from the hyperthermophile archaebacterium '*Thermococcus litoralis*' (commonly known as Vent Polymerase, used in certain PCR applications), discovered the presence of two in-frame intervening sequences in the DNA, the second of which codes for a 'homing' endonuclease. The mature polymerase protein is produced by the recently discovered phenomenon of protein-splicing, and not by RNA splicing to remove introns. Site-directed mutations of the splice junctions at the protein level either abolish or decrease the rate of splicing reaction. Pulse-chase experiments demonstrate the initial appearance of a precursor followed by appearance of the spliced products and the intron-encoded endonuclease protein. Other experiments show that protein splicing and the 'homing' endonuclease activity are independent of each other[8].

The poster sessions covered a wide range of topics related to RM systems. Eric Fisher, of the University of Illinois, Urbana-Champaign, USA, presented his work on the isolation of mutants of *Eco*R1 endonuclease with enhanced specificity for the methylated GAATTC sequence of the DNA. Cloning, expression and purification of the recombinant *Bam*H1 enzyme was presented in a poster by M. A. Mukund of Astra Research Centre India, Bangalore in which overexpression was achieved using the dual compatible plasmid strategy. Wolfgange Wende of Medizin Hochschule, Hannover, Germany, described the construction of fusion proteins of the enzyme *Eco*RV, with different N-terminal tags, such that heterodimers of the protein could be made for purification by a rapid affinity chromatography procedure. Maria Yebra of the Department of Chemistry, Wayne State University, USA presented her work on a rapid, sensitive and quantitative method to detect restriction enzyme activity, which involves the incubation of an oligonucleotide substrate DNA (having its 5′ end radiolabelled and its 3′ end tagged with Biotin) with a chosen enzyme. One of the products would be radioactive and could therefore be quantitated, after its separation from the other (biotinylated) fragment on a streptavidin-agarose column.

Future directions of enquiry in this expanding field point towards investigating the structural aspects of protein–DNA interactions in the restriction and methylation reactions, identification of the catalytically important amino acids in these proteins, and elucidation of their reaction mechanisms.

1. Wilson, G. G., *Nucleic Acids Res.*, 1991, **19**, 2359–2566.
2. Brooks, J. E. *et al.*, *J. Bacteriol.*, 1992, **174**, 7194–7201.
3. Raleigh, E. A. *et al.*, *J. Mol. Biol.*, 1992, **225**, 327–348.
4. Rosenberg, J. M., *Curr. Opin. Struct. Biol.*, 1991, **1**, 104–113.
5. Winkler, F. K., *Curr Opin. Struct. Biol.*, 1992, **2**, 93–99.
6. Pingoud, A. *et al.*, *Biochemistry*, 1992, **31**, 3727–3732.
7. Halford, S. E. *et al.*, *Biochemistry*, 1991, **31**, 8743–8753.
8. Perler, F. B. *et al.*, *Proc. Natl. Acad Sci. USA*, 1992, **89**, 5577–5581.

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The measure of science and scientists

A report recently released by the Philadelphia-based Institute for Scientific Information (ISI), USA, (*New Scientist*, 1993, **138**, 12–15) regarding detailed analysis of the work of scientists, has kicked off a debate among scientists in the West. Commissioned by a science magazine, *New Scientist*, published from the UK, the report is a study of scientists' published work, especially citation-analysis of their publications during a period of ten years. Though the analysis was specifically carried out with reference to AIDS research, the results have a bearing on all areas of science. The report suggests that a lot of work is generally redundant, mediocre and rarely read by scientists. In turn, the analysis indicates as to which science (and scientists) should be supported.

Detailed analysis of individual scientist's publications brings out quite a few surprises. The more important results are: funding of scientific projects is often continued for years without proper evaluation; good science often emerges from small countries and laboratories with modest funds where researchers are working on well-defined areas. At a time when public funds for S&T are scarce, such an analysis can provide good insights into a laboratory's work, help a scientist in planning the experiments and publishing judiciously, and assist the donor in coming to a right decision regarding financing.

Largely, these points are true in the Indian context too. With about 2,000 Indian scientific journals, work in approx. 20 is internationally indexed and cited. And for the work published abroad by the bulk of our scientists, according to the report, India finds no place among the first fifteen countries with a high citation index.

Objectives of the study

Economic crunch in most of the countries of the world has led to decreased funding of S&T. This, in turn, has led to quite a few changes, the extreme case being the closure of laboratories or discontinuation of on-going programmes. In this exercise, questions being increasingly asked are: what is the importance and the impact of the on-going science programmes?

Here the time-tested methods which have been relied upon are peer review, the ability to raise funds for a project and citation analysis. Scientific works which are quoted maximally by colleagues in their publications (i.e. receive a large number of citations) are often considered as the more influential papers. While there are occasional misgivings regarding the relative fairness of the first two criteria, the reliability of citation index can become a highly contentious issue. This is specially true for scientists in India and other developing countries and has been dealt in great detail by several eminent scientists (see *Current Science*, 1991, **61**, 25 July and 1992, **63**, 10&25 November). In brief,

it is well known that scientists in the West rarely cite the work done in India. What's more upsetting, several Indian scientists also seem to follow them for several reasons, not entirely scientific. This factor naturally distorts the citation index. However, despite the weaknesses in the three indicators, overall they give a fairly good idea about the quality of a work which, in turn, reflects a scientist's worth.

In general, these criteria have served the managers quite well in assessments of scientists and their work. However, the current ISI analysis has upset many well-established notions. The analysis was requisitioned to give a new dimension to AIDS debate, specifically the question of continuing the financing of research in this disease. In the last 10 years, billions of dollars have been spent to find a cure for AIDS. With no cure in sight, questions were being asked about the quality of AIDS research and the scientists were even accused of not being critical enough to stop the 'rubbish' being churned out. The acrimonious nature of the debate prompted a closer look into the publication record of some prominent scientists working in the area. And hence the ISI's involvement.

An aggregate of 36,000 papers on AIDS published in major journals between 1981 and 1992 were analysed. These were individually sorted out for their detailed citation-record. Contributions of different countries, laboratories and scientists were also analysed. In 1981–86, 15.37 and 14.59 per cent of AIDS and general biology papers (taken as base-line data) respectively, did not receive a single citation; about 52% of papers in AIDS (and in biology) received just 4 or less citations; 38% received 5 to 49 citations; only 10% received 50 or more citations. The situation improved marginally during 1987–92 for AIDS, though not for publications in biology research. Apparently, a large chunk of papers are going uncited, implying that just too many trivial and inconsequential papers are being published.

Another point which emerged is that contributions from small countries like Belgium, Sweden, the Netherlands obtained greater number of citations on the average than major countries like the USA and the UK. For instance, out of 18,495 publications, 15.24 citations/paper were received for USA in contrast to 15.70 citations/paper for 573 papers from Belgium during the same period. This implies that science in small set-ups is closely integrated, with work in well-defined problems. Generally this is a wise strategy to follow, especially when funds are scarce.

Lastly, when ISI looked at citations of an institution or of an individual, one aspect which seemed to dominate was that the overall quantity was in no way a measure of its impact or quality. Apparently, largely scientists are 'forced' to follow the idea of 'publish or perish'.

Implications of the study

The above discussion raises some important questions. Is the large volume of scientific literature really worthless? How is it that this research is going unnoticed for such long time periods, and still getting financed? One would have expected that at some point, critical reviewing would have cried a halt to further work in these programmes.

There are no easy solutions to these problems. Stricter vigil and reviewing processes (and implementing the reviewer's comments), and a more open atmosphere can certainly improve the situation. Above all, a group leader could set a precedent by publishing only such work which is significant and impress on his/her team the need to carry out and publish only well rounded and path breaking conceptual ideas. In this discussion, one point which needs to be remembered and which is also highlighted by the analysts is that a scientist's contributions need not be measured only in terms of his scientific work and publications; invaluable and not-too visible contributions may also be there in the nature of teaching, or training students and staff, or building a group. Many of such scientists are known to publish their work only after many years and these publications are known to be important. It is hoped that this discussion will initiate a debate in India, too, which, in turn, can lead to phasing out many redundant projects and encourage good work.

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SCIENTIFIC CORRESPONDENCE

Enigma of the negative $\delta^{18}O$ pulse at LGM

With reference to S. K. Gupta and P. Sharma's paper 'Enigma of the negative $\delta^{18}O$ pulse at the last glacial maximum in the Arabian Sea' (*Curr. Sci.*, 1993, **64**, 107–110): Downcore records[1] of $\delta^{18}O$ in the shells of planktonic foraminifera in a sediment core collected from the southeastern Arabian Sea (SK 20–185; lat. 10° N, long. 71° 50′ E; water depth 2523 m) show negative excursions of up to 1‰ during or close to the last glacial maximum (LGM). The cause of the observed excursion that lasted for approximately 4,000 years has been the subject of some debate. Sarkar *et al.*[1] proposed that it might arise from an intensification of the northeast (NE) monsoon during the LGM: this was assumed to have led to an enhanced transport of fresher waters from the Bay of Bengal to the eastern Arabian Sea. However, Krishnamurthy[2] suggested that the observed excursion could be caused by local changes in the seasonal temperature distribution brought about by a weak southwest (SW) monsoon during the LGM. Now another explanation for the shift in $\delta^{18}O$ has been offered by Gupta and Sharma[3]. They suggest that the lighter oxygen in foraminiferal tests might be the consequence of an increased meltwater discharge from the Himalayas during ~ 22–18 kyr BP. These authors cite a variety of