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2. Chattopadhyaya, D., in *History of Science and Technology in Ancient India: Formation of Theoretical Fundamentals of Natural Science*, NISTAD, New

Delhi, KLM Pvt., Ltd. Calcutta, 1991, pp. 89-148.

3. Abdul Kalam, A. P. J. and Rajan, Y. S., *India 2020: A Vision of the New Millennium*, Viking, 1998, p. 186.
4. Polyanyi, M., in *Science, Faith and Society*, University of Chicago, Chicago, 1964, p. 50.

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India's status after Pokhran-II

I read the letter entitled 'Nuclear weapons' by B. M. Udgaonkar in the correspondence section (*Curr. Sci.*, 1998, **75**, 871). I would like to make a few comments.

Firstly, Udgaonkar's reference to Einstein's moral realism appears somewhat misplaced. Einstein modified his pacifist position in the face of the great threat posed to humanity by the rise of Hitler and Nazism to power in Germany, the 'compelling circumstances' that Udgaonkar refers to. Rajasekaran's reference, which Udgaonkar is critical of, is to Einstein's position against nuclear weapons in the Cold War era, when the situation had substantially changed. Surely it cannot be Udgaonkar's position that any security threat that India faces today is comparable to the one faced by the world from fascism. If such a strange conclusion is indeed his position, then Udgaonkar needs to substantiate it in far greater detail than he has in the letter.

Secondly, Udgaonkar refers to the rejection by the nuclear weapons states of the Indian stand, that the use of nuclear weapons be declared a war-crime, in the final June-July 1998 negotiations to frame the statutes of the International Criminal Court. Undoubtedly the nuclear weapon powers have hypocritically preached the virtues of non-proliferation while continuing to refine and develop their nuclear arsenals. These arsenals remain despite the demand for the abolition of nuclear weapons that have come from governments and peoples all over the world. But after Pokhran-II, after the declaration that India was inescapably a nuclear weapons state, after it had been declared that the possession of nuclear weapons was the 'inalienable right of one-sixth of mankind', after 'a comprehensive security dialogue' had begun with the world's leading nuclear weapon power

to bolster claims to nuclear power status, did Indian negotiators retain the moral high-ground to declare that the use of nuclear weapons must be made a war-crime? When negotiations were on to justify India's entry into the nuclear weapons club, it is somewhat unsurprising that India's stand at the International Criminal Court negotiations was dismissed as posturing.

Similarly with regard to Udgaonkar's reference to the advisory opinion of the International Court of Justice, the current official position on nuclear weapons status is a comprehensive rejection of the earlier position that India had taken before that court.

Thirdly, Udgaonkar is of the opinion that India should continue to press for a nuclear weapon-free world while 'maintaining a minimal deterrence'. However, it has been widely noted by several commentators on nuclear issues that the concept of *minimal deterrence* is a very nebulous one.

It is worth noting that the concept itself had its origin as a possible mid-way point on route to total abolition¹. Several difficulties are evident in regarding this concept as part of a nuclear doctrine².

i) If zero is not the minimum required by minimal deterrence, as is clearly implied by Udgaonkar, then what constitutes an acceptable number? The relevant question here is of course minimum with respect to what. Is it to be defined with respect to Pakistan's capabilities, China's or even that of the United States, given that its nuclear fleet traverses the entire globe? Depending on the answer to this question, a minimal deterrence could take on vastly different forms. It is not clear whether India currently has attained either the technological capability (without resorting to further testing, an option that

appears unavailable)³ or the economic capability to deal with all the possible scenarios of 'minimal' deterrence.

ii) Will 'minimum' deterrence be fixed at a stable minimum or will the numbers constantly shift, leading to an open nuclear arms race, particularly in the sub-continent? The point to remember here is that the same level of weaponization will be perceived differently by different observers, a fact which is clear from the history of the Cold War. Whatever constitutes a minimum deterrence for India would be construed as an aggressive threat by India's neighbours in the sub-continent. Pakistan would continue building a nuclear arsenal while other nations would be threatened by the nuclear risk posed by this race.

Even without external pressures, once nuclear weaponization is accepted as policy, new ideas for further weaponization will emerge, pushing an arms build-up and furthering heightening tensions and imposing costs. A notable recent example is the reported decision to develop an anti-ballistic missile shield for New Delhi⁴ that has attracted criticism even from pro-weapons strategic affairs experts.

iii) Will the declaration of a posture of minimal nuclear deterrence enhance our security, or lead instead to a degradation of the security environment with increased strains on our conventional arms as well as increased defence costs all round? The current evidence is that the posture of nuclear weaponization has not only *not* improved our security (it became clear with the Chagai tests that Pakistan had been given the opportunity to weaponize too), but in fact has gifted our western neighbour a situation of strategic parity. India had, prior to Pokhran-II, a situation of strategic superiority, based on its superiority in conventional arms.

The closure of India's nuclear option on the side of weaponization also appears to have reduced India's options on matters that have to be taken care of by conventional arms. In an important comment made after Pokhran-II, the Vice-Chief of Army Staff emphasized the need for a negotiated settlement on Kashmir because, according to him, solutions based on conventional arms were no longer possible, including temporary measures like hot pursuit in counter-insurgency operations⁵. Clearly the conditions for a peaceful settlement are not entirely in India's control.

iv) Why could zero not have remained the desired minimum, with our demonstrated technical capability in Pokhran-I itself functioning as a non-weaponized deterrent⁶, forcing our sub-continental neighbour to maintain a similar posture?

Given the post-Pokhran-II international pressure on India's independent nuclear policy, particularly the pressure to sign the CTBT, the pressure to enter FMCT negotiations, which we have accepted now, (we had rejected this earlier in part because it would involve an inspection regime that was near-equivalent to NPT-style full-scope safeguards), has India gained from the turn towards nuclear weaponization? Such intensified pressure on our nuclear policy would not have arisen if we had persisted with the policy of non-weaponized deterrence.

To these arguments, we may add the unacceptability of the idea of deterrence itself, minimal or otherwise, on both moral and security grounds. Crucial to the idea of stable deterrence is the notion that populations must be vulnerable to nuclear weapons. Any attempt to offset this vulnerability will be a destabilizing act, provoking an arms race, or, in the worst case scenario, a nuclear attack. India had always rejected the doctrine of deterrence as unacceptable. What reason is there to adopt these notions in an era when our earlier objections have begun to be echoed and strengthened even by the generals of the nuclear age⁷.

In the light of these considerations it appears that non-deployment and non-induction of nuclear weapons is in fact the only option that lowers regional tensions, enhances security and ensures much greater leverage in pushing for the total abolition of nuclear weapons and global disarmament, while providing an opportunity to regain the moral high-ground. As such it appears a far more robust, viable and sustainable option than the alternative suggested by Udgankar.

1. Schell, J., *The Abolition*, Avon Books, New York, 1986.
2. Raghavan, V. R., *The Hindu*, 1998, 8 Sep.; Ramdas, L., *Frontline*, 1998, vol. 15, 4-17 July.
3. Doubts have been expressed on both sides of the weaponization debate on whether India has attained credible nu-

clear deterrent capability. See for example, Iyengar, P. K., *India Today*, 9 November 1998, p. 72; Brahma Chellaney, *Hindustan Times*, 4 November 1998; Gopalakrishnan, A., *The Hindu*, 18 November 1998; Jayaraman, T., *Frontline*, 10-23 October 1998, vol. 15.

4. Joshi, M., *India Today*, 19 October 1998, p. 76. It is also worth noting K. Subrahmanyam's comment as quoted by Joshi: 'The present confusion is the result of politicians not being able to differentiate between the job of scientists and strategists..., when this happens scientists will run away with the strategic agenda.' In other words, arms for arms' sake in the form of agendas pushed by pro-nuclear weapons scientists is as much a danger in India as it has been in other nuclear weapons states.
5. Army Vice-Chief, *Times of India*, 5 September 1998.
6. Jasjit Singh has been among the most articulate exponents of this idea prior to Pokhran-II, for instance in his popular presentation in *Frontline*, 11-24 April 1998, vol. 15. For a reluctant defence of Pokhran-II, while still trying to retain as much as possible of the idea of non-weaponized deterrence, see his contributions in *Nuclear India*, IDSA publication, 1998.
7. See for instance the views of military commanders, particularly Gen. Lee Butler, in Schell, Jonathan, *The Gift of Time*, Penguin Books, India, 1998.

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On way to extinction? The scene in Indian grasses

Large variations exist regarding estimates on species inhabiting the globe¹ and those facing extinction². The situation is further obscure in the world of plants³. Skepticism prevails, from likely hyperbolizing these estimates⁴, to species erosion at rates faster than our capacity to catalogue them². Nevertheless, the increased anthropogenic activity in present times has variedly influenced most of the global ecosystems, resulting in species loss as well as their geographical relocation. What is being lost may well be the one-time's next door plant. The WWF's Biodiversity Conservation Prioritization Project (BCPP) re-

port⁵ on the dwindling diversity of grasslands in Assam is one such case.

The significance of about 10,000 odd known grass species⁶ in the world is enormous in lending vegetational cover to about 17% of the earth's land surface⁷, besides providing a number of cereals and fodder to mankind. Nearly 15% of the world grasses are represented in India⁸, ranging from the most noxious weeds⁹ to those relatively rarer¹⁰.

One of the earlier records for Shimla district refers to the work of Collett¹¹. Later, Nair¹² published *Flora of Bashahr Himalayas* (30°46'-32°5'N;

76°28'-79°4'E), representing Kinnaur and Mahasu, including Shimla (31°6'N; 77°10'E). Some species found outside the Mahasu and Kinnaur regions were omitted. It is interesting to observe that 48 grass species, or 35% of those reported by Collett are not found in Nair's record (Table 1). Of all the Indian grasses⁸, only a few (*Deyeuxia simlensis* Bor, and *Eragrostis rottleri* Staph.) are reported to be probably extinct¹⁰, while a greater number of species listed as threatened¹³, do not include those in Table 1.

The number is too large for crediting to the area omitted, especially when the