**Table 1.** Types of motors employed by the cell

| Type of motor | Direction of movement | Example from biology |
|---|---|---|
| Rotary | Anticlockwise | Flageller movement in bacteria |
| Rotary | Anticlockwise | ATP synthase |
| Linear | Bidirectional | Actin/myosin |
| Linear | Bidirectional | Kinesin (dyanin)/microtubule |
| Linear | Unidirectional | RNA polymerase/DNA |

Recently, Noji *et al.*[7] have identified the first molecular motor, $F^1$-ATPase. Cells employ a variety of linear motors (Table 1) which exert forces as they move along. We know of one rotary motor, the bacterial flagellum which propels bacteria by a circular motion and comprises 100 different proteins. Single molecule measurements have shown that $F^1$-ATPase acts as a rotary motor, the smallest known so far. $F^1$-ATPase is known to contain three $\alpha$- and three $\beta$-subunits and one $\gamma$-subunit. $F^1$-ATPase, together with the membrane embedded $F_o$ unit forms $H^+$-ATP synthase that reversibly couples transmembrane proton flow to ATP synthesis/hydrolysis in respiring and photosynthetic cells. Various structural and biochemical studies suggested that the $\gamma$-subunit rotates within the hexamer of $\alpha_3\beta_3$. Noji *et al.* have now fixed the $\alpha_3\beta_3$ hexamer on a glass coverslip coated with Ni(11) complex with the help of His-tag. Then $\gamma$-subunit was attached with a fluorescent actin filament and in the presence of ATP the anticlockwise rotation was noticed from the coverslip (membrane) side. The speed of revolution was measured to be 4 Hz and the torque produced reached up to 40 pico Newton per nm.

However, the most novel conclusion which has come at the beginning of this year[8] would force all of us to look again at the ligand–receptor interaction. A report showed that the ligand–receptor interaction strength is not fixed. At least in the single molecule level, the strength of interaction can be tuned to be weak or strong by varying the retracting force, which is known as 'loading rate'. Patrick Stayton wrote 'Nature might regulate bioadhesive strengths through activation barriers engineered by evolution'[9]. The affinity between streptavidin and biotin is the strongest noncovalent interaction in biology ($10^{13}$ to $10^{15}$ $M^{-1}$). However, the authors probed bond formation over six orders of magnitude in the loading rate and observed that the stability of the bond varies from 1 min to 0.0001 s, with increasing loading rate. They attached streptavidin to a surface (immobilization) and biotin to a probe. They were allowed to interact and form a bond and were then pulled apart. Upon measuring the force necessary to pull them apart, the authors found that the interaction strength depends on how fast they were pulled! It may be impossible to arrive at such conclusions from bulk measurements.

One of the major drawbacks of single molecule measurements is the technological limitations, cost and maintenance of such a facility. As one can understand, signal to noise is extremely weak and therefore requires very clean measurements for reproducibility. Cost is not the rate-determining step; the better the probe having strong signals, less is the cost. So, the chemistry for probe selection, and attachments, will diversify further. However, it requires participation of many experts in various disciplines to start such an activity.

1. Uppenbrink, J. and Clery, D., *Science*, 1999, **283**, 1667.
2. Kabata, H. *et al.*, *Science*, 1993, **262**, 1561.
3. Yin, H. *et al.*, *Science*, 1995, **270**, 1653–.
4. Wang, M. D. *et al.*, *Science*, 1998, **282**, 902.
5. Weiss, S., *Science*, 1999, **283**, 1676.
6. Funatsu, T. *et al.*, *Nature*, 1995, **374**, 555.
7. Noji, H. *et al.*, *Nature*, 1997, **386**, 299.
8. Merkel, R. *et al.*, *Nature*, 1999, **397**, 50.
9. Stayton, P. S., *Nature*, 1999, **397**, 20.

*Dipankar Chatterji is in the Molecular Biophysics Unit, Indian Institute of Science, Bangalore 560 012, India.*

## OPINION

# Survey of India maps: (Ir)rationale about restricted maps

*S. M. Mathur*

Restricted maps are such topographic sheets of the Survey of India (SoI) that are not sold freely and require permission from certain government departments (in some cases even the Ministry of Defence) for sale. The buyer is bound to observe stringent conditions, violations of which are liable to attract penal action. The categories of maps that have been declared restricted are all topographical and geographical maps which cover about 80 km wide strip of the land along the coasts and along the international boundaries, the whole of Jammu & Kashmir (J&K), and the islands of Andaman & Nicobar and Lakshadweep on scales 1:1 million and larger as depicted on an index map. Gridded topographic sheets of unrestricted areas are also not for open sale. There are restrictions on depiction of contours and heights as also of several types of installations and lines of latitudes and longitudes. Even the map catalogue of SoI is restricted.

However, 1:1 million World aeronautical charts and International maps of the world (Carte Internationalé du Monde), including that of J&K, sold by SoI are exempted. Is it because such

maps are freely available abroad and form part of a global system? For example, the US Army Map Service has covered the whole of India, including the mountainous regions, on maps on a scale as large as 1:25,000. Detailed maps of the western Karakoram glaciers have been published in Italy (1:500,000 scale) and Germany (1:450,000 scale).

These restrictions hamper the efforts of many people, agencies and institutions engaged in developmental work and scientific research. Earth scientists are specially hampered because numerous regions in the restricted zone happen to be geologically important. They cannot easily obtain the standard 1:50,000 scale topographic sheets – not to speak of sheets on a larger scale – that are normal for geological mapping and other investigations.

Another arm of the Government of India, the National Remote Sensing Agency (NRSA), freely sells detailed imageries not only covering India but also adjoining territories; these include areas that fall under SoI 'restricted' categories. These imageries have a resolution of 5.2 to 5.8 m. This means that objects even as small as a truck on the ground can be identified. Also, the height of any topographic feature or object can be calculated thereform, making the prohibition of depicting contours on maps of certain domains redundant. On the other hand, the largest standard topographic sheet produced by SoI is on the 1:250,000 scale with contour interval of 10 m. This shows only broad topographic features, and even a small village is depicted not larger than a dot. Then, what is the rationale of SoI to restrict sale of numerous maps on scales larger than 1:1 million?

The policies of SoI and NRSA contradict each other though both are Central Government organizations. Is SoI, carrying the burden of its hoary old age of 232 years (established in the year of grace 1767) so hidebound that it is unable to shake off its antediluvian outlook?

The geological maps of the 'restricted' areas published by the Geological Survey of India (GSI) are also restricted because they are based on SoI maps.

Also in SoI, all topographic sheets on scales larger than one-fourth inch or more equal to a mile come stamped with the injunction 'not for export'. The obvious intention is that the maps should not be taken out of India. The rationale behind this rule is also questionable, when foreign agencies have published maps of these areas for open distribution.

While SoI will not allow its maps to go out of the country, NRSA sells freely the imageries, tapes and maps the world over, earning valuable foreign exchange. As a global player in this field, it offers quite a competition to NASA, America, in providing satellite photographs and data.

Foreign agencies publish maps of India without obtaining the permission of the Surveyor General of India. For example, bathymetric Admiralty maps of the seas surrounding the Indian coast for navigation purposes, are available from a firm in Calcutta (possibly from other sources as well in India) issued by a foreign organization, obviously without the mandatory approval of the coastal features by the Survey.

In the interest of not only geological investigations but of scientific research and overall development as well, it is urged that the Government remove the irrational classification of restricted maps, and make available freely all maps issued by SoI.

Quite a few laws and rules on the statute books are hopelessly outdated having no relevance now, but the Government has taken no action to repeal them. The Ministry of Science and Technology should advise the Government about the absurd restrictions enumerated above and urge for their removal.

*S. M. Mathur lives at B-15, Alokpuri, Ravindrapalli, Lucknow 226 016, India.*

# Futile exercise in thought control

*S. R. Valluri*

*The Hindu* of 17 December 1998, reporting on a parliament proceeding stated that 'A formal warning has been issued to a scientist at the Institute of Mathematical Sciences (IMSc) for writing an article specifically critisizing the present nuclear tests' and that 'Action has been initiated against T. Jayaraman under the provision of the Institute conduct rules and that some scientists wrote to the IMSc Director, opposing any disciplinary action'. Since the issue has attracted parliament attention, it has assumed political overtones and raises some issues of wider importance. Jayaraman discussed some very important policy issues. To argue his viewpoint he quoted statements publicly reported to have been made by the secretaries to the Department of Atomic Energy (DAE) and DRDO. In a democracy, it is not a crime to base ones argument on public statements of politicians or government officials. In fact, in a similar situation, the scientists in United States started publishing the *Bulletin of Atomic Scientists* to give an opportunity to 'non establishment scientists' to freely express their viewpoint on the US nuclear policies. It is within the right of citizens in a democracy with many political parties to hold 'politically partisan views', such as they are on issues of vital importance that can affect all of us.

This action of the Director of IMSc has apparently been prompted by the unhappiness expressed by the Secretary to the DAE which is the grant-in-aid funding agency for IMSc. This precipitated the present anomalous situation. It has attracted more attention than the original article of Jayaraman among the scientific community. One wonders, if this was what the Secretary, DAE