IRS-1D orbit raising manoeuvre

The Indian Remote Sensing Satellite, IRS-1D, was injected into an elliptic orbit of 822 × 301 km instead of 817 km circular polar orbit by the Polar Satellite Launch Vehicle (PSLV-C1) on 29 September 1997, due to an anomaly in the fourth stage performance, resulting in a ΔV deficiency of 130 m/s. The inclination of the orbit was 98.64° as intended. Soon after injection into the orbit, the solar panels were deployed automatically by the on-board sequencer. The three axis stabilization of the spacecraft was also accomplished through the auto acquisition sequence as planned and all the systems performed satisfactorily.

Considering the shortfall in the ΔV and the need to attain a functional sun-synchronous orbit for nominal payload operations, a strategy was worked out carefully, keeping in mind the limited onboard monopropellant hydrazine fuel (84 kg) and the RCS thruster performance. The orbit was raised in a step-by-step manner by concurrently firing the 11 N and the four 1 N thrusters. More than 5½ h of thruster firing carried out over a period of ten days, raised the perigee of the orbit to 737 km by 11 October 1997. These operations were carried out using the Time-Tag telecommand mode at the apogee in the non-visible region of the orbit. The performance of the RCS system using for the first time all-surface tension tanks, was perfectly normal and all the thrusters functioned well providing the needed throughput and the nominal ISP was more than 200 s. At the end of the orbit raising operations, around 16.5 kg fuel was left in the tanks which would provide a minimum satellite mission of around 3 years.

International Academy of Astronautics Book Award

Space Technology for Sustainable Development, a book written by Prof. U. R. Rao, Member, Space Commission and former Chairman of ISRO, has won the prestigious Book Award of the International Academy of Astronautics (IAA). The book is published by Tata McGraw-Hill Publications, Delhi. The annual Book Award, consisting of a citation and medal, was presented to Rao on 7 October 1997 during the 48th International Astronautical Federation (IAF) Congress at Turin, Italy.

Accepting the award, Rao stated that his close working with developing nations was what provided him the inspiration to undertake this work. The book deals with the relevance and application of space technology for socio-economic development of three quarters of the global population which is struggling to find their equitable and rightful place in the global village.

It may be recalled that Rao had earlier received Alan D. Emil Award for International Cooperation in 1992, and Frank G. Malina Award for Space Education in 1994, both given by IAF, Paris. He is the only person to-date who has received all the three prestigious awards instituted by IAF/IAA.

European Patent Office delivers favourable interim judgement on opposition to Neem Patent

On 30 September 1997, the European Patent Office (EPO) delivered a favourable interim judgement on the challenge of a European patent on the fungicidal effects of neem oil (Patent No. 436 257 BI) owned by W. R. Grace & Co. Dr Vandana Shiva, Ms Magda Alvoet (MP of the European Parliament) and other NGOs of the Neem Campaign enabled this optimistic development close on the heels of the repeal of the turmeric patent (No. 5 401 504) in the US on 23 August 1997, after the US Patent Office found the claim to novelty to be unsustainable in US patent law.

The Opposition Division of the EPO issued a provisional statement on the basis of the European Patent Convention (EPC). It reads in summary:

> 3.7 In summary, it appears that the present patent cannot be maintained in view of the affidavit A2 (Articles 54 and 56 EPC). Moreover, the content of the affidavits A3 and A4 could possibly form a very relevant prior art with regard to the inventive step.

The Opposition Division has asked the applicants for more detailed information concerning the extraction process in order to proceed to the next stage.

The Neem Campaign consisting of a group of NGOs and individuals, was initiated in 1993 in India to mobilize world-wide support to protect the technical knowledge systems and resources of bio-rich countries from piracy by the bio-poor ones, particularly in light of intellectual property rights regimes under WTO and TRIPS. The neem patent became the first case to challenge, on grounds of biopiracy, European and US patents.

Indian NGOs active in this arena maintain that the revoking of the turmeric patent in the US, and now the consideration of revocation of the neem patent on the grounds of 'prior art' in the European Patent Office, demonstrates the imperative need for Europe and the US to revoke all patents based on foreign knowledge and 'prior art'.

'Mis-governance of the bio-sphere and rapacious bio-mining in the bio-poor countries by unaccountable corporate dictatorships over the years has been the root cause of their present plight. They must democratize bio-governance and reform their antiquated IP laws in this arena so that benign technologies and ethical practices can be transferred to them from such bio-rich countries as India', said a CEO of a farmers' co-operative in Gujarat now investing abroad in Israel and other countries. Further, the bio-poor countries also need to strengthen and update their archaic patent laws to bring them in line with ethical conduct and to disallow rampant biopiracy. A patent expert from another bio-rich country said the US must recognize foreign prior art. Patents are supposed to satisfy three criteria – of novelty, non-obviousness and utility. Novelty implies that the innovation must be new. It cannot be part of 'prior art' or existing knowledge. Non-obviousness implies that someone familiar in the art should not be able to achieve the same step. Most patents based on misappropriation of prior bio- knowledge violate the criteria of novelty read with non-obviousness because they range from direct piracy to minor tinkering which involves obvious steps to anyone trained in the techniques and disciplines involved.

According to many natural-product chemists in India and abroad, the precedents of the turmeric and neem cases should be used by India to require the World Trade Organisation (WTO) to 'outlaw bio-piracy by such bio-poor countries as the US'.

Physics of melts*

One of the most fundamental geodynamic processes to which can be traced a host of planetary structures and phenomena, each in its turn, central to several subdisciplines of earth and planetary sciences, is mediated by rock melting in planetary interiors and the subsequent deformation and relative movement of the melt and the matrix (two-phase flow). Earth scientists have long been aware of the implication of this process to the extent and composition of continental and sea floor volcanism that create the basic layout of the earth's surface. However, not much progress could be made until the mid-eighties in using the knowledge of the volcanic features of the globe (Deccan, Hawaii, Iceland, Indian Ocean) delineated from their geophysical (gravity and bathymetry/topography and seismics) and geochemical (trace element distribution) signatures to obtain the attendant conditions of their origin in terms of quantitative thermodynamical parameters, because of the difficulty in describing the fluid mechanical behaviour of the matrix and of the melt fraction separating from it.

A distinct advance in tackling this problem was made by Dan McKenzie of Cambridge who provided a basic mathematical framework constituted by four conservation principles: the conservation equations of mass, momentum, energy and of atomic species. These equations, however, are quite complicated especially the energy equation. For, it contains terms that account for the latent heat of melting, for the heat transport by the separate movement of the melt and the matrix, and for the heat generation by their deformation. Their complete solution is therefore not yet available. Yet, much enlightening insight can be gained by analysing their solutions under simplified conditions as in many a fluid dynamical problem. Specifically for example, the assumption of isentropic melting produced by upwelling, which is believed to be valid for the mantle both under the ridge axes and intraplate volcanoes, leads to fairly accurate estimates of the melt fraction generated during upwelling and of the volume of magma that would then erupt at the surface. Thus, proceeding from first principles, McKenzie and his colleagues showed how an oceanic crust of the observed thickness (7–8 km) would result from the partial melting of a mantle whose mean temperature is 1350°C and how localized hot jets with temperature of 1550°C can generate just the right amount of melt needed to produce the Hawaiian ridge, or how the trace element concentrations can provide constraints on the relative movements between the matrix and the separating melt.

Indeed, this approach has many other fruitful applications to the solution of a variety of important terrestrial processes involving two-phase flow, notably the movements of fluids during crustal metamorphism and in fluidized beds leading to mineral concentration and hydrocarbon migration, as well as environmental modification by dispersion and differential transport of solutes and suspended materials.

These exciting possibilities of understanding crucial earth processes through a more basic approach of mixed phase fluid flow have, in turn, spurred fruitful interdisciplinary collaboration between a few geophysicists, geochemists and fluid dynamicists towards developing a quantitative framework for studying geological phenomena of a remarkably fluid-like earth. Herbert Huppert (DAMTP, Cambridge) recently coined the word 'geological fluid dynamics' to underline the fact that the ideas of continuum and fluid dynamics are central to understanding almost every aspect of the earth. The Cambridge University graduate programme in Earth Sciences now has a core course in this subject, and a debate on the implications of this step to the content and structure of other geological courses has already begun.

A discussion meeting on 'Physics of Melts' was accordingly arranged in April this year during the visit of Dan McKenzie to Bangalore as Raman Professor of the Indian Academy of Sciences. It was felt that an approach to the new quantitative culture in earth sciences could be quite effective if it is launched from a somewhat familiar ground notably, the physico-chemical aspects of rock melting which, howsoever qualitative, form a basic element of research in igneous petrology, and expose the expressive power of this paradigm for studies in hydrology, sediment compaction and hydrocarbon for-

*Report of an Academy Discussion Meeting at Kodaikanal, 9–13 March 1997.