

Re: Spliceosomal introns

Source: <http://sci.tech--archive.net/Archive/sci.bio.evolution/2006-02/msg00456.html>

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 - *Date:* Sun, 19 Feb 2006 19:33:16 -0500 (EST)
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Those interested in possible functions for at least some junk and those interested in alternative splicing will probably find much of interest here. Available free online with registration. I, unfortunately, haven't read it yet, ...

<http://www.nature.com/nrg/journal/v7/n3/abs/nrg1807.html>

Review
Nature Reviews Genetics 7, 211-221 (March 2006)

The evolution of spliceosomal introns: patterns, puzzles and progress
Scott William Roy and Walter Gilbert

I've read it now. Interesting indeed. Much of the review is dedicated to the 'introns early' (IE) vs 'introns late' (IL) debate. Did this class of introns exist in the Eukaryote common ancestor (and perhaps even earlier, in the LUCA) or did introns only appear later in Eukaryote evolution? If IE is true, then a lot of introns have been lost in some lineages. If IL is true, then a lot of introns have been gained.

Well, the answer that Gilbert and Roy give is that there has been massive gain AND loss. Some introns appeared early and were already there in the ur-Eukaryote; others have appeared much more recently.

Gilbert seems to think that there is still some life in the idea of exons = domains. Apparently, if you look just at the class of introns which seem to be most ancient, there is a strong tendency for such introns to cleanly separate codons, and even to cleanly separate protein domains. But the correlation is not so good for the more recently introduced introns. Old theories never die. Well, in any case, this theory and Gilbert himself are probably good for at least a few more years.

Re: Spliceosomal introns

Box 1 of the review lists some "selective forces that might favor introns". At the risk of convincing Larry Moran that I am an incorrigible adaptationist, I would like to add one more speculative hypothesis to that list.

I suggest that the function of introns is to convert nucleotide triphosphates (NTPs) to single stranded RNA and pyrophosphate (PP). And since the extra useless single stranded RNA is fairly quickly hydrolysed down to nucleotide monophosphates, and since the PP is very quickly hydrolysed to P + P, it can be seen that the net effect of having introns is to catalyze the reaction

$NTP \rightarrow NMP + P + P$

It is that simple. ;-)

Well, explaining why this dissipation of the 'high energy phosphate potential' might be advantageous may not be so simple. I am assuming here that the intron transcripts are not exported from the nucleus, but rather are degraded in place by a ribonuclease. What I have described is a futile cycle. It is well known that futile cycles waste energy, but it is less widely appreciated that they sometimes increase the precision of metabolic regulation. Some futile cycles, used in moderation, are adaptations.

I claim that introns are common in Eukaryotes because Eukaryotes have a nucleus. Furthermore, in multi-cellular Eukaryotes, the total level of transcription and the relative usage of particular bases in the transcript may vary widely between cell types within a species. Also, I point out that for transcription to operate accurately, it is important that a whole variety of ratios be held relatively constant. Ratios of each of the four NTP/NMP. Ratios among the four nucleotide species. Electrolyte ratios between nucleoplasm and cytoplasm.

I won't go into details. In fact, I haven't worked out the details. In fact, I probably wouldn't understand the details if they were explained to me. ;-) But I will point out that confirming or refuting evidence for this hypothesis may be found by looking for positive or negative correlations between the base content of introns and exons expressed in different types of cells.

Just an idea.

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