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Immune System: Not So Superior

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In his news focus story “on the origin of the immune system” (1 May, p. 580), J. Travis nicely lays out some of the issues surrounding the evolution of the adaptive immune system, particularly the biologically novel VDJ recombination process. The selective advantage of the adaptive immune system is, however, not at all clear. Citing the view of “many immunologists,” Travis describes the notion that the adaptive immune system allowed more complex organisms to deal with more complex threats. He also cites Craig Thompson’s suggestion that the adaptive immune system conserves resources, implying that the innate immune system is more resource intensive. These arguments fail by simple inspection. Whatever organismal complexity means, there is no evidence that invertebrates are less complex than gnathosomes or agnatha (which has its own version of adaptive immunity). On the issue of resource intensity, as T. Pradeu points out in his reply (“Immune system: ‘Big Bang’ in question,” Letters, 24 July, p. 393), the adaptive immune system never works on its own; it is activated first by an intensive innate response. In addition, adaptive immunity further amplifies innate reactions. An equally likely possibility is thus the adaptive immune response, with its high rate of cellular expansion and contraction, is actually more resource intensive. In any event, neither of these conjectures has been supported by experimentation.

The underlying theme of the Travis news story as well as the reply by A. M. Silverstein (“Immune system: Promethean evolution,” Letters, 24 July, p. 393) is that the adaptive immune system is somehow a great advance (“Big Bang”) in the evolution of free-living organisms. Proponents of this view would thus be obliged to show that gnathosomes have a reduced incidence of mortality associated with disease, but I know of no such evidence. In fact, invertebrates are plagued by many of the same families of viruses, bacteria, and protists as vertebrates, and yet they do not exhibit high mortality rates due to infection nor do their populations collapse under the weight of parasitism. In fact, the immune system may be the cause of its own necessity (1). Incremental immune evolution surely confers a selective advantage, but such an advantage is quickly countered by the more facile evolution of thousands of parasitic agents. Over eons, there has grown an immune appendage that is nonetheless unable to decrease the overall burden of parasitism. This principle was described by van Valen as “The Red Queen Hypothesis” (2).

The notion that the immune system plays the bouncer, raising the velvet rope for beneficial bacteria and giving attitude to their less desirable brethren, was taken one step further by Margaret McFall-Ngai. She proposed that the adaptive immune system evolved, in part, to recognize and manage complex communities of beneficial microbes living on or in vertebrates (3). In summary, comparative genomics has shown various components of the immune system to be under continuous positive selection, and yet we cannot assume we know the basis for this selective pressure (4).

References

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