

Voices against the militarization of science

M. V. N. Murthy, Madan Rao, R. Shankar, J. Samuel and A. Sitaram

C. V. Raman and M. N. Saha are towering figures in Indian science. Apart from their considerable scientific contributions, both of them were deeply committed to developing Indian science, building institutions and making science take root in this country as a positive social force. Both reflected deeply about aspects of science in relation to the society and believed that science must be used for humane ends. They used their considerable weight as reputed scientists in order to proclaim truths they believed in. They had contrasting styles: Raman was passionate and emotional, whereas Saha argued from a political and rational point of view. However, both were courageous and expressed their views in a fearless fashion. Not only were they great humanists, they were the social conscience of scientists of their times.

In the euphoria following Pokharan II, not many voices have been raised against the development of nuclear weapons. We wish to point out that there are illustrious examples of Indian scientists who opposed the destructive use of science. Both Raman and Saha were outspoken opponents of the development of nuclear weapons anywhere in the world. These are voices we sorely miss today. Indeed their words appear to have been forgotten. The purpose of this article is to remind the scientific community of these words. Their views are offered as a catalyst for introspection about the role of science in our society, and its ethical and moral foundations.

Raman against the militarization of science

Apart from being a brilliantly original scientist, C. V. Raman was an outspoken advocate of the human dimension of science. His views on the militarization of science, in general, and the use of nuclear physics for nuclear weapons, in particular, were vocally and clearly rendered. Raman was honest and forthright and did not care if his views made him unpopular. Raman was never one to hold back his views and today, a 110 years after his birth, they are still relevant.

On 19 September 1946, Raman addresses the Ceylon Association of Science thus: 'The atom-bomb is the latest weapon created by science for the benefit of war-mongers' (*Bombay Chronicle*, 6 October 1946). This was barely over a year after Hiroshima and Nagasaki. The Mayor of Hiroshima (or, more probably, his representative) visited Raman after the devastation and presented him with two scorched pebbles from Hiroshima in appreciation of the views expressed by him. The two pebbles which still lie in the Museum at Raman Research Institute, Bangalore, are mute stone witnesses to the tragic events of 6 August 1945.

In a stirring, emotional public lecture delivered in Hubli in December 1954, Raman, then the only Indian Nobel Laureate in Science, takes advantage of his public status: 'The world will be a better place if those who made these deadly bombs destroyed themselves and are dead and gone'. (*The Hindu*, 30 December 1954).

His message to the Annual Nobel Dinner on the 11 January 1958 is more reasoned if less emotional: 'I am also convinced that a policy of competition in the manufacture of weapons can serve no useful purpose and that, if continued, it would inevitably lead to an armed conflict. It also seems to me that the way to avoid such a conflict would be for the common people of all nations to assert themselves and resolve that in no circumstances would they be a party to the outbreak of war. It is necessary also that the policy makers in every country should appreciate the strength of such a resolve and that the leaders of the nations should get together and build a bridge of reconciliation and understanding between the peoples, who seem today to stand on the verge of conflict.'

Raman's Convocation address in 1966 is a brilliant enunciation of his position. Speaking to a gathering at the IIT, Madras, he comes out openly, admonishing, warning, appealing. Only a couple of years after the Chinese nuclear tests, he traces the fear psychosis that has led to nuclear proliferation, using the simple yet powerful analogy of a man drowning in debt to bring home his point. '...

here is an instrument of dreadful power. If we use it we can destroy mankind. And fear, the fear that the other man may use it led to the development of the atom bomb every where ... (This fear is) like what happens to a man when he borrows money. You see the interest goes on adding up. It becomes a colossal figure, which bears no resemblance whatsoever to the loan which he took at first. This kind of explosive development of fear complex has produced a psychological, a pathological, state of affairs in the human mind in which all evils thrive and sustain. ... today, science in many countries is simply the hand-maid of the war machine' (italics added). At this stage he goes beyond the nuclear weaponization issue, to the very practice of post-war science, and its nexus with the political and military establishment. He perceived that to an increasing extent, agendas and developments in the international arena of space and nuclear sciences were 'nothing but militarism very thinly disguised'. While he sounds optimistic in declaring that 'there are sensitive consciences even in those countries who revolt from this sort of thing', he is not sure of where it would end—'it is going on, this prostitution of science'. Strong words perhaps, but reflecting strong feelings!

Raman's IIT Madras Convocation address stands out as one of the most passionate of public speeches against weaponization ever made in India by a prominent scientist. The address carries moral conviction, courage, and concern for the future road of science. He was profoundly convinced that science must be put to humane ends and not serve the machines of war and destruction. In this he was not alone, sharing space with Bethe, Bohr, Einstein, Pauling, Russel, Weisskopf, Szilard and Urey amongst thousands of others.

Saha against nuclear weaponization

Considered by many as the father of modern astrophysics, M. N. Saha is fully Indian in image, as is Raman. He was perceived as a rustic who lived a life of

'plain-living and high thinking'. Saha did most of his scientific and organizational work during the pre-independence era. He supported the independence movement and believed that there had to be a complete reorganization of society and the economy after independence.

While Saha and Raman differed on many aspects of development of science in the country, their views on nuclear weapons are almost identical. If anything, Saha is more vocal in expressing his views: 'the logical pursuit (of utilizing nuclear fission for military purposes) by rival power groups will mean the destruction of the present form of civilization ...' (*Sci. and Cult.*, 1947, **13**, 86).

Quite early he realized that nuclear warfare should be banned—'Though the possession of atomic weapons appears to constitute great military strength, actually it is not so. Its use constitutes a great moral sin against humanity. Its production involves immense organization and cost, which only the big nations are capable of undertaking. It is effective only against great centers of population and industry, whose destruction would be an unpardonable crime against civilization.' Commenting on a decision made on 18 December 1954 by the NATO Council to base its military strategy on the use of nuclear weapons, he said, 'The decision is immoral because the very persons in whose interest atomic weapons are proposed to be used would be its first victims. History teaches that "wars to end wars", "violence to end violence" have never accomplished their objective. The conse-

quence of the decision will be to intensify the race for nuclear armaments and endanger the peace of the world. If the conflagration spreads, as it is sure to do, it will lead to sheer mass destruction.' He believed that the NATO decision made the destruction of modern civilization a technological possibility.

On the attitude of scientists, intellectuals and artists towards the nuclear danger he has this to say: 'Apart from the fire-eating generals, admirals and politicians of the McCarthy type (and, we might add, scientists of the Teller type), the world opinion of scientists, artists and intellectuals is definitely against the manufacture and use of atomic weapons.'

Note how this logical, reasoning scientist clearly always holds the larger good of humanity in mind: 'Those who are indulging in the testing of thermonuclear bombs, even in distant areas, cannot avoid the moral responsibility of committing a crime against humanity.' 'The atomic logic has been used since 1946 to frighten nations. The "atomic war-mongering" is chiefly the work of ill-informed generals, admirals and politicians' (*Sci. and Cult.*, 1955, **21**, 70).

Conclusion

It is not coincidental that the best of scientists, the men and women who have dramatically altered our view of nature, have been opposed to the destructive aspects of science. The pursuit of truth as one perceives science to be, also entrusts scientists with a responsibility to put it to humane uses. This aspect of

science has as much to do with the blossoming of a science culture in India as with having creative scientists and well-equipped labs.

In a letter addressed to many scientists around the world including Saha, Einstein had this to say: '... Through the release of atomic energy, our generation has brought into the world the most revolutionary force since prehistoric man's discovery of fire. This basic power of the universe cannot be fitted into the outmoded concept of narrow nationalisms. For there is no secret and there is no defence; there is no possibility of control except through the aroused understanding and insistence of the peoples of the world.' 'We scientists recognize our inescapable responsibility to carry to our fellow citizens an understanding of the simple facts of atomic energy and their implications for society. In this lie our only security and our only hope—we believe that an informed citizenry will act for life and not for death.'

It is about time that the humanist tradition of science, so eloquently expressed by Raman and Saha, asserted itself in the collective consciousness of our community.

M. V. N. Murthy, Madan Rao, R. Shankar are in the Institute of Mathematical Sciences, CIT Campus, Taramani, Chennai 600 113, India; J. Samuel is with the Raman Research Institute, C. V. Raman Avenue, Bangalore 560 080, India; A. Sitaram is with the Indian Statistical Institute, Statistics and Mathematics Unit, R.V. College P.O., Bangalore 560 059, India.

SCIENTIFIC CORRESPONDENCE

Algal flora in the cave soils

Caves although are one of the stressed environments, they are inhabited by a number of species of vertebrates¹, invertebrates², and microorganisms such as bacteria and fungi³. Apart from these, algae are one among the smaller organisms which inhabit only the light-receiving entrance zone of the cave⁴. Diatoms were often collected from subterranean waters, but they cannot be kept alive under total darkness, while those collected from dark zone of subterranean

rivers were always found dead⁵. The present study describes the algae cultured from the soils of six different caves in South India.

Soil samples were collected from six caves: Samanar (C1), Pannian (C2), KKB I (C3), and KKB II (C4). The Samanar cave faces southeast, whereas the other caves face the northwest within a radius of about 10 km from the Madurai Kamaraj University campus (9°58' N, 78°10' E). The other two caves Ramanathapuram

(C5) and Vecrasihamani (C6) are located at a distance of about 140 km in the north from Tirunelveli (8°44' N, 77°42' E). The temperature and humidity were recorded continuously inside the first four caves for a period of one year^{6, 8}. The geophysical characteristics of the caves are given in Table 1. Based upon penetration of light, all caves are arbitrarily divided into three parts, namely entrance, twilight and dark zones. Cave 3 is well illuminated and hence shows