The transposon theory of intron origins best fits the nuclear mRNA and rRNA splicing mechanisms, both of which depend on specific sequences within, as well as at the end of, introns[17]. I suggest that they originated in an early eukaryote and were never present in prokaryotes. The small nuclear RNAs involved in nuclear pre-mRNA splicing might initially have been synthesized from transposon promoters lying on the DNA strand opposite the transcribed strand of the cellular gene into which it had inserted. But nuclear tRNA splicing does depend on specific intron sequences and may have originated independently; the presence of similar tRNA introns in the archaebacterium *Sulpholobus*[18] suggests that it originated before archaebacteria and eukaryotes separated. Chloroplast tRNA introns seem unrelated to nuclear and archaebacterial tRNA introns; they resemble mitochondrial and nuclear rRNA introns and have features suggestive of defective transposons[6,15,19].

The improbability of losing every single intron by accidental deletion[2,4], and the extra complexity that splicing poses for the origin of protein coding[4], make it improbable that RNA splicing was the general rule in the primordial cell, and favour the view that archaebacteria and eukaryotes both evolved from a eubacterium lacking split genes[4]. Once introns evolved, their number and total length per genome would increase or decrease in response to generalized selection for larger or smaller total genome size[1] and transcript size, as well as to selection for specific functions[16] for at least some introns.

The relative uniformity of exon length in protein-coding genes is not, as claimed by Lonberg and Gilbert[12], good evidence against an insertional origin. The periodic structure of chromatin may prevent totally random insertions. The correspondence between the three major peaks in exon size distribution and the DNA lengths in nucleosome core particles, linkers and whole nucleosome[20], suggests that the junctions between linkers and core particles have been 'hotspots' for intron insertion and therefore that introns in protein genes originated after the origin of eukaryotic chromatin. By contrast, exon length in mitochondria [20] and chloroplasts[13,14,21,22], which lack histones, is much less uniform and more random than in nuclei.

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Chemical warfare evidence unconvincing

SIR — Rosen *et al.*[1] fail to substantiate their contention that environmental samples from south-east Asia provide evidence of chemical warfare. They base their argument on reports of trichothecene mycotoxins in six samples from alleged chemical attack sites[2,3]. In arguing that the toxins they reported were not of natural origin, they astonishingly say that the US Army Chemical Systems Laboratory found no trichothecenes in samples from south-east Asia.

This incorrectly implies that the Army's samples were controls. In fact, at least 60 of the Army's samples, like those of Mirocha and Rosen, were from alleged chemical attack sites. As far as we know, the Army laboratory has not found trichothecenes in any sample from such sites. Mirocha and Rosen have known of this since at least October 1983, when one of us (M.M.) wrote to them asking "Why does the Army find no positives out of 60 samples while Mirocha plus Rosen find six out of six positive?" The evidence for trichothecenes at sites of alleged chemical warfare is inconclusive at best: 6 positives out of 6 samples compared with 60 negatives out of 60 samples.

Rosen *et al.* ignore the fact that it is pollen, and not trichothecenes, which is the consistent and confirmed finding in samples of yellow rain, the alleged chemical warfare agent. Since 1979, many samples have been turned in by Hmong refugees from Laos, and then examined by US and other investigators. In November 1982, the head of the US Army laboratory referred to above stated "most of the samples that are of yellow rain are fairly dry and they have a high level of pollen grains in them"[4].

To our knowledge, *all* samples of yellow spots and powders from sites of alleged chemical attack that have been examined under the microscope, including those analysed by Mirocha and Rosen, consist largely of pollen. This is also true of honeybee faeces. Moreover, our analysis of the pollen types in samples of the alleged agent collected by Hmong in April 1981 and in March 1982, and comparison with pollens gathered by local honeybees, strongly supports the identification of yellow rain as the faeces of south-east Asian honeybees[5].

Rosen *et al.* also ignore descriptions of the alleged agent by Hmong refugees. Summarizing interviews with Hmong for the period 1978-82, the official reports of Secretaries of State Alexander Haig and George Shultz state that the alleged agent is yellow and falls like rain[6,7]. This resembles mass defaecation flights of the giant Asian honeybee, *Apis dorsata*, which two of us (M.M. and T.D.S.) observed in Thailand in March 1984[8]. Although now realized to be common, such flights were previously unknown, perhaps because they occur at so great a height, even though hundreds of thousands of bees may be involved. Further, nearly all the Hmong to whom we showed bee faeces on leaves failed to identify them. Some said they were *kemi*, a Hmong term for the alleged chemical warfare agent.

Our conclusion that yellow rain is probably the faeces of honeybees and not a chemical warfare agent is thus supported by Hmong accounts of its appearance by pollen analysis, and by observations of the behaviour of honeybees in south-east Asia.

Studies of the yellow rain phenomenon in several countries, particularly in government laboratories, have still to be made public. It is to be hoped that the responsible officials will make every reasonable effort to move further investigation of this problem into the normal channels of scientific communication.

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