

J. B. S. Haldane, an Indian scientist of British origin

Veena Rao

J. B. S. Haldane, one of the architects of the post-Darwinian evolutionary synthesis, can be counted among the greatest scientists of the 20th century. He made significant contributions to biology, physiology and biochemistry. Surprisingly, in 1957, when Haldane was at the height of his fame, he and his wife Helen Spurway (an accomplished geneticist herself) emigrated from Britain to India. They lived here until their deaths, having taken up Indian citizenship in the meanwhile in 1961. They first held positions at the Indian Statistical Institute (ISI), Calcutta (July 1957–February 1961). From there they went on to set up the ‘Genetics and Biometry Laboratory’ in Bhubaneswar (July 1962–December 1964). Haldane succumbed to cancer of the colon there on 1 December 1964. He managed to accomplish a great deal even within his brief residence in India. He concentrated upon setting up a strong base for research in biological sciences and helped to usher positive changes in the set-up of universities and research laboratories. His zeal was such that some of the research projects under his supervision were self-financed. His life and work continue to stimulate and inspire us. It is appropriate that we recall them today, 50 years after his death.

The present note is based largely on data collected from various archives in India, the UK and the USA (some unpublished) and is concerned with features that accompanied and followed Haldane’s transplantation to India¹. His role in giving a thrust to the fields of animal and human genetics and science education will be highlighted. Attention will be drawn to issues, some of them relevant today, that arose in his dealings with the Indian scientific establishment; an earlier article has dealt with cultural aspects of Haldane’s involvement with Indian science². The biography by Clark and other publications should be consulted for more information pertaining to Haldane’s life and science³. *Current Science* marked the centenary of his birth in 1992 by reprinting an illustrative sample of his writings along with an overview of his life and contributions⁴.

Background

Haldane was among the more controversial, colourful and erudite personalities in the annals of science. At the time of his move to India, he had been acknowledged as one of the pre-eminent biologists of the 20th century. He was one of the founders of population genetics, which attempted to fuse Darwinian evolutionary thinking with the principles of Mendelian genetics⁵. Among his significant accomplishments in many areas of biology, contributions to the understanding of organic evolution stand out. It would not be an overstatement to call him the father of biochemical genetics. He was instrumental in the development of human genetics as a distinct discipline. Remarkably, ideas pioneered by Haldane as far back as the 1930s remain relevant today. He first pointed out why the replication of genes had to be ‘semi-conservative’⁶ and, well before Beadle and Tatum, what the relation was between a gene and an enzyme⁷. The ideas of *in vitro* fertilization (IVF)⁸, cloning⁹, transgenic organisms¹⁰, the notion of disease as a factor in evolution¹¹ and genetic counselling¹² were all floated by Haldane. But, as he did not pursue them, the credit has gone to others.

Haldane’s Indian period (1957–64) offers an example of a Western scientist trying to work in an Eastern context. His desire to build a strong foundation for biological research in India was evident well before he immigrated to India. This comes through in a letter written in February 1952 to the then Prime Minister Jawaharlal Nehru¹³: ‘I could, I believe, assist in the development of human physiology and of the more academic side of genetics... However, I fully realize that the time has ceased when an Englishman can claim any right to advise Indians.’

Nehru utilized Haldane’s expertise whenever possible and assisted in clearing more than one bureaucratic hurdle encountered by Haldane.

From West to East

Haldane’s move to India makes for an unusual story. Not just in those times,

even today it is rare for a scientist of his calibre to move from the West to India, and become a citizen. At the time he left Great Britain, Western science was taking giant leaps and important discoveries were being made, especially in biology: the structure of DNA had been announced four years earlier and work on the genetic code was in full swing. On the other hand, the state of modern science in India was not on par with that in the West, whether in terms of the size of the scientific community, its interests, infrastructure or library facilities.

What made Haldane emigrate from Great Britain to India, that too relatively late in life?¹⁴ Possible reasons have been noted before, among them a strong dislike for the still-imperialistic policies of the British Government. Also, Haldane had felt slighted because positions appropriate to his standing were being denied to him in Britain. Possibly the fact that he had been a prominent Marxist for several years had not gone down well with the British establishment (on Haldane’s part, after the Lysenko episode disenchantment with the Soviet Union had begun to set in too). For someone who was already unhappy with his government and workplace, the Anglo-French invasion of the Suez in 1956 supplied an excuse with which to go public while announcing that he was leaving for India.

There were deeper reasons. A growing fondness for India had existed ever since childhood. It was partly based on an attraction to Indian philosophy and mythology, partly on his excitement with the adventure of creating a socialist democracy by planning and partly on what Haldane had seen for himself. He discovered much that was agreeable to him during the many months he had spent in Poona, Simla (recuperating from injuries sustained while fighting in Mesopotamia during world war I; not using a capital W in ‘world war’ is a Haldanism) and Mhow while running a bombing school¹⁵. As he explained in the course of making a formal application for Indian citizenship: ‘In 1918, I formed a resolution to return to India when it had achieved such a degree of self-government as would permit me to associate with Indians on a footing of equality.’¹⁶

Haldane was taken up by Jawaharlal Nehru's emphasis on planning and scientific temper as foundations on which to build a modern socialist India, and his friend P. C. Mahalanobis was advising Nehru on suitable statistical methods. Haldane had a long-standing interest in Indian culture. He had studied the ancient scriptures and epics and frequently quoted from them in books, talks and articles¹⁷. Even while India was under the British, Haldane had expressed his wish to come and contribute to its development. He felt committed to doing what he could for improving science in India. In a letter of 1946 to Mahalanobis, he makes this clear¹⁸: 'May I say once more how much I hope, that it may be possible for me to come. I have a number of ideas which I believe Indian workers might care to follow up. I am sure that I should learn as much from them as they would from me.'

(As it happened, a shortage of funds made Haldane, cancel plans for the planned trip to India at that time. Instead he went to Princeton University, his second choice, and took part there in a famous conference that is recognized as a landmark in the history of the evolutionary synthesis¹⁹.) According to John Maynard Smith, Haldane had been stimulated by the enthusiasm of bright-minded scholars and the informal way of life in India²⁰. Haldane himself stated that he and Spurway were excited by the diversity of flora and fauna, unusual marriage customs, easily observable traits (an interesting offshoot of traditional Indian wear) and the wealth of brilliant young people, all ideal for conducting interesting research projects in population genetics



Figure 1. J. B. S. Haldane and Helen Spurway, after the move, at home in Calcutta.

(Figure 1). He emphasized this to his friend, Ernst Mayr, a naturalist and major contributor to the evolutionary synthesis: 'Perhaps nowhere in the world are there more plants and animals, which seem to shout questions at one or more brilliant young men and women, whose capacities for research are not used.'²¹

Haldane and science in India

After coming to India Haldane's contributions to science were both direct, by way of his own publications, and indirect, by helping others. At ISI he was largely responsible for planning a unique integrated course for the Bachelor's and Master's degrees in statistics²². While there he helped in establishing a unit for the study of human genetics²³ and with the help of Pamela Robinson, a unit for the study of palaeontology (Figure 2)²⁴. He was responsible for bringing in quantitative biology as an essential component of research training²⁵. He took part in efforts to improve science education in the country by travelling extensively as head of a University Grants Commission sub-committee to universities and research laboratories, evaluated them and advised them on how to rectify drawbacks.

He was mainly responsible for S. P. Ray Chaudhuri's success in establishing the first *Drosophila* laboratory in India at Calcutta University – with the intervention of Nehru²⁶. In the course of time this gave rise to other units in different parts of India, headed by scientists trained at the Calcutta laboratory. Among the findings made many years later by the palaeontology unit at ISI was the skeleton of a



Figure 2. Haldane, Pamela Robinson and Mahalanobis.

Jurassic mammal which came to be named as *Kotatherium Haldanei*, as a tribute to his memory²⁷. Haldane channelled the money he received from various prizes, awards and lectures to the research work done under his supervision. One such was the prestigious Feltrinelli Prize²⁸ from Italy. On hearing the news his reaction was: 'Such a great sum would be of help to a biologist anywhere. In India, it may actually influence the whole development of the biological sciences...'²⁹.

By the time of the prize Haldane had resigned from ISI, Calcutta. Following some persuasion by the renowned philosopher S. Radhakrishnan, then Vice-President of India, he had accepted an offer by M. S. Thacker, head of the Council for Scientific and Industrial Research (CSIR), to head a research unit for genetics and biometry³⁰.

Haldane fostered international scientific relationships and financed a collaboration with Italian geneticists, among them Marcello Siniscalco from Naples (a former colleague at University College London), on a World Health Organization project in population genetics³¹. Haldane supported the travel of his student P. Meera Khan to Naples and Sardinia for training under Siniscalco³². The object of the project was to discover the genetic basis for protection against malaria in endemic areas such as Polavaram in coastal Andhra Pradesh (Figure 3). Haldane himself being the originator of the hypothesis that disease was a major agent in human evolution, he seized the opportunity of testing it. In pioneering studies on human genetics, the local population was studied for genetic variations linked with thalassemia or malaria: abnormalities of haemoglobin, carrier status for a thalassaemic variant gene, and deficiency in the gene encoding the enzyme glucose 6-phosphate dehydrogenase. Meera Khan and colleagues discovered that G-6-PD deficiency did exist in the Godavari valley of Andhra Pradesh. Both the Caucasian type and the partial Negro type were found in the same area³³. The project faced hurdles due to government bureaucracy, but Haldane retained the hope that a long-term collaboration would ensue and contribute significantly to research on human genetics in India. Even as this project was progressing, Haldane passed away; lacking financial support or supervision, the work came to a standstill. The principal

workers moved away, Meera Khan to Leiden University in the Netherlands and Ajit Kishore Ray (formerly an associate of the anthropologist Nirmal Kumar Bose) to the University of Toronto in Canada.

The unusual marriage customs of South India (which permit marriages between uncle and niece or between first cousins) motivated Haldane to initiate a large-scale study of the genetic impact of marriages between close relatives. Thirty per cent of all marriages in Andhra Pradesh were found to be consanguineous, offering a good prospect of spotting recessive homozygotes³⁴. Haldane was convinced that such projects did not need expensive tools. For example, because people went about in slippers, their feet were visible: keen observation might be enough to spot examples of what could be hereditary developmental defects. Ray was quick to pick out a trait – a short fourth metatarsal bone – that, in the event, turned out to be an ‘irregular’ autosomal dominant with 20–40% penetrance. The finding was published in the *Proceedings of the US National Academy of Sciences* after Haldane’s death³⁵. It should interest readers to know that Haldane published a paper on ‘Blood grouping and human trisomy’ in *Current Science*³⁶, in which he suggested a way of identifying (or ruling out) the location of the ABO blood group gene by examining Down syndrome cases.

Haldane’s attention to evolutionary issues did not flag. An original hypothesis for the evolution of lactation in mammals³⁷ was inspired by the observations

of Spurway and Jayakar on the habits of the yellow-wattled lapwing (*Vanellus malabaricus*, ‘Haladi tittiba’ in Kannada). A much debated work dealt with the concept of the ‘Cost of natural selection’, i.e. the number of genetic deaths that accompany the population-wide replacement of one genetic variant (allele) by another³⁸. Together with a gifted and mathematically inclined student, Suresh Jayakar, he continued studying several problems in population genetics, among them the maintenance of stable polymorphisms³⁹. Articles and lectures from the Indian period show that Haldane continued constantly to reformulate his thinking on the evolutionary process.

The most discussed scientific paper that he wrote after coming to India was from Bhubaneswar, and it relates to what is known as the ‘beanbag genetics’ dispute. It pitted him against Ernst Mayr, who gave the inaugural lecture at the prestigious Cold Spring Harbor Symposium in 1959. Mayr’s derisive description of the apparent focus of classical population genetics on single genes functioning in isolation was ‘beanbag genetics’⁴⁰. Haldane’s spirited rebuttal was titled ‘A defense of beanbag genetics’⁴¹. It has become famous for its analysis of the role of mathematics in the study of evolution. The dispute did not disturb the tenor of their friendship. Mayr had inscribed the copy of his book, *Animal Species and Evolution*, that he sent to Haldane, thus: ‘To Haldane, who has asked more challenging questions about the working of evolution than any other contemporary and who has started us well on the way toward the solution of most of them’⁴².

Haldane and science administration in India

Haldane encountered obstacles in his attempt to instil a Western attitude to doing science, especially biological science, in an Indian setting; and at the same time, to nurture that sort of Indian science which took advantage of local material and used independent criteria for acceptability from those set by Western science. In this attempt he led by example.

He could be critical of the conditions under which scientific research was carried out in India and was unhappy with the hierarchy and bureaucracy that pre-

vailed in the universities, which he felt was a hangover from colonial rule. He observed meaningfully that the type of rote learning encouraged by the British would suppress originality in the thinking process. There were other aspects that were detrimental to doing good science, he said: among them were the emphasis on getting a first class, the obsession with foreign degrees and the tendency to ape the West blindly when so much research work of high calibre was possible in India with simple apparatus. In a letter to his friend in Cold Spring Harbor, the distinguished geneticist Miloslav Demerec, Haldane observed⁴³: ‘We ought to have some really good genetics here in about ten years. The trouble is that most geneticists here would like to do the sort of thing you are doing, which needs a lot of apparatus, highly purified amino acids and so on. Whereas plenty of things can be done here that can’t be done in London or Long Island.’

Haldane was critical of science conferences in which politicians and officials held sway and seniors hogged the limelight thanks to the work done by their students. He called it ‘an organised conspiracy against originality in Indian science’⁴⁴. It is sobering to realise that Science Congresses in India are not always noted for the quality of science presented in them today either⁴⁵. Haldane’s thoughts after attending the Science Congress held in Bombay in 1960 bear reflection⁴⁶: ‘In India today, the unworthy successors of Durvasa and Visvamitra actually invite governors, vice-chancellors, and the like, to address them. This may be a relic of British rule. If so it is a regrettable one.’

Haldane found himself at the receiving end of the bureaucracy when he accepted the CSIR appointment after leaving ISI in 1961. Many promises were made to him, but even after a year, most were not kept. The reaction expressed in a letter to a friend in the UK, with a twist on the letters ‘CSIR’, was typical: ‘Even I cannot accelerate the “Conspiracy for the Suppression of Independent Research.”’⁴⁷

Haldane seems to have had a premonition of what was in store with CSIR. In a prophetic letter to J. D. Bernal he had said: ‘I am seeing Thacker about a job. But I expect it will be so tied up by government regulations as to render research very difficult.’⁴⁸

Still, the frustrations that he faced never made him reconsider the decision



Figure 3. Marcello Siniscalco and Haldane, in Polavaram during the WHO project. Photo courtesy: Marcello Siniscalco³¹.

to leave Britain and he remained optimistic about building a strong base for biological science in India. To his friend Tracy Sonneborn he wrote: 'Don't think I am gloomy about this country. I shouldn't have become an Indian if I were. But there is a hell of a lot to do before we can get research going in a big way.'⁴⁹

Haldane was enormously supportive of his juniors and claimed that his most noteworthy contribution in India was to start several bright young scholars, many of whom received international acclaim in later life, on their scientific careers. This is indicated by his response to being elected to the US National Academy of Sciences in 1964: 'Since I have done little independent work in the last 7 years I venture to hope that, my election is in part a recognition of the research done by my colleagues in India. I regard the help which I have been able to give to young men of great ability who would have had little chance without me, as a service to science as important as, and perhaps more difficult than, the first estimation of a human mutation rate or the discovery that oxygen at seven atmospheres' pressure, has a taste.'⁵⁰

Haldane's legacy in India

Haldane's Indian period was memorable for the few who were directly associated with him. Among the students, T. A. Davies, S. D. Jayakar and P. Meera Khan carried on his tradition in research and became well-known in different fields; K. R. Dronamraju has kept his memory alive through numerous writings. Ironically, apart from Davies, all left India to work in other countries. An important gift presented by Haldane to India was *The Journal of Genetics*, which played a preeminent role in the early days of genetics. He had been its editor since 1945 and carried on writing for the journal even after the move in 1957; it continues to be published from India⁵¹. The content of his articles ranged from original scientific research to idiosyncratic book reviews⁵². A review of a book on sub-cellular (extranuclear) particles complains that none of the authors went back more than a hundred years while citing references; another, on a book containing the proceedings of a conference on the genetics of human disease⁵³, congratulates the editors for '[not] recording all the bad jokes made by speak-

ers'. His popular scientific articles in *The Hindu* and Patel Lecture talk on the theme 'Unity and Diversity of Life', broadcast on All India Radio in December 1957 are remembered to this day⁵⁴.

What was his impact on Indian biology, and are there any traces of Haldane's influence that we can see today? On the one hand, the obsession with all things Western has only grown, and not just in science. On the other hand, the entry of a number of people with fresh minds into the areas of evolutionary biology and ecology has invigorated the study of living organisms in their natural context. Human genetics is much talked about, though as much for its applied and commercial spin-offs as an object of basic research. Haldane was apprehensive of such tendencies: 'It is quite possible, I think, that as the ideals of pure science become more and more remote from those of the general public, science will tend to degenerate more and more into medical & engineering technology, just as art may degenerate into illustration and religion into ritual, when they lose the vital spark.'⁵⁵

When all is said and done, Haldane was trained in a system that emphasized rationality, directness and individuality, or at any rate did so much more than demanded by Indian cultural norms. Inevitably there was a clash of values, and it extended to the practice of science. In his view, there were many reasons why 'science in India was developing with disappointing slowness'. People were too polite and not sufficiently critical of each other's work; 'spend hours daily in conversation...on personal topics'; there was a 'new caste system' coming into play based on academic degrees, especially foreign degrees, rather than professional competence; seniors discouraged originality or stole the results of their juniors; worst of all, 'a large number of Indian scientists have no pride in their profession, though they are proud of their salaries and positions'⁵⁶. Haldane was a rationalist who had rejected British imperialism to lead what he had hoped would be a simple life as a native in India. He was annoyed to come across, time and again, traces of the colonial past entrenched in Indian culture. But till the end he pursued his goal of contributing to the growth of science in India with unstinting optimism. As he said to Howard Florey in the course of sounding off on various issues: 'Please don't think I am

fed up with this country...But the young men are grand and so are a lot of the plants and animals.'⁵⁷

1. The spelling of place names in the present text is in the way that was standard at the time.
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3. Clark, R., *The Life and Work of J. B. S. Haldane*, Oxford University Press, Oxford, 1984; *J. B. S. Haldane: A Tribute*, Indian Statistical Institute, Kolkata; Dronamraju, K. R., *The Life and Work of J. B. S. Haldane with Special Reference to India*, Aberdeen University Press, Aberdeen, 1985; Majumder, P. P., Haldane's contributions to Biological Research in India. *Resonance*, 1998, 3(12), 32–35; Nanjundiah, V., J. B. S. Haldane: His life and science. *Curr. Sci.*, 1992, 63(9&10), 10&25, 582–588.
4. Haldane Centennial, *Curr. Sci.*, 1992, 63(9&10), 10–25.
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7. Crew, F. A. E., Haldane as a geneticist. In *Haldane and Modern Biology* (ed. Dronamraju K. R.), The Johns Hopkins Press, Baltimore, 1968, p. 18.
8. Haldane, J. B. S., *Daedalus or Science and Future*, Kegan Paul, Trench, Trubner & Co, London, 1930, pp. 65–67.
9. Haldane, J. B. S., The implications of genetics for human society. In *Genetics Today* (ed. Geerts, S. J.), Proceedings of the XI International Congress of Genetics, The Hague, Pergamon Press, Oxford, 1965, p. xviii.
10. See reference no. 8, p. 69.
11. Haldane, J. B. S., Disease and evolution. *La Ricerca Sci. Suppl.*, 1949, 19, 2–11.
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13. Letter from J. B. S. Haldane to Jawaharlal Nehru dated 15 February 1952 (Box 35, Archives of University College London).

14. Letter from J. B. S. Haldane to D. W. Logan, University of London dated 23 July 1957. He mentions that he is leaving London prematurely as promises made over 20 years to him by administrative authorities of both university and University College London had been systematically broken... And a colleague junior to himself was chosen as the official representative to an International Genetics Congress.
15. Autobiographical notes of J. B. S. Haldane in a Royal Society Note Book. Haldane Collections, Centre for Cellular and Molecular Biology, Hyderabad.
16. J. B. S. Haldane to Home Secretary, West Bengal, 1960 (accs. no. 9589, Archives at National Library of Scotland, Edinburgh, UK).
17. Haldane, J. B. S., Syadvada system of predication. *Sankhya*, 1958, **18**, 195.
18. Haldane was replying to an invitation by Mahalanobis, then Secretary, Indian Science Congress Association to speak at the Science Congress and deliver a course of lectures at the Indian Statistical Institute, Calcutta, 25 July 1946 (Box 35, Archives at University College London).
19. See reference no. 5.
20. John Maynard Smith wrote to the author in spite of a serious health condition. He passed away after a few months.
21. Letter from J. B. S. Haldane to Ernst Mayr (No. HUGFP 74.7, Box 7, 761; Pusey Library, Harvard University Archives, Cambridge, MA, USA).
22. Farewell speech by P. C. Mahalanobis to J. B. S. Haldane. He said that the B Stat and M Stat courses at ISI could not have been put together without Haldane's help. In *J. B. S. Haldane: A Tribute*, Indian Statistical Institute, Calcutta, 1992, p. 49.
23. Rao, C. R., J. B. S. Haldane Centenary Lecture. In *Human Population Genetics* (ed. Majumder, P. P.), Plenum Press, New York, 1993, pp. 1–7.
24. Pamela Robinson, well known palaeontologist from University College London was brought in by Haldane to establish and guide a Geological Studies Unit with emphasis on paleontology, at ISI, Calcutta.
25. Haldane, J. B. S., Let us develop a statistical conscience. In *J. B. S. Haldane: A Tribute*, Indian Statistical Institute, Calcutta, 1992, pp. 25–32.
26. First *Drosophila* Laboratory in India. *J. B. S. Haldane Commemoration Volume*, Proceedings of the Zoological Society of W. Bengal, Calcutta, 1993.
27. Roy Chowdhury, T. K., J. B. S. Haldane and palaeontology. In *J. B. S. Haldane: A Tribute*, Indian Statistical Institute, Calcutta, 1992, pp. 157–159.
28. The Feltrinelli Prize is the highest honour accorded to an individual by the Italian Accademia Nazionale Dei Lincei. The amount it carried was 20 million Italian Lire, at the time about 32,000 US dollars or 1.5 lakh rupees (see <http://fxtop.com/en/historical-exchange-rates.php>). Haldane received the award in Rome dressed in traditional South Indian attire.
29. Letter from J. B. S. Haldane to Arangio-Ruiz, Rome, Italy, 1961 (MS 20541, f216-225, Archives of National Library of Scotland, Edinburgh, UK).
30. Clark, R., *The Life and Work of J. B. S. Haldane*, Oxford University Press, Oxford, 1984, p. 233.
31. Siniscalco, M. (pers. commun.) who provided the photograph in Figure 3.
32. Meera Khan, P., J. B. S. Haldane as an informal teacher: some personal reminiscences. In *J. B. S. Haldane: A Tribute*, Indian Statistical Institute, Calcutta, 1992, pp. 99–109.
33. Meera Khan, P., Glucose-6-phosphate dehydrogenase deficiency in an Indian rural area. *J. Genet.*, 1965, **59**(1), 14–18.
34. Dronamraju, K. R. and Meera Khan, P., The frequency and effects of consanguineous marriages in Andhra Pradesh. *J. Genet.*, 1963, **58**, 387–401.
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38. Haldane, J. B. S., The cost of natural selection. *J. Genet.*, 1957, **55**, 511–524.
39. Haldane, J. B. S. and Jayakar, S. D., Polymorphism due to selection of varying direction. *J. Genet.*, 1963, **58**, 237–242; Polymorphism due to selection depending on the composition of a population. *J. Genet.*, 1963, **58**, 318–323.
40. See reference no. 5.
41. Haldane, J. B. S., A defense of beanbag genetics. *Perspect. Biol. Med.*, 1964, **7**, 343–359.
42. Mayr, E., A personal dedication to J. B. S. Haldane in his book. *Animal Species and Evolution*, sent to Haldane for review, March 1963.
43. Letter from J. B. S. Haldane to Miloslav Demerec in Cold Spring Harbor, USA, 17 September 1958 (MS 20536, f 92-105, Archives at National Library of Scotland, Edinburgh, UK).
44. Haldane, J. B. S., The scandal of the Science Congress. In *Science and Indian Culture*, New Age Publishers Ltd, Calcutta, 1965, pp. 20–25.
45. Narasimha, R., The 'historic' storm at the Mumbai Science Congress. *Curr. Sci.*, 2015, **108**(4), 471–472; Rishi has given guidelines to make planes. *The Hindu*, 5 January 2015; <http://www.the-hindu.com/news/cities/mumbai/first-man-to-build-and-fly-an-aircraft-was-indian/article6753840.ece>
46. See reference no. 44.
47. Letter from J. B. S. Haldane to a friend in the UK dated 22 March 1962 (MS 20543, f 132-142, Archives at National Library of Scotland, Edinburgh, UK).
48. Letter from J. B. S. Haldane to Bernal, J. D. dated March 1961 (acc. no. 9589, Archives at National Library of Scotland, Edinburgh, UK).
49. Letter from J. B. S. Haldane to T. M. Sonneborn of Indiana University dated 12 May 1961 (acc. no. 9589, Archives at National Library of Scotland, Edinburgh, UK).
50. See reference no. 32.
51. *Journal of Genetics* was founded by William Bateson and R. C. Punnett in 1910. Punnett invited J. B. S. Haldane to join the journal as its editor in 1945. Haldane brought the journal with him to India and edited it till his death.
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54. Haldane, J. B. S., Patel Lectures. *Unity and Diversity of Life*, Publications Division, Delhi, 1957.
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56. See Haldane, J. B. S., in a compilation of Haldane's comments titled 'What ails Indian science' by Sen, S. K. *Curr. Sci.*, 1999, **77**(2), 305–307.
57. Letter from J. B. S. Haldane to Howard Florey, dated 15 June 1962 (acc. no. 9589, Archives at National Library of Scotland, Edinburgh, UK).

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Veena Rao is in the National Institute of Advanced Studies, IISc Campus, Bengaluru 560 012, India.
e-mail: aneev52@yahoo.co.uk