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Sociology of Nuclear Research in India

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The 'sociology of science' underlines that the development of science and scientific knowledge is not autonomous from social influence and can be analysed using the tools of sociology. On the other hand, Indian nuclear research is considered an autonomous institute without being influenced by even parliamentary politics. This paper tries to analyse these two opposite aspects to understand whether Indian nuclear research and its knowledge are autonomous from the influence of the social milieu. It analyses the social and religious influences on the structure, function, and outcome of nuclear research in India. Sociologists consider Indian society a traditional society in which religious and other social norms have to play a significant role in daily life. The influence of religion and religious norms is reflected in government policy-making and scientific research institutions' structure and procedures. But, since India does not have a uniform social system and values, the ideas followed by influential personalities get prominence in the final outcome. So sociology of the Indian nuclear programme needs to consider the social background of such individuals and the dominant social norms of each period. The paper concludes that the autonomy of nuclear research institutes and their lack of accountability does not mean they are beyond the influence of social norms, but this hierarchy and uncritical acceptance itself is a product of the nature of the Indian social system.

Keywords: Nuclear Weapons; Caste; Sociology of Science; India

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The development of science and scientific knowledge is not autonomous from social influence and can be analysed using the tools of sociology. David Bloor (2005) discusses how social factors impact the process and outcome of scientific knowledge. Bloor indicates different ways of influencing society on science, such as the connection between the gross social structure of groups and the general form of cosmologies subscribed by them, secondly; the relationship between economic, technical, and industrial development and the content of scientific theories, thirdly; the influence of non-scientific features of culture on both creation and evaluation of scientific theories and findings and fourthly; the impact of training and socialisation of scientists on their scientific discoveries.

The works on the sociology of science triggered me to analyse the social aspects of Indian nuclear and space research since these are considered autonomous research institutions from political influences and accountability of the larger society. My concern is whether the autonomous aspect of the institutions causes autonomy of scientific research outcomes and how the argument Bloor- social factors influence both right and wrong and true and false research outcomes- would be applied in the context of Indian nuclear research. This paper will analyse the impact of both domestic

and international society and its values on the structure, motivations, process, and outcomes of nuclear and space research. The first part of the paper will deal with works on the sociology of science in general, and it will be followed by a discussion on the nature of Indian society. The following section will analyse the influence of social factors on Indian nuclear research and the role of groups and individuals in shaping and interpreting these social aspects.

Sociology of Science

According to David and Sullivan (1975), the sociology of science deals with the social conditions and effects of science and the social structures and processes of scientific activity. The sociology of knowledge, which was developed by eminent sociologists Emile Durkheim and Marcel Mauss during the 19th and 20th centuries, focused on the relationship between human thought and its social context. According to Jefferson D. Pooley, the term 'sociology of knowledge' was coined by Max Scheler (1874–1928), a German Philosopher, in 1924 and quickly embraced by Karl Mannheim (1893–1947), a Hungarian-born sociologist (Pooley, 2016).

Similarly, the Sociology of Scientific Knowledge was developed in the late 1960s and early 1970s by theorists, including Barry Barnes, David Bloor, Harry Collins, Paul Feyerabend, Thomas Kuhn, and Mike Mulkay. In the words of Boumans and others, the Sociology of Scientific Knowledge refers to "the way in which sociology has been used to explain science and knowledge" (Boumans et al. 2016, p. 135). Dick Pels classified the Sociology of Scientific Knowledge into two traditions: Mannheimian and Wittgensteinian (Pels, 1996). The Mannheimian tradition is considered a 'weak program', and it gives social explanations for errors in scientific research. According to it, while the correct findings in science do not need any sociological explanation, errors in scientific reasons can result from social factors. So, the Mannheimian tradition supports social explanations for such errors. The Wittgensteinian tradition of the strong programme was followed and developed by Bloor, Barnes, Collins, Henry, and Mulkay. David Bloor (2005) called the Mannheimian tradition the sociology of error and advocated for the strong programme in his work "The Strong Programme in the Sociology of Knowledge". The strong programme proposed that both true and false scientific theories should be treated in the same way, and both can be analysed using the sociological method. The nature of knowledge is influenced by social factors such as cultural context and self-interest. Since scientists are part of society, their behaviour and beliefs can be studied using the sociological methods of studying other elements social world (Boumans et al., 2016, p. 138). Following the legacy of Bloor's strong programme, Trevor Pinch and Wiebe Bijker developed the concept of 'Social construction of technology' (Pinch & Bijker, 1984). They argued that technology could not be understood without an understanding of its social context.

Vig (1988) identifies three philosophies of technology. They deal with ethical questions of the relationship between technology and society/politics. First is instrumentalism, which holds that technology is a neutral instrument and a means to an end. It creates new choices and remains morally neutral. The second is social determinism, which holds technology as one of many components of a culture and a mere reflection of social values, and it can be understood only in a given social context. The third philosophy is technological determinism which says technology has a unique character and inherent power. Technology has its governing forces that remain inbuilt inside of it. John Street, in his work *Politics and Technology*, proposes

three theories. First is the theory of the autonomy of technology, which says that it has an independent momentum that puts it beyond human control. Second, the theory of technological determinism argues that technology sets the conditions for the operation of the political system. The third theory, the theory of political choice, says that technology development follows directly from the fulfillment of human needs, which are shaped by social and political factors (Street, 1992). Out of these theories on society and technology, this paper recognizes the influence of social conditions on technology and vice versa. Technology is not independent of its surroundings. The values of society, its economic and political system, the ideas and interests of elite groups, and the needs of different sects play significant roles in the process and outcome of scientific and technological research.

Scientific knowledge often claims objectivity and universality without influences from social or personal interferences. But, as mentioned earlier, David Bloor, Thomas Kuhn, and others have rejected this idea of objectivity. Kuhn (1962), in his seminal work "The Structure of Scientific Revolutions", argued that the evolution of scientific theory emerges from a set of changing intellectual circumstances and possibilities and not from the straightforward accumulation of facts.

Science and Indian Society

The nature of Indian society influences the structure and development of India's scientific research, including the nuclear programme. Indian society has a unique character that is different from other countries in many ways. Such a development of Indian society is an outcome of various events and diverse intellectual traditions since the ancient period. T.K Oommen (2001) identifies seven major events that played a significant role in shaping Indian society. They are the advent of Aryans, the emergence of Indian Protestant religions-Jainism, Buddhism, and Sikhism, the entry of non-Indic religions into the sub-continent, the Muslims' conquest and rule, western colonialism, anti-colonial freedom struggle and the partition of the Indian sub-continent in 1947. The results of this long process were that Indian society was stratified based on gender, age, and other differences. Out of these stratifications, what is unique in India is the caste system which is legitimised through doctrines of Karma and Reincarnation.

The traditional hierarchical structure in India encompasses four main castes: Brahmins, who hold the priestly role; Kshatriyas, known as warriors; Vaishyas, who engage in trade; and Shudras, primarily involved in labor. Despite recent efforts through reservation policies to enhance educational opportunities for backward castes, Thomas (2020) notes that the upper-caste Brahmins continue to dominate prestigious science and technology institutes. This dominance has resulted in the prevalent perception of the archetypal scientist in India as being Brahmin. The entrance of non-Brahmin scientists has not altered this perception significantly. Moreover, certain cultural traits associated with Brahmin heritage, such as vegetarianism, have become normalized within scientific institutional settings (Thomas, 2018). Underscoring the Brahmin influence within the renowned Indian Institute of Science in Bangalore, Thomas (2020) uses the term 'Iyer Iyengar Science Campus'.

Sociology of the Indian Nuclear Programme

Traditional realist analysis of nuclear programmes focuses on the external threat

as the driving factor of nuclear weaponisation. In the words of Thayer, "security is the only necessary and sufficient cause of nuclear proliferation" (Thayer, 1995, p. 486). Accordingly, the development of Indian nuclear weapons is explained in the context of its hostile relationship with China and Pakistan. Such analyses see the state as a black box and ignore the domestic and social variables that shape nuclear research and development.

A sociological analysis of the Indian nuclear programme reveals various driving factors related to Indian society. The Indian cultural tradition and values have been identified as both driving and constraining factors of nuclear weaponisation. Jepperson et al. (1996) pointed out the different impacts of domestic culture on strategic decision-making. According to them, the cultural environment affects the behaviour of policymakers and the identity and interest of the states. Such norms set the standard for the legitimacy of developing and using nuclear weapons. According to Kartchner (2009), the proliferation and use of Weapons of Mass Destruction can be legitimized and seen as rational in some cultures. Similarly, such weapons also can be used as a means to achieve culturally endorsed outcomes like prestige in the international community.

Compared to many European countries, cultural heterogeneity and the acceptance of the idea of pluralism were high in India. Thus, there is no uniformity among Indians in their religions or culture. Nevertheless, Hinduism, the religion of the majority of Indians, keeps dominance in shaping Indian social values. At the same time, the values of Hinduism were subjected to diverse and even contradictory interpretations.

In the initial decades of independence, while the ideas of Gandhi and Nehru gained dominance in Indian society and politics, their approaches toward science and modernization were different from each other. When Gandhi proposed idealistic and village-centric development, Nehru recognized the role of modern science and technology in the future development of India. Nehru considered the foreign invasions and colonial experience as a consequence of scientific backwardness and the absence of industrial revolutions and aimed that India should not lag behind Western countries in the coming nuclear decades. However, both Gandhi and Nehru were against the weaponization of nuclear technology. Even though Perkovich (1999) argued that it was not just H.J Bhabha, but Prime Minister Nehru also had the intention of nuclear militarization, the lack of such an initiative during his 17 years long rule shows the unwillingness of Nehru for atomic weapons and the influence of Gandhian ideologies on him.

On the other hand, the right-wing Hindu nationalists, who gained dominance in Indian politics after the 1990s, forwarded a masculinist interpretation of Indian tradition. According to them, India developed technologies similar to modern technologies of airplanes and nuclear weapons in its ancient period. India gradually lagged behind others due to foreign invasions. So they considered the technological development and nuclear programme as necessary steps for the revival of the ancient pride of India. As Young (2004) pointed out, the Hindu right-wing leaders' interpretation of Indian tradition and Hindu religion was different from the Gandhian interpretation. BJP, a Hindu nationalist party, was a major supporter of nuclear bombs, and they mobilized people for it, referring to classical religious texts. Using the term 'Political Hinduism', Kanti Bajpai (2004; 2009) explained the ideological

inspiration of the BJP-led Indian government in the nuclear test of 1998. Although not directly attached to Political Hinduism or right-wing parties, the scientific community also interpreted Indian tradition in a realistic way.

As far as the moral legitimacy of nuclear weapons in Indian/Hindu tradition is concerned, there are multiple interpretations. Soon after the first test of nuclear weapons in New Mexico, Robert Oppenheimer quoted from the Bhagavad Gita saying, "Now I am become Death, the destroyer of worlds" (Young, 2004, p. 277). Emmanuelle Maître pointed out the decisive role of various mythological references of the Hindu tradition in the nuclear weapon tests of 1998 (Maître, 2016. p. 28). Because, in Hindu mythology, Weapons of Mass Destruction, like Bramhastra, were used and even justified as weapons of last resort. *Divya Astra*, divine weapons, many of them are mass destructive, play a crucial role in the epics of *Ramayana* and *Mahabharata*. For example, Arjuna, a renowned hero from the PâG

ava in *Mahabharata*, opts for rigorous austerity to acquire Pâúupatâstra, the most formidable weapon bestowed by the god Shiva. It possesses the power to vanquish adversaries, eliminate demons, and crucially, has the potential to bring about the destruction of the world (Staszczyk, 2014, p, 188). In the words of Jarrod L. Whitaker "In fact, in no other mythological corpus is the concept of divine weapons more developed and more complex than in the two Indian epics" (Whitaker, 2000, p. 87).

On the other hand, Gandhi, who also was inspired by the Bhagavad Gita, responded to the first test of nuclear weapons in New Mexico by saying that "Unless now the world adopts non-violence, it will spell certain suicide for mankind." (Young, 2004, p. 277). The political leaders choose one out of many contradictory interpretations of norms and mobilize people accordingly. In other words, both constraints over nuclear weapons development by the Gandhian interpretation of Indian tradition and inspiration for the weaponization by the Hindu nationalist interpretation of Indian tradition indicate the influence of social values on nuclear weapon research. In addition to political leaders, the scientific community also have been influenced by traditional norms and history. The work of A.P.J Abdul Kalam (1999) also indicates the role of traditional Indian culture in inspiring the scientific community (for example, his autobiography, *Wings of Fire*). The dominance of the knowledge community (Brahmins) over the military community (Kshatriyas) is reflected in the intention of nuclear scientists to keep the military away from nuclear decision-making.

The interests of different institutions, like the military, scientists, political leaders, and the scientific community, towards nuclear projects depend upon their position in society and their aspiration to increase their status through militarisation or arguing for disarmament. The second model of Sagan's three models of nuclear proliferation (Sagan, 1996, p. 63) suggests that the decision of weaponization/ disarmament depends upon the influence of each group in a particular period. As William Epstein explained, in every country there will be different and competing opinions regarding nuclear weaponization. For example, while scientists and bureaucrats associated with nuclear research and strategic thinkers argue for weaponization, civil society groups and like-minded political parties may oppose it (Epstein, 1977, p. 25). The final policy of the state depends strength of each group in this bargaining process. In the case of the Indian nuclear programme, Sagan points out that it is necessary to consider the "prolonged bureaucratic battle", which took

place after Chinse nuclear test in 1964, to explain the Indian tests of 1974 (Sagan 1996, p. 66). The economic condition of Indian society and the aspiration to change from an agrarian society to an industrial society also was the motivation behind the nuclear programme of the country, especially during the time of Nehru. It is reflected in his attitude towards science and his justification of the Indian nuclear programme for civilian purposes.

In addition to the conditions of Indian society, the aspect of global/international society and the function of nuclear weapons in it are also influential in nuclear policies. The possession of nuclear weapons greatly influences the status and role of states at the international level (O'Neill, 2002). Unlike conventional military weapons, a nuclear weapon functions as a symbol of a nation's status and prestige. So, it is an effective tool for strengthening nationalist feelings among citizens. The nuclear programme of India could be explained by using the 'role-playing' theory of sociology. Just like a child imitates the role of different people, India also follows the ways of first-generation nuclear weapon states to achieve what they got through the possession of nuclear weapons, like international status. Additionally, former colonial countries, like India, consider nuclear weapons as a way to redress their inferior position in the global platforms. The nuclear weapons also enable them to avoid dependence on the Nuclear Weapon States (Epstein, 1977, p. 21-22). Due to its commitment to Third World solidarity, Indian nuclear development can also be seen as a means to enhance the status of Third World countries (Modongal & Mousavian, 2022). From the Cold War experiences and other situations, India learned that possessing nuclear weapons helps deal with certain situations in international society. The internalisation of these experiences socialises states, including India, to behave in a particular way. But since the internalisation and interpretation of different actors are different, the learning and behaviour of the states also differ from each other. The policy of one state itself can be reformulated from time to time according to which actor is dominating the decision-making and how they internalise and interpret the situations.

In addition to motivations, the structure of the nuclear programme also was affected by the social structure of India. The scientific community emerged as a new caste in Indian social stratification. They were treated as insular from political pressures and social obstacles to their programme. The Indian nuclear programme is characterised by ambiguity and secrecy. Ramana (2009, pp. 45-51) identifies six enabling factors of secrecy in nuclear programmes. Firstly, the Indian bureaucracy generally lacks accountability. Secondly, the structure of the atomic establishment lacks democratic character. Unlike other policy matters, it is the Atomic Energy Commission of India (AEC), which consists of scientists, not the cabinet, who control the programme. The AEC is accountable to only the Prime Minister, not the parliament or cabinet. Thirdly legal structure legitimises this secrecy and empowers the Department of Atomic Energy (DAE) to restrict any information on atomic issues. The Atomic Energy Act and the Official Secrets Act of 1962 are examples of such laws. Fourth is the absence of experts outside of the DAE. The practical difficulty in obtaining even available information is another factor in enabling secrecy. Last, but not least, this factor is the support of Indian media for the nuclear programme and its unwillingness to offer critical perspectives on nuclear issues. The ambiguity of the purpose of the nuclear programmes is a significant reason behind the secrecy. India had not separated its military and civilian programmes till the nuclear treaty with

the USA. During the first decades of independence, India argued for nuclear disarmament and declared its programme as for the peaceful use of energy, but it had kept the option of nuclear weapon open.

The nuclear scientists keep control over nuclear projects while the cabinet or the military are kept out of major decision-making on nuclear weapon programmes. Instead of political leaders like Nehru and Shastri, it was H.J Bhabha and scientists who diverted the nuclear program from military to civilian control. This control of nuclear scientists on the weapon of Mass Destruction and their superiority over the military can be analogised to the traditional caste division between Brahmins and Kshatriyas. The military and ruling duties were assigned to the Kshatriyas, and they were below Brahmins, whose task was to study Vedas and practice them. The legend that Parasurama, the sixth avatar of Vishnu, destroyed Kshatriyas as a punishment for their tyranny is thought by some scholars to reflect a long struggle for supremacy between priests and rulers (Encyclopaedia Britannica, n.d.). According to Perkovich (1999), the scientists, mostly from South Indian Brahmin backgrounds, were eager to showcase their expertise in the most profound scientific domains. However, they were reluctant to relinquish their independence, preferring to maintain their autonomy.

Even though the Kshatriya had military duty, it is believed that the certain mantras of Brahmins and their imprecation could destroy the entire world, which can be equalized to the effects of the Weapon of Mass Destruction. The massive impact of the Brahmins' weapons, like mantras and imprecation, compared to the military power of Kshatriyas, symbolises the power of knowledge than muscle power. When the military of India inherent the duty of Kshatriyas, the nuclear scientists seem to be the present model of Brahmins. It must be noted that the main architects of the 1974 nuclear test— Raja Ramanna, PK Iyengar, Rajagopala Chidambaram—were upper-caste Hindus. Similarly, VSR Arunachalam, who led the Defence Research and Development Organisation during the development of the Prithvi missile and many of India's nuclear weapon capabilities, also belongs to the high caste (Perkovich, 1999, p. 401). Referring to the former vice chief of naval staff K. K. Nayyar, Perkovich (1999, p. 450) has pointed out that the "Indian caste system has contributed to the exclusion of the military from nuclear policymaking". As Brahmins kept the knowledge of Vedas exclusively among them, nuclear scientists kept the military away from the knowledge of nuclear issues. The nuclear programme was a means to demonstrate the power of knowledge and the supremacy of scientists over the muscle power of the military.

Conclusion

Nuclear research in India, like any other scientific endeavor, is not immune to the influence of social values and interests. The theory of political choice underscores that the development of technology is intricately linked to political and social values, challenging the notion of scientific objectivity. In reality, the evolution of scientific knowledge is deeply intertwined with societal preferences. Similarly, scientific research in India is shaped by the values and structure of Indian society, with caste hierarchies playing a visible and influential role among Indian scientists and in scientific research.

When it comes to nuclear development, scholars have highlighted various domestic factors, such as the political system, and social and strategic values, as

significant influences. While some cultures view the use of weapons of mass destruction as morally unacceptable, others justify their use if the end goals are considered legitimate. In the Indian context, the BJP government's masculinist interpretation of Indian tradition was a major driving force behind the nuclear tests of 1998. Despite claims of autonomy from democratic institutions such as parliament and the cabinet, this autonomy itself reflects the hierarchical nature of Indian society.

The motivations behind India's nuclear research and militarization cannot be divorced from the political and economic conditions of the country. They are also shaped by the ideological frameworks of society, which exert influence on both policymakers and nuclear scientists, reinforcing the complex interplay between science, politics, and societal values. This dynamic underscores the need for a more nuanced understanding of how societal structures and cultural ideologies shape scientific pursuits and technological advancements in India. Addressing these underlying influences is crucial for fostering a more inclusive and equitable approach to scientific development that reflects the diverse needs and aspirations of society.

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