

demics and consultants that helped speed up the process. He said that the companies were part of TIFAC's Advanced Composite Mission, which primarily supplied railway requirements, etc. and the items provided by them were in fact not part of their main product line. However, the companies rose to the occasion and delivered the first lot of items in 45 days. Recognizing a deficiency in availability of heavy equipment for moving debris, etc. the Bharat Earth Movers Limited, Bangalore had stepped in to help. Ongoing work in this regard was progressing well, he added. Having shown the way, it was now for others to take it up from there, he said. But it was TIFAC's large existing network between local NGOs and local industries that had contributed to the effectiveness of the operations.

From this it is clear that the country needs to go full-steam ahead on the proper implementation of all that S&T can offer in the area of earth sciences. Be it results from basic research or research in the engineering sciences. Those seismically active areas in the country, where we know well in advance of the possible risks, should be focused upon. The attitude of 'letting it be' till a dangerous situation arises,

would be catastrophic. Finally, one question posed could not get a definitive answer. This was regarding how many villages had been actually rebuilt after the earthquake.

Recently, it has become known that the BIS is going to take up a review of the National Building Code. This has been necessitated by technological advancements that have been made since the existing code was formulated about two decades ago. The exercise is to be completed in about two years and would incorporate alternative technologies, and a system of integrated approval from pollution control boards, Urban Arts Commission and local bodies for building, etc., i.e. all techno-legal requirements would be brought within the code. The revised code would give added focus on safety and preventive measures. This would give a basis for not only reconstructing Bhuj, but also in the design of new structures in the country.

Bachi Singh Rawat, Hon'ble Minister of State for Science and Technology said on the occasion of the New Delhi conference that 'we realize that there is still a lot to be done towards the immediate goal of preparedness'. This speaks volumes about the present situation.

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Genomics and evolution*

The availability of human genome data has sparked-off a great deal of interest and discussion about the new science of genomics (and more recently, proteomics). This discussion has also resonated in the Indian scientific community. There is a tremendous amount of genetic information now available for many species, including humans, and an obvious challenge is to

make 'sense' of this information (in other words, to convert this information into knowledge). One is reminded of Eliot's eloquent lament, 'where is the knowledge we have lost in information', and it is certainly to be hoped that this will not be the fate of the information that sequencing efforts yield. In fact, one could practically define genomics as being an attempt to convert sequence data into genetic knowledge.

In general, the methodologies and conceptualizations used to generate information need not necessarily be the same as those needed to convert the information into knowledge. In the case of genetic sequence data, in particular, the conceptual framework in which these data need to be interpreted is to be found in evolutionary rather than mo-

lecular genetics. It is equally true that the technologies of genomics, which come from the realm of molecular rather than evolutionary genetics, are very useful tools with which one can address many extremely important questions in evolution. This interdependence of genomics and evolution has clearly been recognized in many scientific communities worldwide, and there have been many international meetings on evolutionary genomics in the past year or so. In the Indian context, however, this interdependence does not appear to have been explicitly articulated, whereas, for example, the need for integrating information technology and genomics has been well recognized. I find it particularly distressing that this is the case, because if

*A report based on the Les Treilles Conference on 'Quantitative Evolutionary Genetics: *Drosophila* in the Post-Genome Era', held at Le Domaine des Treilles, Tourtour, France, between 24 and 29 April 2001, supported by the Fondation des Treilles, Paris, France, and organized by Jean R. David, CNRS, Gif-sur-Yvette, France, and Volker Loeschke, University of Aarhus, Aarhus, Denmark.

this lacuna continues to exist in our interpretation and formulation of genomics, our ability to extract the maximum returns from this new technology will be severely compromised. It is this that motivates me to write this report on a meeting held in April last year, which brought together a group of nineteen researchers from the fields of genomics and evolutionary genetics, in part to discuss ways of promoting more interaction between these fields of research. Some of the talks at this meeting dealt with topics of somewhat narrow concern to *Drosophila* evolutionary geneticists, and my approach in this report will be to focus on some broad themes of general interest and significance that were subjects of extended evening discussions, formal and informal, rather than on individual talks in great detail. For readers interested in the details of the talks, contact addresses of speakers are provided.

The declared focus of the meeting was to take stock of the present situation in the understanding of the genetics of evolutionarily important quantitative traits, such as major components of fitness, and to provide a forum for discussion of the importance of emerging technologies of genomics to enhancing our genetic understanding of how quantitative variation relevant to adaptive evolution is structured, maintained and evolves. Another focus of the meeting was to develop plans to better utilize *Drosophila* species as a model system for such studies on the interface of genomics and evolution, in the future. The background and expertise of the participants were, however, much broader than this somewhat narrowly described focus, ranging from people working in *Drosophila* life-history evolution, using methodologies ranging from laboratory selection (A. Joshi, Bangalore) to QTL mapping (L. Van de Zande, ZANDELPW@biol.rug.nl; R. Anholt, anholt@ncsu.edu) to those involved in mammalian genomics (J. F. Bureau, jfb@pasteur.fr; M. Tixier-Boichard, boichard@jouy.inra.fr; R. Mott, rmott@well.ox.ac.uk) or developmental genetics (C. P. Klingenberg, Cpk24@cam.ac.uk; K. P. White, Kevin.white@yale.edu).

Several talks focused on studies of phenotypic variation, both genetically based and arising from phenotypic plasticity, in wild populations of *Droso-*

phila, with an intention of better understanding the central biological problem of adaptation (J. R. David, david@pge.cnrs-gif.fr; G. de Jong, G.deJong@bio.uu.nl; A. A. Hoffmann, A.Hoffmann@latrobe.edu.au; A. S. Gilchrist, stuartg@bio.usyd.edu.au; P. Gibert, gibert@pge.cnrs-gif.fr; B. Moreteau, moreteau@pge.cnrs-gif.fr). One major point made in many of these studies, and in those on inbreeding depression and stress resistance (R. Bijlsma, r.bijlsma@biol.rug.nl; V. Loeschke, volker@biology.au.dk), was the ubiquity and importance of genotype \times genotype (epistasis) and genotype \times environment interactions in determining patterns of observed phenotypic variation. This is likely going to play an important role in many human disorders as well, especially those that are not monogenic in origin. In the application of genomics to bio-medical problems, which is one major cause for the explosion of interest in these technologies, such interactions are going to be increasingly important, and the experience of evolutionary geneticists in dealing with these phenomena will be beneficial to those interested in genomics. Indeed, it was suggested that evolutionary genomics may greatly help us to understand the nature of the mapping between genotype and phenotype (D. Houle, dhoule@bio.fsu.edu), and allow us to ask whether there are regularities in genotype–phenotype maps that can then permit the deriving of some relationships between gene networks and ‘classical’ statistical descriptions of phenotypic and genetic variation. The shortcomings of QTL mapping were discussed, and the fact that QTLs for traits such as longevity in *Drosophila* tend to show effects that are gender-, density- and genetic background-specific in complex interacting ways, was highlighted (T. F. C. Mackay, mackay@unity.ncsu.edu). It has also been a repeated observation in studies with *Drosophila* that many QTLs (which are typically large enough when initially mapped to contain anywhere from 400 to 2000 genes) eventually get mapped down to either non-coding upstream regions or intronic regions, rather than coding regions of the genome. In some cases, evidence has also been found for intragenic epistasis between different single-nucleotide polymorphisms. These findings strike a cautionary note for

those applying such techniques to human studies.

Another issue discussed, which is also relevant to human genomics, was the possibility of applying modified techniques of QTL mapping (such as Quantitative Deletion Mapping) that would permit them to be used on outbreed populations (T. F. C. Mackay). Discussions and presentations at the meeting made it very clear that a combined approach – which would require a lot of collaborative work – that brought together field studies of variation and its ecological correlates, laboratory selection studies, QTL studies followed up by a variety of finer resolution mapping efforts, bio-informatic approaches to seeking patterns in sequence variation, and DNA microarrays and temporal gene expression pattern studies, would go a long way toward enhancing our understanding of many important biological phenomena.

Questions regarding the nature of the genotype–phenotype map (and whether or not it has certain regularities), the mechanisms of maintenance of quantitative genetic variation in populations (antagonistic pleiotropy, mutation-selection balance), and quantifying the prevalence of genotype \times genotype and genotype \times environment interactions and elucidating their molecular basis, are not only central to the concerns of evolutionary biology, but also have tremendous implications for the successful application of genomics to biomedical problems. Traditionally, molecular genetics and evolutionary genetics have developed separately from somewhat different origins. Molecular genetics has taken a bottom-up approach that has occasionally but relatively rarely climbed up even to the level of the whole organism. Evolutionary quantitative genetics has typically taken a top-down approach, which has rarely managed to go below the level of the individual organism. It is clear that a better understanding of living systems in their totality requires an integration of top-down and bottom-up approaches. Some of the presentations provided good examples of the returns from even fairly preliminary attempts at achieving this synthesis. It is, in my opinion, very important that this kind of synthesis be achieved in the Indian scientific community so as to ensure that we benefit to

the maximal extent from opportunities the new technologies offer. Treating genomics as a branch of molecular genetics instead of a methodology that, in conjunction with other entirely non-molecular techniques, can address fundamental biological questions would, in my opinion, be a tragedy for Indian science.

Some of the other issues, of somewhat narrower interest, that were discussed at the meeting included the relationships between within- and among-species variation, and whether or not the same loci and alleles are primarily involved in shaping these two levels of variation. A related issue is that of rates of evolution and whether

these differ for different kinds of traits (developmentally versus ecologically important) and different kinds of loci (regulatory versus structural). A relatively neglected but also important issue is the extent to which transposable element-mediated events play a role in shaping genetic variation at various hierarchical levels from individuals to species (P. Cappy, cappy@pge.cnrs-gif.fr). To sum, the two broad questions raised at the meeting were: (a) Can genomics help address some of the 'classic' questions in evolution? (b) Can evolutionary genetics help in the integration of information generated by genomics into real biological knowledge? The consensus appeared to be

that the answer to both questions is a resounding YES!

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Indian Academy of Sciences' refresher course in experimental physics*

The broad aim of the Refresher Course in Experimental Physics organized by the Indian Academy of Sciences was to help motivated teachers improve their background knowledge and teaching skills. This course was planned with the purpose of exposing teachers to some aspects of experimental physics, mainly centred around experiments on solid state physics. In addition, the teachers had to build a few general-purpose instruments in a 'project' mode, for carrying out measurements of various material properties.

Twenty-four teacher participants were selected from various Indian universities and colleges. The criterion for selection was based on academic qualifications and their involvement in post-graduate teaching. In all, 18 teachers attended this two-week course.

In his inaugural address, B. S. Sonde (Vice-Chancellor, Goa University) referred to several aspects of underlying

physics in various day-to-day human activities, from food preservation to transport, communication, entertainment, etc. He emphasized the role of refresher courses in anti-obsolence and upgradation of teaching faculties. His address was preceded by welcome remarks by P. R. Sarode (Goa University) and Satish Shetye (National Institute of Oceanography, Goa). Shetye referred to various activities related to the Science Education Panel of the Indian Academy of Sciences. K. R. Rao (Course-Coordinator) gave details of the scope and course content.

The scientific programme started with talks on background physics with the slated experiments. Beginning with the third day, the participants were divided into two batches. While one batch carried out the experiments, the other batch worked on the projects. In addition, there were seminars on related and useful topics in the evening. The experiments were carefully selected so as to cover most of the areas in solid state physics and a few aspects of optics and electronics. A manual for all the experiments was made available to the participants. Project handouts were also given to them before starting the project work. Each experiment or project was

carried out individually by each participant.

The selected experiments were the following: Resistivity of metal and semiconductor by the four probe method; Measurement of Hall coefficient and mobility of a semiconductor; Paramagnetic susceptibility of a solid by Gouy's method and verification of Curie law; B-H loop and Curie temperature of ferrite; Electron spin resonance: Determination of 'g' value; Composite piezoelectric oscillator: Determination of elastic constant; Measurement of dielectric constant of a ferroelectric material; Thermoluminescence: Study of defects/colour centres in alkali halides; X-ray diffraction (Debye-Scherrer method): Determination of lattice constant of a material; X-ray spectroscopy: Emission spectrum of tungsten; Analysis of sodium spectrum; Simulation of electronic circuits using SPICE.

In addition, a few more experiments were also set-up for interested participants: Lattice dynamics kit for the study of vibrational modes in monatomic and diatomic lattices; Geiger-Muller counting system; Zeeman effect.

The projects carried out by the participants included building of a constant current source (0.1–10 mA), a furnace

*A report on the 'Refresher Course in Experimental Physics' organized by the Indian Academy of Sciences, Bangalore in collaboration with the Department of Physics, Goa University, Goa for university and college postgraduate teachers from all over India during 29 October to 12 November 2001.