loped on the alternating orthoquartzites/sandstones, shales and limestones of the Upper Vindhyan sequence. Due to the tectonic stress generated by the GBF (at different times), these orthoquartzites/sandstones have undergone certain degree of metamorphism and only occasionally appear as quartzite.

7. Going further NE of Bundi area towards Ranthambhor, the outcrop width of the Vindhyans gradually decreases. Here it is sandwiched between the Bundelkhand Massif and the Aravalli Orogen. The pre-Vindhyan Ranthambhor quartzites are directly juxtaposed with the Upper Vindhyan sandstones, which, in this area due to extreme compression, have also become quartzitic in nature. The two quartzites look very similar and cannot be distinguished without a careful field investigation. A fault scarp of the GBF, often, marks the boundary between the two. The horizontal distance between the GBF and the Chambal lineament is minimum in this locality and the Vindhyan block appears to be compressed along these two megalineaments.

I hope the evidences cited, herein, may be enough to make necessary corrections in the annotation of the image of the Bundi area (plate 23) and also of the Dhar area (plate 20).

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Ashok Kumar Joshi replies:

The objective of the publication was to show the usefulness of IRS-1A data for various applications, and, in particular, the plates were used to demonstrate some interesting areas, not to report or publish something new about these areas. The points raised by Verma are a part of R&D, which certainly was not the aim of the said captions.

Further, the details were collected from well-known published text, not the papers or views of the individual authors, as mentioned in the earlier reply, which extends beyond the areas given in the figures.

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On the one hand...

Petsko[1] commenting on the total chemical synthesis of a D-enzyme by Milton *et al.*[2] and its implications, seems to rely rather too heavily on the random choice model of biological evolution of L-form of life. This apparently is a view shared by most modern biochemists as noted by Milton *et al.* (see foot note 4, page 1447 of ref. 2). While the earlier attempt to explain chiral preference in the biological world as possibly arising out of inherently asymmetric β-decay process[3] is cited[1], both the authors seem to dismiss the effects as probably not sufficient for explanation of the observed preferences. The symmetry breaking interactions exemplified by the β-decay process, originally cited as possible influencing factor[3], has, in recent times, been augmented by the 'Weak Neutral Current' (WNC) theory of elementary particle interactions[4,5]. This is more significant and leads to the result that all atoms and achiral molecules as well as enantiomers are expected to be optically active to electromagnetic radiation and to polarized matter waves. Optical rotation in single species of atoms has been detected confirming the theory[6]. Also, enantiomeric molecules tend to have different electronic binding energies. Mason[7] has shown that L-amino acids come out with energy advantages over D-amino acids, although the energy difference is quite small (one part in 10^{17}). However small this energy difference is its significance cannot be underestimated since, from the point of view of chemical and biological evolution, it is not the smallness that really counts but the finiteness. Since the other major player in this game of evolution is time, which is operative at astronomical level of millions of years, the combination of this with chemical/biochemical reactions (in the subsecond regimes) could bring the whole phenomenon into one of finite and possible *realizability—an argument so forcefully* put forward by Wald[8] four decades ago in the context of spontaneous chemical evolution. Estimates of time scales required for such tilting the channel into one pathway over the other based on enantiomeric energy difference are available[9] and are in the range of tens of thousands of years. Thus even if we allow for probable errors in estimates, the cumulative effect could lead to the observed preference of the L-form over the D-form during the evolutionary time-scale envisaged. It is of interest to point out that the recent results of Engel *et al.*[10] would indicate that the characteristic chirality of biochemistry on earth may have been caused ultimately by an asymmetry already existing in the amino acids in the solar system.

Chirality being a fundamental aspect, is not peculiar to only biological molecules but is reflected in all forms of matter including the inorganic world. This has led some to seek and interpret observed difference in relative occurrence of L and D forms of rockcrystals (quartz) on the earth's crust[7]. A slight excess of one form of quartz over its chiral mate experimentally recorded in

earlier times (and originally disposed of as experimental error) seems to assume significance in the light of the above findings. A parallel line of argument has been advocated[11] to substantiate the contention that, in compiling the space group frequency tables on organics, all the space groups in their entirety need to be presented and documented in terms of observed structures and their space group preferences. There is no reason to suppose that there will not be found eventually an asymmetry in the distribution of frequency preferences among chiral structures even among chiral space groups, although currently the data are inadequate to analyse and draw positive conclusions thereon.

The question of understanding what 'framed our fearful asymmetry' is thus not restricted to the study of gegen-eins alone but to a larger range of materials both organics and inorganics. The probability that life, if found elsewhere, is based on L-amino acids and D-sugars is sufficiently strong. It might be added here while the above observations are to emphasize the plausible and highly probable reasons for preference of L-forms of life on the Universe, the significance of the total synthesis of the D-protein and its implications as discussed by Petsko[1] and Milton *et al.*[2] are in no way diminished.

It may not be out of place to point out that Petsko's enunciation of condition of chirality (non-superposibility of an object over its mirror image) should read as 'lack of centre of inversion or mirror' and not include 'axis of symmetry'. Chirality implies automatically the presence of any n-fold rotation axis (including $n=0$, absence of any symmetry axis) and indeed is responsible for chiral behaviour in a large number of cases.

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Editor's note

Two recent reports describe the synthesis of enantiomorphs of proteins. S. B. H. Kent's group at the Scripps Research Institute, La Jolla has synthesized the all D analogue of the HIV-1 protease (99 residues)[1], while L. E. Zawadzke and J. M. Berg of Johns Hopkins University, Baltimore report the preparation of all D rubredoxin (45 residues)[2]. This flurry of recent activity in the synthesis of all D proteins may have been stimulated by the rather enigmatic suggestion that present day synthetic methodology should be employed to produce *racemic* crystals of proteins, which would then occur in centrosymmetric space groups, resulting in a simplification of the problem of phase determination[3]. Among the intriguing possibilities considered in ref. 1 are the probable absence of an immune response to all D proteins, the potential use of enzyme enantiomers in production of chiral fine chemicals and the therapeutic applications of a proteolytically stable D-enzyme that operates on an achiral substrate (cf. carbonic anhydrase).

Finally, Srinivasan's correction (above) of Petsko's enunciation of the chirality condition is probably necessitated by an error where the phrase 'axis of symmetry' has been used instead of 'improper (rotation–reflection) axis of symmetry'[4].

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Poredam urn burial—A Chalcolithic culture

Prehistoric cultures in Kerala include the Palaeolithic, Mesolithic, Neolithic and Megalithic, and their occurrences have already been recorded from various places in Kerala[1]. In recent years, since 1988, eight Megalithic sites, one Neolithic site and a Mesolithic site have been discovered from South Kerala. Two urn burial sites, discovered one each at Poredam near Chadayamangalam in Quilon district and at Chenkalthadam in Malayalappuzha in Pathanamthitta district, have yielded child fossil bones from within the potteries. The other material cultural evidences obtained from Poredam consist of several red ware and micaceous grey ware potteries along with a few number of small black-and-red ware pots and a few iron implements (Figure 1).

The fluorine test was carried out on the child fossil bones from Poredam. This test is often used for relative dating purpose. The element fluorine occurs in almost all groundwaters and is gradually absorbed in buried bones. The fluorine content thus increases with passage of time in the buried bones. Hence its amount is more in the older bone than that in the younger bone and its determination is useful for relative dating. Oakley[2] suggested to compare fluorine/phosphate ratio which is expre-