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Indian Fellows of the Royal Society, London (1841–2000)

The fellowship of the Royal Society of London commands a special prestige in India (and other Commonwealth countries) for historical reasons. Table 1 lists the 39 Indian Fellows of the Royal Society (FRS) so far. Out of these six were in their thirties at the time of their election; 8 in their forties; 13 in their fifties; 11 in their sixties; and 1 in his seventies. Twenty-one of the Indian FRS are living; three of them (G. S. Khush, D. Lal and C. R. Rao) live in USA. To help place data in context, it may be noted that the total current fellowship is 1191; 59 fellows are in Australia, 48 in Canada and six in New Zealand. (Description in Table 1 is as in the Royal Society records.)

Contrary to popular belief, the mathematical genius Ramanujan is not the first Indian FRS. The distinction goes to Ardaseer Cursetjee (Wadia), India's first modern engineer (whose lineal descendents would found the Bombay Dyeing and Manufacturing Company at Mumbai). He was elected in 1841, while in England on official duty. At the time, the Society was still a club of gentlemen broadly interested in science. By the time Ramanujan became a fellow, the Society had already acquired its present rigour. Accordingly, Ramanujan's recognition greatly spurred Indian nationalist scientific endeavours. It is to the credit of the Society that Raman was elected a fellow before he was awarded the Nobel prize. (Even his knighthood preceded the prize.) Saha's fellowship helped him receive a research grant from a recalcitrant government. His contemporary S. N. Bose's election came much later, on Paul Dirac's initiative, as a corrective for the Society's oversight in

Table 1. Indian Fellows of the Royal Society, London (1841–2000)

No	Year of election	Name	Profession
1.	1841	Cursetjee, Ardaseer (1808–77)	Shipbuilder and engineer
2.	1918	Ramanujan, Srinivasa (1887–1910)	Mathematician
3.	1920	Bose, Sir Jagadis Chunder (1858–1937)	Biophysicist
4.	1924	Raman, Sir (Chandrasekhara) Venkata (1888–1970) (withdrawn 4 April 1968)	Physicist
5.	1927	Saha, Meghnad (1893–1956)	Physicist
6.	1936	Sahni, Birbal (1891–1949)	Palaeobotanist
7.	1940	Krishnan, Sir Kariamanikkam (Srinivasa) (1898–1961)	Physicist
8.	1941	Bhabha, Homi Jahangir (1909–1966)	Physicist
9.	1943	Bhatnagar, Sir Shanti Swarup (1895–1955)	Chemist
10.	1944	Chandrasekhar, Subrahmanya (1910–1995)	Astrophysicist
11.	1945	Mahalanobis, Prasanta Chander (1893–1972)	Statistician
12.	1957	Wadia, Darashaw Nosherwan (1883–1969)	Geologist
13.	1958	Bose, Satyendranath (1894–1974)	Statistician
14.	1958	Mitra, Sisir Kumar (1890–1963)	Upper-atmosphere physicist
15.	1960	Seshadri, Tiruvenkata Rajendra (1900–1975)	Chemist
16.	1965	Maheshwari, Panchanan (1904–1966)	Botanist
17.	1967	Rao, Calyampudi Radhakrishna (1920–)	Statistician
18.	1970	Menon, Mambillikalathil Govind Kumar (1928–)	Physicist
19.	1972	Pal, Benjamin Peary (1906–1989)	Agriculturist
20.	1973	Harish-Chandra (1923–1983)	Mathematician
21.	1973	Swaminathan, Mokombu S. (1925–)	Agriculturist
22.	1977	Ramachandran, Gopalasamundram Narayana (1922–)	Biophysicist
23.	1979	Lal, Devendra (1929–)	Physicist
24.	1981	Paintal, Autar Singh (1925–)	Physiologist
25.	1982	Rao, Chintamani Nagesa Ramachandra (1934–)	Chemist
26.	1983	Chandrasekhar, Sivaramakrishna (1930–)	Crystallographer
27.	1984	Siddiqui, Obaid (1932–)	Molecular biologist
28.	1986	Ramalingaswamy, Vulimiri (1921–)	Medical scientist
29.	1987	Gopalan, Coluthar (1918–)	Nutritionist
30.	1988	Mitra, Ashesh Prasad (1927–)	Ionospheric scientist
31.	1988	Seshadri, Conjeevaram (1932–)	Mathematician
32.	1990	Sharma Man Mohan (1937–)	Chemical engineer
33.	1991	Swarup, Govind (1929–)	Radioastronomer
34.	1992	Narasimha, Roddam (1933–)	Fluid mechanicist/ aeronautist
35.	1995	Gurdev Singh Khush (1935–)	Rice breeder
36.	1998	Mashelkar, Raghunath Anant (1943–)	Polymer engineer
37.	1998	Sen, Ashoke (1956–)	Physicist
38.	2000	Raghunathan, Madabusi Santanam (1941–)	Mathematician
39.	2000	Ramakrishnan, Tiruppattur Venkatachalamurti (1941–)	Physicist

having ignored him till then. Chandrasekhar's election as a fellow in 1944 ended his professional isolation in British India which had begun in 1935 with Sir Arthur Eddington's imperious dismissal of his now-celebrated white dwarf work. Interestingly, Eddington strongly supported Chandrasekhar's nomination.

Not surprisingly, (what is now) the Indian National Science Academy (INSA), set up in 1935, was modelled after the Royal Society. Curiously, of the Society fellows since elected, B. P. Pal is the only one who was not a fellow of INSA.

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Genetically modified organisms – A brave new world??

Recent researches have enabled manipulation of the existing genetic configurations of organisms, thereby giving rise to what in scientific parlance are called genetically modified organisms (GMOs). These can be microbes, plants or even mammals. Are we not then eventually playing God to ourselves? Even creation can now be challenged, modified and manipulated. Alterations are possible to what was even a few years back considered inevitable and providential; for example, dwarfism, if detected early, can be genetically modified to help escape from such a disorder.

Genetically modified bacteria are routinely used in the production of human therapeutics and offer impressive proof of clinical efficacy and safety to human beings. For instance, human insulin gene has been expressed in *E. coli* and has been approved for clinical use in humans for the treatment of diabetic patients. In another example, the recombinant bacterial product is human tissue plasminogen activator used in the treatment of patients with acute myocardial infarction. Besides, interleukins, interferons, serum albumin and superoxide dismutase, are also produced from recombinant bacteria for different clinical uses. Another thrust of GMOs is in the agricultural sector. Leguminous plants such as soybean form symbiotic associations with *Rhizobium*, *Bradirhizibium* and *Frankia* bacteria, which fix atmospheric nitrogen to the soil by *nif* gene. Now-a-days genetically modified *Rhizobia* have been added to the soil as legume inoculum, to reduce need of the nitrogenous fertilizer.

Like bacteria, GM crops are also coming up very fast; these crops are endowed with higher yield, nutritional quality and resistance to insects and pests. This could be done by modifying genomes of crop plants through biotechnological methods. Several genes are available for designer crops; for example; *glufosinate* (herbicide resistance), *Bacillus thurigiensis* toxins (insect resistance), *barnase* (male sterile), *virus coat protein* (virus resistance). Many commercial organizations utilize technical development, both for commercial and developmental purposes. Different crops have been modified and are in commercial use; for example, herbicide-resistant canola and sugarbeet, insect-resistant cotton and tomato, virus coat progein-resistant papaya, squash, soybean and potato and male sterile corn for hybrid seed production. The next generation rice with more vitamin A and transgenic tomato, with an anti-freeze gene, which will increase its shelf life, are on the way to more widespread commercial use.

In animal husbandry too, GM animals are on their way. For example, designer eggs and genetically engineered salmon fish with human growth hormone are just waiting to appear on our dining tables, subject to regulatory approval. And, waiting in the pipeline are fast-growing trout and catfish, oysters which can withstand virus, as well as an 'enviropig', whose faeces is supposed to contain less phosphorus and therefore will be less harmful to the environment.

Lay people are concerned about the safety of genetically engineered organisms and GM food, as one is not yet aware of the long-term effects on human health and on the ecological environment. Genes that make crops herbicide-resistant could spread by pollination to weedy relatives, creating super weeds. Or fish with growth hormones which make them grow faster, might out-compete others for food or mate.

Genetic food alert (GFA) was founded by the UK wholefood trade in 1998 to compaign for a GM free trade, and ask for a ban on the production, import and sale of GM food. Companies should provide a summary of products, their safety and nutritional assessments, and discuss their result prior to commercial distribution. Talks on these topics broke down at the WTO in December 1999 at Seattle, USA. The Third World united to stop WTO, multinationals and biotech industries from release of GM foods and crops, arguing that the GMOs are 'anti-environmental', promote an 'exploitative economic system' and are 'anti-union'. They also asked for an immediate five-year freeze on these products. There is fear among the general public because of the perceived threat to health and environment, as seen in the after-effects of the occurrence of mad cow disease in Britain and dioxin-tainted chicken in Belgium.

The examples cited above show that alterations in the smallest unit of organic life form can have far reaching changes. There is another side that is beyond the merely biological/scientific issue, namely legal and ethical. The pressing question is to what extent should we lead our lives according to the directions of a handful of scientists, whose promotion of the new technologies can have unforeseen consequences.

Biotechnological advancement involves a lot of money. And more than that the power to control, alter and