitoes) is more than all the articles that ERI produced on plant biotechnology (47) in the same period (refer **Table 7-2**).

Pest type	Damage caused	Number of articles published (2000-2017)
Lepidopteran pests (bollworm complex and tobacco caterpillar)	Damage to wide variety of food and commercial crops; develop resistance to synthetic pesticides	40
Vector carrying mosquitoes	Vector-borne diseases in humans	22

Table 7-3 Articles published by Ignacimuthu et al on pest management (2000-17)

It could be said then that ERI intentionally chose to focus on the undone science of developing biopesticides to tackle the lepidopteran pests affecting commercial crops rather than resort to the “commercial” agenda of developing transgenic crops. It was in pursuing this kind of research that Ignacimuthu and his colleagues were eventually able to develop PONNEEM in the 2010s. True enough, PONNEEM is presently used by both small-scale and commercial farmers to protect their crops including in some of the north-eastern states in India.

However, it could be argued that Ignacimuthu and his colleagues at ERI were only pursuing a line of research that would gain them rewards in the form of patents and peer approval. In the next section, I engage with this claim and evaluate Ignacimuthu’s “alternative pathway” to get undone science done. I submit that Ignacimuthu may not have intentionally pursued undone science. In retrospect however, he is nevertheless a proponent for doing undone science. I briefly describe the context in which ERI developed PONNEEM and how it qualifies as knowledge produced in the interest of “the poor and the neglected” as suggested by Arrupe.

7.5.4 PONNEEM: a step towards getting undone science done

In the 1990s, plant strains were developed which could synthesize an insecticidal protein. This was done by encoding a gene (Bt) isolated from the bacterium *Bacillus thuringiensis*. In 1996, the American company Monsanto used Bt technology to protect cotton crops against the bollworm complex – a group of lepidopteran pests that attack cotton and several other crops (Herring, 2015; Srivastava & Kolady, 2016). These pests include the American bollworm (*Helicoverpa armigera*), Spotted bollworm (*Earias vittella*) and Pink bollworm (*Pectinophora gossypiella*). In 2002, the Government of India approved commercial cultivation of three Bt cotton hybrid varieties developed by Mahyco–Monsanto Biotech (a joint venture between the Indian firm Mahyco and Monsanto) cotton-growing states in India.

In 2006, a double-gene Bt cotton hybrid (Bollgard-II) was approved to provide additional protection against the tobacco caterpillar (*Spodoptera litura*), another pest that causes damage to cotton crops. By 2010, India became one of the largest countries planting transgenic cotton (Sanahuja et al., 2011).

As described earlier, Ignacimuthu was also involved in research on transgenic crops and even developed strains of GM rice and GM millet. However, he did not subscribe to the “magic bullet” argument that transgenic crops could solve all the problems of Indian agriculture. On the other hand, Ignacimuthu promoted the adoption of a spectrum of measures – including the adoption of transgenic crops if required. He also expressed concern that insect pests could potentially develop resistance to Bt genes, and that transgenic crops could have unintended effects on natural enemies of pests (Ignacimuthu & Jayaraj, 2006). At a conference in 2004, he encouraged his peers to “carry out more research on botanical pesticides and low-cost production technologies (in response) to the demand of farmers and to protect the environment from harmful effects” (Ignacimuthu, 2004).

By advocating research on botanical pesticides or biopesticides Ignacimuthu was not proposing something radical. He was only trying to “stay relevant” with contemporary research on natural products. The development of drugs from natural products peaked in the 2000s, when for example the World Bank adopted natural product based drugs to treat the malaria epidemic (e.g. Shen, 2015). New drugs continued to be investigated from plant and microbial sources in the 2000s (Bhutani & Gohil, 2010; Harvey, 2008). This enthusiasm continued in the search for natural products to be used in crop protection (Dayan et al., 2009). Besides being less expensive than petroleum-based pesticides natural products were observed to be much safer and even more effective in some cases (J. Varma & Dubey, 1999). ERI also began research on plant-based insect control methods in the early 2000s with a focus on developing biopesticides using locally available natural products.

Biopesticides are natural products which are developed by direct or indirect means. Direct methods include grinding plant leaves into powders or extracting plant oils. Indirect methods use laboratory procedures (including techniques in biotechnology) by extracting plant molecules or compounds exhibiting pesticidal properties. Ignacimuthu and his colleagues began exploring the effects of plant oils against the bruchid beetle in 2001 (Raja et al., 2001). Around the same time, other colleagues at ERI began exploring the biology of the tobacco

caterpillar and the mechanisms by which this pest developed resistance to insecticides (Janarthanan et al., 2003). Yet another team at ERI began researching the effects of plant essential oils (also called volatile oils) against crop pests. In collaboration with his colleague R Maheswaran, Ignacimuthu began to explore the larvicidal effect of some plant extracts against disease causing mosquitoes in 2008 (Maheswaran et al., 2008). This research was aided with inputs from ethnobotanical surveys carried out by research teams headed by Ignacimuthu (e.g. Ignacimuthu et al., 2008).

By this time, Monsanto had already begun marketing its double-gene variants of Bt cotton hybrids for protection against the tobacco caterpillar as well as the bollworm complex. On the other hand, ERI's researchers did not follow the transgenic crop route but began to explore the effects of plant based oils against the American bollworm (Baskar et al., 2009). That is, Ignacimuthu began to pursue an "alternate pathway" in dealing with one of India's most problematic crop pests. Meanwhile, other research teams at ERI were developing plant based products against disease causing mosquitoes (Balaraju et al., 2009). The breakthrough came when a combination of neem oil and pongam (beech tree) oil was found to demonstrate pesticidal properties against the tobacco caterpillar and the American bollworm in 2006. Soon after, Ignacimuthu and Maheswaran demonstrated that this combination could also be used against disease causing mosquitoes. In 2009, Ignacimuthu and his colleagues were awarded a patent for the pesticidal combination, which was named PONNEEM (Ignacimuthu & Packiam, 2009).

Contemporaneous with ERI's research on biopesticides, Ignacimuthu also initiated a farmer extension program that was funded by government agencies such as Department of Science and Technology (2005-08) and Department of Biotechnology (2009-11). Under this program, ERI collaborated with the Loyola College chapter of Students in Free Enterprise (SIFE), an international student body that promotes entrepreneurship, to demonstrate PONNEEM to farmers in villages. In 2008, student members of SIFE and researchers at ERI tested PONNEEM with farmers in three districts of Tamil Nadu (Tirunelveli, Kancheepuram and Thiruvallur). The results of the pilot tests with over a thousand farmers were encouraging and PONNEEM was registered for marketing in May 2009 ("Students in Free Enterprise," 2009). ERI then employed the services of a marketing agency, Nimbion Organics, to sell PONNEEM to farmers. Interestingly, the person heading the agency was an alumnus of Loyola College, who Ignacimuthu stated was "a very moderate kind of businessman". In

2011, PONNEEM was approved for use as an organic biopesticide according to the National Programme for Organic Production (NPOP) standards (IMO, 2013). Further, PONNEEM received widespread attention in the media particularly in regional agricultural magazines. By 2012, PONNEEM was demonstrated to be effective against the pests which Monsanto claimed could only be dealt with by transgenic crops (Packiam et al., 2012b, 2014; Packiam & Ignacimuthu, 2012).

ERI's research agenda did not exclude any line of research. Research on transgenic crops and biopesticides proceeded simultaneously. But the focus appears to have been on pursuing science in the best interests of those who needed it the most. In this pursuit, Ignacimuthu demonstrated that GM crops are not the only solution for dealing with some of the leading pests in Indian agriculture. In fact, his team at ERI showed that botanical pesticides like PONNEEM are better because they do not lead to pesticide resistance, do not attack non-target organisms, and are not harmful to humans and the environment. Further, ERI was able to pursue research on biopesticides even when funding elsewhere was dominated by the synthetic agro-chemical industry.

A closer look at the funding sources for ERI's research shows that the institute was never funded by private agro-chemical corporations. This was not because ERI was against private funding; the institute had indeed received funding from corporate entities ranging from pharmaceutical companies (such as Nicholas Piramal Labs) to confectionery manufacturers (such as EID Parry). During the first decade of his leadership at ERI, Ignacimuthu was able to secure funds from government agencies (such as CSIR, ICMR and DBT). Later, ERI carried out research in collaboration with international universities. But the major part of research and development of PONNEEM over nearly a decade (from 2005 to 2014) was supported by the corpus of funds that ERI built up over time. As proposed by Woodhouse et al (2002), ERI took up biopesticide research even with the knowledge that no corporate donor would support a research field that benefits farmers alone and not a corporation. In other words, ERI was able to set its own agenda without having to follow the "money trail" or to pursue the dominant line of research (on transgenic crops).

It is my submission that ERI's success with PONNEEM is a promising small step in effecting large-scale transformative change. It is a vital step to put biopesticides on the larger map of getting undone science done in the field of agricultural biotechnology – a field dominated by

synthetic chemicals and transgenic crops. Doing agricultural research independent of the dominant paradigm of market-led biotechnology is particularly challenging when industrial elites are focused on developing saleable “products” rather than address farmers’ needs. It is in this context that ERI stands out as an example of doing research according to Arrupe’s agenda of prioritizing “local needs” over simply achieving “technological progress”. By tackling the problem of crop pests in a concrete way amidst different research agendas and priorities, Ignacimuthu demonstrated that a science “that does justice” is possible in the Jesuit way of proceeding even though it may only be a “small win” in the long run to get undone science done (see, Weick, 1984; Termeer & Dewulf, 2019).

The fact that Ignacimuthu was a Jesuit and that ERI was housed in a Jesuit college, were important factors in determining the kind of research that was done at ERI. For instance, Ignacimuthu revealed how some Jesuit colleagues in Zambia were disappointed that he was pursuing research in transgenic crops.⁹⁸ However, he tried to reason with them that he was only interested in the benefits of transgenic technology and not in promoting the commercial interests of profit-oriented corporations. Even within the Madurai Province, Maria Packiam recalled how Jesuits in the social apostolate suggested that research in Jesuit institutions should not pursue chemical intensive or transgenic crop based agriculture. In any case, ERI does not pursue these lines of research dominantly. These instances indicate that doing research as a Jesuit in a Jesuit college meant that the researchers had to constantly engage with the question of whether the research fulfils the demands of the Jesuit mission. As we have seen, it can be reasonably assumed that ERI’s research on PONNEEM did fulfill the Jesuit agenda for scientific research, as I summarize in **Table 7-4**.

But how different were the research agendas of Ignacimuthu and Maria Packiam from the pre-Arrupe agendas of Yeddanapalli and Ananthakrishnan? On the face of it, there does not appear to be much difference. ERI under both Ignacimuthu and Ananthakrishnan pursued excellence in research, sought funds from donors of all kinds, and tried to stay relevant with contemporary trends. The significant difference was in how the broader Jesuit agenda for social justice began to influence all Jesuit apostolates, including scientific research. As a result, Ignacimuthu was also inspired to engage with socially-relevant research though it was not his primary motivation. He was certainly not a scholar oriented towards activism, but he

⁹⁸ For an overview of the GM crops controversy in Zambia and the role of the Jesuits in opposing GM crops, see (Bowman, 2015).

did pursue research that was “directed towards local needs and oriented towards the transformation of society”. In retrospect, the social impact of PONNEEM shows that ERI under Ignacimuthu did make a significant contribution to getting undone science done.

Characteristic of Jesuit research	PONNEEM as a response
Does the research seek to understand “unjust structures of society?”	PONNEEM was a small-scale response to the “unjust” practice of monocropping of transgenic crops and widespread usage of synthetic chemicals
Does the research “combat the causes of injustice”?	Though PONNEEM is a patented product, the general procedure for producing a local version of PONNEEM is also available to farmers so that they can prepare it in on their own. So the knowledge is available unrestricted to those who need it, thus enabling justice through research
Did the research emerge from a “greater insertion into the community around”?	The identification of plant oils was done based on locally available materials. Further, the efficacy of PONNEEM was done based on pilot studies done in collaboration with farmers and students
Does the research consider “what is relatively most urgent and most needed in different places”?	The need for natural products in crop protection has been emphasized across the developing world, though it has not been prioritized in the global political economy
Is the research “directed towards local needs and oriented towards the transformation of society”	PONNEEM is cost-effective and intended for use by small-scale farmers, though it is also used by large-scale farmers.
Is it a unified (interdisciplinary) solution?	While PONNEEM is an agro-ecological biopesticide, it was developed by using the latest methods in agricultural biotechnology

Table 7-4: PONNEEM as a product of the “Jesuit” research agenda

7.6 Discussion and Conclusion

This chapter began by exploring how the Jesuits first pursued scientific research at the Loyola College in Chennai, through the initiative of Jesuit priest and chemist Yeddanapalli. It was noted that his research was oriented towards the Nehruvian approach of promoting industrialization and self-sufficiency to accommodate the needs of the rising Indian economy. The arrival of the new Jesuit Superior General Pedro Arrupe brought forth a shift in the focus of Jesuit higher education, most notably towards creating “men for others” who sought justice for the poor and the marginalized. Arrupe also called for a reorientation in research according to the justice mission he espoused. This “reorientation” created a tension among Jesuits in science. We noted that Arrupe’s demand was more in line with the call for “undone science”

advocated by civil society organizations, where research priorities are set by the need for social change rather than by commercial or government interests. We observed that this posed a challenge to Jesuit research on how to get “undone science” done as articulated by Arrupe. We then proceeded to analyze the research of Ignacimuthu and his associates at ERI, to show that despite being a proponent of GM crops, they still pursued an agenda of getting “undone science” done by working on biopesticides.

The research agenda led by Yeddanapalli and later Ananthakrishnan was no doubt focused on national development. While Yeddanapalli was oriented towards industrial research Ananthakrishnan was keen on understanding insect ecology towards improving agricultural production. They excelled in their fields and put Loyola College on the international map of scientific research in their respective fields. Yet, it was only after Arrupe introduced a rethink of Jesuit scholarly research that Loyola College began orienting itself towards local needs. But the shift in research agenda did not come about rapidly. As Frickel et al. (2010) suggest, implementing alternative research agendas is a continuing struggle in the “broader politics of knowledge” (p. 464).

Within ERI’s research on biopesticides, we noticed that different actors had different orientations: Ignacimuthu was moved by the farmers’ plight while Maria Packiam was concerned about the environment. However, both of them used mainstream biotechnological research to promote the alternative pathway of biopesticides research. Thus, ERI was able to maintain allies in the scientific community as well as with the farming community. Further, ERI did not give up all mainstream research; Ignacimuthu continued promoting research on transgenic crops even as research on PONNEEM yielded results. In this particular instance, one can see that doing undone science does not mean giving up mainstream research. Further, Arrupe also encouraged Jesuits to pursue research of all kinds provided that research fulfilled the needs of “the poor and the neglected”. This chapter shows that ERI attempted to maintain that balance.

In addition, the case of ERI also shows the dilemma in choosing between different research areas. Despite conflicting opinions from within the larger Jesuit community, ERI continued to work on transgenic research because the institute was forced to establish its academic credentials to the larger scientific community. For instance, Ignacimuthu served as an adviser to the development of a curriculum on transgenic crops for an agricultural degree program.

So, doing research on biopesticides did not stop Ignacimuthu from pursuing mainstream research. At the same time, he ensured that the applications of ERI's research were available to all. In fact, even though PONNEEM is a patented product, the recipe for making the biopesticide with plant oils is made available free to all farmers. This chapter has shown that the research agenda of ERI tried to take on a uniquely Jesuit character, only after the various GCs under Arrupe initiated a focus on socially relevant research. As a result, ERI shifted its research priorities from a broader national orientation under Ananthakrishnan towards a local needs based approach which prioritized the needs of the poor and the neglected, thus doing “undone science”.

This chapter helped to understand how Jesuit scientists navigate the challenges of doing research while also fulfilling the Jesuit mission. We also noted how the trajectories of Jesuit science changed under the influence of both external and internal factors. Yet, it is my submission that the research agenda of Jesuit scientists during and after the leadership of Arrupe is more socially relevant and geared towards getting undone science done, in comparison to Jesuit science before Arrupe.

(8) Conclusion: Unravelling the Jesuit sociotechnical imaginary in postcolonial India

8.1 Introduction

I began this research with the objective of unravelling the “multi-layered array of missionary, intellectual and cultural activities” of the Jesuit priest-scientists of Madurai Province (Section 1.2). In the introduction, I described the focus of my exploration as what could be called Jesuit postcolonial science in India, that is the scientific activities of Jesuits in independent India. In this thesis, I presented the scientific biographies of a few Jesuit priest-scientists of the Madurai Province, from the standpoints of Science, Technology and Society Studies (STS), the social history of missionary science and the historiography of Christianity in postcolonial India (Chapter (2)). While focusing on the “social turn” this thesis also draws from the “affective turn” in the social and historical studies of science (as discussed in Section 4.1). Specifically, the role of affective spirituality in orienting the scientific activities of the Jesuits is a common theme throughout this thesis.

As I draw close to the end of this exploration, some important ideas can be identified to have emerged from this thesis – the primary idea being that the cultures of Jesuit scientific activity in independent India were diverse. These cultures were driven by missionary considerations but were dependent on socio-political factors local to the region. In this feature, Jesuit postcolonial science in India shares a common feature with Jesuit colonial science – neither is boring nor homogenous (Raina, 2014). But as recent explorations of Jesuit science in Europe and North America have demonstrated, I have also tried to show that the characteristics of Jesuit science in a specific time and space need to be examined on its own merits and considered separately from other avatars (Geschwind, 1998; Romeiras & Leitão, 2016). Accordingly, the micro-histories explored in this thesis suggest that the Jesuits’ practice of science *Ad Maiorem Dei Gloriam* (“for the greater glory of God”) in India was thoroughly entangled in their missionary goals and the sociotechnical imagination of postcolonial India. This “entanglement” was driven by two factors, as I explain below.

First, the missionary orientation of the Christians in postcolonial India had undergone a paradigm shift from one of “conquest” to “dialogue” (see Section 2.5). The postcolonial emphasis on social justice and the postmodern engagement with new religions further pushed the Catholic Church to realize that it could no longer claim to hold the blueprint for human

salvation (e.g. Njoku, 2007; Latinovic et al., 2018). This meant that missionary scientists in the 20th century were forced to think beyond proselytization but work towards improving the quality of life for *all* peoples - not just Christians. This was one of the reasons why, this thesis suggests, the Madurai Jesuits were forced to reorient their scientific activity in independent India. Secondly, the reoriented missionary goals of the Madurai Jesuits became embedded into, if not dependent upon, how they construed science and technology in independent India. I submit that the Jesuits organized their missionary activities and occasionally even their collective value systems, around their many interpretations of science and technology. It is this theme that I elaborate in this concluding chapter by adapting Sheila Jasanoff's idea of sociotechnical imaginaries. I suggest that the Jesuit reorientation with science and technology in independent India, contributed to the birth of a new collective imagination around what it means to be a missionary for the greater glory of (the Christian) God while also being supportive of contemporary advances in science and technology. It was this collective imagination, I argue, that led to a new culture of Jesuit science in independent India – a culture which was quite different from its colonial avatar. In the next section, I provide a brief background into the concept of sociotechnical imaginaries.

8.2 Sociotechnical imaginaries as collective visions of social progress

Jasanoff notes that STS theories have helped describe how technological systems are socially constructed and have explained the role of human choice in the design of technological objects (e.g., Bijker et al., 1987). Yet, conceptual frameworks that integrate “material, moral and social landscapes” so as to better engage with “the normative dimensions of science and technology” are yet to emerge in STS literature (Jasanoff, 2015a, p. 3). Indeed, scholars like Woodhouse et al. (2002) have raised normative questions such as “how to reconstruct technoscience to promote a more democratic, environmentally sustainable, socially just or otherwise preferable civilization” (pp. 297-298). Also in a related context, Bruno Latour (2005) suggests that it could be useful to ask why religious people do what they do while exploring these normative questions in the social studies of science (p. 235). Similarly, Jasanoff also argues that a framework could be useful to explain how our values and norms (including religious values though she does not refer to them explicitly) are integral to how we make sense of science and technology in a globalized world. Towards this goal, Jasanoff (2015a) drew inspiration from the concept of imaginaries, which broadly refers to collective beliefs about how social order is imagined and maintained in modern society.

The political scientist Benedict Anderson (1991) suggested that nationalism is a collective, mental construct which is stabilized through common practices such as remembering, forgetting and narrating (as cited in Jasanoff, 2015a). The philosopher Charles Taylor (2004) described the emergence of modernity as a result of how “people imagine their social existence... how things go on between them... the expectations that are normally met, and the deeper normative notions and images that underlie these expectations” (as cited in Jasanoff, 2015a). Jasanoff extended these conceptualizations and argued that collective imagination could be key to explain different scientific and technological trajectories in different social circumstances.

Jasanoff and Sang-Hyun Kim (2009) illustrated the role of imaginaries in the case of American and South Korean responses to the emergence of nuclear power technologies. They explained that the US saw itself as a risk-averse regulator of the technology while South Korea saw nuclear power as a pathway for development. These divergences in how two nations imagined social order led to differences in how they framed risk and state responsibility in technological projects. Using this comparative example, Jasanoff and Kim suggested that the collective imagination of different groups can result in a diversity of sociotechnical visions of the public good. Later, they updated their conceptualization to suggest that these collective imaginations need not be limited to nation-states but could also be extended to other organized groups such as collectives driving social movements, international corporations and professional societies. Towards this effect, Jasanoff defines “sociotechnical imaginaries... as collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology” (Jasanoff, 2015a, p. 4).

Jasanoff suggests that sociotechnical imaginaries can originate in the vision of a single individual or a group of individuals. This vision attains the status of an imaginary when it is adopted communally by an organized group. For instance, the technocratic vision of the businessman and (racist) politician Cecil Rhodes led to the sociotechnical imaginary that founded the colony of Rhodesia, now known as Zimbabwe. This imaginary had wide-ranging social and environmental implications for southern Africa in the twentieth century (Storey, 2015).

Jasanoff also states that imaginaries describe visions of “desirable futures”. In other words, they are grounded in “positive visions of social progress” and describe “not only visions of what is attainable through science and technology but also of how life ought, or ought not, to be lived” (Jasanoff, 2015a, p. 4). For this reason, multiple imaginaries can co-exist in society with one imaginary eventually being elevated to a dominant position through institutions of power (like governments or courts). Ulrike Felt (2015) illustrates this in the example of how Austrian people were driven by the imaginary of “Austria being free” from harmful technologies like genetically modified organisms (GMOs) and nuclear power. This “imaginary of the absent” later governed the emergence of innovations like nanotechnology in Austria.

The concept of sociotechnical imaginaries could be employed to understand how specific kinds of techno-scientific trajectories are integral to collectively imagined ways of social progress. The concept helps to consider the relation between the values and world-views of social groups on the one hand, and the choices and desirable futures associated with sociotechnical systems on the other. Jasanoff (2015a) argues that this concept can help to explain “temporally situated and culturally particular” imaginations which emerge through the embedding of science, technology and society (p. 19).

The mission of the Jesuits, as we noted in Chapter (3), is primarily drawn from the teachings of their founder Ignatius of Loyola. We further observed in Chapter (5) that this mission was renewed in the 20th century, thanks to the Second Vatican Council and Pedro Arrupe. This renewed mission made the Jesuits more socially reflexive, urging them to reflect on what Jesuits ought to do, for whom and for what. In other words, the Jesuit mission for the 21st century essentially provided for them a vision for a desirable future (Kolvenbach, 2000). In this thesis, I have described how the missionary trajectories of the Jesuits of Madurai Province were shaped by (among other things) their response to ongoing developments in science and technology in independent India. The three case studies show that these trajectories did not always overlap neatly to create a universal agenda for Jesuit science. In this context, I consider the concept of sociotechnical imaginaries useful to describe this emergence of a pluriform character of Jesuit science in postcolonial India. I extend the utility of this concept by integrating the importance of Jesuit missionary spirituality in the Madurai Jesuits’ idea of sociotechnical progress. Based on my explorations in this thesis, I identify

three features which contributed to the evolution of a Jesuit sociotechnical imaginary in independent India.

Firstly, the collective imagination of the Jesuits was born from remembering a “glorious” legacy of Jesuit science. It was this remembered legacy of the pioneering Jesuit men of science (within India and beyond) together with their roots in Jesuit spirituality that set in motion the Madurai Jesuits’ engagement with science and technology, albeit in a form adapted to postcolonial India.

Secondly, the Jesuits embedded their vision of science “for the greater glory of God” in material artefacts. The Madurai Jesuits exemplified the practice of science through tangible outputs such as the publication of journal articles, registration of patents and trademarks and launch of research institutes. Further, these outputs began to be celebrated as landmarks of sociotechnical excellence and social progress, both among the Jesuits and in non-Jesuit circles.

Finally, the vision of scientific research as a valid Jesuit mission was extended into the Jesuit imagination through institutional recognition. Despite competing opinions on what it meant to fulfil the Jesuit mission, the Jesuit priest-scientists’ visions of “faith that does justice” gained traction among their superiors and administrators. This helped to stabilize the Jesuit sociotechnical imaginary despite internal resistance. I explore these above three features in some detail in the following sections.

8.3 Reinforcing the legacy of Jesuit science vis-à-vis Jesuit spirituality

The Jesuits generally consider the Order’s historic engagement with science as an integral part of their legacy. The Jesuit priest-scientists of the Madurai Province claimed to be descendants of this legacy thanks to the many pioneering Jesuit men of science in the region (as we noted in Section 3.8). It did not matter to the contemporary Jesuits that most of their predecessors were amateurs and not formally trained in the sciences. In Chapters (3) and (6), I described that two of these pioneers – Louis Anglade and Alfred Rapinat – were science educators and communicators at best. Even though KM Matthew pointed out that Anglade’s celebrated floral portraits were not made as per accepted standards (refer Section 6.4.1), Anglade continues to be celebrated as a “Jesuit scientist” precisely because of those portraits. Another seminal figure celebrated by the Jesuits is the French Jesuit palaeontologist Teilhard

de Chardin. KM Matthew considered him “the model of the Jesuit and of the man of science” while Valan Benjamin described himself as a “priest of the cosmos” using Teilhardian theological constructs (see Chapter (4)). Ironically, Teilhard was never considered a Jesuit role model in his lifetime and was even censored for a while; his writings gained traction only posthumously (Grumett & Bentley, 2018). Aligning their personal spiritual-scientific journeys with that of Teilhard or Anglade helped to legitimize the Jesuits’ scientific engagements to themselves and their peers. The role of such “mythical” figures of Jesuit science helped to reinforce the contemporary Jesuits’ engagement with science.

Reinforcing the scientific legacy of the Jesuits is a trait found not only among Jesuit scientists but also their superiors. In Chapter (5), I described how the Provincial Leslie Almeida motivated Joseph V D’Souza to encourage young Jesuits to study and pursue research in science. The superiors of Loyola College in the Andhra region of Madurai Province had welcomed D’Souza from Goa-Pune Province, specifically to help establish a research division in their college. Likewise in Chapter (6), I described how KM Matthew was encouraged by Provincial Douglas Gordon to pursue postdoctoral research before Matthew established an autonomous research centre at St. Joseph’s College, Trichy.

Based on interview data presented in this thesis, I explained that the Jesuit superiors insisted on science education for some of the more brilliant Jesuits because of the perceived needs of the Province. In Chapter (4), I described how Matthew Paul wondered if his superiors wanted him to specialize in microbiology because there were no Jesuits trained in that field. Likewise, Valan Benjamin was asked to pursue doctoral studies in a field (biochemistry) he was not originally trained in because his Province required a qualified Jesuit in that discipline. The trigger for these actions seems to have been the superiors’ desire to have their Province Jesuits present in and excel in as many scientific disciplines as possible, especially to teach and pursue research in their colleges. Promoting the scientific apostolate was often in the minds of the superiors and remembering the Jesuit scientific legacy aided this effort of reinforcing Jesuit presence in the sciences.

Despite initial obstacles to studying and engaging with science, these Jesuits were able to overcome these challenges because, they said, of their formation in Jesuit spirituality. In Chapter (4), I explained how training in the Spiritual Exercises helped these Jesuits to align their personal goals with the broader Jesuit mission and to find spiritual consolation in their

scientific work. Unlike their predecessors who engaged with science as hobbies or to complement other work, the postcolonial Jesuit scientists had no choice but to find purpose and meaning in their scientific work. They therefore had to find “flow” in their work, as I explained in Chapter (4). Besides their scientific work, these Jesuits also found ways to strengthen their spirituality and commitment to the Church and to the Society of Jesus.

In Chapter (5), I described how Joseph V D’Souza went on personal spiritual retreats while working at the Social Centre in Pune. Similarly, KM Matthew remained up-to-date in Catholic theology by reading theological journals; this also helped in later orienting his eco-theological perspectives (refer Chapter (6)). Matthew also offered spiritual retreats to nuns and students in Trichy while simultaneously pursuing his taxonomic projects. In Chapter (4), I described how the Jesuit priest-scientists reinforced their imaginations of “science-as-spiritual practice” by adapting their initial spiritual formation to the evolving postcolonial, postmodern context in India. These Jesuits attempted to “find God” in their scientific practice in ways similar to how other secular scientists find transcendent meaning in their work. This allowed the Jesuit men of science to claim to even be aware of the presence of God in the lab, as Valan Benjamin described in Chapter (4). This reinforcement of the Jesuits’ scientific practice through their shared spiritual formation allowed them to engage in science as a distinct missionary activity. This emphasis on their spirituality differentiates the Jesuit scientists from other theistic scientists who attribute their “rational beliefs” to their social and cultural upbringing (R. Thomas, 2019). The impression, that science could also be a spiritual practice was born by recalling the legacy of the Jesuit past but also evolved in the context of postcolonial India and the postmodern Church (Chapter (4)). The entanglement between the legacies of Jesuit science and of Jesuit spirituality, this thesis suggests, also contributed to the distinct, collective imagination of the Madurai Jesuit priest-scientists.

8.4 Stabilizing the Jesuit sociotechnical imaginary through material artefacts

The collective imagination of Jesuit priest-scientists originated by remembering the roots of their spirituality and their scientific legacy. But for the idea that science could be a legitimate Jesuit mission to take root and gain legitimacy it had to be translated into “tangible things that circulate and generate economic or social value” (Jasanoff, 2015b, p. 326). I suggest that this translation from ideas to materiality was another distinct feature of Jesuit postcolonial science.

The Jesuits in colonial India also produced technoscientific artefacts but it was not an integral part of their mission. The Madurai Jesuit scientists however, had to demonstrate their commitment to the Jesuit mission precisely through the production of those artefacts. The Jesuit man of science in postcolonial India could no longer be a “Jack of all trades” in the manner of Louis Anglade but a specialist in the likes of KM Matthew. In this thesis, I have variously described how the Madurai Jesuits in independent India produced tangible outputs such as science textbooks, genetically modified crops, research articles, biopesticides, patents, registered trademarks, environmental awareness programs and also research institutes of international repute. This embedding of the Jesuit sociotechnical imagination did not take place independently but in and through the developments in science and technology in independent India.

In Section 7.3 , I described how the focus of Jesuit scientific activity took shape in the “research for national development” paradigm of Jawaharlal Nehru. I explained that Lourdu Yeddanapalli played an important role for the Madurai Jesuits to promote this paradigm. This approach was also followed by KM Matthew who promoted economic botany (initially) to support the identification of “useful plants” (Section 6.4). I also described that these Jesuits accessed grants provided by government bodies and philanthropic organizations to establish independent research centres at Jesuit colleges in the Madurai Province. Significantly, these Jesuits were among the first of the Madurai Jesuits to be allowed to pursue research as their only missionary assignment. This led to the gradual embedding of the Jesuit sociotechnical imaginary within the tangible outputs of these Jesuit men of science, ultimately shaping a new Jesuit scientific culture in the Madurai Province. As a consequence, their superiors even began to make accommodations in their governance structures. For instance, prior to Indian independence, Jesuits were seldom allowed to stay in one institution for more than five years. But Jesuits engaged in science were now allowed to remain in their labs/research centres for decades together. For example, Ignacimuthu (Chapter (7)) stayed as Director of Entomological Research Institute (ERI) for more than two decades, while Matthew (Chapter (6)) was Director of Rapinat Herbarium Trichy (RHT) and Anglade Institute of Natural History (AINH) for nearly four decades.

The Jesuits also updated their scientific pursuits with changing technoscientific policies in India. For instance, the Department of Botany which was established by Rapinat at Loyola

College, Chennai in the 1940s was re-christened the Department of Plant Biology and Biotechnology in 2000 to signify that Jesuits were at the forefront of emerging disciplines. Likewise, the Rapinat Herbarium in Trichy was renamed the Rapinat Herbarium *and* Centre for Molecular Systematics in the 2000s. In Chapter (7), we noted Ignacimuthu's emphasis on "staying relevant" as a mark of Jesuit excellence in science. Therefore, he made the Entomological Research Institute a multidisciplinary centre for research in agricultural biotechnology. While these many attempts did help in embedding the Jesuit sociotechnical imaginary in the collective psyche of the Jesuits it did not happen without resistance.

As Jasanoff suggested, multiple imaginaries can co-exist in tension within a social group. So despite the Jesuits' efforts to promote scientific activity as a distinct missionary apostolate a clear agenda to achieve this goal never quite emerged. In Chapter (5), I described how Joseph V D'Souza tried to establish a nationwide network of Jesuit scientists with a common agenda. D'Souza did manage to keep the network operational for a few years and the network even gained the appreciation of the Jesuit Superior General Pedro Arrupe. Yet, the members of the network never seemed to quite agree on what kinds of science were worth exploring. For instance, I described that Arrupe wanted Jesuit men of science to promote community oriented research. D'Souza was convinced that appropriate technology would help in fulfilling Arrupe's vision for science as well as bring Jesuit scientists together under a common banner. But he did not consider the reality that the Jesuit scientists, like most other scientists, were trained in different fields and thus had different visions of what a desirable sociotechnical future looked like. On the other hand, in Chapter (6), I described how Matthew was able to navigate such tensions in the boundaries of his organization by creating different boundary objects. Matthew's vision of science as mission appears to have succeeded while D'Souza's apparently failed.

In Section (6)5.3, I described how the Jesuits adopted a renewed mission of a "faith that does justice". I also described that Arrupe instructed Jesuit men of science to use their scientific acumen and identify solutions to problems faced by the poor and the oppressed. I explained that this social justice mandate from Arrupe created tensions between Jesuits of the social apostolate and those in the scientific apostolate. The Madurai Jesuits even acknowledged these tensions in their province meetings (Section 7.3). Interestingly, the Jesuit men of science did not find it necessary to present a unified agenda to address their grievances. As outlined in the previous paragraph, the lack of a common agenda was due to the existence of

different visions of Jesuit science among the Jesuits. D'Souza was keen on promoting appropriate technology; Matthew had a passion for ecological justice; Ignacimuthu worked on cutting edge biotechnological research; the superiors were satisfied as long as these men gained public recognition for the Jesuit colleges. So in an indirect manner, the Jesuit sociotechnical imaginary gained traction through Jesuit men of science working in silos rather than collectively. The imaginary appears to have stabilized because these men adapted their independent research projects to the collective Jesuit mission of a “faith that does justice”. Each of the Jesuit scientists I discuss in this thesis chose to adapt their work to focus on serving the marginalized even though they had differences among themselves as well as with other Jesuits.

In Section 7.5 , I described how Ignacimuthu began his research with a “pure” science focus and later shifted to applied research. He included an agricultural extension wing at ERI to directly engage with farmers eventually supervising the development of the PONNEEM biopesticide which served farmers as well as gained fame for the Jesuits. In Section 6.4 , I described how Matthew began with taxonomic research and later adapted it to advocate environmentalism. While he was not entirely in favour of the social justice mandate adopted by the Madurai Jesuits he made it clear that research should indeed serve the interests of the people. He also collaborated with activists and environmentalists to promote “science for social change”. In other words, despite the existence of multiple imaginaries, the Jesuit men of science served as “social change agents” and engaged in doing science in the fulfilment of the Jesuit mission – thus contributing to a dominant sociotechnical imaginary of science “for the greater glory of God”.

The simultaneous existence of multiple visions of social progress in the case of the Madurai Jesuits only seems to have strengthened the Jesuit sociotechnical imaginary, because it allowed the Jesuits to advance their work in science and technology in multiple disciplines and forums. Multiple imaginations permitted the Jesuit scientists to act upon the Jesuit maxim of “finding God in all things and all things in God” in the manner best suited to them (as long as it had the approval of their superiors). Despite their differences, the Madurai Jesuits were able to construct a narrative that they were a collective force in using science “for the greater glory of God”. By placing their scientific work in the context of the Jesuit mission in postcolonial India and as a continuation of the historical legacy of Jesuit science, they were able to present themselves as a collective that reinforced the Jesuit mission. The other non-

scientist Jesuits helped to embed this narrative in the collective memory of the Province thus stabilizing the Jesuit sociotechnical imaginary.

8.5 Extending the Jesuit imaginary through institutional recognition

Jasanoff explains that it is through the phenomenon of extension that ideas gain traction and endure an imaginary. She defines extension as “the complex of processes by which unconventional ideas gain traction, acquire strength, and cross scales, for example, by persisting through time or by overcoming geopolitical boundaries” (Jasanoff, 2015b, p. 323). In the case of the Jesuit men of science in the Madurai Province, the “unconventional idea” that gained traction in postcolonial India was that Jesuit involvement in science and technology was a distinct missionary pursuit. Previously, I observed that the collective memory associated with past Jesuit involvement in science and the embedding of that memory in tangible outputs helped to stabilize the Jesuit sociotechnical imaginary. In this section, I explain that the Jesuit superiors extended this imaginary by enabling the institutional recognition of the Madurai Jesuits’ scientific activities.

In Chapter (5), I briefly noted that after the 1960s the Vatican began to take a more favourable approach towards training priests in the sciences. This was considered necessary in the context of adapting the evangelical mission for (post-)modern times. Significantly, Pope Paul VI also published a letter directly addressing scientists and other intellectuals (Paul VI, 1965b). These important milestones in the Church’s positive outlook towards science were welcomed by Superior General Pedro Arrupe. In the same chapter, I described that it was Arrupe who first established a separate Jesuit apostolate for science. This was the earliest of instances when recognition was formally accorded to Jesuit scientific engagement across the world. In India, this recognition came through the establishment of the Jesuit Scientists’ Secretariat under Joseph V D’Souza.

Based on my description of the demise of the Secretariat, it may be tempting to consider the work of D’Souza and his secretariat as a failed experiment. But I have shown that the Jesuits nationwide were indeed interested in science and technology as a missionary apostolate – it so happened that they were not impressed with D’Souza’s vision. Arrupe himself impressed upon Jesuit superiors to enable Jesuit men of science to pursue research as long as it fulfilled the Jesuit mission (refer (6)5.5). Despite its short-lived existence, the secretariat set in motion other science-related ministries by the Jesuits. Significantly, D’Souza drafted a

manifesto for Jesuit scientists and so was instrumental in extending the Jesuit sociotechnical imaginary in postcolonial India.

In a similar fashion, we can consider KM Matthew's journey (Chapter (6)) from being a teacher of botany to establishing a "two-station botanical establishment" as one particular trajectory of how the Jesuits extended the Jesuit sociotechnical vision in the Madurai Province. Like D'Souza, Matthew also faced hurdles in embedding his vision for the utility of botanical research. However, the relevance of his vision was ultimately understood in the context of the environmental crises. Matthew was successful in extending the idea of ecological justice as an integral component of the Jesuit mission, because he was also able to relate it to pastoral themes of ecotheology. His ideas were formally adopted within the collective Jesuit mission – when the Social Justice Secretariat in Rome was renamed as the Social Justice *and* Ecology Secretariat (refer Section 6.5). Matthew's case demonstrates how an individual's vision was successfully translated into the collective imagination of the Jesuit order.

The case of the Entomological Research Institute (ERI) at Loyola College also indicates the gradual extension of the Jesuit sociotechnical imaginary through institutional recognition. In Chapter (7), I explained how Yeddnapalli's vision overlapped with the Nehruvian vision of science for national development. The Madurai Jesuits' embrace of scientific research as a tool to enhance their public image gathered strength in the research activities of both Jesuits and non-Jesuits in the Loyola College. The foundations for entomological research were established by the non-Christian layman Ananthakrishnan whose vision was formally approved by the Jesuit superiors of the college. Eventually when Ignacimuthu took over as director of ERI, the Jesuit sociotechnical imaginary gained traction through the multidisciplinary activities of the institute. Despite his endorsement of transgenic crops and agricultural biotechnologies, Ignacimuthu's primary work was with biopesticides and ethnomedicine which was enmeshed in the Arrupean vision of doing science to solve people's problems.

In Section 4.4 , I drew from Isabella Csikszentmihaly's conclusion that it was the Jesuit "system of all-embracing rules" that enabled the Jesuit priest-scientists to find consolation in their scientific work (I. Csikszentmihalyi, 1988). I explained that the scientific engagements of the Jesuits would not have been possible if not for their formation in the spiritual tradition

institutionalized by the Jesuits. Further, the role of the Jesuit superiors – particularly, the novice master and the provincial – was crucial in encouraging the Jesuit men of science to pursue and excel in science. In addition, the idea of mission as mere evangelization was no longer considered valid among the postcolonial Jesuits (Amaladoss, 1988). Mission came to be seen by the Jesuits as promoting social justice and improvement in the quality of lives of the people. Hence, science was considered worth pursuing and formally endorsed by the Jesuit superiors as I summarize in this section. I submit therefore that the material achievements of the Jesuit men of science are intricately entangled with the moral/normative infrastructures of the Society of Jesus. As a result, the sociotechnical imaginary of the Madurai Jesuit priest-scientists has endured in independent India through formal recognition and organization of Jesuit scientific activity by the administrators of the Society of Jesus.

8.6 A final word

The purpose of this thesis was to explore the scientific practice of Jesuits in postcolonial India and how it is entangled with their missionary spirituality. I explored the varieties of science practised by the Jesuit priest-scientists of the Madurai Province by using a “history from below” approach. That is, I examined the cultures of Indian Jesuit scientists in independent India from a viewpoint of Indian Christianity. This is a markedly different approach as previous accounts of Jesuit science in India have often been explored only from the perspective of European missionaries during colonial rule. Further, I have employed the complexity thesis of science and religion in suggesting that Jesuit scientific activity in independent India was not merely a missionary ploy for proselytization but was socially constructed through Jesuit involvement in science education and research. I explored the diversity of Jesuit scientific activity through micro-histories of seminal Jesuit priest-scientists in the Madurai Province. In each case, I examined how Jesuits’ engagement with science and technology is temporary and culturally situated, while also rooted in the Jesuit spiritual tradition and oriented towards fulfilling the Jesuit mission of “faith that does justice”. In conclusion, I argued that Jesuit scientific activity in independent India gave rise to a distinct sociotechnical imaginary which reinforced the idea that Jesuit science is a missionary pursuit “for the greater glory of God”.

This thesis contributes to social studies of science and belief in its approach to integrate the historiography of science and religion with conceptual tools employed in STS. Further, the thesis critically engages with Jesuit scientific activity without elevating them beyond their

historical and cultural significance. The thesis points towards the necessity of engaging with the scientific outlook of different religious communities in India to understand how the collective imagination of such groups gives rise to diverse visions of sociotechnical progress.

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Annexures

A) List of interviews

	Name	Institution	Date (Location)
1	Rev. Dr. Savarimuthu Ignacimuthu SJ	Director, Entomological Research Institute, Loyola College, Chennai	15 December 2015, 15 May 2017, 18 May 2017 (Chennai)
2	Rev. Dr. S. John Britto Bonaventure SJ	Director, Rapinat Herbarium & Centre for Molecular Systematics Institute, St. Joseph's College, Trichy	24 May 2017, 26 May 2017 (Trichy)
3	Rev. Dr. Maria Packiam SJ	Deputy Director, Entomology Research Institute, Loyola College, Chennai	20 August 2018 (Chennai)
4	Rev. Yendrapati Taraka Prabhu SJ	Research Scholar, CSIR-Indian Institute of Chemical Technology, Hyderabad	5 June 2019 (Hyderabad)
5	Rev. Vincent Joachim Braganza SJ	Director, Xavier Research Foundation, Loyola Centre for Research and Development, St. Xavier's College, Ahmedabad	10 February 2018, 11 February 2018 (Mumbai)
6	Rev. Job Kozhamthadam SJ	Director, Indian Institute of Science and Religion, New Delhi	11 February 2018 (Mumbai)
7	Anand	PhD Researcher, Rapinat Herbarium & Centre for Molecular Systematics Institute, St. Joseph's College, Trichy	13 November 2017 (Shembaganur)
8	J Mariyaraj	PhD Researcher, Rapinat Herbarium & Centre for Molecular Systematics Institute, St. Joseph's College, Trichy	14 November 2017 (Shembaganur)

	Name	Institution	Date (Location)
9	Rev. Dr. Edward Jeganathan SJ	Former Assistant Director, Jesuit Archives of Madurai Province, Sacred Heart College, Shembaganur	19 November 2017 (Madurai)
10	Rev. Fr. Gregory Naik SJ	Archivist, Jesuit Archives of Goa Province, Panjim	3 May 2018 (Panjim)
11	Rev. Fr. P. Francis Xavier SJ	Former Provincial, Madurai Jesuit Province & Former Director, Loyola Institute of Frontier Energy, Loyola College	21 June 2018 (Email interview)
12	Rev. Dr. Paul Gabor SJ	Vice-Director, Vatican Observatory, Arizona (USA)	5 June 2019 (Email interview)
13	Rev. Dr. Stephen Jeyard	Professor, Jnana Deepa Vidyapeeth	22 January 2017 (Pune)
14	Prof. Dhruv Raina	Professor, Zakir Hussain Centre for Educational Studies, Jawaharlal Nehru University, New Delhi	21 January 2017 (Pune)
15	Rev. Dr. Vincent Sekhar SJ	Director, Institute of Dialogue with Culture and Religions, Loyola College, Chennai	23 August 2018 (Chennai)
16	Rev. Dr. Michael Amaladoss SJ	Founding Member, Institute of Dialogue with Culture and Religions, Loyola College, Chennai	24 August 2018 (Chennai)
17	Dr. Bernard D'Sami	Director, Loyola Institute for Social Sciences Training and Research, Loyola College, Chennai	15 December 2015 (Chennai)
18	Rev. Fr. Patrick Arokiaraj SJ	Professor, Satya Nilayam Institute of Philosophy,	10 February 2018 (Pune)

	Name	Institution	Date (Location)
		Chennai	
19	Rev. Fr. Patrick Ravichandran SJ	Minister, Sacred Heart College, Shembaganur	17 November 2017 (Shembaganur)
20	Rev. Fr. JM Das SJ	Superior, Sacred Heart College, Shembaganur	16 November 2017 (Shembaganur)
21	Mr Christy Lobo Arputham	Jesuit Madurai Province Archives, Shembaganur	15 November 2017, 18 November 2017 (Shembaganur)
22	Rev. Fr. Roland Coelho SJ	Provincial, Goa Jesuit Province, Panjim	7 May 2018 (Panjim)
23	Rev. Dr. Anthony De Silva	Director, Xavier Centre of Historical Research	5 May 2018 (Panjim)
24	Rev. Fr. Amalraj Paramasivam SJ	Provincial, Andhra Jesuit Province, Secunderabad	2 Mar 2020 (Secunderabad)
25	Rev. Dr. Jerry Rosario SJ	Dhyana Ashram, Chennai	23 July 2019, 3 April 2020 (Email)
26	Mr Rajasekharan	Draughtsman, Rapinat Herbarium, Trichy	24 May 2017 (Trichy)
27	Mr S Raja	Senior Co-ordinator, Science and Humanities for People's Development (SHEPHERD), St. Joseph's College, Trichy	13 November 2017 (Trichy)
28	Rev. Dr. Robin S Seelan SJ	Director, Satya Nilayam Research Institute, Chennai	1 November 2018, 3 October 2020 (Chennai)
29	Rev. Dr. Gabriele Gionti SJ	Vatican Observatory, Rome	21 January 2017 (Pune)

B) List of events participated in as observer

	Event	Organizer	Date (Location)
1	Programme on Education and Training in Nature Conservation and Eco-Development	Anglade Institute of Natural History, Shembaganur	13-15 November 2017 (Shembaganur)
2	International Symposium on The Discovery of Gravitational Waves and the Future of Religion & Society	Indian Institute of Science and Religion, New Delhi	20-23 January 2017 (Pune)
3	International Symposium on Developments in the Neurological Sciences and the New Interpretation of the Spiritual Dimension of Humans	Indian Institute of Science and Religion, New Delhi	9-11 February 2018 (Mumbai)
4	National Seminar on Religions, Food and Health	Institute of Dialogue with Cultures and Religions, Loyola College, Chennai	22-24 August 2018 (Chennai)
5	Research Scholars' Study Circle of Satya Nilayam Research Institute	Satya Nilayam Research Institute, Chennai	3 October 2020 (Chennai)
6	Lecture on "Bible and the Origins of Modern Science"	Satya Nilayam Research Institute, Chennai	19 September 2016 (Chennai)

C) List of archives and libraries visited

	Archive/library	Place	Dates
1	Jnana Deepa Vidyapeeth Library	Papal Seminary, Pune	18-19 January 2017
2	Kolvenbach Library	Satya Nilayam, Chennai	25-26 September 2017, 3- 11 November 2018, 3-7 October 2019
3	Central Library, Loyola College	Loyola College, Chennai	15 December 2016
4	Madras University Library	Madras University, Chennai	7-10 June 2016
5	Archives of the Jesuit Madurai Province	Sacred Heart College, Shembaganur	15-18 November 2017
6	Archives of the Jesuit Goa Province	Jesuit House, Panjim	3-9 May 2018
7	Xavier Centre of Historical Research	Panjim	4 May 2018
8	Rapinat Herbarium Library	St. Joseph's College, Trichy	24-26 May 2017

D) Jesuit periodicals accessed

	Name	Type	Published by
1	Caritas	Periodical for private circulation among Madurai Jesuits (estd. 1917)	Superiors of Madurai Province
2	Jivan	Regional monthly magazine of the Jesuits for public circulation (estd. 1979)	Jesuit Conference of South Asia
3	Madurai News Letter	Monthly newsletter for circulation among Madurai Jesuits	Superiors of Madurai Province
4	Studies in the Spirituality of Jesuits	Quarterly journal on the history and contemporary issues related to Jesuit spirituality (estd. 1969)	American Assistancy Seminar on Jesuit Spirituality
5	Ignis	A monthly journal on Jesuit spirituality in South Asia (estd. 1972)	Jesuit Conference of South Asia
6	Review of Ignatian Spirituality	Quarterly journal as an international forum on Jesuit spirituality (estd. 1970)	Jesuit Curia, Rome
7	Annual Reports of Loyola College, Chennai	(From 1925-2018)	Loyola College, Chennai
8	<i>Promotio Iustitiae</i>	Half-yearly journal reporting on the global social apostolate of the Jesuits (estd. 1977)	Social Justice and Ecology Secretariat, Rome

E) Jesuit sources accessed

	Name	Author/Editor/Publisher	Year
1	Decrees of the 32 nd to 35 th General Congregations	Jesuit Curia, Rome	1975-2008
2	Spiritual Exercises of St. Ignatius of Loyola	Ignatius of Loyola	
3	Constitutions of the Society of Jesus	Ignatius of Loyola	
4	Conclusions of the Jesuit Conference of India on the Report of Inculturation	Jesuit Conference of India	1978
5	Golden Jubilee Souvenir, Andhra Loyola College	Andhra Loyola College	1979
6	Contemplation in Action: A Study in Ignatian Prayer	Joseph F. Conwell SJ	1957
7	Directory of Jesuit Educational Association of India	Jesuit Educational Association of India	1969-70
8	Formation in Mission: The Final Report of the Formation Review Commission	South Asian Assistancy of the Jesuits	1991
9	Jesuit Formation and Inculturation in India Today	Jesuit Conference of India	1978
10	Statutes of the Jesuit Conference of India and the Provincial of India	Jesuit Conference of India	1980
11	Constitution of the Jesuit Educational Association of India	Jesuit Educational Association of India	1986
12	Jesuit Education and the National Imperatives	Jesuit Educational Association of India	1992
13	Perspectives in Jesuit Higher Education in India Today	Jesuit Educational Association of India	1996
14	Set the World on Fire: Golden Jubilee of the Jesuit Madurai Province	Jesuit Madurai Province	2002
15	Roots and Blossoms: Tamil Nadu Jesuits' New Ventures	Vaigarai Publications	1987
16	A Journey in Progress: Centenary Souvenir of the Sacred Heart College	Satya Nilayam	1995
17	Jesuits in India: In Historical Perspective	Xavier Centre of Historical Research	1992
18	Jesuit Survey: Report on the Indian Assistancy	Indian Social Institute	1969
19	Our Way of Life	Jesuit Madurai Province	1982
20	Sacred Heart College: Golden Jubilee Souvenir	Sacred Heart College	1945
21	Sacred Heart College: Platinum Jubilee Souvenir	Sacred Heart College	1970
22	Guidelines for Local Superiors: Guidelines for the relationship between the Superior and the	Jesuit Roman Curia	1998

	Name	Author/Editor/Publisher	Year
	Director of the Work		
23	Guidelines for Provincials	Jesuit Roman Curia	2003

JESUIT SPIRITUALITY AND GANDHIAN PRAXIS: EMBRACING AN INTER- FAITH DIALOGUE THAT DOES ENVIRONMENTAL JUSTICE IN INDIA

Joseph Satish Vedanayagam*

Introduction by Editor

Howard Thurman, the late Afro-American preacher cites in one of his lectures, "what Mr. Gandhi calls Truth and I call God are the same". The deep influence that Gandhi had in a very brief encounter with Thurman and subsequently the impact Thurman had on the shaping of the civil rights movement in the US as a mentor for Martin Luther King Jr. is increasingly being realised in the USA (as Ashish Kothari points out in another article in this compilation). Gandhi always engaged and worked with religious groups across the boundaries of faith, deepening his own faith in the process. Religion was extremely important for Gandhi, whose famous quote on 'religion and politics' today may seem like clairvoyance or sorcery depending on ones' influences and interpretations. He had very strong opinions about almost all religions and these religions in turn were influenced and deeply impacted by him. He saw in all of them an attempt to uplift human spirit and otherwise opined that, to try and estimate the merits of religion is unnecessary and even harmful. In this, he articulated a deeply cultural aspect of India that U.R. Ananthamurthy, the famous writer and thinker summarises, he states, that in the Indian culture, evil is constructed as another facet of divinity and everyone is accommodated.

His engagement with the Christian faith is one of longest standing as it started from his days in London as a student and continued for the rest of his life. Several people of Christian faith came to him not merely to discuss politics or social issues, but also religion and spirituality. He himself summarises what Christ means to him thus –

* Joseph Satish Vedanayagam is a Ph.D. student in Science, Technology & Society Studies (STS) at the Centre for Knowledge, Culture and Innovation Studies (CKCIS), University of Hyderabad, India. His research focuses on the relation between the scientific practice of Jesuit priest-scientists in south India and their missionary spirituality. Joseph's writings have appeared in *The Hindu Survey on Indian Agriculture* (The Hindu Group, 2012), *Femmes savantes, femmes de science* (ASBC, 2014), *Social Entrepreneurship and Sustainable Business Models: The Case of India* (Palgrave Macmillan, 2018), *Society and Culture in South Asia* (Sage, 2018) and *Historical Studies in the Natural Sciences* (UC Press, 2019). Previously, he served on the Editorial Team of *Intersect: The Stanford Journal of Science, Technology, and Society*. He is presently an Assistant Editor for *Backchannels*, the international newsletter of the Society for Social Studies of Science (4S).



INDIAN INSTITUTE OF TECHNOLOGY DELHI
DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
HAUZ KHAS, NEW DELHI - 110016

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*This is to certify that Mr/Ms Joseph Satish [University of Hyderabad]
has presented/participated in the departmental workshop on 21st, 22nd April 2017.*

Head *Ramdeo Kaur*
Department of Humanities & Social Sciences



UCSIA SUMMER SCHOOL
BETWEEN MARKET, STATE AND RELIGION: ECONOMIC REALITIES, SOCIAL JUSTICE & FAITH TRADITIONS

CERTIFICATE OF PARTICIPATION

We declare that **JOSEPH SATISH VEDANAYAGAM**

affiliated to: Centre for Knowledge, Culture and Innovation Studies, University of Hyderabad, INDIA

participated in the UCSIA summer school 'Between Market, State and Religion: Economic Realities, Social Justice & Faith Traditions' in Antwerp, Belgium from 27/08/2017 until 2/09/2017. Joseph Satish Vedanayagam actively attended the classes of the guest lecturers and presented his academic work: 'Jesuit science in the Indian knowledge economy: Whither stands "the service of faith and the promotion of justice"?'.

On behalf of UCSIA

Guest lecturers

Prof.

Luc Braeckmans

Prof.

Christiane Timmerman

Prof.

David Henig

Prof.

Jennifer Olmsted

Prof.

Paul Oslington

Prof.

Mayfair Yang

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Society for Social Studies of Science (4S)

Associate Professor Matthew Kearnes
School of Humanities and Languages
University of New South Wales
Sydney, NSW, Australia
m.kearnes@unsw.edu.au

9 October 2018

4S Sydney 2018 Certification of Attendance

Dear Joseph Satish,

On behalf of the Program Committee for the 2018 Annual Meeting of the Society for Social Studies of Science, I thank you for your recent participation in the conference, which was held from 29 August to 1 September at the International Conventional Centre Sydney, in Sydney, Australia.

We appreciate your contribution to the program by organising an Open Panel entitled 'Being Religious, Being Scientific: The Dynamics of Science and Religion in the Laboratory', in which you presented the paper 'For the Greater Glory of God – Jesuits and the Debate on Genetically Modified Food Crops'. We note that you also participated in the postgraduate workshop on 28 August.

The Annual Meeting of the Society for Social Studies of Science is the peak international meeting for the field of Science and Technology Studies, and approximately 1200 international delegates took part this year.

We hope to see you again at next year's meeting.

Sincerely,

Associate Professor Matthew Kearnes
Program Chair

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Joseph Satish Vedanayagam
Centre for Knowledge, Culture and Innovation Studies (CKCIS),
School of Social Sciences, University of Hyderabad,
Hyderabad – 500046, INDIA

October 31, 2018

Dear Joseph Satish,

On behalf of the Center for Science, Technology, Medicine and Society at the University of California at Berkeley, I thank you for your participation in the “Techno-Optimism Within and Beyond Silicon Valley” conference, which was held on October 19 and 20, 2018 at the University of California at Berkeley.

We appreciate your participation in the panel on “Traveling Techno-Optimisms” in which you presented your paper ‘Catholic imaginaries of GM crops: Jesuits, techno-optimism and the common good’.

The conference was organized by the Center for Science, Technology, Medicine and Society, and co-sponsored by the Social Science Matrix and the Institute of International Studies at the University of California at Berkeley. As a laboratory for the 21st century university, the Center for Science, Technology, Medicine and Society (CSTMS) conducts cross-disciplinary research, teaching, and outreach on the histories and implications of scientific research, biomedicine, and new technologies. The University of California at Berkeley is a public research university located in Berkeley, California. Founded in 1868, Berkeley is the flagship institution of the ten research universities affiliated with the University of California system, and one of the premiere public universities in the world.

Best Regards,

Morgan G. Ames
Conference Chair
Associate Director of Research, CSTMS



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United Kingdom

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Certificate of Participation

The organisers of the **STEMM and Belief in Diverse Contexts: Publics, Praxis, Policy and Pluralism** conference, held 7-9 of July 2021, confirm that the following participant(s) attended the online event and gave the following presentation:

Name: Joseph Satish Vedanayagam

Organisation: University of Hyderabad

Paper: Finding God in all things: The spirituality of the Jesuit priest-scientist in post-colonial India

For more information about the conference, including a full programme, please see:

<https://bit.ly/3yXbauh>

Yours faithfully,

Dr Alexander Hall,

Co-Principal Investigator, [International Research Network for Science and Belief in Society](#)



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Scientific Research as a Spiritual Mission: A social history of the Madurai Jesuits and their scientific practice in independent India

by Joseph Satish V

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