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Saha and Raman

This note is regarding the November 10 & 25 issue of *Current Science*, which dealt with the origins of the three Academies of Science in India. The historical hindsight was illuminating. However, it is not clear whether the comments of Raman on the scientific productivity of M. N. Saha and S. N. Bose in later life are to be accepted as the editorial view.

The December 1994 issue of the *Indian Journal of Physics* is a commemoration volume on M. N. Saha. A glance shows that not only did Saha pioneer research in experimental and theoretical nuclear physics in India, he worked and published in radio wave propagation, cosmic rays, solar physics and mineralogical dating. The first biophysics group in India with N. N. Dasgupta was set up by him in 1946 when he was past fifty. Contrary to the assertion in another issue of *Current Science*, nuclear magnetic resonance studies were started in India by T. P. Das and M. N. Saha in Calcutta. The first cyclotron, the first electron microscope, these were his brain children. He did not merely make it as a scientist, he made it BIG!

The second point is the quality of scientists trained by Saha – T. P. Das, Manoj Banerjee and Manoj Pal are just a few names that spring to mind when one thinks of scientists who made their mark internationally. They flourished working with Saha as well as in later life. Could this be said of Raman's students, who worked under the proverbial banyan tree?

From the thirties Saha devoted himself to promoting science and technology for national development in contrast to the 'ivory tower' attitude advocated by C. V. Raman, exemplified by his famous retort to Nehru. While there is much to be said on both sides, there is no gainsaying the fact that the scientific basis of the Planning Committee (*sic*) was laid by Saha even before Jawaharlal Nehru was persuaded to become the Chairman at the initiative of the Congress President, Subhas Bose. The Damodar Valley Corporation was conceived by him, a result of his realization that the economic prosperity of India depended to a large extent on the proper utilization of its rivers.

G. Venkataraman in *Journey into Light* mentions Raman's interest in entering the frontier area of nuclear physics in the thirties and early forties. This was thwarted by the formation of the Atomic Energy Commission in Bombay. Ironically, it was Saha who was able to venture into nuclear physics in India. He proposed having nuclear reactors at universities following the US pattern. After keeping the subject under wraps for 50 years, the Inter-University Centres have now been set up to popularize reactor- and accelerator-based research. Plus ca change. . . .!

Bose's productivity, *if* the number of papers is the indicator, was not very high. But is it not true of many theoretical physicists that their most original work is done before they are thirty, as Bose was in 1924, when he discovered Bose statistics? Chandrasekhar's essay 'Creativity in Science' is surely relevant in this context.

Finally, is it not time that we stop seeking foreign approbation for our scientific attainments (pace remarks of Max Born) for someone as great as Raman? Unfortunately, he also originated the Nobel Prize syndrome – which has plagued Indian science ever since. I think in reviewing history the personal animosities between great scientists should not be raked up 50 years afterwards – there is no end to quotes and counter-quotes and as such I shall desist from referring to other debatable points.

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Altruism of selfish DNA and evolution

Gadagkar in 'Observational study of animal behaviour' (*Curr Sci*, 1995, **68**, 185) mentions about 'B-chromosome in a parasitic wasp – the most selfish DNA known'. It might be an amusing pastime for some of the readers to figure out the important role of such DNA in the evolution of life from water to land.

Some 50 years ago, it was discovered that certain bacteria resident in an aphid kill all males and propagate through the females. In a sense the DNA of these bacteria are selfish, feminist DNA. Recently, such foreign DNA has been known to parasitize some 5–10% of insects. Warren also found the most horrible selfish DNA in the jewel wasp refered to by Gadagkar. According to Margulis' hypothesis, some foreign DNA became part and parcel of the cells they invaded, in the form of mitochondria. Other classic examples at a higher scale are the invasive bacteria (i.e. their DNA) in cockroach egg; without the bacteria the roaches attain only half the normal size (Henry, S. M., *Symbiosis*, vol II, Academic Press, 1967). The late G. C.

Bhattacharya, a naturalist from Calcutta described a similar result in a local ant which he did not understand (posthumously published letter). These foreign DNA, initially selfish, turned out to be altruistic, in fact, vitally necessary for the parasitized organism itself. We can go one step further, apart from the well-known story of iodine and thyroid in the metamorphosis of amphibia, certain bacteria resident in the tadpole are also responsible for this crucial phenomenon (Bhattacharya *et al.*, *Sci. Cult.*, (Calcutta), 1954, **19**, 571).

These invasive foreign DNA may have made possible a major step in evolution – transition of vertebrates from water to land.

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NEWS

Flashes and bursts – Mysterious happenings in the sky

The American Geological Union a few months ago held a symposium to discuss the phenomena relating to high-altitude flashes (also called sprites, jets or bursts), which are mystifying scientists all over the world. Although very little is understood about these, many speculate that these flashes in our restless atmosphere may even be hazards to high-flying aircraft and satellites.

More than a 100 years ago observations have been recorded of intense optical flashes appearing much above thunder clouds during electrical storms (Figure 1).

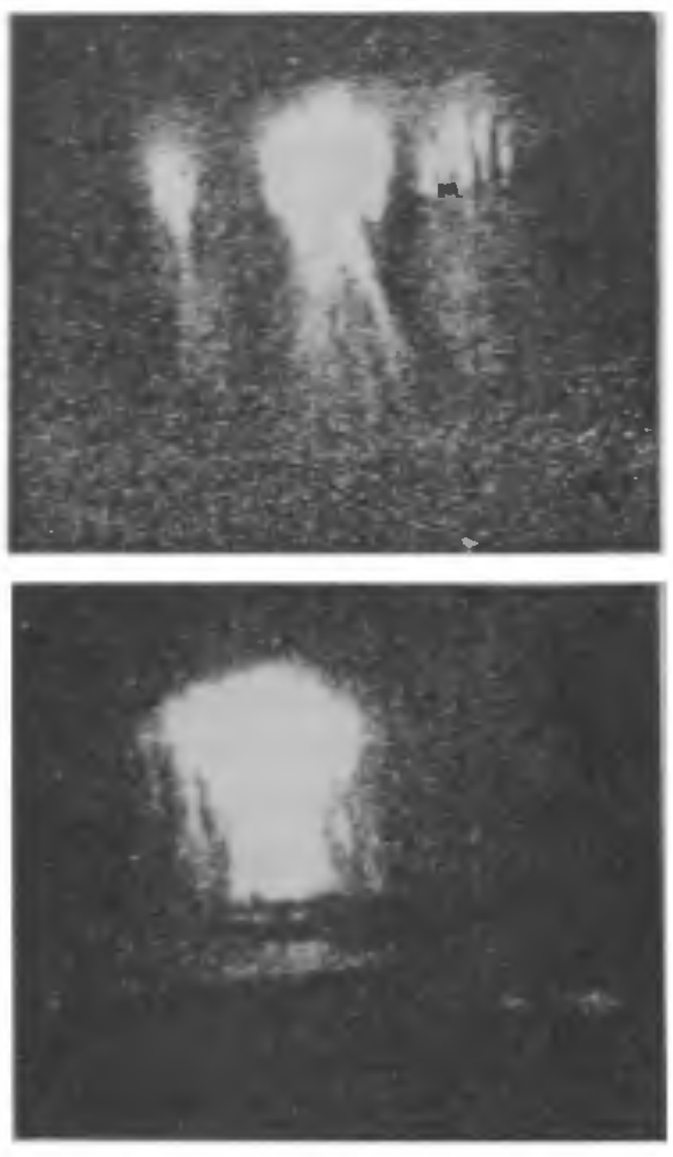

Figure 1. The fantastic light flashes that occur much above thunderstorm clouds in the stratosphere.

Very few took this seriously till these ghost-like luminous discharges were no longer found to be rare. More than a 1000 flashes were seen each year. A few years ago these flashes were given respectability by being mentioned in the *Handbook of Unusual Natural Phenomena*. The documentation since then has been quite reliable. The Space Shuttle in one of its flights recorded 18 such flashes over Australia, Africa, South and North America. High-flying aircraft have recorded hundreds of flashes within a few hours.

Visual reports say that the flashes, which have variously been described as carrot-, turnip- or jelly fish-shaped, exhibit a variety of colours like red, yellow, green, pink and blue. These colours have now been recorded photographically and by video cameras. The flashes have an unusual appearance and some consist of dazzling arrays of fireworks which seem to dance for milliseconds much above the clouds. The red ones are known to reach more than 90 km above the top of the storm clouds. The blue ones have a completely different structure, usually narrowly collimated sprays of light in the form of fans which propagate at a speed of $100\ km\ s^{-1}$.

The early theories followed the concept formulated by C. T. R. Wilson (famous for his cloud chamber) that electrical fields generated by lightning can propagate upwards. It was now thought that these fields go through the mesosphere and stratosphere and rip off electrons from molecules there. Avalanches result when more electrons are created and crash into other molecules. The red colour is caused from emission from positively ionized oxygen, while the singly ionized negative nitrogen ions are responsible for the green and the blue colours. It was thought that ultraviolet and infrared studies would give much deeper insight into these phenomena.

At this stage the plot thickened and the subject became more confusing because two entirely new phenomena were discovered. The satellite launched to test ways of monitoring nuclear blasts detected radio flashes which are at least 10,000 time more intense than the radio signals normally generated by storms or lightning.

The Compton Gamma-Ray Observatory, which was launched to study celestial γ-rays, discovered accidentally extremely intense γ-ray flashes which originated in the upper atmosphere about 30 km above the storm clouds. These new discoveries in the radio and γ-ray regions seem to be beyond the pale of the earlier theories based on Wilson's ideas as the energies required are much too high.

Theorists and modelers are hard at work. The latest and most acceptable speculations take recourse to extraterrestrial sources. A single powerful cosmic-ray particle probably collides with an air molecule in the mesosphere or stratosphere and starts off a runaway breakdown. Workers in the field are optimistic that this model may possibly explain emissions in the optical radio and γ-ray regions. The general consensus is that it is too early to theorize and that more observations are essential before there is any real understanding of these phenomena (*Science*, 1994, **264**, 1250, 1313 and *E.O.S.*, 1994, **75**, 601).

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