Starting at the post-graduate level, scholarships are available in biotechnology. Scholarships are also provided at the doctorate and post-doctorate levels. Overseas Associateships are given to scientists for undergoing advanced training in the best research organization in the world.

To promote research and innovation the government offers a number of schemes and various options are available with the scientist for working towards excellence in his chosen field. In fact, scientific research is no longer limited to public institutions; the biotech industry is increasingly focusing on research and development.

Thus, research in biotechnology and related fields would have placement openings with multinationals, pharma majors, research institutions, laboratories and organizations both government and private in the country. The options do not end with research; managing offshoots of the biotech research sector is equally challenging and wide in its scope. MBA in biotechnology has immense potential. In the coming years technology transfer expertise would be much sought after by public institutions and private industry.

Other specialists relating to biotechnology could be patent attorneys, clinical researchers, bio-information technologists and social scientists who can create social awareness, be it for genetically modified organisms, transgenics, vaccine development, clinical research, bioethical issues or biosafety concerns.

To meet the challenges of a growing industry, allowing the pursuit of research and monitoring the esteem and position of science in society, it is crucial to evolve an educational system which is flexible and diverse in its options and allows students to choose and exploit the opportunities of a relatively new but fast-expanding industry.

1. ABLE Biotech Industry Survey, *Biospectrum*, 2006, **4**.

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The Berlin group on genetically modified crops in developing countries

The Commission on Green Biotechnology is a constituent of the Union of the German Academies of Sciences and Humanities (UGASH). The InterAcademy Panel (IAP), a worldwide network of 92 Academies of Sciences, with its Secretariat in Trieste, Italy, advises citizens and politicians in their home countries on current problems of global relevance. The 'Berlin Group' are the participants of a workshop on 'Genetically modified crops in developing countries', jointly conducted by UGASH and IAP in Berlin (27–29 May 2006). The Berlin Group has now issued a statement that is being circulated for adoption by various academies in Europe and elsewhere.

The Berlin Group has taken the position that 'Molecular engineering of crops has brought revolutionary advances in agriculture. In just ten years since their introduction, many GM crop varieties have been grown on about 5 per cent of all global arable cropland in 21 countries by 8.5 million farmers, 90% of them being resource-poor. Some developing countries have benefited from GM crops and are now in a position to affirm their need and their will to adopt GM crops'. Based on this assertion, the Berlin Group states that:

– Foods from GM crops are more extensively tested than any other and have been shown to be as safe as, or even sometimes safer than, foods derived from the corresponding conventional plants. Ten years of human consumption and extensive nutritional testing amply support this conclusion. Any food, GM or other than GM may certainly involve some risks for human health. There is presently not the least scientific and/or medical evidence that the risks possibly entailed by the former would be higher than those entailed by the latter.

– The environmental impact of GM crops is no greater than that of traditional crops. In some cases GM crops have diminished the negative effects of current agricultural practices. Insect-resistant cotton requires substantially decreased applications of chemical pesticides while herbicide-tolerant crops permit no-till practices, cutting energy use and promoting healthy soils. Seed-incorporated technology is particularly suitable for small farmers in developing countries. GM crops resistant to pests and diseases reduce farmers' exposure to chemical pesticides, particularly when applied by hand sprays. The successful cultivation of GM cotton in the developing countries shows how subsistence farmers have significantly increased their income and improved the quality of their life.

– In both developed and some developing countries, organic farmers have already been operating in an environment subjected to influences from neighbouring activities. With proper separation safeguards, the presence of genes encoding GM traits in organic products is trivial. Nothing in GM agriculture prevents organic farmers from pursuing their normal practices. There is no evidence-based justification in the rules of organic farming to exclude the use of GM crops.

– GM crops can make a major global contribution to the quantity and quality of food. In developing countries, farmers suffer major crop losses caused by insects and diseases. GM technology has already shown that such losses can be significantly reduced, leading directly to improvements in food quality and safety (e.g. insect-resistant maize has appreciably lower levels of highly carcinogenic fungal toxins).

– Just as each consumer ought to have the right to adopt or reject GM food, farmers should be able to decide for themselves whether to plant conventional, organic or GM crops. For such a choice, appropriate regulations including labelling of GM products must be in place, and such regulations should be proportionate and not excessive. The safety assessment procedures now enacted in developed countries for GM crops and products result in needlessly high costs and hinder the application of this valuable technology to the many crops grown in the developing world. For developing countries to have access to crop biotechnology for their own agriculture, international and non-profit organizations must help governments to formulate appropriate regulations and assist with the training of personnel to administer them.

– It is frequently argued that farmers growing GM crops lose their freedom when they are obliged to buy their seeds annually. However, in most developing countries farmers are accustomed to using farmer-saved seeds that is in many cases allowed by law, and this could also be applied to GM cultivars.

The Berlin Statement denounces the unsupported arguments used against GM crops and calls upon governments and environmental NGOs to end unjustified campaigns against GM crops.

Such a firm and positive stance covering all contingent issues is most welcome, more particularly since it comes from Europe, often cited as 'vehemently anti-GM'. The scientific community of developing countries should provide all the support to this effort of the Berlin Group.

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Comments on measurement of organizational scientific productivity

Mehta[1] has provided the verbal description of Lotka's law. Lotka also provided a 'general formula for the relation... between the frequency v of persons making x contributions' as '$x^n v$ = const'[2]. Lotka found the value of n as 2 (ref. 3). Suppose, in a sample it is found that 1,000 authors have contributed one paper each. According to Lotka's law, the number of authors contributing different number of papers will be as in Table 1.

The equation provided by Lotka is an exponential one, hence, it generates an exponential curve. With the values of P and A given in Table 1, the curve takes the shape as in Figure 1. In Mehta's paper figure 1 shows 12 graphs which are all straight lines[4]! They do not represent typical Lotka curve and may mislead readers.

The curve generated by the author's data for the year 1994 (Table 2) is presented in Figure 2 which is not a straight line but an exponential curve.

Aggregated papers (1994–2003) (ref. 5; table 1) show that as many as 1394 scientists of the Laboratory have contributed only one paper each in a period of 10 years on whole count. In fractional count, the number drops down to 691. This is unbelievable. Normally, while cumulating, the names of the authors are arranged in one alphabetical sequence, and the number of contributions made by each author is posted against each name. The figures against each author is then summed up for the period of cumulation. In this case, it is ten years. In a ten-year cumulation it is usually seen that even the most unproductive author has to his credit two or three publications. This phenomenon brings down sharply the number of authors contributing single papers. However, contrary to expectations, the number has gone up in Mehta's paper!

Mehta also tried to apply Zipf's law by taking the number of papers against the rank of the authors[6]. In fact, Zipf's law is applied to study the *frequency of words occurring in a published item*. Zipf wrote in his paper: 'Observing the speech of many hundreds of millions of people, we have demonstrated, in part actually, in part by induction, that the conspicuousness or intensity of any element of language is inversely proportionate to its frequency. Using X for frequency, and Y for conspicuousness (rank) we can express our thesis thus: $Y = n/X$ or $XY = n$, where n is some constant'[7]. The verification of the Law came through the use of Miles L Hanley's *Index of Words for James Joyce's Ulysses*. Zipf found that the rank frequency word distribution 'approximate the simple equation of an equilateral hyperbola: $r \times f = C$' (ref. 8), where r indicates rank and f frequency. The two graphs presented by the author (figure 5 a and b) are far from hyperbolas.

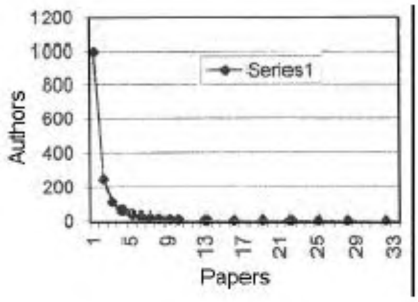

Figure 1. Lotka curve.

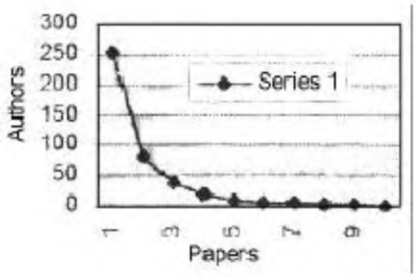

Figure 2. Curve based on author's data.

Table 1. Number of papers contributed by authors

P	1	2	3	4	5	6	7	8	9	10	13	16	19	25	28	32
A	1000	250	111	63	40	28	20	16	12	10	6	4	3	2	1	1

P, papers; A, authors.

Table 2. 1994 data of Mehta's paper

No. of papers	1	2	3	4	5	6	7	8	9	10
No. of authors (observed value)	253	82	38	20	10	7	6	3	2	1