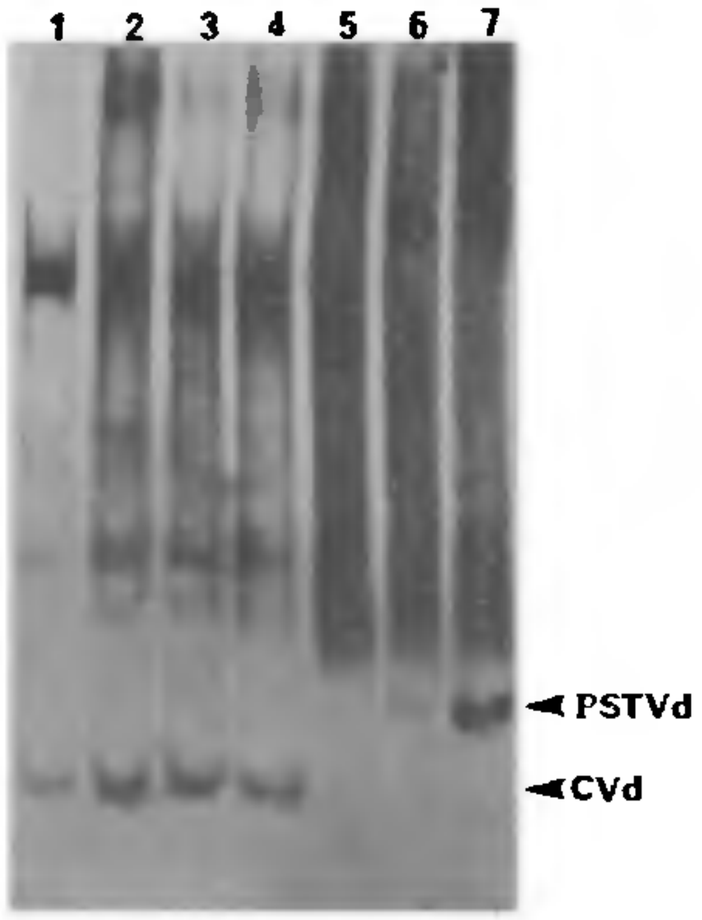

R-PAGE detection of viroid in coleus Lanes 1–4 nucleic acids from leaves of individual coleus plants containing viroid, lanes 5 and 6, nucleic acids from leaves of coleus plant in which viroid was not detected, lane 7, PSTVd, used as marker

Delhi. The coleus viroid band migrated differently in R-PAGE from potato spindle tuber viroid (PSTVd), which was used as the reference sample (see figure). The viroid band is about 1 to 2 cm lower than any RNA band visible in non-infected plant tissue. On electrophoretograms, the lowest bands always represent only circular RNA. In R-PAGE, because of the denaturation (by low molarity and high temperature), viroid molecules lose their double-stranded structure and become single-stranded circular forms, and migrate very slowly in the reverse direction. On the other hand, RNAs that are not covalently closed molecules become linear when denatured, migrate faster, and move ahead of the viroid bands.

We also tested coleus seeds obtained from Indo-American Hybrid Seeds (Bangalore, India) and seeds locally collected from coleus plants for presence of the viroid in lots of 10 seeds, replicated thrice, from each seed source. No viroid was detected in seeds collected from the garden plants. However, all commercial seed samples were infected with a viroid that migrated to the same distance as the viroid from coleus leaves. The high incidence of viroid in commercial coleus seeds in India and Canada suggests that viroids may be widely spread throughout the world, and may have a common origin in some tropical parts of the world.

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Remote sensing

I wish to draw attention to the following in the special issue of *Current Science* on remote sensing (vol. 61, nos. 3&4, August 1991):

(i) Page 230, plate 20. The image reproduced has been annotated to represent Ujjain district. To the best of my knowledge, nowhere in Ujjain district are the Vindhyan rocks exposed. This image may represent some other part of Madhya Pradesh, probably Mandsaur district.

(ii) Page 232, plate 23. The homoclinal ridges shown by the image have been identified as unmetamorphosed Aravalli sandstone. This image refers to the Bundi area and the homoclinal ridges are of unmetamorphosed Vindhyan sandstone (Upper Vindhyans). The Aravalli Supergroup rocks are highly metamorphosed and no unmetamorphosed Aravalli rock has been described from anywhere (except some limestones).

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Ashok Kumar Joshi of Regional Remote Sensing Service Centre (RRSSC), Nagpur, replies:

Plate 20 covers parts of Dhar and Ujjain District. The original image covers a much larger area, which falls mainly in Ujjain district and includes a smaller area of Dhar district. However, in this plate a LISS-II-A1 quadrant is reproduced. The northeastern part of the image covers Ujjain district, the rest being area falling in Dhar district. This particular plate was chosen to show contrasting landscapes due to different geologic formations and larger individual agricultural holdings. In a global context, the scene has been identified with the well-known Ujjain. It certainly does not form a part of Mandsaur district.

With regard to the second comment:

(i) The homoclinal ridges are steeply dipping and show two stages of folding as seen just west of Bundi city, which is in accordance with Aravalli deformation.
(ii) These ridges are actually Basal quartzites of Lower Aravalli Supergroup, which are more compact than Upper Vindhyan– Lower Bhander sandstone.
(iii) The continuation of the same ridge northeast forms the Ranthambhor Hills, which is type area of Ranthambhor quartzite. The lithologic characteristics of these rocks are very similar.
(iv) The shallow sedimentary depositional structures found in Basal quartzites of Aravalli Supergroup led some geologists to classify them with the Vindhyan Supergroup where these structures are very common.
(v) These quartzites in Bundi are so different from Lower Bhander sandstone that Soni *et al.*[1] put them as a separate geologic unit, called Bundi sandstone formation.

These features clearly indicate that the quartzites around Bundi are of Lower Aravalli Supergroup, which contradicts work by Heran (1953) and the Geological Survey of India (1967).

The comment that 'the Aravalli Supergroup rocks are highly metamorphosed and no unmetamorphosed Aravalli rock has been described from anywhere is not supported by facts. There is a good collection of papers on this subject in the memoir of Geological Society of India entitled *Precambrian of*

the Aravalli Mountain, Rajasthan, India, edited by A. B. Roy (1988).

The Aravalli Supergroup has been divided into Upper and Lower based on degree of metamorphism and facies. As one proceeds from the centre of Aravalli Mountain towards southeast or east the degree of metamorphism decreases. In fact, along the southeastern boundary, they are totally unmetamorphosed. This led some Precambrian geologists to place them with rocks of 'Gwalior Series' rather than with Aravalli Supergroup.

1. Soni, M. K., Chakraborty and Jain, V. K., in *Purana Basins of Peninsular India*, Memoir 6, Geological Society of India, Bangalore, 1987, pp. 87- 138.

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RESEARCH NEWS

Duplicitous duplications: Is *Sd* selfish DNA or a treacherous neomorph?

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One way genes evolve is by duplication; while one copy of the duplicated genomic segment can retain its function the other may accumulate mutations to assume novel roles. Tandem duplications are produced at surprisingly high frequencies by unequal crossing-over between small stretches of homologous DNA sequences—such sequences may arise from insertion of transposable elements—located at distinct sites within the same region of parental chromosomes[1]. Conversely, even after each member of a duplicated element has functionally diverged and become a distinct gene, the two may retain enough sequence similarity to engage in unequal crossing-over, in which one or the other gene may be lost. This is thought to be responsible for certain human thalassaemias[2] and red-green colour blindness[3]. But tandem duplications would appear to have few phenotypic consequences immediately upon their generation other than the relatively minor effects of gene dosage alteration because very few genes are known to be dosage-sensitive. Recent reports suggest otherwise. Occasionally tandem duplications can yield novel phenotypes that are unrelated to dose alteration. That is, they behave as *neomorphs* (mutant alleles producing an effect qualitatively different from that of the wild-type allele) rather than as *hypermorphs* (mutant alleles whose effects are similar to, but greater than those of the wild-type allele). This is because the duplication breakpoint juxtaposes sequences, either producing novel fusion proteins or imposing novel expression patterns upon existing genes.

Perhaps the most dramatic case is that of the *Sd* locus, situated on chromosome 2 of the much-studied fruit fly *Drosophila melanogaster*. *Sd* is a genetic element that is responsible for the phenomenon of segregation distortion in males. Chromosomes that carry the *Sd* genetic element are designated SD and those lacking it SD^+. Distorting males are heterozygous, with SD and an SD^+ homologue, and induce dysfunction of spermatids that receive SD^+. Consequently, they transmit a vast excess of SD chromosomes to their progeny. The sensitivity of the SD^+ chromosome to *Sd*-induced spermatid dysfunction has been traced to a satellite DNA sequence, called Responder (Rsp^s), in the centromeric heterochromatin of chromosome 2. In fly populations free of SD chromosomes, Rsp^s confers a fitness advantage relative to flies lacking it (Rsp^i, Responder-insensitive), but introduction of SD reverses their relative fitness values[4]. It is not surprising that all SD chromosomes isolated from natural populations bear Rsp^i, because the *Sd* Rsp^s combination is suicidal.

Given the insidious manner of *Sd*'s action it was tacitly assumed that it represented some foreign DNA sequence that behaved selfishly. This assumption was consistent with results showing that deletions of *Sd* from SD chromosomes restored normal segregation and addition of extra doses of the homologous region from SD^+ chromosomes to SD/SD^+ males did not alleviate distortion. *Sd* has now been cloned[5], and instead of foreign DNA a 5-kilobase (kb) tandem duplication was found. This tandem duplication is uniquely associated with all SD chromosomes, absent from all SD^+ chromosomes, and detectably altered in some revertants. However, the duplication alone is not sufficient for *Sd* activity; flanking nonduplicated regions are also required. This is consistent with the finding that some of the cDNAs specific to SD are coded for by elements within the duplication as well as by flanking regions that extend to 40-50 kb beyond the duplication. It may not be a mere coincidence that some of these cDNAs span a topoisomerase II gene located just proximal to the tandem duplication. Since topoisomerase II is required for chromosome condensation, the possibility that *Sd* acts by a subtle alteration of the expression of this gene cannot be ruled out. It would be interesting to determine whether mutations in topoisomerase II affect the Sd phenotype.

The *Bar* (*B*) mutation in *Drosophila*[6] and the *Knirps* (*Kni*) mutation of