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INDIA

Tracing science communication in independent India

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The shadow of imperialism and European colonisation of the subcontinent looms large in the narration of the history of modern science in India (Phalkey, 2013). So where the role of science and technology in independent India is concerned, the lens used by political and social scientists is that of post-colonial nation-building (Visvanathan, 1997; Abraham, 2006; Roy, 2007). Phalkey further observes, in her introduction to the Focus section on 'Science, History and Modern India' in *Isis*, the premier journal in the field of history of science, that historians have claimed scientific practice in India to be derivative, and that these claims have happened in the absence of national histories of ideas, pedagogy, policies and practices of science. To address this lacuna, she suggests the study of institutional, social, political, economic and cultural contexts with a focus on the experiences of practitioners so that a practice-oriented understanding of science in India can emerge. This short essay, ambitious as it is in its scope, attempts to fill the void by working through science policies; dissemination and communication practices at institutions such as museums and universities; journalistic writings on science and technology; and people's science movements (critical science literacy movements organised by civil society and community-level groups). By doing so, the essay purports to narrate a history of science communication practices in independent India (that is, post-1947).

However, before delving into the practices, it is important to review the sociocultural context of contemporary India and examine its specific communication politics and policies.

1. Science, technology, innovation and the Indian state

In a 2015 news feature in *Nature*, Indian science journalist T. V. Padma listed some of the highlights in India's road to becoming a science superpower and some of the structural and societal challenges impeding the country from fulfilling its technological, industrial and economic potential (Padma, 2015). Several major achievements have emerged: in the fields of space research (the Indian Space Research Organisation (ISRO) completed its Mars mission in 2014 by successfully launching its Mars Orbiter on its first attempt at a fraction of the cost incurred by other space research agencies in the developed world); in the pharmaceutical industry (India produces a large volume of low-cost medication and vaccines); and in renewable energy (there is an increased focus on making India a major solar power; it already is a world leader in wind power).

However, the list of challenges for a country with a population of 1.3 billion people, with many living below the poverty line, is immense and often seems to outweigh the positives. Padma notes that the problem starts at the very top and is a result of a lack of political will. Successive governments, while pledging financial support for the Indian scientific community, have not increased the budget for research and development from about 0.9 per cent of GDP (with conspicuously less investment from the private sector), a figure significantly lower than other BRICS[1] economies. The quality of education at the universities, save for a few that receive central government patronage, has been inadequate to produce world-class research or build the competencies required for its successful dissemination. India has one of the lowest densities of scientists and engineers in the world, which is surprising as the country produces many scientists and engineers who then move on to work in foreign countries, especially the US. Brain drain is a cause for concern in Indian society, as some of the most qualified among Indian students migrate in search of better opportunities. Then there are continuing societal challenges such as concerns over public health: maternal deaths, malnutrition, and high incidence of tuberculosis and malaria. And yet Mèdecins sans Frontières regards India as the 'pharmacy of the developing world' (Padma, 2015) because of its significant output in low-cost drugs. Scientists and entrepreneurs have recommended enhanced ties between universities, research laboratories and industry, and the government has responded by setting up incubators and by supporting start-ups to transfer knowledge from research facilities to industries.

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1 BRICS is the acronym for an association of five major emerging national economies: Brazil, Russia, India, China and South Africa.

1.1. Which science for which people: Discussing 'public' and 'policy'

The question of which science and technology should be communicated to the public merits a deeper interrogation of the 'public' itself. For a country as vast as India, with many sociocultural/economic identities that form and inform individual (and collective) choices, the question is especially complex. While solutions cannot only come from government policymakers and experts, it is worth discussing how experts have tackled this debate.

The issue of what science should take precedence in the national imagination to ensure sustainable, equitable development of the population (a majority of which lives in material poverty) has been present in the rhetoric of politicians for a long time. One of the strongest articulations was Indira Gandhi's speech at the 63rd Indian Science Congress at Waltair (now Vishakapatnam) in 1976, when she emphasised the need for science and technology in India to take a rural turn.

> There should be greater attention to rural engineering … Rural electrification has made rapid progress but we have not yet succeeded in teaching villagers how to use power to advantage. There is a woeful lack of rural technicians and of innovative work. The village and the home should become laboratories for inter-disciplinary scientific and technological investigation (Gandhi, 1976).

That science and technology in India is an elitist enterprise has been argued by critics, scholars and practitioners. Abha Sur, who studies science in India in the interstices of caste and gender, points out that scientific practice and establishments are embedded in a male upper-caste ethos that refuse to translate concerns of ordinary people into agendas of scientific research (Sur, 2011). She argues that the formal laboratory remains an upper caste, elite space of learning and doing, making a strong case that the former prime minister's concerns remain valid to the present day (Sur, 2012).

A study of science policy documents in independent India tells us that in rhetorical terms, the focus has been to harness the capabilities of the population and reach the poorest sections of society. The *Scientific Policy Resolution* (Government of India, 1958), the first national policy, was released in 1958 and placed great emphasis on industrialisation for the creation of national wealth and prosperity, with a focus on science education and training in technical skills. The Technology Policy Statement of 1983 discussed the need to become self-reliant and technologically independent and shifted the emphasis to technological development (Government of India, 1993). In 2003, the government proposed a science and technology policy where the two were brought together and the need for investment in research and development was highlighted. This document is of particular interest to scholars of public communication of science and technology as it has a clearly defined section on the public awareness of science:

> There is growing need to enhance public awareness of the importance of science and technology in everyday life, and the directions where science and technology is taking us. People must be able to consider the implications of emerging science and technology options in areas which impinge directly upon their lives, including the ethical and moral, legal, social and economic aspects. … Support for wide dissemination of scientific knowledge, through the support of science museums, planetaria, botanical gardens and the like, will be enhanced. Every effort will be made to convey to the young the excitement in scientific and technological advances and to instil scientific temper in the population at large (Government of India, 2003).

The most recent government science policy document, *Science, Technology and Innovation Policy* (Government of India, 2013), discusses the aspirations of India for 'faster, sustainable and inclusive growth' (p. 1) and the role of the huge talent pool that India's largely young population offers. The 2013 document makes it clear that the focus will be on people, and the national science, technology and innovation (STI) system must recognise society as its major stakeholder. Thus, the 'emphasis will be to bridge the gaps between the STI system and socio-economic sectors by developing a symbiotic relationship with economic and other policies' (p. 3). To empower people and incorporate them into the STI framework of the country, one of the suggestions in the policy document is the promotion of scientific temper among all sections of society.

It is interesting that over the years the rhetoric of the documents grants the public a greater level of agency. If the 1958 resolution was all about the scientific and technical education of the masses, the 2003 policy shows awareness of the growing interest of the public in science and technology and how they have to be included in debates of the ethical, social and economic dimensions of science. The 2013 document observes that people should not be mere recipients of scientific knowledge but must be made an active part of the scientific innovation framework. This increase in agency of the public in policy formulation goes along with the similar emphasis on the building of 'scientific temper' through school education—the National Curriculum Framework (NCF) of 2005 spends a lot of time discussing science education in this manner.[2] The position paper on science education that formed part of the NCF 2005 formulation process notes that school education in India 'develops competence but does not encourage inventiveness and creativity' (NCERT, 2005, p. 3). It says that 'schools promote a regime of thought that discourages thinking and precludes new and surprising insights' (p. 22). Clearly, there is awareness of the failure of school education to build this scientific temper (NCERT, 2005).

1.2. The journey of 'scientific temper' to the Constitution of India

'Scientific temper' is a phrase attributed to Jawaharlal Nehru's *The Discovery of India* (1946), a monograph he wrote while imprisoned with other leaders agitating against British rule. Presented as a part-autobiography, part-civilisational history of India, the patriotic overtones are evident. While recounting India's many existing social problems, like poverty, overt religiosity, superstition and the caste system, Nehru (1889–1964), a science graduate of Cambridge, emphasised the need to cultivate scientific thinking in order to approach life and its challenges:

> The applications of science are inevitable and unavoidable for all countries and peoples to-day. But something more than its application is necessary. It is the scientific approach, the adventurous and yet critical temper of science, the search for truth and new knowledge, the refusal to accept anything without testing and trial, the capacity to change previous conclusions in the face of new evidence, the reliance on observed fact and not on pre-conceived theory, the hard discipline of the mind—all this is necessary, not merely for the application of science but for life itself and the solution of its many problems (Nehru, 1946, p. 512).

It is important to pause here and reconsider the phrases *scientific approach* and *critical temper of science*. Not only did Nehru recognise the material and practical benefits of foregrounding science and technology for national development, he also strongly argued for science (scientific method and approach) as a 'philosophical approach' (Arnold, 2013). This is the enduring legacy of Nehru and his contribution to post-colonial scientific debates: the shift of understanding from science and technology as an imposition of Western authority, to science and technology as answerable to the state and the public for its capability of delivering a better, more inclusive and humane society.

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2 Also in the 1990s major policy decisions, such as the overhaul of the electricity generation and transmission systems, were preceded by a series of public consultations—see prayaspune.org, which is one of the advocacy organisations that facilitated these public conversations.

The post-Nehruvian period in Indian politics and policymaking saw a growing interest in the concept and its increasing importance in the mandate of several public institutions working at the interface of science and society (including those in charge of promoting scientific literacy and popularising science). The inculcation of scientific temper was added to the Indian Constitution in 1976 as one of the 10 fundamental duties of every citizen under Article 51(A)(H) by the 42nd constitutional amendment: 'to develop the scientific temper, humanism and spirit of inquiry and reforms' (Raza et al., 2014; Ministry of Law and Justice, 2019). India became the first country to include such a clause in its constitution, and the change occurred while Nehru's daughter Indira Gandhi was at the helm and during the period of political Emergency. The purpose was to fight religious obscurantism: scientific temper was interpreted as a rejection of unscientific, irreligious or superstitious beliefs often fostered by organised religion(s).

It is important to recollect that scientific temper and its promotion appear in the two latest science and technology policy documents of 2003 and 2013 (in the latter, it is even accorded the position of the primary objective of the policy formulation).

In this chapter, one key aim is to engage critically with the rhetoric of scientific temper and examine how it has become a part of institutional and public narratives on science and technology in India. We will examine different institutions that are formally and informally engaged with science communication, and comment on how they have promoted scientific temper and scientific attitude among the public. Information has been sourced from government documents and from personal research and experience in the field.

2. Science communication: Institutions and movements

2.1. Indian science museums

With the sustained importance of nationalism in the period of decolonisation after World War II, museums were recognised as powerful tools for radical socioeconomic transformation (Ghose, 1992; Venugopal, 1995). The first government attempt at defining India's scientific heritage and promoting science education was the establishment of Birla Industrial and Technological Museum (BITM) in Calcutta in 1959. Saroj Ghose, erstwhile president of ICOM, explained the need was felt by the central and state governments, and especially by the then chief minister of West Bengal, Dr Bidhan Chandra

Roy, to preserve artefacts of historical significance in the newly formed and diverse state. Roy had visited the Deutsches Museum in Munich and was influenced and inspired to form a similar institution in India.[3]

The opening of the Exploratorium in 1969 in San Francisco was a challenge to museums around the world. The Exploratorium's hands-on approach to science communication strongly favoured science education and active participation in the understanding of science. As Ghose said, a young country with its policies firmly grounded in the need to become self-sufficient and educate its large rural masses, science communication had to be based on a model where education was foregrounded rather than science appreciation. The narrative of attaining self-reliance and self-sufficiency through the acquisition of technical skills in the Fifth Five Year Plan (1974–1979) (Planning Commission, 1974) spilled over to the creation of scientific and technical institutions of national importance. It is around this time that a task force was set up to evaluate science popularisation efforts, and the Exploratorium's model of hands-on science training gained currency among policymakers and science museum professionals, resulting in the formation of the National Council of Science Museums (NCSM) in 1978.

The promotion of scientific temper, a crucial clause frequently mentioned in the rhetoric of science popularisation in India, was the NCSM's primary activity to ensure that demographic dividends could be reaped in the future. The phrase finds mention in the outcome budget of 2016/17 of the Ministry of Culture, with reference to NCSM:

> National Council of Science Museums (NCSM) has been engaged in creating awareness on Science & Technology, developing scientific temper in society and promoting science literacy throughout the length and breadth of the country and engaging young students in creative and innovative activities. For last 35 years, the Council has developed a nationwide infrastructure of 48 science museums & centres to achieve these goals. Its outreach activities throughout the year aspire to develop a culture of science and innovation by engaging people from all segments of the society in the process of science & technology (Ministry of Culture, 2016, p. 369).

3 Personal communication, August 2015.

Figure 16.1: Mobile science exhibition.
Source: Birla Industrial and Technological Museum, Kolkata.

Since its inception the NCSM has expanded, developing a nationwide infrastructure for science communication and informal science learning. The number of visitors to the 25 museums and centres of NCSM has grown progressively, with the 2013/14 Activity Report of NCSM recording 9.1 million visitors to the various centres (Ministry of Culture, n.d.). In 2016, the director of NCSM Headquarters revealed in a personal interview that another 15 million people participate in the NCSM's engagement and outreach programs annually. As new centres are built and engagement and outreach programs expanded, these numbers will grow. Attendance figures may appear very low for such a populous country, but India has a disproportionately small number of science museums and centres for its large population. As one of the top officials of NCSM said in a peronsal interview in 2015: 'We have a lot to achieve in the field of public engagement with science. As of now we have about 95 science museums (including centres, planetaria and zoos) for a population of 1.25 billion people.'

Any narrative on scientific temper and how it is being promoted should include the history of mobile science exhibitions (or MSEs) and how they became a huge success with the rural population. In the 1960s and early 1970s, two major science museums, BITM and Bangalore's Visveswaraya Industrial and Technological Museum (VITM), started the first MSEs. These travelling exhibitions ventured out into small towns and villages to create scientific awareness. Each exhibition comprised the following resources and persons: a bus, 24–28 simple exhibits focusing on everyday scientific phenomena and the uses of science and technology in daily life, a technician, an explainer and a driver. The Museobus proved to be immensely popular and created a target group of visitors distinct from school students (Mukherjee, 2003). NCSM today is quick to point out the sheer ambition of the MSEs, given that they manage to reach 2 per cent of the entire population. Their aim is to ensure universal awareness of science and technology, percolating down to the common individual. As the director of one national centre noted in a personal interview in 2015: 'What we are definitely interested in promoting is science as culture through the concept of scientific temper. We want to communicate the idea that science is not just a set of rules and knowledge, but it is a way of thinking, of doing things. A person with scientific temper would be willing to receive inputs from everywhere without perception bias.'

Science Express is a similar travelling science exhibition, but travels through India by train. This collaborative project was started in 2007 by two institutions dedicated to science popularisation and education: the National Council for Science and Technology Communication (part of the Department of Science and Technology, or DST) and the Vikram Sarabhai Community Science Centre (whose partners include the NCSM and the DST).

Another crucial objective of the NCSM is to provide assistance in science communication activities to other institutions of learning, both public and private. This reflects NCSM's important role as a broker of science communication activities, connecting schools, universities, technical institutions, other museums, think tanks, government and the public. Activity reports through the years show that apart from creating and maintaining galleries, the constituent members of NCSM are also in charge of conducting a vast array of public engagement programs. These include science seminars, drama competitions and science quizzes conducted at the local, zonal and national levels. For visitors to the centres in cities and small towns, there are programs that highlight health and environmental issues, such as water scarcity or the need to prevent child marriage. There are also special events for children living below the poverty line. Teacher-training programs help teachers working with students in Indian classrooms. The NCSM has offered a two-year Master of Technology program to science communication aspirants since 2005, in conjunction with the Birla Institute of Technology and Science, Pilani. The degree trains students to work in the sector of science museums and centres. The range of activities may seem overwhelming, but from the perspective of promotion of scientific temper, it is understandable that the NCSM has engaged in a multi-pronged approach to ensure that a strong narrative about science and its role in society is communicated to the people.

One critique of NCSM is that it derives almost all its funding from the national government exchequer. The issue of government control over the rhetoric and activities of NCSM is one of great significance, because the political and ideological affiliation of governments can influence activities. Recent updates on the council's social media pages suggest it is promoting a number of activities unrelated to science: celebrating a special day to commemorate Hindi as the major national language, or the birth anniversary of a nation builder. These activities seem innocuous but clearly do not belong to the resume of a science museum. And while scientific temper is fundamentally about promoting anti-superstitious thoughts, spreading public awareness and understanding of science, NCSM activities also promote careers in STEM without critiquing institutionalised big science in the exhibits and displays.

2.2. Science communication courses in universities

While developing a scientific temper through general education is one strategy for building a critically engaged and scientifically literate citizenry, the media and other communication channels also disseminate information about science. As a corollary to this, creating a pool of professionals able to convincingly and engagingly speak about science to lay audience becomes essential. While there is little formal documentation or scholarship examining science communication/journalism courses in India, we attempt to fill out the picture by drawing on our own experience as journalism educators and science communication professionals. The history and development of science communication education in India may be broadly traced along two paths: one, within the institutional framework of universities; the other, in private and quasi-governmental organisations. The earliest efforts to build capacity to communicate research to lay audiences had their origins in departments of agriculture, in courses known as 'agricultural extension'. It is no coincidence that the first journalism course (a diploma program) within a university (Punjab University) had a strong emphasis on agriculture education as far back as 1941 (Bharthur, 2017).

The focus has been, largely, to equip communicators to convey advances in agricultural technology and farming practices to farmers in a manner in keeping with the 'development communication' paradigm, premised on the belief that an efficient flow of appropriate information will bring about positive social and economic change (or 'development'). This tradition of science communication education to serve the needs of the research establishment, and to inform both the general public and specific 'end-user audiences', dominated through the 1960s and 1970s. 'Science' was by and large interpreted as 'institutional science', and many communication graduates with an interest in 'science' became public relations officers in public sector laboratories established under the Council for Scientific and Industrial Research (CSIR) or Indian Council of Medical Research (ICMR). These science communicators popularised the research output of these laboratories, putting out press releases, organising public events and managing in-house publications.

As journalism and mass communication education programs proliferated within the Indian university system, agricultural extension and development communication remained an important component, particularly in graduate-level education. This took the form of an optional course (or, rarely, a series of courses) in science communication, health communication or science writing. These courses combined institutional science communication with science journalism. A few universities offered graduate degrees specialising in development communication or health communication (Jamia Milia Islamia in New Delhi, Tezpur University in Assam, for instance), and graduates from these programs often secured jobs in the emergent social sector. This tradition of science communication education saw the professional communicator as being in service to the cause of science—his or her job was to clarify and explain and show applicability of science to life. Clearly, there were two career options for the professional science communicator: one was to serve the science establishment, while the other was to report science for the mass media, as a science journalist. Most science communication and journalism courses, however, focused on the 'how' of writing about science rather than on understanding its structure, dynamics or the process of science, much less looking at it critically as another area of human endeavour (for instance, in non-government and multilateral organisations engaged in science popularisation, eduation and advocacy).

In the aftermath of the Bhopal Gas tragedy in 1984 and the growing disenchantment with Big Science and its close links with the military-industrial complex and apparent disregard for ethical and environmental issues, a large number of civil society organisations joined with conscientious scientists to articulate the need for better informed and more critical engagement with publicly funded science as well as corporate research and development. This, along with the unrelated but concomitant effort to set up short-term training courses in science writing for new and practising journalists, led to the growth of the second set of programs: private and quasi-governmental efforts in science journalism training. Brian Trench reports that, by the early 2000s, there were several government-supported science journalism programs in India (Trench, 2012). These range from one-year programs such as those offered by the Indian Science Communication Society (offered online), to the two-week intensive course run annually by the National Centre for Biological

Sciences. The National Council for Science and Technology Communication (NCSTC), a body set up under the CSIR to promote science outreach and foster public understanding of science, offers short-term capacity-building programs to professional journalists and science communicators but does not train new entrants to the field.

Universities have found it difficult to sustain standalone science communication or science journalism diploma or degree programs, although the national higher education governing body, the University Grants Commission, has provided limited funding for new 'innovative' programs. These aim to build capacity in niche areas of journalism perceived to have market demand or that serve certain social or development goals. Apart from science communication, they have included postgraduate diploma or degree programs in areas like community media, agricultural journalism and development communication. The funding is normally provided for a specified period of three to five years, with the host university committing to continuing funding and faculty positions beyond that. These programs have not been able to attract students, who seem to prefer a broad-based program that prepares them for multiple roles in media/institutional communications.

Unlike some of the strongest programs in science journalism/writing in the West (such as MIT's graduate program in science writing, or science journalism programs at Cornell University, University of California, and others) the university-based programs are generally not run by faculty with a science background, although scientists may be invited for guest lectures. The emphasis is on the journalistic process—writing, production, interviewing—with the critique of science taking a backseat. Some courses in recent times—such as the module on health journalism at the Delhi-based Indian Institute of Mass Communication (IIMC)—have included a critical appraisal skills component, introducing students to the process, pitfalls and politics of doing science, and building competence in assessing the claims of science publicists. But in this regard, science journalism is no different from any other specialisation: students learn the nitty-gritty of how to cover a particular field when they are on the job; and acquire with experience the critical temperament to write about science dispassionately, yet with an eye for detail.

2.3. Science in the Indian media

It is curious that despite the huge focus on science and technology (in education, industry and institutional research) in India over the past half century, and the unrelated development of media in the country, there is hardly any scholarship on science journalism or media-based science communication. After an extensive literature search, Dutt and Garg could find only two studies that looked at science and technology content in Indian news media (Dutt and Garg, 2000). This relative lack of scholarly interest is not reflected in the actual presence of science in the mainstream media; even a cursory examination of newspapers and magazines will yield a fair amount of science news, much of it relating to the fields of health, environment, agriculture and, overwhelmingly, technology (computers, consumer electronics, and automobiles). Manoj Patairiya, a scientist at the NCSTC and honorary secretary of the Indian Science Writers' Association, pointed to the demise of magazines like *Science Today* and *Bulletin of Sciences* as indicating there was not much interest in science communication (Patairiya, 2002). However, Dinesh Sharma, editor of the *India Science Wire*, a daily science news service funded by Vigyan Prasar (an autonomous organisation under the Department of Science and Technology, whose name translates as 'Science Dissemination'), says that the enthusiastic uptake of stories from *India Science Wire* by mainstream media suggests a definite interest in such content.[4] Also, the continuing (though limited) popularity of an environment-focused magazine like *Down To Earth*, published by the Centre for Science and Environment, New Delhi, suggests that there is an audience for such material, however niche.

Figure 16.2: *India Science Wire* and *Down to Earth* magazine.

As in other mainstream media vehicles, science coverage in the daily press may appear either in the main body of the newspaper or as part of a news bulletin, or in special sections or programs that focus on science. Until the late 1990s, most large English and regional language dailies had multiple-page sections devoted to science, but by the early 2000s these sections had been incorporated into the main paper and reduced to one or two pages.

4 Personal communication, 8 January 2019.

The Hindu, a major national daily published from Chennai, had for many years a 6–8-page weekly supplement, but this was reduced to a one-page weekly section in about 2005, and subsequently (in 2017) increased to a two-page section in the Sunday magazine. Dinesh Sharma observes that despite the disappearance of exclusive science sections, the daily newspaper has more science and technology news today than in the past. 'It's no longer ghettoised in a separate section,' he notes.[5] Most media organisations have designated journalists covering science—again, *The Hindu* has for many years had reporters specialising in science, health, environment and technology.

As Patairiya (2002) observes, the popular science magazine is practically absent from the Indian media scene. *Science Today*, a publication from the *Times of India* group, was perhaps the only magazine that combined an overt mission of science popularisation with a degree of critical examination of the process and culture of science. The magazine had a line of distinguished public scientists at its helm and a committed though small readership; but it was clearly not a money spinner and was laid to rest in 1992. The National Institute of Science Communication and Information Resources (NISCAIR, under the CSIR) now brings out three lay publications—*Science Reporter* (English), *Vigyan Pragati* (Hindi: Progress in Science), and *Science-ki-Duniya* (Urdu: The World of Science)—that position themselves as serving the goal of 'science education'. The Bangalore-based Indian Academy of Sciences publishes two journals widely read within the scientific community and by science aficionados: *Resonance* and *Current Science*, which often form the basis for science stories in the mainstream media.

With the growth of online media, science writing has gained something of a resurgence. Online news sites like *thewire.in* and *scroll.in* have sections for science and technology, while *indiaspend.com*, a data journalism website, produces critical, long-form pieces on science, the environment and public health. Some (*thewire.in*) have trained the science journalists who manage the section. The wire service *Press Trust of India* is a leader in science reporting, and its first designated science editor K. S. Jayaraman mentored many young journalists who went on to write early critical and investigative reports on science.

While there is fair amount of coverage of science in the mainstream media as news, opinion or features, the scope and quality of this reporting is another matter. Much of what might be classified as 'science writing' is generated from press reports and institutional press releases, mostly from public

5 Personal communication, 8 January 2019.

laboratories. In recent years, public concerns around areas such as genetically modified crops and multi-drug-resistant pathogens has led to a journalistic interest in such stories, fuelled partly by activism. The same may be said for environmental and health areas. Dutt and Garg in their 1996 analysis of 27 major metropolitan dailies found that nuclear science, defence technology and space research were the most common subjects (Dutt and Garg, 2000). A special issue of the Indian edition of the *Global Media Journal*, published by Calcutta University, published a set of papers examining science coverage in the media in India (University of Calcutta, 2013). While most were broad commentaries on the possible impact and quality of science and technology communication, there were a few empirical studies based on small data-sets. A content analysis of 10 major Hindi and English-language dailies found: a) more science news in the English newspapers; and b) that health and environment were the most covered topics (Kumar, 2013).

Another aspect of science coverage is its framing. An analysis of the English-language press in India by Samuel Billet (2010) found that environmental journalists situate 'climate change' as a socioeconomic and political issue, but that coverage tends to place the issue either within a nationalistic frame or along global north–south lines, thus losing much of the nuance that the topic requires.

This 'nationalistic' frame was certainly a feature of science reporting in the first five decades after Indian independence, but one may argue that critical reporting has increased in the last two decades, and multiple viewpoints are available to news consumers who peruse more than one news source. The rise of data-based journalism has given science writers another tool to examine scientific claims, and there is a greater pressure on scientists to better communicate the results of their research with an eye to both the public interest and the demand for accountability from funders. But like elsewhere in the world, Indian academics and scientists are focused almost exclusively on scholarly publishing and are not very interested in popularising their work through the mainstream media. There are exceptions, and occasional pieces by scientists do appear in magazines and newspapers such as *The Hindu*'s Sunday edition, which routinely carries a policy-related or perspective piece by a senior scientist.

2.4. Popular science movements

The 1950s were a decade of euphoria and unbounded optimism for the nascent nation. Its flavour and distinctness from the colonial past rose from the extraordinary energy that accompanied the birth of the new nation. But the trauma experienced by partition left deep scars in its psyche, and it was against this violent background that science became an expression of desire for the newly independent nation-state. Science was called upon to provide the moral, material and emotional basis of the largest post-colonial democratic experiment in the world. The bestowing of modern apparatus— in the form of the bureaucratic state —onto the nation required a public/ policy imagination that rested on universal algorithms rather than culturally specific formulations. The technocratic elite had to circumvent the historical and cultural logic of the anti-colonial struggle and cast the theme of economic development and growth as a foregrounding principle of building a new India. It was a decade when modern institutional India emerged, laying the foundations for economic, political, industrial, scientific and cultural institutions to be built. It is in this context that efforts to produce an enlightened public was considered as a noble enterprise by the ruling political and cultural elite. In order to fashion such a cultural horizon, a variety of interventions were undertaken by both civil society and the state.

The establishment of the Kerala Sastra Sahitya Parishat (KSSP: Kerala Forum for Science Literature), in the southern tip of the country, was a classic example: scientific literacy was part of a cultural literacy, to be disseminated to an allegedly backward, scientifically distanced population. In one sense, science communication and science literacy alluded to rationalities of a social, political and economic nature. KSSP took up issues that informed the transformation of the cultural and social habitus that had seemingly obstructed the production of modern citizen subjects. The spirit of KSSP spread to neighbouring regions and science activists took up the evangelical role of spreading a secular, scientific form of rationality to engage with an everyday life still mired in deep inequalities. This led to the formation of People's Science Movement (PSM) later re-designated as All India Peoples Science Network (AIPSN).

Multiple scholars have commented on the KSSP, which was primarily interested in communicating scientific information to the masses on wide-ranging topics from environment to gender sensitisation (see, for example, Parameswaran, 1979; Devika, 2005). Others have pointed at the close linkages with leftist parties in Kerala, where the central idea of KSSP was to transform society into a less hierarchical and more egalitarian one (Kannan, 1990). In this kind of thinking, science communication has the responsibility of addressing diverse social inequities. It can be said that KSSP, along with other left-leaning policies, has effectively intervened in public life. The federal state of Kerala has more positive indicators in the realm of primary health, education and sex ratio (i.e. birth ratio of male children to female) than many other states in the country, but there still exist deep gender, caste, class and religious fissures.

Other important organisations related to AIPSN included Delhi Science Forum, Eklavya (Madhya Pradesh), Madhya Pradesh Vigyan Sabha [Madhya Pradesh Science Forum], Pondicherry Science Forum (PSF), Lok Vigyan Sangathana [People's Science Organisation] (Maharashtra), Tamil Nadu Science Forum (TNSF), and Karnataka Rajya Vignana Parishath (KRVP) [Karnataka State Science Council]. AIPSN expanded its base rapidly by chalking out and executing a national-level action plan known as Jan Vigyan Jatha [Peoples' Science Campaign] (Raza et al., 2008). *Jatha* refers to a journey by foot, and scientists and science activists organised long *jathas* in different parts of the country to give talks, demonstrations, stage plays and utilise other indigenous media to convey the spirit and benefit of scientific thought including its technological prowess for the benefit of the masses.

3. Science communication today: An appraisal

The spirit of the Nehruvian state's stance towards science contains within it civilisational and historical dimensions. In that sense, the science policy documents should be seen as a particular form of historical inscription and a distinct variety of civilisational aspiration. It appears that ambitious gestures of such kind take a long time to influence a religiously charged society. Some policies towards building of scientific institutions premised on a secular ethos still seem to be working on the ground, but with little formal power. The aura generated around big dams, commercial agriculture, capital intensive industries, educational institutions like the Indian Institutes of Technology, space sciences and large national laboratories was to dwarf the solidarities built around charismatic, religious and mystical identities, and replace them with industrial productive capacities. The coalescing of science with the building of human capital required for a modern industrial country together with the erasure of loyalties and solidarities attached to primordial identities like religion, caste and region becomes the agenda and the reason for the post-independent nation-state. It is almost as though 'science' becomes another name for the Indian state (Nandy, 1988). While the positive narrative of the fruit of modern science and technology continues to hold sway in policy documents, political parties (especially of those of a nationalist hue) tend to appropriate ancient Indian mythologies and scriptures to posit a continuum of Indian scientific achievements for several millennia.[6] This tendency does actual disservice to the history of ancient Indian contributions in mathematics, astronomy, medicine and architecture.

6 Prabir Purkayastha, noted science activist, has written about this appropriation of mythologies by the government in power (Purkayastha, 2019).

In the rarest of rare moves, the phrase 'to develop the scientific temper, humanism and a spirit of enquiry' was added to the Constitution of India (largely inspired by Nehruvian ideas) in 1976. This provided the modern cultural context for the Indian State to establish institutions to achieve this ambition and became a crucial focus for NGOs to carry out and realise the cultural and civilisational ambition of the nationalist leaders at a post-independence historical juncture. A number of centrally funded institutions were formed, including the National Institute of Science Communication (NISCOM), which started publishing several popular science journals such as the Hindi journal *Vigyan Pragati* in 1952. The National Council of Science and Technology Communication was established in 1982 under Narendra Sahegal and became involved in both science communication and the popularisation of science. *Vigyan Prasar* was established in 1989 as part of the Department of Science and Technology and its mandate included communicating science from laboratories to the field.

The emphasis of the Indian state to build a self-reliant economy around agriculture, industry and commerce presupposed scientific knowledge and scientific practices amongst its population. It was precisely to address these issues that science communication was foregrounded in areas including agricultural extension work, health delivery systems and modern school education. There were two aspects to federally sponsored science communication institutions and programs. University departments and allied educational institutions were sponsored by organisations like NCSTC to train science students to write and make programs for newspapers, radio and television. The second aspect relates to popularisation of science through a variety of indigenous cultural forms like folk theatre and music, *jathas*, exhibitions and storytelling traditions. This was primarily done through liaisons with NGOs and other civil society organisations. Major surveys were carried out by institutions like National Institute of Science, Technology and Development Studies (NISTADS) to study the efficacy of public understanding of science among the general population.

While a number of institutions were created by the central government after independence, and especially after the Scientific Policy Resolution of 1958, 'the Resolution did not succeed in generating "the scientific cultural revolution", so badly needed by the Indian society' (Sharma, 1976, p. 1969). Unscientific religious mores and practices continue to play a major role in civil society, kept alive by self-styled godmen and godwomen, and attract significantly larger audiences than science communication networks. The murder of Narendra Dabholkar in 2013, a rationalist and social activist who espoused the cause of scientific temper by establishing a committee in Maharashtra to fight superstition, is possibly the most lethal instance of the clash of rational and irrational beliefs.

The major issue characterising much of the science communication activity carried out by institutions is that science is too often framed in a nationalistic and often jingoistic way, with government-led science communication efforts aiming to create a sense of pride in the products of Indian scientific activity rather than to build critical appreciation for the process of science (which arguably is the essence of scientific temper). This is seen not only in the framing of science communication education but also in popular science initiatives, including museums and science fairs. While the economic potentials of science have been rhetorically appropriated, the power of science to build an equitable society, non-coercive solidarities and humanise relations in a deeply divided society has yet to be realised. The Indian state continues to battle a plethora of socioeconomic challenges, many of which do not have science and technology-based solutions.

However, one cannot deny the power of effective science communication in a young post-colonial nation, young both in terms of years of existence and the age of the majority of the population, and its ability to create aspirational value for people. Particularly illuminating in this regard was the *India Science Report*, a first-of-its-kind nationally conducted survey with a sample size of over 100,000 people (Shukla, 2005). It was published by the National Council of Applied Economic Research (NCAER) in 2005 and discussed public awareness of science and technology as well as participation of the population in science education and in scientific jobs. Two issues stand out from the report: the first is that, even with a relatively low percentage of literate people (about 64 per cent according to the 2001 census), interest in issues of science and technology and awareness of basic science is very high. A second, more telling figure is the 60 per cent of middle school students who want to pursue a career in sciences, technology, engineering and medicine. This percentage is sustained through all school years with about 57 per cent in high school recording a similar response. About 40 per cent of all middle school students said that they wanted to become 'an engineer or a doctor' (Shukla, 2005, p. 16), thereby indicating the perceived importance of science in the society. However, the number of students aspiring for a STEM career drops significantly in the rural areas. This is where the question of reaping demographic dividends of India's vast young population becomes extremely challenging, and Indian science communicators need to address the urban–rural divide on a priority basis, while also bringing a more critical and interrogative lens to the process and outcomes of science in general, and Indian science in particular.

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Timeline

Event	Name	Date	Comments
First interactive science centre established.	Birla Industrial and Technological Museum, Kolkata	1959	1978: National Council of Science Museums established to oversee the administration of science centres in India
An association of science writers or journalists or communicators established.	Kerala Sastra Sahitya Parishat (KSSP) started as a forum of science writers	1962	1972: KSSP become a People's Science Movement. Their motto is 'Science for Social Revolution' 1985: Indian Science Writers' Association (ISWA) established 1988: All India People's Science Network formed
First university courses to train science communicators.	Dept. of Science Communication and Journalism, Madurai Kamaraj University	1988	
National government program to support science communication established.	National Institute of Science Communication (NISCOM) was set up to publish scientific journals and periodicals	1951	1952: Indian National Scientific Documentation Centre (INSDOC) set up with UNESCO help 2002: NISCOM and INSDOC merged to form National Institute of Science Communication and Information Resources (NISCAIR)
National Science Week founded.	National Science Week	1987	Held around National Science Day, on 28 February
A journal completely or substantially devoted to science communication established	*Vigyan Pragati* [Progress in Science] a Hindi popular science journal published by NISCOM	1952	2002: First issue of *Indian Journal of Science Communication* 2013: The quarterly *Journal of Scientific Temper* published by NISCAIR
First significant radio programs on science.	*Maanav ka Vikaas* [Human Evolution]	Early 1990s	144-part radio series
First significant TV programs on science.	*Bharat ki Chaap* [India Key Impressions]	1989	Broadcast on Doordarshan (now DD India), an Indian English news and current affairs channel
First awards for scientists or journalists or others for science communication.	National Science Popularisation Awards	1987	Instituted by National Council of Science and Technology Communication
Date hosted a PCST conference.	11th PCST Conference, New Delhi	December 2010	

Event	Name	Date	Comments
Other significant events.	Scientific Policy Resolution (SPR) to 'foster, promote and sustain' the 'cultivation of science and scientific research in all its aspects'	1958	1983: Technology Policy Statement 1976: Inclusion of 'scientific temper' in the Indian Constitution 2003: Declaration of National Science and Technology Policy 2010: Declaration of Decade of Innovation 2013: Declaration of Science, Technology and Innovation Policy
	India Science Wire, a daily news and features service in English and Hindi	2017	Organised by from Vigyan Prasar, a unit of the Department of Science and Technology, New Delhi

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