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Unannotated Bibliography on the Evolutionary Origin of the Immune System

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Sections:

Introduction

This webpage contains contains a bibliography of 357 references specifically on the evolutionary origin of the immune system. This list includes the 70 or so

Some simple statistics will also be used to describe the collection.

How the list was assembled

This list was assembled over several months. Beginning with the annotated bibliography, articles were added to this collection if they were cited an informative way in an article in the evolutionary immunology literature, and if they appeared to be directly on or directly relevant to the evolutionary origins of immune systems. For example, Hiom et al. (1998), unintentionally neglected in the annotated bibliography, is repeatedly referenced in the evolutionary immunology literature. Other articles were included as they were gradually discovered in reference lists and database searches, based on an inspection of the title and/or abstract.

The references that were collected fell into several main groups:

1. Articles published after the *Kitzmiller* case
2. Articles repeatedly referenced by immunologists in the annotated bibliography
3. Articles by noted evolutionary immunologists that had evolutionary content upon inspection
4. Articles picked up in "Related Articles" searches on PubMed, starting with articles in the annotated bibliography
5. A few relevant books and book chapters that were discovered or rediscovered after the annotated bibliography was assembled

Many of the articles in this collection have not been looked up, but the chances of "false positives" should be quite low, as the evolutionary relevance is usually made clear by the title and abstract, or by repeated citation in the literature.

Although this list of publications is much longer, it still cannot be considered

1. The collection is still biased towards adaptive immunity and V(D)J recombination, although a great deal more comparative immunology has been included.
2. The collection is biased towards authors found in the annotated bibliography.
3. The collection exhibits a "pull of the recent", as recent articles are more likely to be accessible, more likely to be cited, and more likely to be listed in online databases.
4. Like the annotated bibliography, this collection is biased towards review literature rather than research literature.

Nevertheless, some interesting features emerge when the bibliography is analyzed quantitatively. In 1996, Michael Behe claimed that a thorough search of the scientific literature showed that the evolutionary emperor had no clothes. About the evolution of irreducibly complex systems in general, Behe wrote,

> *There is no publication in the scientific literature -- in prestigious journals, specialty journals, or books -- that describes how molecular evolution of any real, complex, biochemical system either did occur or even might have occurred." (Darwin's Black Box, p. 185)*

This was in a chapter boldly entitled "Publish or Perish," which contains section headings like "The Missing Papers" and "Searching High and Low." Behe made a great show of searching biochemistry textbooks, the university library, and the journals, especially a detailed search through the *Journal of Molecular Evolution*, which occupies four pages of *Darwin's Black Box* (pp. 173-177). On p. 179, Behe wrote,

evolution of complex biochemical systems."

Behe's famous assertions about the evolutionary immune system literature were quoted in the annotated bibliography, but it is also worth noting that Behe cited a grand total of *five* publications on evolutionary immunology in the entire immune system chapter of *Darwin's Black Box*. They have been marked with an asterisk (*) for the reader's convenience. In his new afterword to the tenth anniversiary edition of *Darwin's Black Box*, Behe cited exactly *one* additional immune system paper, Klein and Nikolaidis (2005), also marked with an asterisk in this list. Behe completely misses the point of the article, which is discussed in the annotated bibliography. Behe's critique consists of, first, trumpeting the mere fact that the the authors use words like "probably", as if such qualifiers were not found in virtually every careful scientific publication. Apart from Behe, this juvenile tactic is only commonly found among the least sophisticated internet creationists. Second, Behe doesn't find enough mentions of the words he thinks he should find, cognates of "Darwin", "natural selection", and "mutation" -- Behe made this same trivial critique of several immune system articles at trial, and the problems with it were exposed in short order during Rothschild's cross-examination. Here, we can add that Behe's problem is that the immune system literature is too advanced for him -- general "mutations" are not discussed so much as the *specific kinds* of mutations relevant to the origin of the immune system, such as -- wait for it -- *transposition*. Regarding natural selection, entire articles, indeed entire careers (see articles by Cohn, Gould, etc.) have been devoted to studying, and often mathematically modeling, the selection forces that lead to immune systems, the diversity of immune system receptor genes, and the ways that various specific hypotheses can be tested by examining substitution ratios and other evidence. Behe seems to assume that if the first random article he reads doesn't start completely from scratch and educate him personally about everything going on in research labs across the country, then the article is worthless. The reality, on the other hand, is that any article

Finally, Behe says that Klein and Nikolaidis admit themselves that this immune system evolution stuff is just speculation, because they suggest some experiments that have not yet been done, and without them "their scenario would 'remain hopelessly in the realm of mere speculations.'" But let's look at the actual concluding paragraph of the article:

> *The agnathan [jawless fish] genomes should bear witness to how close they have come to acquiring the AIS [Adaptive Immune System]. The closeness can be determined experimentally in two ways: by introducing agnathan genes into the gnathostome [jawed vertebrate] genome or the other way around. It should be possible to determine which changes are necessary for agnathan genes, such as the PSMB, ATP-binding cassette transporter, or CD45, to replace the functions of their gnathostome counterparts. In the opposite direction, introducing gnathostome genes such MHC, BCR, or RAG, into agnathan cells or animals should reveal to what extent the cells' or animals' physiology is "ready" for some of the functions associated with the AIS. Extant agnathans are, of course, evolutionarily far away from the agnathan-gnathostome ancestors, but this kind of experimental molecular evolution should nevertheless shed light on events that would otherwise remain hopelessly in the realm of mere speculations. (Klein and Nikolaidis, 2005, p. 174)*

In context, it is clear that what the authors consider "speculation" is the detail of exactly how close the agnathan genome is to acquiring an adaptive immune system. In figure 2, the authors show that agnathans, which lack the adaptive immune system, nevertheless have 12 of the 16 key components of adaptive immunity that the authors identify, and in the conclusion the authors are simply wondering what would happen if a few more key components of the adaptive immune system were introduced into agnathans. Strangely, Behe doesn't take

and therefore "cannot be produced gradually" because "it would have to arise as an integrated unit, in one fell swoop, for natural selection to have anything to act on" (Behe 1996, p. 39).

Regardless, Behe writes on p. 270 of his afterword,

> *Today the situation remains unchanged from what it was ten years ago. As I wrote in Chapter 8:*
>
> > *There is no publication in the scientific literature -- in prestigious journals, specialty journals, or books -- that describes how molecular evolution of any real, complex, biochemical system either did occur or even might have occurred. There are assertions that such evolution occurred, but absolutely none are supported by pertinent experiments or calculations.*
>
> *(Behe 2006, p. 270)*

With this in mind, let us examine the bibliography.

Quantitative Description

This bibliography contains 357 articles, books, and book chapters. Counting up the page numbers in the citations yields about 4,700 pages of material, not including the books which would total another few thousand pages. The citations have been arranged chronologically and alphabetically

The number of articles in the bibliography published in each year since 1962 is plotted in the below graph. The number for 2006 was estimated by multiplying by three the number of articles available as of April 2006.

Number of publications per year found in this bibliography. Keeping in mind that the bibliography is probably biased against older articles, the general trend is still suggestive of a rapidly growing research field. The vertical dotted line represents the publication of Behe's 1996 book *Darwin's Black Box*

The bibliography was divided into two periods, the 34 year period from 1962-1995, and the 11 year period from 1996-2006. *Darwin's Black Box* was published in early 1996, and it can be seen that this bibliography contains 150 articles on evolutionary immunology published before that date. This is 39% of the collection. This seems to substantially weaken Behe's 1996 claims about the scientific literature. From 1996-2006, a further 236 articles were published, or 61% of the collection. This seems to contradict Behe's re-assertions of his claims in the 2006 edition of *Darwin's Black Box*.

By Author

The authorship of the articles can also be quantified. Academics know that every academic has a specialty, and that in order to be conversant in a particular field you simply must be familiar with the research and publications of the key people in that subfield. This bibliography contains 192 different first authors, and hundreds of additional secondary authors. Who are some of the leaders in evolutionary immunology? The top ten first authors in the bibliography are listed below, along with the number of times each of these researchers appears as an

Author	No. articles (first author)	No. articles (any author)
Gary Litman	22	49
John Marchalonis	21	38
Martin Flajnik	13	23
Louis Du Pasquier	12	19
Masaru Nonaka	11	22
L. William Clem	7	14
Sir Frank Macfarlane Burnet	6	6
David Schatz	5	9
J. Oriol Sunyer	5	7
Melvin Cohn	4	6

The top ten first authors in the bibliography. The number of publications in the bibliography that they have first-authored, or coauthored in any fashion, is listed. All of these authors have written many more articles than just the ones listed here; see their linked webpages for publication lists and research descriptions. E.g., Martin Flajnik, "My work is centered on the evolution of the immune system, with the major goal being to understand the origins of adaptive immunity...."

Although the top ten authors constitute only 5.2% of the first authors in this bibliography, they have first-authored 106 (30%) of the articles. Counting articles on which the top ten have been an author in any position, including first, they have coauthored *over half* of the articles in the bibliography (193, or 52%).

At this juncture, readers should ask themselves: has the ID movement grappled with the work of *any* of these researchers? Is the ID movement simply hoping that they can keep their supporters ignorant that numerous researchers are, daily, doing the work that the ID movement says doesn't exist? If the reader has followed the "intelligent design" movement for a substantial length of time, but has never heard of these researchers or their work, they should ask themselves if

By Journal

The top ten journals in the bibliography can be tabulated in a similar fashion:

Journal	No. articles
Proceedings of the National Academy of Sciences	27
Developmental and Comparative Immunology	25
Immunological Reviews	23
Journal of Immunology	21
Nature	20
Cell	12
Journal of Experimental Medicine	10
Immunogenetics	9
Molecular Immunology	8
Science	7

The top ten journals in the bibliography. The number of publications in the bibliography that they have appeared in each journal is listed. The top ten journals account for 162 articles, or 45% of the publications in the bibliography.

It is evident that the top ten journals in the list fall into two categories. First, immunology journals read by immunologists. This is not surprising, although it may surprise the reader to know that there is a whole journal devoted to comparative immunology. Of the publications listed in this bibliography, 192 (54%) are published in journals or books with a cognate of "immunity" in the title, while the rest are in a wide array of more general biology and science publications.

The second category found in the top ten list, of course, is prestigious general science journals (*Nature*, *Science*, *PNAS*, or the more specialized *Cell*, the most prestigious journal in cell biology). The ID movement would kill for just one ID publication in any one of these journals.

searching for evolution articles, has *only one* publication in this *entire* bibliography. Behe pretends that the *Journal of Molecular Evolution* must be the primary place one would look for the kinds of articles that he seeks -- after all, "molecular evolution" is right there in the title! But if one understands the subtleties of academic tradition, one realizes that *JME* has tended to focus on slightly different topics such as gene phylogenies and molecular clocks. It is not necessarily the journal one would go to for everything involving evolution for any system, especially when fields like immunology have a set of their own journals, and save the really revolutionary stuff for *Science* and *Nature*.

The Implications

In the new afterword to *Darwin's Black Box*, Behe told his readers what should be expected "at an absolute minimum" for research on the evolutionary origin of the eukaryotic cilium:

> *It would take at least as much work to figure out how such a structure could evolve by random mutation and natural selection as it did to figure out how it works in the first place. At an absolute minimum that would be expected to result in hundreds of papers -- both theoretical and experimental -- many reviews, books, meetings, and more, all devoted to the question of how such an intricate structure could have evolved in a Darwinian fashion. (Darwin's Black Box, 2006, p. 267)*

Admittedly, this level of research has not been conducted on the evolutionary origin of the cilium yet. Although Behe claims the cilium is well understood because the basic mechanism of microtubule sliding is understood, it is actually still a deeply mysterious structure, fundamentally tied to the centriole and the

blatant contradiction between Behe's lax scientific standards for understanding current cell biology -- on the cilium, he basically says, "The microtubules slide past each other, what else is there to know?" -- and his ridiculous scientific standards for evolution -- basically, "Give me every single mutation and selection pressure in every lineage over the last billion years" -- will have to be explored in more detail elsewhere. Also saved for later is the question of where exactly the ID movement's hundreds of papers are that give detailed accounts of the ID explanation for the cilium, the immune system, etc.

Although there are not hundreds of papers, meetings, books, etc., on cilium evolution, the point of these webpages is -- as the reader has already guessed -- that evolutionary immunology *does* have this level of research behind it. Will the ID movement ever admit it, or will they just continue to brazenly dismiss the work of hundreds of scientists as "speculation"? Time will tell. In the meantime, unsupported statements about the lack of scientific literature on the evolution of irreducibly complex systems -- even statements from seemingly authoritative sources -- must be treated with skepticism (the ID movement has a small handful of quotes from respected scientists that they wield like talismans against criticism, but there is no evidence that these authorities have any particular familiarity with evolutionary immunology).

Full Bibliography: Alphabetical

1. Adelman, M. K., Schluter, S. F. and Marchalonis, J. J. (2004). "The natural antibody repertoire of sharks and humans recognizes the potential universe of antigens." *Protein Journal* 23(2): 103-118. (Google Scholar | PubMed)

2. Agrawal, A., Eastman, Q. M. and Schatz, D. G. (1998). "Transposition mediated by RAG1 and RAG2 and its implications for the evolution of the

3. Alder, M. N., Rogozin, I. B., Iyer, L. M., Glazko, G. V., Cooper, M. D. and Pancer, Z. (2005). "Diversity and function of adaptive immune receptors in a jawless vertebrate." *Science* 310(5756): 1970-1973. (PubMed)

4. Al-Sharif, W. Z., Sunyer, J. O., Lambris, J. D. and Smith, L. C. (1998). "Sea urchin coelomocytes specifically express a homologue of the complement component C3." *Journal of Immunology* 160(6): 2983-2997. (PubMed)

5. Altmann, S. M., Mellon, M. T., Distel, D. L. and Kim, C. H. (2003). "Molecular and functional analysis of an interferon gene from the zebrafish, Danio rerio." *Journal of Virology* 77(3): 1992-2002. (PubMed)

6. Amemiya, C. T. and Litman, G. W. (1990). "Complete nucleotide sequence of an immunoglobulin heavy-chain gene and analysis of immunoglobulin gene organization in a primitive teleost species." *Proceedings of the National Academy of Sciences* 87(2): 811-815. (PubMed)

7. Amemiya, C. T., Ohta, Y., Litman, R. T., Rast, J. P., Haire, R. N. and Litman, G. W. (1993). "VH gene organization in a relict species, the coelacanth Latimeria chalumnae: evolutionary implications." *Proceedings of the National Academy of Sciences* 90(14): 6661-6665. (PubMed)

8. Anderson, M. K., Pant, R., Miracle, A. L., Sun, X., Luer, C. A., Walsh, C. J., Telfer, J. C., Litman, G. W. and Rothenberg, E. V. (2004). "Evolutionary origins of lymphocytes: ensembles of T cell and B cell transcriptional regulators in a cartilaginous fish." *Journal of Immunology* 172(10): 5851-5860. (PubMed)

9. Anonymous (1971). "A Wise Cell Knows Which its Parent." *Nature* 232(5308): 219-220. (DOI | Journal)

10. Armstrong, P. B. and Quigley, J. P. (1999). "Alpha2-macroglobulin: an

11. Azumi, K., De Santis, R., De Tomaso, A., Rigoutsos, I., Yoshizaki, F., Pinto, M. R., Marino, R., Shida, K., Ikeda, M., Arai, M., Inoue, Y., Shimizu, T., Satoh, N., Rokhsar, D. S., Du Pasquier, L., Kasahara, M., Satake, M. and Nonaka, M. (2003). "Genomic analysis of immunity in a Urochordate and the emergence of the vertebrate immune system: "waiting for Godot"." *Immunogenetics* 55(8): 570-581. (PubMed)

12. Banerjee-Basu, S. and Baxevanis, A. D. (2002). "The DNA-binding region of RAG 1 is not a homeodomain." *Genome Biology* 3(8): interactions1004.1001-1004.1004. (DOI | Journal | PubMed)

13. Bang, D. D., Verhage, R., Goosen, N., Brouwer, J. and van de Putte, P. (1992). "Molecular cloning of RAD16, a gene involved in differential repair in Saccharomyces cerevisiae." *Nucleic Acids Research* 20(15): 3925-3931. (PubMed)

14.* Bartl, S., Baltimore, D. and Weissman, I. L. (1994). "Molecular evolution of the vertebrate immune system." *Proceedings of the National Academy of Sciences* 91(23): 10769-10770. (Google Scholar | Journal | JSTOR | PubMed)

15. Bartl, S., Miracle, A. L., Rumfelt, L. L., Kepler, T. B., Mochon, E., Litman, G. W. and Flajnik, M. F. (2003). "Terminal deoxynucleotidyl transferases from elasmobranchs reveal structural conservation within vertebrates." *Immunogenetics* 55(9): 594-604. (PubMed)

16. Beck, G., Cooper, E. L., Habicht, G. S. and Marchalonis, J. J., eds. (1994). *Primordial Immunity: Foundations for the Vertebrate Immune System*. New York, The New York Academy of Sciences. (Library | PubMed | Publisher | Amazon | Google Print)

17. Beck, G., Ellis, T. W., Habicht, G. S., Schluter, S. F. and Marchalonis, J. J.

(PubMed)

18. Beck, G. and Habicht, G. S. (1996). "Immunity and the invertebrates." *Scientific American* 275(5): 60-63, 66. (Journal)

19. Belov, K., Deakin, J. E., Papenfuss, A. T., Baker, M. L., Melman, S. D., Siddle, H. V., Gouin, N., Goode, D. L., Sargeant, T. J., Robinson, M. D., Wakefield, M. J., Mahony, S., Cross, J. G., Benos, P. V., Samollow, P. B., Speed, T. P., Graves, J. A. and Miller, R. D. (2006). "Reconstructing an Ancestral Mammalian Immune Supercomplex from a Marsupial Major Histocompatibility Complex." *PLoS Biology* 4(3): e46. (PubMed)

20. Bernstein, R. M., Schluter, S. F., Bernstein, H. and Marchalonis, J. J. (1996). "Primordial emergence of the recombination activating gene 1 (RAG1): Sequence of the complete shark gene indicates homology to microbial integrases." *Proceedings of the National Academy of Sciences* 93(18): 9454-9459. (Google Scholar | Journal | JSTOR | PubMed)

21. Berstein, R. M., Schluter, S. F., Shen, S. and Marchalonis, J. J. (1996). "A new high molecular weight immunoglobulin class from the carcharhine shark: implications for the properties of the primordial immunoglobulin." *Proceedings of the National Academy of Sciences* 93(8): 3289-3293. (PubMed)

22. Boehm, T. (2006). "Co-evolution of a primordial peptide-presentation system and cellular immunity." *Nature Reviews Immunology* 6(1): 79-84. (DOI | Journal | PubMed)

23. Burnet, F. M. (1963). "The Evolution of Bodily Defence." *Medical Journal of Australia* 15: 817-821. (PubMed)

25. Burnet, F. M. (1969). "The evolution of adaptive immunity in vertebrates." *Acta Pathologica, Microbiologica et Immunologica Scandinavica* 76(1): 1-11. (PubMed)

26. Burnet, F. M. (1970). "A certain symmetry: histocompatibility antigens compared with immunocyte receptors." *Nature* 226(5241): 123-126. (DOI | Journal | PubMed)

27. Burnet, F. M. (1971). "Self-recognition in colonial marine forms and flowering plants in relation to the evolution of immunity." *Nature* 232(5308): 230-235. (Google Scholar | DOI | Journal | PubMed)

28. Burnet, F. M. (1973). "Multiple polymorphism in relation to histocompatibility antigens." *Nature* 245(5425): 359-361. (DOI | Journal | PubMed)

29. Butler, J. E. (1997). "Immunoglobulin gene organization and the mechanism of repertoire development." *Scandinavian Journal of Immunology* 45(5): 455-462. (PubMed)

30. Cannon, J. P., Haire, R. N. and Litman, G. W. (2002). "Identification of diversified genes that contain immunoglobulin-like variable regions in a protochordate." *Nature Immunology* 3(12): 1200-1207. (Google Scholar | DOI | Journal | PubMed)

31. Cannon, J. P., Haire, R. N., Pancer, Z., Mueller, M. G., Skapura, D., Cooper, M. D. and Litman, G. W. (2005). "Variable Domains and a VpreB-like molecule are present in a jawless vertebrate." *Immunogenetics* 56(12): 924-929. (Google Scholar | DOI | Journal | PubMed)

32. Cannon, J. P., Haire, R. N., Rast, J. P. and Litman, G. W. (2004). "The

33. Chartrand, S. L., Litman, G. W., Lapointe, N., Good, R. A. and Frommel, D. (1971). "The evolution of the immune response. 12. The immunoglobulins of the turtle. Molecular requirements for biologic activity of 5." *Journal of Immunology* 107(1): 1-11. (PubMed)

34. Chu, T. W., Capossela, A., Coleman, R., Goei, V. L., Nallur, G. and Gruen, J. R. (1995). "Cloning of a new "finger" protein gene (ZNF173) within the class I region of the human MHC." *Genomics* 29(1): 229-239. (PubMed)

35. Clatworthy, A. E., Valencia, M. A., Haber, J. E. and Oettinger, M. A. (2003). "V(D)J recombination and RAG-mediated transposition in yeast." *Molecular Cell* 12(2): 489-499. (Google Scholar | DOI | Journal | PubMed)

36. Clawson, C. C., Finstad, J. and Good, R. A. (1966). "Evolution of the immune response. 5. Electron microscopy of plasma cells and lymphoid tissue of the paddlefish." *Laboratory Investigation; a journal of technical methods and pathology* 15(12): 1830-1847. (PubMed)

37. Clem, I. W., De Boutaud, F. and Sigel, M. M. (1967). "Phylogeny of immunoglobulin structure and function. II. Immunoglobulins of the nurse shark." *Journal of Immunology* 99(6): 1226-1235. (PubMed)

38. Clem, L. W. (1971). "Phylogeny of immunoglobulin structure and function. IV. Immunoglobulins of the giant grouper, Epinephelus itaira." *Journal of Biological Chemistry* 246(1): 9-15. (PubMed)

39. Clem, L. W. and Leslie, G. A. (1982). "Phylogeny of immunoglobulin structure and function. XIV. Peptide map and amino acid composition studies of shark antibody light chains." *Developmental and Comparative Immunology* 6(2): 263-269. (PubMed)

Developmental and Comparative Immunology 6(3): 463-472. (PubMed)

41. Clem, L. W. and McLean, W. E. (1975). "Phylogeny of immunoglobulin structure and function. VII. Monomeric and tetrameric immunoglobulins of the margate, a marine teleost fish." *Immunology* 29(4): 791-799. (PubMed)

42. Clem, L. W. and Small, P. A., Jr. (1967). "Phylogeny of immunoglobulin structure and function. I. Immunoglobulins of the lemon shark." *Journal of Experimental Medicine* 125(5): 893-920. (PubMed)

43. Clem, L. W. and Small, P. A., Jr. (1970). "Phylogeny of immunoglobulin structure and function. V. Valences and association constants of teleost antibodies to a haptenic determinant." *Journal of Experimental Medicine* 132(3): 385-400. (PubMed)

44. Cohn, M. (1998). "At the feet of the master: the search for universalities. Divining the evolutionary selection pressures that resulted in an immune system." *Cytogenetics and Cell Genetics* 80(1-4): 54-60. (DOI | Journal | PubMed)

45. Cohn, M. (2002). "The immune system: a weapon of mass destruction invented by evolution to even the odds during the war of the DNAs." *Immunological Reviews* 185: 24-38. (PubMed)

46. Cohn, M. (2005). "The common sense of the self-nonself discrimination." *Springer Seminars in Immunopathology* 27(1): 3-17. (PubMed)

47. Cohn, M. (2006). "What are the commonalities governing the behavior of humoral immune recognitive repertoires?" *Developmental and Comparative Immunology* 30(1-2): 19-42. (Google Scholar | DOI | Journal | PubMed)

49. Czompoly, T., Olasz, K., Simon, D., Nyarady, Z., Palinkas, L., Czirjak, L., Berki, T. and Nemeth, P. (2005). "A possible new bridge between innate and adaptive immunity: Are the anti-mitochondrial citrate synthase autoantibodies components of the natural antibody network?" *Molecular Immunology*. (PubMed)

50. Danilova, N. (2006). "The evolution of immune mechanisms." *Journal of Experimental Zoology, Part B: Molecular and Developmental Evolution*. (Google Scholar | DOI | Journal | PubMed)

51. Davidson, E. H. (1994). "Stepwise Evolution of Major Functional Systems in Vertebrates, Including the Immune System." *Phylogenetic Perspectives in Immunity: The Insect Host Defense*. Edited by J. A. Hoffman, C. A. Janeway and S. Natori. Austin, R.G. Landes Company: 133-142. (Library | Amazon | Google Print)

52. Davis, M. M. (2004). "The evolutionary and structural 'logic' of antigen receptor diversity." *Seminars in Immunology* 16: 239-243. (Google Scholar | DOI | Journal | PubMed)

53. De Gregorio, E., Spellman, P. T., Rubin, G. M. and Lemaitre, B. (2001). "Genome-wide analysis of the Drosophila immune response by using oligonucleotide microarrays." *Proceedings of the National Academy of Sciences* 98(22): 12590-12595. (PubMed)

54. De Tomaso, A. W., Nyholm, S. V., Palmeri, K. J., Ishizuka, K. J., Ludington, W. B., Mitchel, K. and Weissman, I. L. (2005). "Isolation and characterization of a protochordate histocompatibility locus." *Nature* 438(7067): 454-459. (DOI | Journal | PubMed)

Immunology 8(7): 525-530. (PubMed)

56. Diaz, M. and Flajnik, M. F. (1998). "Evolution of somatic hypermutation and gene conversion in adaptive immunity." *Immunological Reviews* 162: 13-24. (PubMed)

57. Difilippantonio, M. J., McMahan, C. J., Eastman, Q. M., Spanopoulou, E. and Schatz, D. G. (1996). "RAG1 mediates signal sequence recognition and recruitment of RAG2 in V(D)J recombination." *Cell* 87(2): 253-262. (PubMed)

58. Dodds, A. W. (1994). "Molecular and Phylogenetic Aspects of the Complement System." *Phylogenetic Perspectives in Immunity: The Insect Host Defense*. Edited by J. A. Hoffman, C. A. Janeway and S. Natori. Austin, R.G. Landes Company: 143-155. (Library | Amazon | Google Print)

59. Dodds, A. W. and Law, S. K. (1998). "The phylogeny and evolution of the thioester bond-containing proteins C3, C4 and alpha 2-macroglobulin." *Immunological Reviews* 166: 15-26. (PubMed)

60. dos Remedios, N. J., Ramsland, P. A., Hook, J. W. and Raison, R. L. (1999). "Identification of a homologue of CD59 in a cyclostome: implications for the evolutionary development of the complement system." *Developmental and Comparative Immunology* 23(1): 1-14. (PubMed)

61. Dreyfus, D. H. (1992). "Evidence suggesting an evolutionary relationship between transposable elements and immune system recombination sequences." *Molecular Immunology* 29(6): 807-810. (Google Scholar | DOI | Journal | PubMed)

62. Du Pasquier, L. (1982). "Antibody diversity in lower vertebrates--why is it so restricted?" *Nature* 296(5855): 311-313. (PubMed)

100: 383. (Google Scholar)

64. Du Pasquier, L. (1993). "Phylogeny of B-cell development." *Current Opinion in Immunology* 5(2): 185-193. (PubMed)

65. Du Pasquier, L. (2000). "The Phylogenetic Origin of Antigen-Specific Receptors." *Origin and Evolution of the Vertebrate Immune System*. Edited by L. Du Pasquier and G. W. Litman. Berlin, Springer. 248: 159-185. (Library | PubMed | Amazon | Google Print)

66. Du Pasquier, L. (2001). "The immune system of invertebrates and vertebrates." *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology* 129(1): 1-15. (Google Scholar | DOI | Journal | PubMed)

67. Du Pasquier, L. (2002). "Several MHC-linked Ig superfamily genes have features of ancestral antigen-specific receptor genes." *Current Topics in Microbiology and Immunology* 266: 57-71. (PubMed)

68. Du Pasquier, L. (2004). "Speculations on the origin of the vertebrate immune system." *Immunology Letters* 92(1-2): 3-9. (PubMed)

69. Du Pasquier, L. (2005). "Germline and somatic diversification of immune recognition elements in Metazoa." *Immunology Letters*. (PubMed)

70. Du Pasquier, L. (2005). "Meeting the demand for innate and adaptive immunities during evolution." *Scandinavian Journal of Immunology* 62(s1): 39-48. (Google Scholar | DOI | Journal | PubMed)

71. Du Pasquier, L. and Litman, G. W., eds. (2000). *Origin and Evolution of the Vertebrate Immune System*. Current Topics in Microbiology and

"Somatic mutation in ectothermic vertebrates: musings on selection and origins." *Current Topics in Microbiology and Immunology* 229: 199-216. (PubMed)

73. Du Pasquier, L., Zucchetti, I. and De Santis, R. (2004). "Immunoglobulin superfamily receptors in protochordates: before RAG time." *Immunological Reviews* 198: 233-248. (PubMed)

74. Dunne, D. W. and Cooke, A. (2005). "A worm's eye view of the immune system: consequences for evolution of human autoimmune disease." *Nature Reviews Immunology* 5(5): 420-426. (PubMed)

75. Eason, D. D., Cannon, J. P., Haire, R. N., Rast, J. P., Ostrov, D. A. and Litman, G. W. (2004). "Mechanisms of antigen receptor evolution." *Seminars in Immunology* 16: 215-226. (Google Scholar | DOI | Journal | PubMed)

76.* Farries, T. C. and Atkinson, J. P. (1991). "Evolution of the complement system." *Immunology Today* 12(9): 295-300. (PubMed)

77. Farries, T. C., Steuer, K. L. and Atkinson, J. P. (1990). "Evolutionary implications of a new bypass activation pathway of the complement system." *Immunology Today* 11(3): 78-80. (PubMed)

78. Fearon, D. T. and Locksley, R. M. (1996). "The instructive role of innate immunity in the acquired immune response." *Science* 272(5258): 50-53. (JSTOR | PubMed)

79. Finstad, C. L., Litman, G. W., Finstad, J. and Good, R. A. (1972). "The evolution of the immune response. 13. The characterization of purified erythrocyte agglutinins from two invertebrate species." *Journal of Immunology* 108(6): 1704-1711. (PubMed)

Organized Lymphoid Tissue." *Laboratory Investigation; a journal of technical methods and pathology* 13: 490-512. (PubMed)

81. Flajnik M. (editor) (1998). "The immune systems of ectothermic vertebrates." *Immunological Reviews* 166: 1-384. (PubMed)

82. Flajnik, M. F. (1996). "The immune system of ectothermic vertebrates." *Veternary Immunology and Immunopathology* 54(1-4): 145-150. (PubMed)

83. Flajnik, M. F. (2002). "Comparative analyses of immunoglobulin genes: surprises and portents." *Nature Reviews Immunology* 2(9): 688-698. (Google Scholar | DOI | Journal | PubMed)

84. Flajnik, M. F. (2004). "Immunology: another manifestation of GOD." *Nature* 430(6996): 157-158. (Google Scholar | DOI | Journal | PubMed)

85. Flajnik, M. F., Canel, C., Kramer, J. and Kasahara, M. (1991). "Evolution of the major histocompatibility complex: molecular cloning of major histocompatibility complex class I from the amphibian Xenopus." *Proceedings of the National Academy of Sciences* 88(2): 537-541. (PubMed)

86. Flajnik, M. F., Canel, C., Kramer, J. and Kasahara, M. (1991). "Which came first, MHC class I or class II?" *Immunogenetics* 33(5-6): 295-300. (PubMed)

87. Flajnik, M. F. and Du Pasquier, L. (1990). "The major histocompatibility complex of frogs." *Immunological Reviews* 113: 47-63. (PubMed)

88. Flajnik, M. F. and Du Pasquier, L. (2004). "Evolution of innate and adaptive immunity: can we draw a line?" *Trends in Immunology* 25(12): 640-644. (Google Scholar | DOI | Journal | PubMed)

90. Flajnik, M. F., Miller, K. and Du Pasquier, L. (2003). "Evolution of the Immune System." *Fundamental Immunology*. Edited by W. E. Paul. Philadelphia, Lippincott Williams & Wilkins: 519-570. (Library | Amazon | Google Print)

91. Flajnik, M. F., Ohta, Y., Namikawa-Yamada, C. and Nonaka, M. (1999). "Insight into the primordial MHC from studies in ectothermic vertebrates." *Immunological Reviews* 167: 59-67. (PubMed)

92. Flajnik, M. F. and Rumfelt, L. L. (2000). "Early and natural antibodies in non-mammalian vertebrates." *Current Topics in Microbiology and Immunology* 252: 233-240. (PubMed)

93. Flajnik, M. F. and Rumfelt, L. L. (2000). "The immune system of cartilaginous fish." *Current Topics in Microbiology and Immunology* 248: 249-270. (PubMed)

94. Frommel, D., Litman, G. W., Chartrand, S. L., Seal, U. S. and Good, R. A. (1971). "Carbohydrate composition in the evolution of the immunoglobulins." *Immunochemistry* 8(6): 573-577. (PubMed)

95. Frommel, D., Litman, G. W., Finstad, J. and Good, R. A. (1971). "The evolution of the immune response. 11. The immunoglobulins of the horned shark, Heterodontus francisci: purification, characterization and structural requirement for antibody activity." *Journal of Immunology* 106(5): 1234-1243. (PubMed)

96. Fugmann, S. D., Messier, C., Novack, L. A., Cameron, R. A. and Rast, J. P. (2006). "An ancient evolutionary origin of the Rag1/2 gene locus." *Proceedings of the National Academy of Sciences* 103(10): 3728-3733. (DOI

role in innate immunity." *Nature Reviews Immunology* 2(5): 346-353. (PubMed)

98. Fujita, T., Endo, Y. and Nonaka, M. (2004). "Primitive complement system--recognition and activation." *Molecular Immunology* 41(2-3): 103-111. (PubMed)

99. Fujita, T., Matsushita, M. and Endo, Y. (2004). "The lectin-complement pathway--its role in innate immunity and evolution." *Immunological Reviews* 198: 185-202. (PubMed)

100. Galaktionov, V. G. (2004). "Evolutionary Development of the Immunoglobulin Family." *Biology Bulletin* 31(2): 101-111. (Google Scholar | DOI | Journal | PubMed)

101. Gellert, M. (1996). "A new view of V(D)J recombination." *Genes to Cells* 1(3): 269-275. (PubMed)

102. Gellert, M. (1997). "Recent advances in understanding V(D)J recombination." *Advances in Immunology* 64: 39-64. (PubMed)

103. Gellert, M. (2002). "V(D)J recombination: RAG proteins, repair factors, and regulation." *Annual Review of Biochemistry* 71: 101-132. (PubMed)

104. Gilbertson, P., Wotherspoon, J. and Raison, R. L. (1986). "Evolutionary development of lymphocyte heterogeneity: leucocyte subpopulations in the Pacific hagfish." *Developmental and Comparative Immunology* 10(1): 1-10. (PubMed)

105. Girardin, S. E. and Philpott, D. J. (2004). "Mini-review: the role of peptidoglycan recognition in innate immunity." *European Journal of*

Adaptive Immunity." *Advances in Immunology* 27: 1-115. (PubMed)

107. Gould, S. J., Hildreth, J. E. and Booth, A. M. (2004). "The evolution of alloimmunity and the genesis of adaptive immunity." *Quarterly Review of Biology* 79(4): 359-382. (Google Scholar | DOI | Journal | PubMed)

108. Greenberg, A. S., Avila, D., Hughes, M., Hughes, A., McKinney, E. C. and Flajnik, M. F. (2002). "A new antigen receptor gene family that undergoes rearrangement and extensive somatic diversification in sharks." *Nature* 374(6518): 168-173. (Google Scholar | DOI | Journal | PubMed)

109. Grosberg, R. K. and Hart, M. W. (2000). "Mate selection and the evolution of highly polymorphic self/nonself recognition genes." *Science* 289(5487): 2111-2114. (PubMed)

110. Gross, P. S., Al-Sharif, W. Z., Clow, L. A. and Smith, L. C. (1999). "Echinoderm immunity and the evolution of the complement system." *Developmental and Comparative Immunology* 23(4-5): 429-442. (PubMed)

111. Gross, P. S., Clow, L. A. and Smith, L. C. (2000). "SpC3, the complement homologue from the purple sea urchin, Strongylocentrotus purpuratus, is expressed in two subpopulations of the phagocytic coelomocytes." *Immunogenetics* 51(12): 1034-1044. (PubMed)

112. Grossberger, D., Marcuz, A., Du Pasquier, L. and Lambris, J. D. (1989). "Conservation of structural and functional domains in complement component C3 of Xenopus and mammals." *Proceedings of the National Academy of Sciences* 86(4): 1323-1327. (PubMed)

113. Hagmann, M. (1997). "RAGged repair: what's new in V(D)J recombination." *Biological Chemistry* 378(8): 815-819. (PubMed)

functional homology with mammalian complement components." *Proceedings of the National Academy of Sciences* 89(17): 7910-7914. (PubMed)

115. Hansen, J. D. and McBlane, J. F. (2000). "Recombination-Activating Genes, Transposition, and the Lymphoid-Specific Combinatorial Immune System: A Common Evolutionary Connection." *Origin and Evolution of the Vertebrate Immune System*. Edited by L. Du Pasquier and G. W. Litman. Berlin, Springer. 248: 111-135. (Library | PubMed | Amazon | Google Print)

116. Harding, F. A., Cohen, N. and Litman, G. W. (1990). "Immunoglobulin heavy chain gene organization and complexity in the skate, Raja erinacea." *Nucleic Acids Research* 18(4): 1015-1020. (PubMed)

117. Harvell, C. D. (1990). "The evolution of inducible defence." *Parasitology* 100 Suppl: S53-61. (PubMed)

118. Hassanin, A., Golub, R., Lewis, S. M. and Wu, G. E. (2000). "Evolution of the recombination signal sequences in the Ig heavy-chain variable region locus of mammals." *Proceedings of the National Academy of Sciences* 97(21): 11415-11420. (PubMed)

119. Haynes, M. R. and Wu, G. E. (2004). "Evolution of the variable gene segments and recombination signal sequences of the human T-cell receptor alpha/delta locus." *Immunogenetics* 56(7): 470-479. (PubMed)

120. Hendrickson, E. A., Qin, X. Q., Bump, E. A., Schatz, D. G., Oettinger, M. and Weaver, D. T. (1991). "A link between double-strand break-related repair and V(D)J recombination: the scid mutation." *Proceedings of the National Academy of Sciences* 88(10): 4061-4065. (PubMed)

122. Hildemann, W. H. and Reddy, A. L. (1973). "Phylogeny of immune responsiveness: marine invertebrates." *Federation Proceedings* 32(12): 2188-2194. (PubMed)

123. Hinds, K. R. and Litman, G. W. (1986). "Major reorganization of immunoglobulin VH segmental elements during vertebrate evolution." *Nature* 320(6062): 546-549. (PubMed)

124. Hinds-Frey, K. R., Nishikata, H., Litman, R. T. and Litman, G. W. (1993). "Somatic variation precedes extensive diversification of germline sequences and combinatorial joining in the evolution of immunoglobulin heavy chain diversity." *Journal of Experimental Medicine* 178(3): 815-824. (PubMed)

125. Hiom, K., Melek, M. and Gellert, M. (1998). "DNA transposition by the RAG1 and RAG2 proteins: a possible source of oncogenic translocations." *Cell* 94(4): 463-470. (Google Scholar | DOI | Journal | PubMed)

126. Hoffman, J. A., Janeway, C. A. and Natori, S., eds. (1994). *Phylogenetic Perspectives in Immunity: The Insect Host Defense*. Austin, R. G. Landes Company. (Library | Amazon | Google Print)

127. Hoffmann, J. A. (1995). "Innate immunity of insects." *Current Opinion in Immunology* 7(1): 4-10. (PubMed)

128. Hoffmann, J. A., Kafatos, F. C., Janeway, C. A. and Ezekowitz, R. A. (1999). "Phylogenetic perspectives in innate immunity." *Science* 284(5418): 1313-1318. (PubMed)

129. Hoffmann, J. A. and Reichhart, J. M. (2002). "Drosophila innate immunity: an evolutionary perspective." *Nature Immunology* 3(2): 121-126.

1269-1269. (Google Scholar | DOI | Journal | PubMed)

131. Hughes, A. L. and Yeager, M. (1997). "Molecular evolution of the vertebrate immune system." *BioEssays* 19(9): 777-786. (Google Scholar | PubMed)

132. Ishikawa, G., Azumi, K. and Yokosawa, H. (2000). "Involvement of tyrosine kinase and phosphatidylinositol 3-kinase in phagocytosis by ascidian hemocytes." *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology* 125(3): 351-357. (Journal | PubMed)

133. Iwanaga, S. and Kawabata, S. (1998). "Evolution and phylogeny of defense molecules associated with innate immunity in horseshoe crab." *Frontiers in Bioscience* 3: D973-984. (PubMed)

134. Iwanaga, S., Kawabata, S.-i., Miura, Y., Seki, N., Shigenaga, T. and Muta, T. (1994). "Clotting Cascade in the Immune Response of Horseshoe Crab." *Phylogenetic Perspectives in Immunity: The Insect Host Defense*. Edited by J. A. Hoffman, C. A. Janeway and S. Natori. Austin, R.G. Landes Company: 79-96. (Library | Amazon | Google Print)

135. Janssen, B. J. C., Huizinga1, E. G., Raaijmakers, H. C. A., Roos, A., Daha, M. R., Nilsson-Ekdahl, K., Nilsson, B. and Gros, P. (2005). "Structures of complement component C3 provide insights into the function and evolution of immunity." *Nature* 437(7058): 505-511. (Google Scholar | DOI | Journal | PubMed)

136. Ji, X., Azumi, K., Sasaki, M. and Nonaka, M. (1997). "Ancient origin of the complement lectin pathway revealed by molecular cloning of mannan binding protein-associated serine protease from a urochordate, the Japanese ascidian, Halocynthia roretzi." *Proceedings of the National*

137. Joly, E. (2006). "Various hypotheses on MHC evolution suggested by the concerted evolution of CD94L and MHC class Ia molecules." *Biology Direct* 1(1): 3. (Google Scholar | DOI | Journal | PubMed)

138. Joly, E. and Rouillon, V. (2006). "The orthology of HLA-E and H2-Qa1 is hidden by their concerted evolution with other MHC class I molecules." *Biology Direct* 1(1): 2. (Google Scholar | DOI | Journal | PubMed)

139. Jones, J. M. (2004). "The taming of a transposon: V(D)J recombination and the immune system." *Immunological Reviews* 200(1): 233-248. (Google Scholar | DOI | Journal | PubMed)

140. Kairies, N., Beisel, H. G., Fuentes-Prior, P., Tsuda, R., Muta, T., Iwanaga, S., Bode, W., Huber, R. and Kawabata, S. (2001). "The 2.0-A crystal structure of tachylectin 5A provides evidence for the common origin of the innate immunity and the blood coagulation systems." *Proceedings of the National Academy of Sciences* 98(24): 13519-13524. (PubMed)

141. Kapitonov, V. V. and Jurka, J. (2005). "RAG1 Core and V(D)J Recombination Signal Sequences Were Derived from Transib Transposons." *PLoS Biology* 3(6): e181:0001-0014. (Google Scholar | DOI | Journal | PubMed)

142. Kasahara, M., Flajnik, M. F., Ishibashi, T. and Natori, T. (1995). "Evolution of the major histocompatibility complex: a current overview." *Transplant Immunology* 3(1): 1-20. (PubMed)

143. Kasahara, M., McKinney, E. C., Flajnik, M. F. and Ishibashi, T. (1993). "The evolutionary origin of the major histocompatibility complex: polymorphism of class II alpha chain genes in the cartilaginous fish." *European Journal of Immunology* 23(9): 2160-2165. (PubMed)

X

blooded vertebrates." *Trends in Immunology* 25(2): 105-111. (PubMed)

145. Kasahara, M., Vazquez, M., Sato, K., McKinney, E. C. and Flajnik, M. F. (1992). "Evolution of the major histocompatibility complex: isolation of class II A cDNA clones from the cartilaginous fish." *Proceedings of the National Academy of Sciences* 89(15): 6688-6692. (PubMed)

146. Kaufman, J. (2002). "The origins of the adaptive immune system: whatever next?" *Nature Immunology* 3(12): 1124-1125. (Google Scholar | DOI | Journal | PubMed)

147. Kelsoe, G. and Schulze, D. H., eds. (1987). *Evolution and Vertebrate Immunity: The Antigen-Receptor and MHC Gene Families.* Austin, University of Texas Press. (Library | Amazon | Google Print)

148. Kennedy, A. K., Guhathakurta, A., Kleckner, N. and Haniford, D. B. (1998). "Tn10 transposition via a DNA hairpin intermediate." *Cell* 95(1): 125-134. (PubMed)

149. Khalturin, K., Panzer, Z., Cooper, M. D. and Bosch, T. C. (2004). "Recognition strategies in the innate immune system of ancestral chordates." *Molecular Immunology* 41(11): 1077-1087. (PubMed)

150. Kimbrell, D. A. and Beutler, B. (2001). "The evolution and genetics of innate immunity." *Nature Reviews Genetics* 2(4): 256-267. (PubMed)

151. Klapper, D. G. and Clem, L. W. (1977). "Phylogeny of immunoglobulin structure and function; characterization of the cysteine-containing peptide involved in the pentamerization of shark IgM." *Developmental and Comparative Immunology* 1(2): 81-91. (PubMed)

153. Klein, J. (1997). "Homology Between Immune Responses in Vertebrates and Invertebrates: Does it Exist?" *Scandinavian Journal of Immunology* 46(6): 558-564. (Google Scholar | Journal | PubMed)

154.* Klein, J. and Nikolaidis, N. (2005). "The descent of the antibody-based immune system by gradual evolution." *Proceedings of the National Academy of Sciences* 102(1): 169-174. (Google Scholar | DOI | Journal | PubMed)

155. Kokubu, F., Litman, R., Shamblott, M. J., Hinds, K. and Litman, G. W. (1988). "Diverse organization of immunoglobulin VH gene loci in a primitive vertebrate." *The EMBO Journal* 7(11): 3413-3422. (PubMed)

156. Krem, M. M. and Di Cera, E. (2002). "Evolution of enzyme cascades from embryonic development to blood coagulation." *Trends in Biochemical Sciences* 27(2): 67-74. (Google Scholar | DOI | Journal | PubMed)

157. Lachmann, P. J. (1998). "Microbial immunology: a new mechanism for immune subversion." *Current Biology* 8(3): R99-R101. (PubMed)

158. Lachmann, P. J. and Hobart, M. J. (1979). "The genetics of the complement system." *Ciba Foundation Symposium*(66): 231-250. (PubMed)

159. Laird, D. J. (2002). "Immune System." *Encyclopedia of Evolution*. Edited by M. Pagel. Oxford, Oxford University Press. 2: 558-564. (Library | Publisher | Amazon | Google Print)

160. Laird, D. J., De Tomaso, A. W., Cooper, M. D. and Weissman, I. L. (2000). "50 million years of chordate evolution: seeking the origins of adaptive immunity." *Proceedings of the National Academy of Sciences* 97(13): 6924-

guide our understanding of this complex biological defense system. San Diego, Academic Press, Inc.

162. Langman, R. E. and Cohn, M. (1992). "What is the selective pressure that maintains the gene loci encoding the antigen receptors of T and B cells? A hypothesis." *Immunology and Cell Biology* 70 (Pt 6): 397-404. (PubMed)

163. Langman, R. E. and Cohn, M. (2002). "If the immune repertoire evolved to be large, random, and somatically generated, then." *Cellular Immunology* 216(1-2): 15-22. (PubMed)

164. Lawlor, D. A., Zemmour, J., Ennis, P. D. and Parham, P. (1990). "Evolution of Class-I MHC Genes and Proteins: From Natural Selection to Thymic Selection." *Annual Review of Immunology* 8: 23-63. (DOI | Journal | PubMed)

165. Lee, S. S., Fitch, D., Flajnik, M. F. and Hsu, E. (2000). "Rearrangement of immunoglobulin genes in shark germ cells." *Journal of Experimental Medicine* 191(10): 1637-1648. (PubMed)

166. Leslie, G. A. and Clem, L. W. (1972). "Phylogeny of immunoglobulin structure and function. VI. 17S, 7.5S and 5.7S anti-DNP of the turtle, Pseudamys scripta." *Journal of Immunology* 108(6): 1656-1664. (PubMed)

167. Lewis, S. M. (1994). "The mechanism of V(D)J joining: lessons from molecular, immunological, and comparative analyses." *Advances in Immunology* 56: 27-150. (PubMed)

168. Lewis, S. M. (1999). "Evolution of Immunoglobulin and T-Cell Receptor Gene Assembly." *Annals of the New York Academy of Sciences* 870: 58-67.

Cell 88(2): 159-162. (Google Scholar | DOI | Journal | PubMed)

170. Lewis, S. M. and Wu, G. E. (2000). "The old and the restless." *Journal of Experimental Medicine* 191(10): 1631-1636. (Google Scholar | DOI | Journal | PubMed)

171. Liddington, R. and Bankston, L. (2005). "Structural biology: origins of chemical biodefence." *Nature* 437(7058): 484-485. (PubMed)

172. Lindstrom-Dinnetz, I., Sun, S. C. and Faye, I. (1995). "Structure and expression of Hemolin, an insect member of the immunoglobulin gene superfamily." *European Journal of Biochemistry* 230(3): 920-925. (PubMed)

173. Litman, G. W. (1975). "Relationship between structure and function of lower vertebrate immunoglobulins." *Advances in Experimental Medicine and Biology* 64: 217-228. (PubMed)

174. Litman, G. W. (1996). "Sharks and the origins of vertebrate immunity." *Scientific American* 275(5): 67-71. (Journal | PubMed)

175. Litman, G. W. (2005). "Histocompatibility: colonial match and mismatch." *Nature* 438(7067): 437-439. (DOI | Journal | PubMed)

176. Litman, G. W., Amemiya, C. T., Harding, F. A., Haire, R. N., Hinds, K. R., Litman, R. T., Ohta, Y., Shamblott, M. J. and Varner, J. A. (1991). "Evolutionary development of immunoglobulin gene diversity." *Advances in Experimental Medicine and Biology* 292: 11-17. (PubMed)

177. Litman, G. W., Anderson, M. K. and Rast, J. P. (1999). "Evolution of antigen binding receptors." *Annual Review of Immunology* 17: 109-147. (Google Scholar | DOI | Journal | PubMed)

Heterodontus, a phylogenetically primitive shark." *Proceedings of the National Academy of Sciences* 82(7): 2082-2086. (PubMed)

179. Litman, G. W., Berger, L., Murphy, K., Litman, R., Podlaski, F., Hinds, K., Jahn, C. L., Dingerkus, G. and Erickson, B. W. (1984). "Phylogenetic diversification of immunoglobulin VH genes." *Developmental and Comparative Immunology* 8(3): 499-514. (PubMed)

180. Litman, G. W., Cannon, J. P. and Dishaw, L. J. (2005). "Reconstructing immune phylogeny: new perspectives." *Nature Reviews Immunology* 5(11): 866-879. (PubMed)

181. Litman, G. W., Cannon, J. P. and Rast, J. P. (2005). "New insights into alternative mechanisms of immune receptor diversification." *Advances in Immunology* 87: 209-236. (PubMed)

182. Litman, G. W., Erickson, B. W., Lederman, L. and Makela, O. (1982). "Antibody response in Heterodontus." *Molecular and Cellular Biochemistry* 45(1): 49-57. (PubMed)

183. Litman, G. W., Finstad, F. J., Howell, J., Pollara, B. W. and God, R. A. (1970). "The evolution of the immune response. 3. Structural studies of the lamprey immuoglobulin." *Journal of Immunology* 105(5): 1278-1285. (PubMed)

184. Litman, G. W., Fromme, D., Chartrand, S. L., Finstad, J. and Good, R. A. (1971). "Significance of heavy chain mass and antigenic relationship in immunoglobulin evolution." *Immunochemistry* 8(4): 345-349. (PubMed)

185. Litman, G. W., Frommel, D., Finstad, J. and Good, R. A. (1971). "Evolution of the immune response. 10. Immunoglobulins of the bowfin: subunit

evolution of the immune reponse. 9. Immunoglobulins of the bowfin: purification and characterization." *Journal of Immunology* 106(3): 747-754. (PubMed)

187. Litman, G. W., Frommel, D., Rosenberg, A. and Good, R. A. (1971). "Circular dichroic analysis of immunoglobulins in phylogenetic perspective." *Biochimica et Biophysica Acta* 236(3): 647-654. (PubMed)

188. Litman, G. W., Haire, R. N., Hinds, K. R., Amemiya, C. T., Rast, J. P. and Hulst, M. (1992). "Evolutionary development of the B-cell repertoire." *Annals of the New York Academy of Sciences* 651: 360-368. (PubMed)

189. Litman, G. W., Hinds, K., Berger, L., Murphy, K. and Litman, R. (1985). "Structure and organization of immunoglobulin VH genes in Heterodontus, a phylogenetically primitive shark." *Developmental and Comparative Immunology* 9(4): 749-758. (PubMed)

190. Litman, G. W., Hinds, K. R., Litman, R. T. and Kokubu, F. (1987). "The early phylogenetic origin of antibody gene structure and function." *Progress in Clinical and Biological Research* 233: 1-11. (PubMed)

191. Litman, G. W., Rast, J. P., Shamblott, M. J., Haire, R. N., Hulst, M., Roess, W., Litman, R. T., Hinds-Frey, K. R., Zilch, A. and Amemiya, C. T. (1993). "Phylogenetic diversification of immunoglobulin genes and the antibody repertoire." *Molecular Biology and Evolution* 10(1): 60-72. (PubMed)

192. Litman, G. W., Rosenberg, A., Frommel, D., Pollara, B., Finstad, J. and Good, R. A. (1971). "Biophysical studies of the immunoglobulins. The circular dichroic spectra of the immunoglobulins--a phylogenetic comparison." *International Archives of Allergy and Immunology* 40(4-5): 551-575. (PubMed)

Heterodontus francisci. Suggested lack of structural variation between light chains isolated from different animals." *Journal of Immunogenetics* 7(3): 197-206. (PubMed)

194. Litman, G. W., Stolen, J. S., Sarvas, H. O. and Makela, O. (1982). "The range and fine specificity of the anti-hapten immune response: phylogenetic studies." *Journal of Immunogenetics* 9(6): 465-474. (PubMed)

195. Lobb, C. J. and Clem, L. W. (1981). "Phylogeny of immunoglobulin structure and function-XII. Secretory immunoglobulins in the bile of the marine teleost Archosargus probatocephalus." *Molecular Immunology* 18(7): 615-619. (PubMed)

196. Lobb, C. J. and Clem, L. W. (1981). "Phylogeny of immunoglobulin structure and function. XI. Secretory immunoglobulins in the cutaneous mucus of the sheepshead, Archosargus probatocephalus." *Developmental and Comparative Immunology* 5(4): 587-596. (PubMed)

197. Lobb, C. J. and Clem, W. (1981). "Phylogeny of immunoglobulin in structure and function-x. Humoral immunoglobulins of the sheepshead, Archosargus probatocephalus." *Developmental and Comparative Immunology* 5(2): 271-282. (PubMed)

198. Magor, B. G., De Tomaso, A., Rinkevich, B. and Weissman, I. L. (1999). "Allorecognition in colonial tunicates: protection against predatory cell lineages?" *Immunological Reviews* 167: 69-79. (PubMed)

199. Magor, B. G. and Magor, K. E. (2001). "Evolution of effectors and receptors of innate immunity." *Developmental and Comparative Immunology* 25(8-9): 651-682. (PubMed)

201. Manning, M. J., ed. (1980). *Phylogeny of Immunological Memory*. Developments in Immunology. Amsterdam, Elsevier/North-Holland Biomedical Press. (Library | Amazon | Google Print)

202. Marchalonis, J. and Edelman, G. M. (1965). "Phylogenetic origins of antibody structure. I. Multichain structure of immunoglobulins in the smooth dogfish (Mustelus canis)." *Journal of Experimental Medicine* 122(3): 601-618. (PubMed)

203. Marchalonis, J. and Edelman, G. M. (1966). "Phylogenetic origins of antibody structure. II. Immunoglobulins in the primary immune response of the bullfrog, Rana catesbiana." *Journal of Experimental Medicine* 124(5): 901-913. (PubMed)

204. Marchalonis, J. J. (1976). *Immunity in Evolution*. Cambridge, Mass., Harvard University Press. (Library | Amazon | Google Print)

205. Marchalonis, J. J., Adelman, M. K., Schluter, S. F. and Ramsland, P. A. (2006). "The antibody repertoire in evolution: Chance, selection, and continuity." *Developmental and Comparative Immunology* 30(1-2): 223-247. (Google Scholar | DOI | Journal | PubMed)

206. Marchalonis, J. J., Adelman, M. K., Zeitler, B. J., Sarazin, P. M., Jaqua, P. M. and Schluter, S. F. (2001). "Evolutionary factors in the emergence of the combinatorial germline antibody repertoire." *Advances in Experimental Medicine and Biology* 484: 13-30. (PubMed)

207. Marchalonis, J. J., Bernstein, R. M., Shen, S. X. and Schluter, S. F. (1996). "Emergence of the immunoglobulin family: conservation in protein sequence and plasticity in gene organization." *Glycobiology* 6(7): 657-663.

of vertebrate immunity." *Australian Journal of Experimental Biology and Medical Science* 51(4): 461-488. (PubMed)

209. Marchalonis, J. J., Decker, J. M., DeLuca, D., Moseley, J. M., Smith, P. and Warr, G. W. (1977). "Lymphocyte surface immunoglobulins: evolutionary origins and involvement in activation." *Cold Spring Harbor Symposium on Quantitative Biology* 41 Pt 1: 261-273. (Journal | PubMed)

210. Marchalonis, J. J. and Edelman, G. M. (1968). "Phylogenetic origins of antibody structure. 3. Antibodies in the primary immune response of the sea lamprey, Petromyzon marinus." *Journal of Experimental Medicine* 127(5): 891-914. (PubMed)

211. Marchalonis, J. J., Hohman, V. S., Kaymaz, H., Schluter, S. F. and Edmundson, A. B. (1994). "Cell Surface Recognition and the Immunoglobulin Superfamily." *Primordial Immunity: Foundations for the Vertebrate Immune System*. Edited by G. Beck, E. L. Cooper, G. S. Habicht and J. J. Marchalonis. New York, New York Academy of Sciences. 712: 20-33. (Library | PubMed | Publisher | Google Print)

212. Marchalonis, J. J., Jensen, I. and Schluter, S. F. (2002). "Structural, antigenic and evolutionary analyses of immunoglobulins and T cell receptors." *Journal of Molecular Recognition* 15(5): 260-271. (Google Scholar | DOI | Journal | PubMed)

213. Marchalonis, J. J., Kaveri, S., Lacroix-Desmazes, S. and Kazatchkine, M. D. (2002). "Natural recognition repertoire and the evolutionary emergence of the combinatorial immune system." *FASEB Journal* 16(8): 842-848. (Google Scholar | Journal | PubMed)

214. Marchalonis, J. J. and Schluter, S. F. (1989). "Evolution of variable and

215. Marchalonis, J. J. and Schluter, S. F. (1989). "Immunoproteins in evolution." *Developmental and Comparative Immunology* 13(4): 285-301. (PubMed)

216. Marchalonis, J. J. and Schluter, S. F. (1990). "On the relevance of invertebrate recognition and defence mechanisms to the emergence of the immune response of vertebrates." *Scandinavian Journal of Immunology* 32(1): 13-20. (PubMed)

217. Marchalonis, J. J. and Schluter, S. F. (1994). "Development of an Immune System." *Primordial Immunity: Foundations for the Vertebrate Immune System*. Edited by G. Beck, E. L. Cooper, G. S. Habicht and J. J. Marchalonis. New York, New York Academy of Sciences. 712: 1-11. (Library | PubMed | Publisher | Google Print)

218. Marchalonis, J. J. and Schluter, S. F. (1998). "A stochastic model for the rapid emergence of specific vertebrate immunity incorporating horizontal transfer of systems enabling duplication and combinational diversification." *Journal of Theoretical Biology* 193(3): 429-444. (PubMed)

219. Marchalonis, J. J., Schluter, S. F., Bernstein, R. M. and Hohman, V. S. (1998). "Antibodies of sharks: revolution and evolution." *Immunological Reviews* 166: 103-122. (PubMed)

220. Marchalonis, J. J., Schluter, S. F., Bernstein, R. M., Shen, S. and Edmundson, A. B. (1998). "Phylogenetic emergence and molecular evolution of the immunoglobulin family." *Advances in Immunology* 70: 417-506. (PubMed)

221. Marchalonis, J. J. and Warr, G. W. (1978). "Phylogenetic origins of immune recognition: naturally occurring DNP-binding molecules in

222. Marchalonis, J. J., Warr, G. W. and Ruben, L. N. (1978). "Evolutionary immunobiology and the problem of the T-cell receptor." *Developmental and Comparative Immunology* 2(2): 203-218. (PubMed)

223. Market, E. and Papavasiliou, F. N. (2003). "V(D)J Recombination and the Evolution of the Adaptive Immune System." *PLoS Biology* 1(1): 24-27. (Google Scholar | DOI | Journal | PubMed)

224. Martinelli, C. and Reichhart, J. M. (2005). "Evolution and integration of innate immune systems from fruit flies to man: lessons and questions." *Journal of Endotoxin Research* 11(4): 243-248. (PubMed)

225. Matsunaga, T. and Rahman, A. (1998). "What brought the adaptive immune system to vertebrates?--The jaw hypothesis and the seahorse." *Immunological Reviews* 166: 177-186. (PubMed)

226. Matsushita, M., Endo, Y., Nonaka, M. and Fujita, T. (1998). "Complement-related serine proteases in tunicates and vertebrates." *Current Opinion in Immunology* 10(1): 29-35. (PubMed)

227. Mayer, W. E., Uinuk-Ool, T., Tichy, H., Gartland, L. A., Klein, J. and Cooper, M. D. (2002). "Isolation and characterization of lymphocyte-like cells from a lamprey." *Proceedings of the National Academy of Sciences* 99(22): 14350-14355. (Google Scholar | DOI | Journal | PubMed)

228. McBlane, J. F., van Gent, D. C., Ramsden, D. A., Romeo, C., Cuomo, C. A., Gellert, M. and Oettinger, M. A. (1995). "Cleavage at a V(D)J recombination signal requires only RAG1 and RAG2 proteins and occurs in two steps." *Cell* 83(3): 387-395. (PubMed)

229. Medzhitov, R. and Janeway, C. A., Jr. (1997). "Innate immunity: the

defense." *Current Opinion in Immunology* 10(1): 12-15. (PubMed)

231. Medzhitov, R., Preston-Hurlburt, P. and Janeway, C. A., Jr. (1997). "A human homologue of the Drosophila Toll protein signals activation of adaptive immunity." *Nature* 388(6640): 394-397. (PubMed)

232. Meister, M., Hetru, C. and Hoffmann, J. A. (2000). "The antimicrobial host defense of Drosophila." *Current Topics in Microbiology and Immunology* 248: 17-36. (PubMed)

233. Menezes, H. and Jared, C. (2002). "Immunity in plants and animals: common ends through different means using similar tools." *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology* 132(1): 1-7. (Journal | PubMed)

234. Merz, D. C., Finstad, C. L., Litman, G. W. and Good, R. A. (1975). "Aspects of vertebrate immunoglobulin evolution. Constancy in light chain electrophoretic behavior." *Immunochemistry* 12(6-7): 499-504. (PubMed)

235. Messier, T. L., O'Neill, J. P., Hou, S.-M., Nicklas, J. A. and Finette, B. A. (2003). "In vivo transposition mediated by V(D)J recombinase in human T lymphocytes." *The EMBO Journal* 22(6): 1381-1388. (Google Scholar | DOI | Journal | PubMed)

236. Metchnikoff, E. (1891 [1968]). *Lectures on the comparative pathology of inflammation; delivered at the Pasteur Institute in 1891*. Dover, New York.

237. Miyazawa, S., Azumi, K. and Nonaka, M. (2001). "Cloning and characterization of integrin alpha subunits from the solitary ascidian, Halocynthia roretzi." *Journal of Immunology* 166(3): 1710-1715. (PubMed)

Immunogenetics 55(12): 836-844. (PubMed)

239. Mushegian, A. and Medzhitov, R. (2001). "Evolutionary perspective on innate immune recognition." *Journal of Cell Biology* 155(5): 705-710. (PubMed)

240. Muta, T. and Iwanaga, S. (1996). "The role of hemolymph coagulation in innate immunity." *Current Opinion in Immunology* 8(1): 41-47. (PubMed)

241. Nair, S. V., Pearce, S., Green, P. L., Mahajan, D., Newton, R. A. and Raftos, D. A. (2000). "A collectin-like protein from tunicates." *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology* 125(2): 279-289. (Journal | PubMed)

242. Neuberger, M. S. (2002). "Novartis Medal Lecture. Antibodies: a paradigm for the evolution of molecular recognition." *Biochemical Society Transactions* 30(4): 341-350. (Journal | PubMed)

243. Newton, R. A., Raftos, D. A., Raison, R. L. and Geczy, C. L. (1994). "Chemotactic responses of hagfish (Vertebrata, Agnatha) leucocytes." *Developmental and Comparative Immunology* 18(4): 295-303. (PubMed)

244. Nonaka, M. (2000). "Origin and evolution of the Complement System." *Origin and Evolution of the Vertebrate Immune System*. Edited by L. Du Pasquier and G. W. Litman. Berlin, Springer. 248: 37-50. (Library | PubMed | Amazon | Google Print)

245. Nonaka, M. (2001). "Evolution of the complement system." *Current Opinion in Immunology* 13(1): 69-73. (PubMed)

246. Nonaka, M. and Azumi, K. (1999). "Opsonic complement system of the

247. Nonaka, M., Azumi, K., Ji, X., Namikawa-Yamada, C., Sasaki, M., Saiga, H., Dodds, A. W., Sekine, H., Homma, M. K., Matsushita, M., Endo, Y. and Fujita, T. (1999). "Opsonic complement component C3 in the solitary ascidian, Halocynthia roretzi." *Journal of Immunology* 162(1): 387-391. (PubMed)

248. Nonaka, M., Fujii, T., Kaidoh, T., Natsuume-Sakai, S., Yamaguchi, N. and Takahashi, M. (1984). "Purification of a lamprey complement protein homologous to the third component of the mammalian complement system." *Journal of Immunology* 133(6): 3242-3249. (PubMed)

249. Nonaka, M. and Miyazawa, S. (2001). "Evolution of the Initiating Enzymes of the Complement System." *Genome Biology* 3(1): 1001.1001-1001.1005. (Google Scholar | DOI | Journal | PubMed)

250. Nonaka, M. and Smith, S. L. (2000). "Complement system of bony and cartilaginous fish." *Fish & Shellfish Immunology* 10(3): 215-228. (PubMed)

251. Nonaka, M. and Takahashi, M. (1992). "Complete complementary DNA sequence of the third component of complement of lamprey. Implication for the evolution of thioester containing proteins." *Journal of Immunology* 148(10): 3290-3295. (PubMed)

252. Nonaka, M., Takahashi, M. and Sasaki, M. (1994). "Molecular cloning of a lamprey homologue of the mammalian MHC class III gene, complement factor B." *Journal of Immunology* 152(5): 2263-2269. (PubMed)

253. Nonaka, M. and Yoshizaki, F. (2004). "Primitive complement system of invertebrates." *Immunological Reviews* 198: 203-215. (PubMed)

254. Nonaka, M. and Yoshizaki, F. (2004). "Evolution of the Complement System." *Molecular Immunology* 40(12): 897-902. (Google Scholar | DOI |

animals: emerging parallels between the recognition of general elicitors and pathogen-associated molecular patterns." *Current Opinion in Plant Biology* 5(4): 318-324. (PubMed)

256. Oettinger, M. A., Schatz, D. G., Gorka, C. and Baltimore, D. (1990). "RAG-1 and RAG-2, adjacent genes that synergistically activate V(D)J recombination." *Science* 248(4962): 1517-1523. (PubMed)

257. Ohinata, Y., Sutou, S. and Mitsui, Y. (2003). "A novel testis-specific RAG2-like protein, Peas: its expression in pachytene spermatocyte cytoplasm and meiotic chromatin." *FEBS Letters* 537(1-3): 1-5. (PubMed)

258. Ohno, S. (1994). "MHC Evolution and Development of a Recognition System." *Primordial Immunity: Foundations for the Vertebrate Immune System*. Edited by G. Beck, E. L. Cooper, G. S. Habicht and J. J. Marchalonis. New York, New York Academy of Sciences. 712: 13-19. (Library | PubMed | Publisher | Google Print)

259. Opal, S. M. (2000). "Phylogenetic and functional relationships between coagulation and the innate immune response." *Critical Care Medicine* 28(9): S77-S80. (Google Scholar | Journal | PubMed)

260. Opal, S. M. (2004). "The nexus between systemic inflammation and disordered coagulation in sepsis." *Journal of Endotoxin Research* 10(2): 125-129. (PubMed)

261. Ota, T., Rast, J. P., Litman, G. W. and Amemiya, C. T. (2003). "Lineage-restricted retention of a primitive immunoglobulin heavy chain isotype within the Dipnoi reveals an evolutionary paradox." *Proceedings of the National Academy of Sciences* 100(5): 2501-2506. (PubMed)

(Google Scholar | DOI | Journal | PubMed)

263. Pancer, Z. and Cooper, M. D. (2006). "The Evolution of Adaptive Immunity." *Annual Review of Immunology* 24. (DOI | Journal | PubMed)

264. Pancer, Z., Saha, N. R., Kasamatsu, J., Suzuki, T., Amemiya, C. T., Kasahara, M. and Cooper, M. D. (2005). "Variable lymphocyte receptors in hagfish." *Proceedings of the National Academy of Sciences* 102(26): 9224-9229. (PubMed)

265. Papermaster, B. W., Condie, R. M., Finstad, J. and Good, R. A. (1964). "Evolution of the Immune Response. 1. The Phylogenetic Development of Adaptive Immunologic Responsiveness in Vertebrates." *Journal of Experimental Medicine* 119: 105-130. (PubMed)

266. Parham P. (editor) (1999). "Genomic organisation of the MHC: structure, origin and function." *Immunological Reviews* 167: 1-379. (Google Scholar)

267. Perey, D. Y., Finstad, J., Pollara, B. and Good, R. A. (1968). "Evolution of the immune response. 6. First and second set skin homograft rejections in primitive fishes." *Laboratory Investigation; a journal of technical methods and pathology* 19(6): 591-597. (PubMed)

268. Plasterk, R. (1998). "Ragtime jumping." *Nature* 394(6695): 718-719. (Google Scholar | DOI | Journal | PubMed)

269. Plouffe, D. A., Hanington, P. C., Walsh, J. G., Wilson, E. C. and Belosevic, M. (2005). "Comparison of select innate immune mechanisms of fish and mammals." *Xenotransplantation* 12(4): 266-277. (PubMed)

270. Poitrineau, K., Brown, S. P. and Hochberg, M. E. (2004). "The joint

271. Pollara, B., Litman, G. W., Finstad, J., Howell, J. and Good, R. A. (1970). "The evolution of the immune response. 7. Antibody to human "O" cells and properties of the immunoglobulin in lamprey." *Journal of Immunology* 105(3): 738-745. (PubMed)

272. Prugnolle, F., Manica, A., Charpentier, M., Guegan, J. F., Guernier, V. and Balloux, F. (2005). "Pathogen-driven selection and worldwide HLA class I diversity." *Current Biology* 15(11): 1022-1027. (PubMed)

273. Quigley, J. P. and Armstrong, P. B. (1983). "An endopeptidase inhibitor found in Limulus plasma: an ancient form of alpha 2-macroglobulin." *Annals of the New York Academy of Sciences* 421: 119-124. (PubMed)

274. Quigley, J. P. and Armstrong, P. B. (1985). "A homologue of alpha 2-macroglobulin purified from the hemolymph of the horseshoe crab Limulus polyphemus." *Journal of Biological Chemistry* 260(23): 12715-12719. (PubMed)

275. Raftos, D. and Nair, S. (2004). "Tunicate cytokine-like molecules and their involvement in host defense responses." *Progress in Molecular and Subcellular Biology* 34: 165-182. (PubMed)

276. Raison, R. L. and Hildemann, W. H. (1984). "Immunoglobulin-bearing blood leucocytes in the Pacific hagfish." *Developmental and Comparative Immunology* 8(1): 99-108. (PubMed)

277. Ramsland, P. A., Kaushik, A., Marchalonis, J. J. and Edmundson, A. B. (2001). "Incorporation of long CDR3s into V domains: implications for the structural evolution of the antibody-combining site." *Experimental and Clinical Immunogenetics* 18(4): 176-198. (DOI | Journal | PubMed)

Immunogenetics 40(2): 83-99. (PubMed)

279. Rast, J. P., Anderson, M. K., Strong, S. J., Luer, C., Litman, R. T. and Litman, G. W. (1997). "alpha, beta, gamma, and delta T cell antigen receptor genes arose early in vertebrate phylogeny." *Immunity* 6(1): 1-11. (PubMed)

280. Rast, J. P. and Litman, G. W. (1994). "T-cell receptor gene homologs are present in the most primitive jawed vertebrates." *Proceedings of the National Academy of Sciences* 91(20): 9248-9252. (PubMed)

281. Rast, J. P. and Litman, G. W. (1998). "Towards understanding the evolutionary origins and early diversification of rearranging antigen receptors." *Immunological Reviews* 166: 79-86. (PubMed)

282. Reinisch, C. L. and Litman, G. W. (1989). "Evolutionary immunobiology." *Immunology Today* 10(8): 278-281. (PubMed)

283. Richards, M. H. and Nelson, J. L. (2000). "The Evolution of Vertebrate Antigen Receptors: A Phylogenetic Approach." *Molecular Biology and Evolution* 17(1): 146-155. (Google Scholar | Journal | PubMed)

284. Rinkevich, B. (2004). "Primitive immune systems: are your ways my ways?" *Immunological Reviews* 198: 25-35. (PubMed)

285. Roth, D. B. (2000). "From lymphocytes to sharks: V(D)J recombinase moves to the germline." *Genome Biology* 1(2): 1014.1011-1014.1014. (Google Scholar | DOI | Journal | PubMed)

286. Roth, D. B., Nakajima, P. B., Menetski, J. P., Bosma, M. J. and Gellert, M. (1992). "V(D)J recombination in mouse thymocytes: double-strand breaks near T cell receptor delta rearrangement signals." *Cell* 69(1): 41-53.

the Evolution of Deuterostome Immune Systems." *Innate Immunity*. Edited by R. A. B. Ezekowitz and J. A. Hoffman. Totowa, NJ, Humana Press: 61-87. (Google Print)

288. Rothenberg, E. V. and Pant, R. (2004). "Origins of lymphocyte developmental programs: transcription factor evidence." *Seminars in Immunology* 16(4): 227-238. (Google Scholar | DOI | Journal | PubMed)

289. Ruben, L. N., Warr, G. W., Decker, J. M. and Marchalonis, J. J. (1977). "Phylogenetic origins of immune recognition: lymphoid heterogeneity and the hapten/carrier effect in the goldfish, Carassius auratus." *Cellular Immunology* 31(2): 266-283. (PubMed)

290. Rumfelt, L. L., Avila, D., Diaz, M., Bartl, S., McKinney, E. C. and Flajnik, M. F. (2001). "A shark antibody heavy chain encoded by a nonsomatically rearranged VDJ is preferentially expressed in early development and is convergent with mammalian IgG." *Proceedings of the National Academy of Sciences* 98(4): 1775-1780. (PubMed)

291. Sahu, A. and Lambris, J. D. (2001). "Structure and biology of complement protein C3, a connecting link between innate and acquired immunity." *Immunological Reviews* 180: 35-48. (PubMed)

292. Sahu, A., Sunyer, J. O., Moore, W. T., Sarrias, M. R., Soulika, A. M. and Lambris, J. D. (1998). "Structure, functions, and evolution of the third complement component and viral molecular mimicry." *Immunologic Research* 17(1-2): 109-121. (PubMed)

293. Saito, Y., Hirose, E. and Watanabe, H. (1994). "Allorecognition in compound ascidians." *International Journal of Developmental Biology* 38(2): 237-247. (PubMed)

Nature 280(6): 288-294. (Google Scholar | DOI | Journal | PubMed)

295. Sato, K., Flajnik, M. F., Du Pasquier, L., Katagiri, M. and Kasahara, M. (1993). "Evolution of the MHC: isolation of class II beta-chain cDNA clones from the amphibian Xenopus laevis." *Journal of Immunology* 150(7): 2831-2843. (PubMed)

296. Schatz, D. G. (1999). "Transposition mediated by RAG1 and RAG2 and the evolution of the adaptive immune system." *Immunologic Research* 19(2-3): 169-182. (Google Scholar | PubMed)

297. Schatz, D. G. (2004). "Antigen receptor genes and the evolution of a recombinase." *Seminars in Immunology* 16(4): 245-256. (Google Scholar | DOI | Journal | PubMed)

298. Schatz, D. G., Oettinger, M. A. and Baltimore, D. (1989). "The V(D)J recombination activating gene, RAG-1." *Cell* 59(6): 1035-1048. (PubMed)

299. Schatz, D. G., Oettinger, M. A. and Schlissel, M. S. (1992). "V(D)J recombination: molecular biology and regulation." *Annual Review of Immunology* 10: 359-383. (PubMed)

300. Schatz, D. G. and Spanopoulou, E. (2005). "Biochemistry of V(D)J recombination." *Current Topics in Microbiology and Immunology* 290: 49-85. (Google Scholar | Journal | PubMed)

301. Schluter, S. F., Bernstein, R. M., Bernstein, H. and Marchalonis, J. J. (1999). "'Big Bang' emergence of the combinatorial immune system." *Developmental and Comparative Immunology* 23(2): 107-111. (Google Scholar | DOI | Journal | PubMed)

Journal | PubMed)

303. Schluter, S. F., Hohman, V. S., Edmundson, A. B. and Marchalonis, J. J. (1989). "Evolution of immunoglobulin light chains: cDNA clones specifying sandbar shark constant regions." *Proceedings of the National Academy of Sciences* 86(24): 9961-9965. (PubMed)

304. Schluter, S. F. and Marchalonis, J. J. (2003). "Cloning of shark RAG2 and characterization of the RAG1/RAG2 gene locus." *FASEB Journal* 17(3): 470-472. (PubMed)

305. Shamblott, M. J. and Litman, G. W. (1989). "Genomic organization and sequences of immunoglobulin light chain genes in a primitive vertebrate suggest coevolution of immunoglobulin gene organization." *The EMBO Journal* 8(12): 3733-3739. (PubMed)

306. Shankey, T. V. and Clem, L. W. (1980). "Phylogeny of immunoglobulin structure and function. IX. Intramolecular heterogeneity of shark 19S IgM antibodies to the dinitrophenyl hapten." *Journal of Immunology* 125(6): 2690-2698. (PubMed)

307. Shankey, T. V. and Clem, L. W. (1980). "Phylogeny of immunoglobulin structure and function--VIII. Intermolecular heterogeneity of shark 19S IgM antibodies to pneumococcal polysaccharide." *Molecular Immunology* 17(3): 365-375. (PubMed)

308. Shen, S. X., Bernstein, R. M., Schluter, S. F. and Marchalonis, J. J. (1996). "Heavy-chain variable regions in carcharhine sharks: development of a comprehensive model for the evolution of VH domains among the gnathanstomes." *Immunology and Cell Biology* 74(4): 357-364. (PubMed)

310. Síma, P. and Vetvicka, V. (1992). "Evolution of Immune Accessory Functions." *Immune System Accessory Cells*. Edited by L. Fornusek and P. Síma. Boca Raton, CRC Press: 1-55. (Library | Amazon | Google Print)

311.* Síma, P. and Vetvicka, V. (1993). "Evolution of immune reactions." *Critical Reviews in Immunology* 13(2): 83-114. (PubMed)

312. Smith, L. C., Azumi, K. and Nonaka, M. (1999). "Complement systems in invertebrates. The ancient alternative and lectin pathways." *Immunopharmacology* 42(1-3): 107-120. (PubMed)

313. Smith, L. C., Clow, L. A. and Terwilliger, D. P. (2001). "The ancestral complement system in sea urchins." *Immunological Reviews* 180: 16-34. (PubMed)

314. Smith, L. C., Shih, C. S. and Dachenhausen, S. G. (1998). "Coelomocytes express SpBf, a homologue of factor B, the second component in the sea urchin complement system." *Journal of Immunology* 161(12): 6784-6793. (PubMed)

315. Smith, S. L. (1998). "Shark complement: an assessment." *Immunological Reviews* 166: 67-78. (PubMed)

316. Sottrup-Jensen, L., Stepanik, T. M., Kristensen, T., Lonblad, P. B., Jones, C. M., Wierzbicki, D. M., Magnusson, S., Domdey, H., Wetsel, R. A., Lundwall, A. and et al. (1985). "Common evolutionary origin of alpha 2-macroglobulin and complement components C3 and C4." *Proceedings of the National Academy of Sciences* 82(1): 9-13. (PubMed)

317. Spanopoulou, E., Zaitseva, F., Wang, F. H., Santagata, S., Baltimore, D. and Panayotou, G. (1996). "The homeodomain region of Rag-1 reveals the

318. Stavnezer, J. and Amemiya, C. T. (2004). "Evolution of isotype switching." *Seminars in Immunology* 16(4): 257-275. (Google Scholar | DOI | Journal | PubMed)

319. Stewart, J. (1992). "Immunoglobulins did not arise in evolution to fight infection." *Immunology Today* 13(10): 396-399; discussion 399-400. (PubMed)

320.* Stewart, J. (1994). *The Primordial VRM System and the Evolution of Vertebrate Immunity.* Austin, R. G. Landes. (Library | Amazon | Google Print)

321. Sun, S. C., Lindstrom, I., Boman, H. G., Faye, I. and Schmidt, O. (1990). "Hemolin: an insect-immune protein belonging to the immunoglobulin superfamily." *Science* 250(4988): 1729-1732. (PubMed)

322. Sunyer, J. O., Boshra, H. and Li, J. (2005). "Evolution of anaphylatoxins, their diversity and novel roles in innate immunity: insights from the study of fish complement." *Veternary Immunology and Immunopathology* 108(1-2): 77-89. (PubMed)

323. Sunyer, J. O., Boshra, H., Lorenzo, G., Parra, D., Freedman, B. and Bosch, N. (2003). "Evolution of complement as an effector system in innate and adaptive immunity." *Immunologic Research* 27(2-3): 549-564. (PubMed)

324. Sunyer, J. O. and Lambris, J. D. (1998). "Evolution and diversity of the complement system of poikilothermic vertebrates." *Immunological Reviews* 166: 39-57. (PubMed)

325. Sunyer, J. O., Tort, L. and Lambris, J. D. (1997). "Structural C3 diversity in fish: characterization of five forms of C3 in the diploid fish Sparus aurata." *Journal of Immunology* 158(6): 2813-2821. (PubMed)

Today 19(11): 519-523. (PubMed)

327. Suzuki, M. M., Satoh, N. and Nonaka, M. (2002). "C6-like and C3-like molecules from the cephalochordate, amphioxus, suggest a cytolytic complement system in invertebrates." *Journal of Molecular Evolution* 54(5): 671-679. (PubMed)

328. Suzuki, T., Shin, I. T., Fujiyama, A., Kohara, Y. and Kasahara, M. (2005). "Hagfish leukocytes express a paired receptor family with a variable domain resembling those of antigen receptors." *Journal of Immunology* 174(5): 2885-2891. (PubMed)

329. Suzuki, T., Shin, I. T., Kohara, Y. and Kasahara, M. (2004). "Transcriptome analysis of hagfish leukocytes: a framework for understanding the immune system of jawless fishes." *Developmental and Comparative Immunology* 28(10): 993-1003. (PubMed)

330. Takahashi, H., Ishikawa, G., Ueki, K., Azumi, K. and Yokosawa, H. (1997). "Cloning and tyrosine phosphorylation of a novel invertebrate immunocyte protein containing immunoreceptor tyrosine-based activation motifs." *Journal of Biological Chemistry* 272(51): 32006-32010. (PubMed)

331. Terado, T., Nonaka, M. I., Nonaka, M. and Kimura, H. (2002). "Conservation of the modular structure of complement factor I through vertebrate evolution." *Developmental and Comparative Immunology* 26(5): 403-413. (PubMed)

332. Thompson, C. B. (1995). "New insights into V(D)J recombination and its role in the evolution of the immune system." *Immunity* 3(5): 531-539. (Google Scholar | DOI | Journal | PubMed)

334. Uinuk-Ool, T., Mayer, W. E., Sato, A., Dongak, R., Cooper, M. D. and Klein, J. (2002). "Lamprey lymphocyte-like cells express homologs of genes involved in immunologically relevant activities of mammalian lymphocytes." *Proceedings of the National Academy of Sciences* 99(22): 14356-14361. (Google Scholar | DOI | Journal | PubMed)

335. Vaandrager, J.-W., Schuuring, E., Philippo, K. and Kluin, P. M. (2000). "V(D)J recombinase-mediated transposition of the BCL2 gene to the IGH locus in follicular lymphoma." *Blood* 96(5): 1947-1952. (Google Scholar | Journal | PubMed)

336. van den Berg, T. K., Yoder, J. A. and Litman, G. W. (2004). "On the origins of adaptive immunity: innate immune receptors join the tale." *Trends in Immunology* 25(1): 11-16. (PubMed)

337. van Gent, D. C., McBlane, J. F., Ramsden, D. A., Sadofsky, M. J., Hesse, J. E. and Gellert, M. (1995). "Initiation of V(D)J recombination in a cell-free system." *Cell* 81(6): 925-934. (PubMed)

338. van Gent, D. C., Mizuuchi, K. and Gellert, M. (1996). "Similarities between initiation of V(D)J recombination and retroviral integration." *Science* 271(5255): 1592-1594. (Google Scholar | Journal | JSTOR | PubMed)

339. van Gent, D. C., Ramsden, D. A. and Gellert, M. (1996). "The RAG1 and RAG2 proteins establish the 12/23 rule in V(D)J recombination." *Cell* 85(1): 107-113. (PubMed)

340. Vasta, G. R. and Marchalonis, J. J. (1987). "Lectins from protochordates as putative recognition molecules." *Progress in Clinical and Biological Research* 233: 23-32. (PubMed)

342. Vetvicka, V. and Síma, P. (1998). *Evolutionary Mechanisms of Defense Reactions*. Basel, Birkhäuser Verlag. (Library | Amazon | Google Print)

343. Vetvicka, V., Síma, P., Cooper, E. L., Bilej, M. and Roch, P. (1994). *Immunology of Annelids*. Boca Raton, CRC Press. (Library | Amazon | Google Print)

344. Vilmos, P. and Kurucz, E. (1998). "Insect immunity: evolutionary roots of the mammalian innate immune system." *Immunology Letters* 62(2): 59-66. (PubMed)

345. Vyazov, O. E. and Murashova, A. I. (1962). "Attempt at a comparative evolutionary approach to the study of the mechanism of antibody formation. I. Study of humoral immunity factors in invertebrates." *Folia Microbiologica (Praha)* 7: 93-97. (PubMed)

346. Vyazov, O. E. and Murashova, A. I. (1962). "Attempt at a comparative evolutionary approach to the study of the mechanism of antibody formation. II. The problem of the mechanism of autoantibody formation." *Folia Microbiologica (Praha)* 7: 98-103. (PubMed)

347. Wagner, C. and Hansch, G. M. (2006). "Receptors for complement C3 on T-lymphocytes: relics of evolution or functional molecules?" *Molecular Immunology* 43(1-2): 22-30. (DOI | Journal | PubMed)

348. Warr, G. W. and Cohen, N., eds. (1991). *Phylogenesis of Immune Functions*. Boca Raton, CRC Press. (Library | Amazon | Google Print)

349. Warr, G. W., DeLuca, D. and Marchalonis, J. J. (1976). "Phylogenetic origins of immune recognition: lymphocyte surface immunoglobulins in

350. Warr, G. W. and Marchalonis, J. J. (1978). "Specific immune recognition by lymphocytes: an evolutionary perspective." *Quarterly Review of Biology* 53(3): 225-241. (PubMed)

351. Weissman, I. L., Saito, Y. and Rinkevich, B. (1990). "Allorecognition histocompatibility in a protochordate species: is the relationship to MHC somatic or structural?" *Immunological Reviews* 113: 227-241. (PubMed)

352. Xiao, Y., Hughes, A. L., Ando, J., Matsuda, Y., Cheng, J. F., Skinner-Noble, D. and Zhang, G. (2004). "A genome-wide screen identifies a single beta-defensin gene cluster in the chicken: implications for the origin and evolution of mammalian defensins." *BMC Genomics* 5(1): 56. (PubMed)

353. Xu, Y., Narayana, S. V. and Volanakis, J. E. (2001). "Structural biology of the alternative pathway convertase." *Immunological Reviews* 180: 123-135. (PubMed)

354. Yoshizaki, F. Y., Ikawa, S., Satake, M., Satoh, N. and Nonaka, M. (2005). "Structure and the evolutionary implication of the triplicated complement factor B genes of a urochordate ascidian, Ciona intestinalis." *Immunogenetics* 56(12): 930-942. (PubMed)

355. Zapata, A., Fange, R., Mattisson, A. and Villena, A. (1984). "Plasma cells in adult Atlantic hagfish, Myxine glutinosa." *Cell and Tissue Research* 235(3): 691-693. (PubMed)

356. Zarkadis, I. K., Mastellos, D. and Lambris, J. D. (2001). "Phylogenetic aspects of the complement system." *Developmental and Comparative Immunology* 25(8-9): 745-762. (Google Scholar | DOI | Journal | PubMed)

357. Zhou, L., Mitra, R., Atkinson, P. W., Hickman, A. B., Dyda, F. and Craig, N. L.

| PubMed)

Full Bibliography: Chronological

1. Metchnikoff, E. (1891 [1968]). *Lectures on the comparative pathology of inflammation; delivered at the Pasteur Institute in 1891*. Dover, New York.

2. Vyazov, O. E. and Murashova, A. I. (1962). "Attempt at a comparative evolutionary approach to the study of the mechanism of antibody formation. I. Study of humoral immunity factors in invertebrates." *Folia Microbiologica (Praha)* 7: 93-97. (PubMed)

3. Vyazov, O. E. and Murashova, A. I. (1962). "Attempt at a comparative evolutionary approach to the study of the mechanism of antibody formation. II. The problem of the mechanism of autoantibody formation." *Folia Microbiologica (Praha)* 7: 98-103. (PubMed)

4. Burnet, F. M. (1963). "The Evolution of Bodily Defence." *Medical Journal of Australia* 15: 817-821. (PubMed)

5. Finstad, J., Papermaster, B. W. and Good, R. A. (1964). "Evolution of the Immune Response. 2. Morphologic Studies on the Origin of the Thymus and Organized Lymphoid Tissue." *Laboratory Investigation; a journal of technical methods and pathology* 13: 490-512. (PubMed)

6. Good, R. A. and Papermaster, B. W. (1964). "Ontogeny and Phylogeny of Adaptive Immunity." *Advances in Immunology* 27: 1-115. (PubMed)

7. Papermaster, B. W., Condie, R. M., Finstad, J. and Good, R. A. (1964). "Evolution of the Immune Response. 1. The Phylogenetic Development of

8. Marchalonis, J. and Edelman, G. M. (1965). "Phylogenetic origins of antibody structure. I. Multichain structure of immunoglobulins in the smooth dogfish (Mustelus canis)." *Journal of Experimental Medicine* 122(3): 601-618. (PubMed)

9. Clawson, C. C., Finstad, J. and Good, R. A. (1966). "Evolution of the immune response. 5. Electron microscopy of plasma cells and lymphoid tissue of the paddlefish." *Laboratory Investigation; a journal of technical methods and pathology* 15(12): 1830-1847. (PubMed)

10. Marchalonis, J. and Edelman, G. M. (1966). "Phylogenetic origins of antibody structure. II. Immunoglobulins in the primary immune response of the bullfrog, Rana catesbiana." *Journal of Experimental Medicine* 124(5): 901-913. (PubMed)

11. Clem, I. W., De Boutaud, F. and Sigel, M. M. (1967). "Phylogeny of immunoglobulin structure and function. II. Immunoglobulins of the nurse shark." *Journal of Immunology* 99(6): 1226-1235. (PubMed)

12. Clem, L. W. and Small, P. A., Jr. (1967). "Phylogeny of immunoglobulin structure and function. I. Immunoglobulins of the lemon shark." *Journal of Experimental Medicine* 125(5): 893-920. (PubMed)

13. Burnet, F. M. (1968). "Evolution of the immune process in vertebrates." *Nature* 218(140): 426-430. (DOI | Journal | PubMed)

14. Marchalonis, J. J. and Edelman, G. M. (1968). "Phylogenetic origins of antibody structure. 3. Antibodies in the primary immune response of the sea lamprey, Petromyzon marinus." *Journal of Experimental Medicine* 127(5): 891-914. (PubMed)

and pathology 19(6): 591-597. (PubMed)

16. Burnet, F. M. (1969). "The evolution of adaptive immunity in vertebrates." *Acta Pathologica, Microbiologica et Immunologica Scandinavica* 76(1): 1-11. (PubMed)

17. Burnet, F. M. (1970). "A certain symmetry: histocompatibility antigens compared with immunocyte receptors." *Nature* 226(5241): 123-126. (DOI | Journal | PubMed)

18. Clem, L. W. and Small, P. A., Jr. (1970). "Phylogeny of immunoglobulin structure and function. V. Valences and association constants of teleost antibodies to a haptenic determinant." *Journal of Experimental Medicine* 132(3): 385-400. (PubMed)

19. Litman, G. W., Finstad, F. J., Howell, J., Pollara, B. W. and God, R. A. (1970). "The evolution of the immune response. 3. Structural studies of the lamprey immuoglobulin." *Journal of Immunology* 105(5): 1278-1285. (PubMed)

20. Pollara, B., Litman, G. W., Finstad, J., Howell, J. and Good, R. A. (1970). "The evolution of the immune response. 7. Antibody to human "O" cells and properties of the immunoglobulin in lamprey." *Journal of Immunology* 105(3): 738-745. (PubMed)

21. Anonymous (1971). "A Wise Cell Knows Which its Parent." *Nature* 232(5308): 219-220. (DOI | Journal)

22. Burnet, F. M. (1971). "Self-recognition in colonial marine forms and flowering plants in relation to the evolution of immunity." *Nature* 232(5308): 230-235. (Google Scholar | DOI | Journal | PubMed)

of the turtle. Molecular requirements for biologic activity of 5." *Journal of Immunology* 107(1): 1-11. (PubMed)

24. Clem, L. W. (1971). "Phylogeny of immunoglobulin structure and function. IV. Immunoglobulins of the giant grouper, Epinephelus itaira." *Journal of Biological Chemistry* 246(1): 9-15. (PubMed)

25. Frommel, D., Litman, G. W., Chartrand, S. L., Seal, U. S. and Good, R. A. (1971). "Carbohydrate composition in the evolution of the immunoglobulins." *Immunochemistry* 8(6): 573-577. (PubMed)

26. Frommel, D., Litman, G. W., Finstad, J. and Good, R. A. (1971). "The evolution of the immune response. 11. The immunoglobulins of the horned shark, Heterodontus francisci: purification, characterization and structural requirement for antibody activity." *Journal of Immunology* 106(5): 1234-1243. (PubMed)

27. Litman, G. W., Frommel, D., Finstad, J. and Good, R. A. (1971). "Evolution of the immune response. 10. Immunoglobulins of the bowfin: subunit nature." *Journal of Immunology* 107(3): 881-888. (PubMed)

28. Litman, G. W., Frommel, D., Rosenberg, A. and Good, R. A. (1971). "Circular dichroic analysis of immunoglobulins in phylogenetic perspective." *Biochimica et Biophysica Acta* 236(3): 647-654. (PubMed)

29. Litman, G. W., Fromme, D., Chartrand, S. L., Finstad, J. and Good, R. A. (1971). "Significance of heavy chain mass and antigenic relationship in immunoglobulin evolution." *Immunochemistry* 8(4): 345-349. (PubMed)

30. Litman, G. W., Frommel, D., Finstad, J. and Good, R. A. (1971). "The evolution of the immune reponse. 9. Immunoglobulins of the bowfin:

31. Litman, G. W., Rosenberg, A., Frommel, D., Pollara, B., Finstad, J. and Good, R. A. (1971). "Biophysical studies of the immunoglobulins. The circular dichroic spectra of the immunoglobulins--a phylogenetic comparison." *International Archives of Allergy and Immunology* 40(4-5): 551-575. (PubMed)

32. Finstad, C. L., Litman, G. W., Finstad, J. and Good, R. A. (1972). "The evolution of the immune response. 13. The characterization of purified erythrocyte agglutinins from two invertebrate species." *Journal of Immunology* 108(6): 1704-1711. (PubMed)

33. Leslie, G. A. and Clem, L. W. (1972). "Phylogeny of immunoglobulin structure and function. VI. 17S, 7.5S and 5.7S anti-DNP of the turtle, Pseudamys scripta." *Journal of Immunology* 108(6): 1656-1664. (PubMed)

34. Burnet, F. M. (1973). "Multiple polymorphism in relation to histocompatibility antigens." *Nature* 245(5425): 359-361. (DOI | Journal | PubMed)

35. Hildemann, W. H. and Reddy, A. L. (1973). "Phylogeny of immune responsiveness: marine invertebrates." *Federation Proceedings* 32(12): 2188-2194. (PubMed)

36. Marchalonis, J. J. and Cone, R. E. (1973). "The phylogenetic emergence of vertebrate immunity." *Australian Journal of Experimental Biology and Medical Science* 51(4): 461-488. (PubMed)

37. Hildemann, W. H. (1974). "Phylogeny of immune responsiveness in invertebrates." *Life Sciences* 14(4): 605-614. (PubMed)

38. Clem, L. W. and McLean, W. E. (1975). "Phylogeny of immunoglobulin

39. Litman, G. W. (1975). "Relationship between structure and function of lower vertebrate immunoglobulins." *Advances in Experimental Medicine and Biology* 64: 217-228. (PubMed)

40. Merz, D. C., Finstad, C. L., Litman, G. W. and Good, R. A. (1975). "Aspects of vertebrate immunoglobulin evolution. Constancy in light chain electrophoretic behavior." *Immunochemistry* 12(6-7): 499-504. (PubMed)

41. Makela, O., Koskimies, S. and Karjalainen, K. (1976). "Possible evolution of acquired immunity from self-recognition structures." *Scandinavian Journal of Immunology* 5(4): 305-310. (PubMed)

42. Marchalonis, J. J. (1976). *Immunity in Evolution*. Cambridge, Mass., Harvard University Press. (Library | Amazon | Google Print)

43. Warr, G. W., DeLuca, D. and Marchalonis, J. J. (1976). "Phylogenetic origins of immune recognition: lymphocyte surface immunoglobulins in the goldfish, Carassius auratus." *Proceedings of the National Academy of Sciences* 73(7): 2476-2480. (PubMed)

44. Klapper, D. G. and Clem, L. W. (1977). "Phylogeny of immunoglobulin structure and function; characterization of the cysteine-containing peptide involved in the pentamerization of shark IgM." *Developmental and Comparative Immunology* 1(2): 81-91. (PubMed)

45. Marchalonis, J. J., Decker, J. M., DeLuca, D., Moseley, J. M., Smith, P. and Warr, G. W. (1977). "Lymphocyte surface immunoglobulins: evolutionary origins and involvement in activation." *Cold Spring Harbor Symposium on Quantitative Biology* 41 Pt 1: 261-273. (Journal | PubMed)

46. Ruben, L. N., Warr, G. W., Decker, J. M. and Marchalonis, J. J. (1977).

47. DeLuca, D., Warr, G. W. and Marchalonis, J. J. (1978). "Phylogenetic origins of immune recognition: lymphocyte surface immunoglobulins and antigen binding in the genus Carassius (Teleostii)." *European Journal of Immunology* 8(7): 525-530. (PubMed)

48. Marchalonis, J. J. and Warr, G. W. (1978). "Phylogenetic origins of immune recognition: naturally occurring DNP-binding molecules in chordate sera and hemolymph." *Developmental and Comparative Immunology* 2(3): 443-459. (PubMed)

49. Marchalonis, J. J., Warr, G. W. and Ruben, L. N. (1978). "Evolutionary immunobiology and the problem of the T-cell receptor." *Developmental and Comparative Immunology* 2(2): 203-218. (PubMed)

50. Warr, G. W. and Marchalonis, J. J. (1978). "Specific immune recognition by lymphocytes: an evolutionary perspective." *Quarterly Review of Biology* 53(3): 225-241. (PubMed)

51. Lachmann, P. J. and Hobart, M. J. (1979). "The genetics of the complement system." *Ciba Foundation Symposium*(66): 231-250. (PubMed)

52. Sakano, H., Hüppi, K., Heinrich, G. and Tonegawa, S. (1979). "Sequences at the somatic recombination sites of immunoglobulin light-chain genes." *Nature* 280(6): 288-294. (Google Scholar | DOI | Journal | PubMed)

53. Litman, G. W., Scheffel, C. and Gerber-Jenson, B. (1980). "Immunoglobulin diversity in the phylogenetically primitive shark, Heterodontus francisci. Suggested lack of structural variation between light chains isolated from different animals." *Journal of Immunogenetics* 7(3): 197-206. (PubMed)

55. Shankey, T. V. and Clem, L. W. (1980). "Phylogeny of immunoglobulin structure and function. IX. Intramolecular heterogeneity of shark 19S IgM antibodies to the dinitrophenyl hapten." *Journal of Immunology* 125(6): 2690-2698. (PubMed)

56. Shankey, T. V. and Clem, L. W. (1980). "Phylogeny of immunoglobulin structure and function--VIII. Intermolecular heterogeneity of shark 19S IgM antibodies to pneumococcal polysaccharide." *Molecular Immunology* 17(3): 365-375. (PubMed)

57. Lobb, C. J. and Clem, L. W. (1981). "Phylogeny of immunoglobulin structure and function-XII. Secretory immunoglobulins in the bile of the marine teleost Archosargus probatocephalus." *Molecular Immunology* 18(7): 615-619. (PubMed)

58. Lobb, C. J. and Clem, L. W. (1981). "Phylogeny of immunoglobulin structure and function. XI. Secretory immunoglobulins in the cutaneous mucus of the sheepshead, Archosargus probatocephalus." *Developmental and Comparative Immunology* 5(4): 587-596. (PubMed)

59. Lobb, C. J. and Clem, W. (1981). "Phylogeny of immunoglobulin in structure and function-x. Humoral immunoglobulins of the sheepshead, Archosargus probatocephalus." *Developmental and Comparative Immunology* 5(2): 271-282. (PubMed)

60. Clem, L. W. and Leslie, G. A. (1982). "Phylogeny of immunoglobulin structure and function. XIV. Peptide map and amino acid composition studies of shark antibody light chains." *Developmental and Comparative Immunology* 6(2): 263-269. (PubMed)

62. Du Pasquier, L. (1982). "Antibody diversity in lower vertebrates--why is it so restricted?" *Nature* 296(5855): 311-313. (PubMed)

63. Litman, G. W., Stolen, J. S., Sarvas, H. O. and Makela, O. (1982). "The range and fine specificity of the anti-hapten immune response: phylogenetic studies." *Journal of Immunogenetics* 9(6): 465-474. (PubMed)

64. Litman, G. W., Erickson, B. W., Lederman, L. and Makela, O. (1982). "Antibody response in Heterodontus." *Molecular and Cellular Biochemistry* 45(1): 49-57. (PubMed)

65. Quigley, J. P. and Armstrong, P. B. (1983). "An endopeptidase inhibitor found in Limulus plasma: an ancient form of alpha 2-macroglobulin." *Annals of the New York Academy of Sciences* 421: 119-124. (PubMed)

66. Tonegawa, S. (1983). "Somatic generation of antibody diversity." *Nature* 302(5909): 575-581. (PubMed)

67. Litman, G. W., Berger, L., Murphy, K., Litman, R., Podlaski, F., Hinds, K., Jahn, C. L., Dingerkus, G. and Erickson, B. W. (1984). "Phylogenetic diversification of immunoglobulin VH genes." *Developmental and Comparative Immunology* 8(3): 499-514. (PubMed)

68. Nonaka, M., Fujii, T., Kaidoh, T., Natsuume-Sakai, S., Yamaguchi, N. and Takahashi, M. (1984). "Purification of a lamprey complement protein homologous to the third component of the mammalian complement system." *Journal of Immunology* 133(6): 3242-3249. (PubMed)

69. Raison, R. L. and Hildemann, W. H. (1984). "Immunoglobulin-bearing blood leucocytes in the Pacific hagfish." *Developmental and Comparative*

recognition protein cross-reacts with an immunoglobulin idiotype." *Journal of Experimental Medicine* 159(4): 1270-1276. (PubMed)

71. Zapata, A., Fange, R., Mattisson, A. and Villena, A. (1984). "Plasma cells in adult Atlantic hagfish, Myxine glutinosa." *Cell and Tissue Research* 235(3): 691-693. (PubMed)

72. Litman, G. W., Hinds, K., Berger, L., Murphy, K. and Litman, R. (1985). "Structure and organization of immunoglobulin VH genes in Heterodontus, a phylogenetically primitive shark." *Developmental and Comparative Immunology* 9(4): 749-758. (PubMed)

73. Litman, G. W., Berger, L., Murphy, K., Litman, R., Hinds, K. and Erickson, B. W. (1985). "Immunoglobulin VH gene structure and diversity in Heterodontus, a phylogenetically primitive shark." *Proceedings of the National Academy of Sciences* 82(7): 2082-2086. (PubMed)

74. Quigley, J. P. and Armstrong, P. B. (1985). "A homologue of alpha 2-macroglobulin purified from the hemolymph of the horseshoe crab Limulus polyphemus." *Journal of Biological Chemistry* 260(23): 12715-12719. (PubMed)

75. Sottrup-Jensen, L., Stepanik, T. M., Kristensen, T., Lonblad, P. B., Jones, C. M., Wierzbicki, D. M., Magnusson, S., Domdey, H., Wetsel, R. A., Lundwall, A. and et al. (1985). "Common evolutionary origin of alpha 2-macroglobulin and complement components C3 and C4." *Proceedings of the National Academy of Sciences* 82(1): 9-13. (PubMed)

76. Gilbertson, P., Wotherspoon, J. and Raison, R. L. (1986). "Evolutionary development of lymphocyte heterogeneity: leucocyte subpopulations in the Pacific hagfish." *Developmental and Comparative Immunology* 10(1): 1-

immunoglobulin VH segmental elements during vertebrate evolution." *Nature* 320(6062): 546-549. (PubMed)

78. Klein, J. (1986). "Evolution of Mhc." *Natural History of the Major Histocompatibility Complex*. New York, John Wiley & Sons: 715-762. (Library | Google Print)

79. Kelsoe, G. and Schulze, D. H., eds. (1987). *Evolution and Vertebrate Immunity: The Antigen-Receptor and MHC Gene Families*. Austin, University of Texas Press. (Library | Amazon | Google Print)

80. Litman, G. W., Hinds, K. R., Litman, R. T. and Kokubu, F. (1987). "The early phylogenetic origin of antibody gene structure and function." *Progress in Clinical and Biological Research* 233: 1-11. (PubMed)

81. Vasta, G. R. and Marchalonis, J. J. (1987). "Lectins from protochordates as putative recognition molecules." *Progress in Clinical and Biological Research* 233: 23-32. (PubMed)

82. Kokubu, F., Litman, R., Shamblott, M. J., Hinds, K. and Litman, G. W. (1988). "Diverse organization of immunoglobulin VH gene loci in a primitive vertebrate." *The EMBO Journal* 7(11): 3413-3422. (PubMed)

83. Grossberger, D., Marcuz, A., Du Pasquier, L. and Lambris, J. D. (1989). "Conservation of structural and functional domains in complement component C3 of Xenopus and mammals." *Proceedings of the National Academy of Sciences* 86(4): 1323-1327. (PubMed)

84. Langman, R. E. (1989). *The immune system: Evolutionary principles guide our understanding of this complex biological defense system*. San Diego, Academic Press, Inc.

FASEB Journal 3(13): 2469-2479. (PubMed)

86. Marchalonis, J. J. and Schluter, S. F. (1989). "Immunoproteins in evolution." *Developmental and Comparative Immunology* 13(4): 285-301. (PubMed)

87. Reinisch, C. L. and Litman, G. W. (1989). "Evolutionary immunobiology." *Immunology Today* 10(8): 278-281. (PubMed)

88. Schatz, D. G., Oettinger, M. A. and Baltimore, D. (1989). "The V(D)J recombination activating gene, RAG-1." *Cell* 59(6): 1035-1048. (PubMed)

89. Schluter, S. F., Hohman, V. S., Edmundson, A. B. and Marchalonis, J. J. (1989). "Evolution of immunoglobulin light chains: cDNA clones specifying sandbar shark constant regions." *Proceedings of the National Academy of Sciences* 86(24): 9961-9965. (PubMed)

90. Shamblott, M. J. and Litman, G. W. (1989). "Genomic organization and sequences of immunoglobulin light chain genes in a primitive vertebrate suggest coevolution of immunoglobulin gene organization." *The EMBO Journal* 8(12): 3733-3739. (PubMed)

91. Amemiya, C. T. and Litman, G. W. (1990). "Complete nucleotide sequence of an immunoglobulin heavy-chain gene and analysis of immunoglobulin gene organization in a primitive teleost species." *Proceedings of the National Academy of Sciences* 87(2): 811-815. (PubMed)

92. Farries, T. C., Steuer, K. L. and Atkinson, J. P. (1990). "Evolutionary implications of a new bypass activation pathway of the complement system." *Immunology Today* 11(3): 78-80. (PubMed)

94. Harding, F. A., Cohen, N. and Litman, G. W. (1990). "Immunoglobulin heavy chain gene organization and complexity in the skate, Raja erinacea." *Nucleic Acids Research* 18(4): 1015-1020. (PubMed)

95. Harvell, C. D. (1990). "The evolution of inducible defence." *Parasitology* 100 Suppl: S53-61. (PubMed)

96. Lawlor, D. A., Zemmour, J., Ennis, P. D. and Parham, P. (1990). "Evolution of Class-I MHC Genes and Proteins: From Natural Selection to Thymic Selection." *Annual Review of Immunology* 8: 23-63. (DOI | Journal | PubMed)

97. Marchalonis, J. J. and Schluter, S. F. (1990). "On the relevance of invertebrate recognition and defence mechanisms to the emergence of the immune response of vertebrates." *Scandinavian Journal of Immunology* 32(1): 13-20. (PubMed)

98. Oettinger, M. A., Schatz, D. G., Gorka, C. and Baltimore, D. (1990). "RAG-1 and RAG-2, adjacent genes that synergistically activate V(D)J recombination." *Science* 248(4962): 1517-1523. (PubMed)

99. Síma, P. and Vetvicka, V. (1990). *Evolution of Immune Reactions*. Boca Raton, CRC Press. (Library | Amazon | Google Print)

100. Sun, S. C., Lindstrom, I., Boman, H. G., Faye, I. and Schmidt, O. (1990). "Hemolin: an insect-immune protein belonging to the immunoglobulin superfamily." *Science* 250(4988): 1729-1732. (PubMed)

101. Weissman, I. L., Saito, Y. and Rinkevich, B. (1990). "Allorecognition histocompatibility in a protochordate species: is the relationship to MHC somatic or structural?" *Immunological Reviews* 113: 227-241. (PubMed)

103. Flajnik, M. F., Canel, C., Kramer, J. and Kasahara, M. (1991). "Evolution of the major histocompatibility complex: molecular cloning of major histocompatibility complex class I from the amphibian Xenopus." *Proceedings of the National Academy of Sciences* 88(2): 537-541. (PubMed)

104. Flajnik, M. F., Canel, C., Kramer, J. and Kasahara, M. (1991). "Which came first, MHC class I or class II?" *Immunogenetics* 33(5-6): 295-300. (PubMed)

105. Hendrickson, E. A., Qin, X. Q., Bump, E. A., Schatz, D. G., Oettinger, M. and Weaver, D. T. (1991). "A link between double-strand break-related repair and V(D)J recombination: the scid mutation." *Proceedings of the National Academy of Sciences* 88(10): 4061-4065. (PubMed)

106. Litman, G. W., Amemiya, C. T., Harding, F. A., Haire, R. N., Hinds, K. R., Litman, R. T., Ohta, Y., Shamblott, M. J. and Varner, J. A. (1991). "Evolutionary development of immunoglobulin gene diversity." *Advances in Experimental Medicine and Biology* 292: 11-17. (PubMed)

107. Warr, G. W. and Cohen, N., eds. (1991). *Phylogenesis of Immune Functions*. Boca Raton, CRC Press. (Library | Amazon | Google Print)

108. Bang, D. D., Verhage, R., Goosen, N., Brouwer, J. and van de Putte, P. (1992). "Molecular cloning of RAD16, a gene involved in differential repair in Saccharomyces cerevisiae." *Nucleic Acids Research* 20(15): 3925-3931. (PubMed)

109. Dreyfus, D. H. (1992). "Evidence suggesting an evolutionary relationship between transposable elements and immune system recombination sequences." *Molecular Immunology* 29(6): 807-810. (Google Scholar | DOI | Journal | PubMed)

X

100: 383. (Google Scholar)

111. Hanley, P. J., Hook, J. W., Raftos, D. A., Gooley, A. A., Trent, R. and Raison, R. L. (1992). "Hagfish humoral defense protein exhibits structural and functional homology with mammalian complement components." *Proceedings of the National Academy of Sciences* 89(17): 7910-7914. (PubMed)

112. Kasahara, M., Vazquez, M., Sato, K., McKinney, E. C. and Flajnik, M. F. (1992). "Evolution of the major histocompatibility complex: isolation of class II A cDNA clones from the cartilaginous fish." *Proceedings of the National Academy of Sciences* 89(15): 6688-6692. (PubMed)

113. Langman, R. E. and Cohn, M. (1992). "What is the selective pressure that maintains the gene loci encoding the antigen receptors of T and B cells? A hypothesis." *Immunology and Cell Biology* 70 (Pt 6): 397-404. (PubMed)

114. Litman, G. W., Haire, R. N., Hinds, K. R., Amemiya, C. T., Rast, J. P. and Hulst, M. (1992). "Evolutionary development of the B-cell repertoire." *Annals of the New York Academy of Sciences* 651: 360-368. (PubMed)

115. Nonaka, M. and Takahashi, M. (1992). "Complete complementary DNA sequence of the third component of complement of lamprey. Implication for the evolution of thioester containing proteins." *Journal of Immunology* 148(10): 3290-3295. (PubMed)

116. Roth, D. B., Nakajima, P. B., Menetski, J. P., Bosma, M. J. and Gellert, M. (1992). "V(D)J recombination in mouse thymocytes: double-strand breaks near T cell receptor delta rearrangement signals." *Cell* 69(1): 41-53. (PubMed)

Immunology 10: 359-383. (PubMed)

118. Síma, P. and Vetvicka, V. (1992). "Evolution of Immune Accessory Functions." *Immune System Accessory Cells*. Edited by L. Fornusek and P. Síma. Boca Raton, CRC Press: 1-55. (Library | Amazon | Google Print)

119. Stewart, J. (1992). "Immunoglobulins did not arise in evolution to fight infection." *Immunology Today* 13(10): 396-399; discussion 399-400. (PubMed)

120. Amemiya, C. T., Ohta, Y., Litman, R. T., Rast, J. P., Haire, R. N. and Litman, G. W. (1993). "VH gene organization in a relict species, the coelacanth Latimeria chalumnae: evolutionary implications." *Proceedings of the National Academy of Sciences* 90(14): 6661-6665. (PubMed)

121. Du Pasquier, L. (1993). "Phylogeny of B-cell development." *Current Opinion in Immunology* 5(2): 185-193. (PubMed)

122. Hinds-Frey, K. R., Nishikata, H., Litman, R. T. and Litman, G. W. (1993). "Somatic variation precedes extensive diversification of germline sequences and combinatorial joining in the evolution of immunoglobulin heavy chain diversity." *Journal of Experimental Medicine* 178(3): 815-824. (PubMed)

123. Kasahara, M., McKinney, E. C., Flajnik, M. F. and Ishibashi, T. (1993). "The evolutionary origin of the major histocompatibility complex: polymorphism of class II alpha chain genes in the cartilaginous fish." *European Journal of Immunology* 23(9): 2160-2165. (PubMed)

124. Litman, G. W., Rast, J. P., Shamblott, M. J., Haire, R. N., Hulst, M., Roess, W., Litman, R. T., Hinds-Frey, K. R., Zilch, A. and Amemiya, C. T. (1993).

125. Sato, K., Flajnik, M. F., Du Pasquier, L., Katagiri, M. and Kasahara, M. (1993). "Evolution of the MHC: isolation of class II beta-chain cDNA clones from the amphibian Xenopus laevis." *Journal of Immunology* 150(7): 2831-2843. (PubMed)

126.* Síma, P. and Vetvicka, V. (1993). "Evolution of immune reactions." *Critical Reviews in Immunology* 13(2): 83-114. (PubMed)

127.* Bartl, S., Baltimore, D. and Weissman, I. L. (1994). "Molecular evolution of the vertebrate immune system." *Proceedings of the National Academy of Sciences* 91(23): 10769-10770. (Google Scholar | Journal | JSTOR | PubMed)

128. Beck, G., Cooper, E. L., Habicht, G. S. and Marchalonis, J. J., eds. (1994). *Primordial Immunity: Foundations for the Vertebrate Immune System*. New York, The New York Academy of Sciences. (Library | PubMed | Publisher | Amazon | Google Print)

129. Davidson, E. H. (1994). "Stepwise Evolution of Major Functional Systems in Vertebrates, Including the Immune System." *Phylogenetic Perspectives in Immunity: The Insect Host Defense*. Edited by J. A. Hoffman, C. A. Janeway and S. Natori. Austin, R.G. Landes Company: 133-142. (Library | Amazon | Google Print)

130. Dodds, A. W. (1994). "Molecular and Phylogenetic Aspects of the Complement System." *Phylogenetic Perspectives in Immunity: The Insect Host Defense*. Edited by J. A. Hoffman, C. A. Janeway and S. Natori. Austin, R.G. Landes Company: 143-155. (Library | Amazon | Google Print)

131. Hoffman, J. A., Janeway, C. A. and Natori, S., eds. (1994). *Phylogenetic Perspectives in Immunity: The Insect Host Defense*. Austin, R. G. Landes Company. (Library | Amazon | Google Print)

Phylogenetic Perspectives in Immunity: The Insect Host Defense. Edited by J. A. Hoffman, C. A. Janeway and S. Natori. Austin, R.G. Landes Company: 79-96. (Library | Amazon | Google Print)

133. Lewis, S. M. (1994). "The mechanism of V(D)J joining: lessons from molecular, immunological, and comparative analyses." *Advances in Immunology* 56: 27-150. (PubMed)

134. Marchalonis, J. J., Hohman, V. S., Kaymaz, H., Schluter, S. F. and Edmundson, A. B. (1994). "Cell Surface Recognition and the Immunoglobulin Superfamily." *Primordial Immunity: Foundations for the Vertebrate Immune System*. Edited by G. Beck, E. L. Cooper, G. S. Habicht and J. J. Marchalonis. New York, New York Academy of Sciences. 712: 20-33. (Library | PubMed | Publisher | Google Print)

135. Marchalonis, J. J. and Schluter, S. F. (1994). "Development of an Immune System." *Primordial Immunity: Foundations for the Vertebrate Immune System*. Edited by G. Beck, E. L. Cooper, G. S. Habicht and J. J. Marchalonis. New York, New York Academy of Sciences. 712: 1-11. (Library | PubMed | Publisher | Google Print)

136. Newton, R. A., Raftos, D. A., Raison, R. L. and Geczy, C. L. (1994). "Chemotactic responses of hagfish (Vertebrata, Agnatha) leucocytes." *Developmental and Comparative Immunology* 18(4): 295-303. (PubMed)

137. Nonaka, M., Takahashi, M. and Sasaki, M. (1994). "Molecular cloning of a lamprey homologue of the mammalian MHC class III gene, complement factor B." *Journal of Immunology* 152(5): 2263-2269. (PubMed)

138. Ohno, S. (1994). "MHC Evolution and Development of a Recognition System." *Primordial Immunity: Foundations for the Vertebrate Immune*

139. Rast, J. P., Anderson, M. K., Ota, T., Litman, R. T., Margittai, M., Shamblott, M. J. and Litman, G. W. (1994). "Immunoglobulin light chain class multiplicity and alternative organizational forms in early vertebrate phylogeny." *Immunogenetics* 40(2): 83-99. (PubMed)

140. Rast, J. P. and Litman, G. W. (1994). "T-cell receptor gene homologs are present in the most primitive jawed vertebrates." *Proceedings of the National Academy of Sciences* 91(20): 9248-9252. (PubMed)

141. Saito, Y., Hirose, E. and Watanabe, H. (1994). "Allorecognition in compound ascidians." *International Journal of Developmental Biology* 38(2): 237-247. (PubMed)

142.* Stewart, J. (1994). *The Primordial VRM System and the Evolution of Vertebrate Immunity*. Austin, R. G. Landes. (Library | Amazon | Google Print)

143. Vetvicka, V., Síma, P., Cooper, E. L., Bilej, M. and Roch, P. (1994). *Immunology of Annelids*. Boca Raton, CRC Press. (Library | Amazon | Google Print)

144. Chu, T. W., Capossela, A., Coleman, R., Goei, V. L., Nallur, G. and Gruen, J. R. (1995). "Cloning of a new "finger" protein gene (ZNF173) within the class I region of the human MHC." *Genomics* 29(1): 229-239. (PubMed)

145. Hoffmann, J. A. (1995). "Innate immunity of insects." *Current Opinion in Immunology* 7(1): 4-10. (PubMed)

146. Kasahara, M., Flajnik, M. F., Ishibashi, T. and Natori, T. (1995). "Evolution of the major histocompatibility complex: a current overview." *Transplant Immunology* 3(1): 1-20. (PubMed)

superfamily." *European Journal of Biochemistry* 230(3): 920-925. (PubMed)

148. McBlane, J. F., van Gent, D. C., Ramsden, D. A., Romeo, C., Cuomo, C. A., Gellert, M. and Oettinger, M. A. (1995). "Cleavage at a V(D)J recombination signal requires only RAG1 and RAG2 proteins and occurs in two steps." *Cell* 83(3): 387-395. (PubMed)

149. Thompson, C. B. (1995). "New insights into V(D)J recombination and its role in the evolution of the immune system." *Immunity* 3(5): 531-539. (Google Scholar | DOI | Journal | PubMed)

150. van Gent, D. C., McBlane, J. F., Ramsden, D. A., Sadofsky, M. J., Hesse, J. E. and Gellert, M. (1995). "Initiation of V(D)J recombination in a cell-free system." *Cell* 81(6): 925-934. (PubMed)

151. Beck, G. and Habicht, G. S. (1996). "Immunity and the invertebrates." *Scientific American* 275(5): 60-63, 66. (Journal)

152. Bernstein, R. M., Schluter, S. F., Bernstein, H. and Marchalonis, J. J. (1996). "Primordial emergence of the recombination activating gene 1 (RAG1): Sequence of the complete shark gene indicates homology to microbial integrases." *Proceedings of the National Academy of Sciences* 93(18): 9454-9459. (Google Scholar | Journal | JSTOR | PubMed)

153. Berstein, R. M., Schluter, S. F., Shen, S. and Marchalonis, J. J. (1996). "A new high molecular weight immunoglobulin class from the carcharhine shark: implications for the properties of the primordial immunoglobulin." *Proceedings of the National Academy of Sciences* 93(8): 3289-3293. (PubMed)

154. Difilippantonio, M. J., McMahan, C. J., Eastman, Q. M., Spanopoulou, E.

155. Fearon, D. T. and Locksley, R. M. (1996). "The instructive role of innate immunity in the acquired immune response." *Science* 272(5258): 50-53. (JSTOR | PubMed)

156. Flajnik, M. F. (1996). "The immune system of ectothermic vertebrates." *Veternary Immunology and Immunopathology* 54(1-4): 145-150. (PubMed)

157. Gellert, M. (1996). "A new view of V(D)J recombination." *Genes to Cells* 1(3): 269-275. (PubMed)

158. Litman, G. W. (1996). "Sharks and the origins of vertebrate immunity." *Scientific American* 275(5): 67-71. (Journal | PubMed)

159. Marchalonis, J. J., Bernstein, R. M., Shen, S. X. and Schluter, S. F. (1996). "Emergence of the immunoglobulin family: conservation in protein sequence and plasticity in gene organization." *Glycobiology* 6(7): 657-663. (PubMed)

160. Muta, T. and Iwanaga, S. (1996). "The role of hemolymph coagulation in innate immunity." *Current Opinion in Immunology* 8(1): 41-47. (PubMed)

161. Shen, S. X., Bernstein, R. M., Schluter, S. F. and Marchalonis, J. J. (1996). "Heavy-chain variable regions in carcharhine sharks: development of a comprehensive model for the evolution of VH domains among the gnathanstomes." *Immunology and Cell Biology* 74(4): 357-364. (PubMed)

162. Spanopoulou, E., Zaitseva, F., Wang, F. H., Santagata, S., Baltimore, D. and Panayotou, G. (1996). "The homeodomain region of Rag-1 reveals the parallel mechanisms of bacterial and V(D)J recombination." *Cell* 87(2): 263-276. (PubMed)

164. van Gent, D. C., Mizuuchi, K. and Gellert, M. (1996). "Similarities between initiation of V(D)J recombination and retroviral integration." *Science* 271(5255): 1592-1594. (Google Scholar | Journal | JSTOR | PubMed)

165. Butler, J. E. (1997). "Immunoglobulin gene organization and the mechanism of repertoire development." *Scandinavian Journal of Immunology* 45(5): 455-462. (PubMed)

166. Gellert, M. (1997). "Recent advances in understanding V(D)J recombination." *Advances in Immunology* 64: 39-64. (PubMed)

167. Hagmann, M. (1997). "RAGged repair: what's new in V(D)J recombination." *Biological Chemistry* 378(8): 815-819. (PubMed)

168. Hughes, A. L. and Yeager, M. (1997). "Molecular evolution of the vertebrate immune system." *BioEssays* 19(9): 777-786. (Google Scholar | PubMed)

169. Ji, X., Azumi, K., Sasaki, M. and Nonaka, M. (1997). "Ancient origin of the complement lectin pathway revealed by molecular cloning of mannan binding protein-associated serine protease from a urochordate, the Japanese ascidian, Halocynthia roretzi." *Proceedings of the National Academy of Sciences* 94(12): 6340-6345. (Google Scholar | Journal | PubMed)

170. Klein, J. (1997). "Homology Between Immune Responses in Vertebrates and Invertebrates: Does it Exist?" *Scandinavian Journal of Immunology* 46(6): 558-564. (Google Scholar | Journal | PubMed)

171. Lewis, S. M. and Wu, G. E. (1997). "The origins of V(D)J recombination."

human homologue of the Drosophila Toll protein signals activation of adaptive immunity." *Nature* 388(6640): 394-397. (PubMed)

173. Medzhitov, R. and Janeway, C. A., Jr. (1997). "Innate immunity: the virtues of a nonclonal system of recognition." *Cell* 91(3): 295-298. (PubMed)

174. Rast, J. P., Anderson, M. K., Strong, S. J., Luer, C., Litman, R. T. and Litman, G. W. (1997). "alpha, beta, gamma, and delta T cell antigen receptor genes arose early in vertebrate phylogeny." *Immunity* 6(1): 1-11. (PubMed)

175. Schluter, S. F., Bernstein, R. M. and Marchalonis, J. J. (1997). "Molecular origins and evolution of immunoglobulin heavy-chain genes of jawed vertebrates." *Immunology Today* 18(11): 543-549. (Google Scholar | DOI | Journal | PubMed)

176. Sunyer, J. O., Tort, L. and Lambris, J. D. (1997). "Structural C3 diversity in fish: characterization of five forms of C3 in the diploid fish Sparus aurata." *Journal of Immunology* 158(6): 2813-2821. (PubMed)

177. Takahashi, H., Ishikawa, G., Ueki, K., Azumi, K. and Yokosawa, H. (1997). "Cloning and tyrosine phosphorylation of a novel invertebrate immunocyte protein containing immunoreceptor tyrosine-based activation motifs." *Journal of Biological Chemistry* 272(51): 32006-32010. (PubMed)

178. Agrawal, A., Eastman, Q. M. and Schatz, D. G. (1998). "Transposition mediated by RAG1 and RAG2 and its implications for the evolution of the immune system." *Nature* 394(6695): 744-751. (Google Scholar | DOI | Journal | PubMed)

179. Al-Sharif, W. Z., Sunyer, J. O., Lambris, J. D. and Smith, L. C. (1998). "Sea urchin coelomocytes specifically express a homologue of the complement

Divining the evolutionary selection pressures that resulted in an immune system." *Cytogenetics and Cell Genetics* 80(1-4): 54-60. (DOI | Journal | PubMed)

181. Diaz, M. and Flajnik, M. F. (1998). "Evolution of somatic hypermutation and gene conversion in adaptive immunity." *Immunological Reviews* 162: 13-24. (PubMed)

182. Dodds, A. W. and Law, S. K. (1998). "The phylogeny and evolution of the thioester bond-containing proteins C3, C4 and alpha 2-macroglobulin." *Immunological Reviews* 166: 15-26. (PubMed)

183. Du Pasquier, L., Wilson, M., Greenberg, A. S. and Flajnik, M. F. (1998). "Somatic mutation in ectothermic vertebrates: musings on selection and origins." *Current Topics in Microbiology and Immunology* 229: 199-216. (PubMed)

184. Flajnik M. (editor) (1998). "The immune systems of ectothermic vertebrates." *Immunological Reviews* 166: 1-384. (PubMed)

185. Hiom, K., Melek, M. and Gellert, M. (1998). "DNA transposition by the RAG1 and RAG2 proteins: a possible source of oncogenic translocations." *Cell* 94(4): 463-470. (Google Scholar | DOI | Journal | PubMed)

186. Iwanaga, S. and Kawabata, S. (1998). "Evolution and phylogeny of defense molecules associated with innate immunity in horseshoe crab." *Frontiers in Bioscience* 3: D973-984. (PubMed)

187. Kennedy, A. K., Guhathakurta, A., Kleckner, N. and Haniford, D. B. (1998). "Tn10 transposition via a DNA hairpin intermediate." *Cell* 95(1): 125-134. (PubMed)

189. Marchalonis, J. J., Schluter, S. F., Bernstein, R. M. and Hohman, V. S. (1998). "Antibodies of sharks: revolution and evolution." *Immunological Reviews* 166: 103-122. (PubMed)

190. Marchalonis, J. J., Schluter, S. F., Bernstein, R. M., Shen, S. and Edmundson, A. B. (1998). "Phylogenetic emergence and molecular evolution of the immunoglobulin family." *Advances in Immunology* 70: 417-506. (PubMed)

191. Marchalonis, J. J. and Schluter, S. F. (1998). "A stochastic model for the rapid emergence of specific vertebrate immunity incorporating horizontal transfer of systems enabling duplication and combinational diversification." *Journal of Theoretical Biology* 193(3): 429-444. (PubMed)

192. Matsunaga, T. and Rahman, A. (1998). "What brought the adaptive immune system to vertebrates?--The jaw hypothesis and the seahorse." *Immunological Reviews* 166: 177-186. (PubMed)

193. Matsushita, M., Endo, Y., Nonaka, M. and Fujita, T. (1998). "Complement-related serine proteases in tunicates and vertebrates." *Current Opinion in Immunology* 10(1): 29-35. (PubMed)

194. Medzhitov, R. and Janeway, C. A., Jr. (1998). "An ancient system of host defense." *Current Opinion in Immunology* 10(1): 12-15. (PubMed)

195. Plasterk, R. (1998). "Ragtime jumping." *Nature* 394(6695): 718-719. (Google Scholar | DOI | Journal | PubMed)

196. Rast, J. P. and Litman, G. W. (1998). "Towards understanding the evolutionary origins and early diversification of rearranging antigen

Lambris, J. D. (1998). "Structure, functions, and evolution of the third complement component and viral molecular mimicry." *Immunologic Research* 17(1-2): 109-121. (PubMed)

198. Smith, L. C., Shih, C. S. and Dachenhausen, S. G. (1998). "Coelomocytes express SpBf, a homologue of factor B, the second component in the sea urchin complement system." *Journal of Immunology* 161(12): 6784-6793. (PubMed)

199. Smith, S. L. (1998). "Shark complement: an assessment." *Immunological Reviews* 166: 67-78. (PubMed)

200. Sunyer, J. O. and Lambris, J. D. (1998). "Evolution and diversity of the complement system of poikilothermic vertebrates." *Immunological Reviews* 166: 39-57. (PubMed)

201. Sunyer, J. O., Zarkadis, I. K. and Lambris, J. D. (1998). "Complement diversity: a mechanism for generating immune diversity?" *Immunology Today* 19(11): 519-523. (PubMed)

202. Vetvicka, V. and Síma, P. (1998). *Evolutionary Mechanisms of Defense Reactions*. Basel, Birkhäuser Verlag. (Library | Amazon | Google Print)

203. Vilmos, P. and Kurucz, E. (1998). "Insect immunity: evolutionary roots of the mammalian innate immune system." *Immunology Letters* 62(2): 59-66. (PubMed)

204. Armstrong, P. B. and Quigley, J. P. (1999). "Alpha2-macroglobulin: an evolutionarily conserved arm of the innate immune system." *Developmental and Comparative Immunology* 23(4-5): 375-390. (PubMed)

and Comparative Immunology 23(1): 1-14. (PubMed)

206. Flajnik, M. F., Ohta, Y., Namikawa-Yamada, C. and Nonaka, M. (1999). "Insight into the primordial MHC from studies in ectothermic vertebrates." *Immunological Reviews* 167: 59-67. (PubMed)

207. Gross, P. S., Al-Sharif, W. Z., Clow, L. A. and Smith, L. C. (1999). "Echinoderm immunity and the evolution of the complement system." *Developmental and Comparative Immunology* 23(4-5): 429-442. (PubMed)

208. Hoffmann, J. A., Kafatos, F. C., Janeway, C. A. and Ezekowitz, R. A. (1999). "Phylogenetic perspectives in innate immunity." *Science* 284(5418): 1313-1318. (PubMed)

209. Lewis, S. M. (1999). "Evolution of Immunoglobulin and T-Cell Receptor Gene Assembly." *Annals of the New York Academy of Sciences* 870: 58-67. (Google Scholar | Journal | PubMed)

210. Litman, G. W., Anderson, M. K. and Rast, J. P. (1999). "Evolution of antigen binding receptors." *Annual Review of Immunology* 17: 109-147. (Google Scholar | DOI | Journal | PubMed)

211. Magor, B. G., De Tomaso, A., Rinkevich, B. and Weissman, I. L. (1999). "Allorecognition in colonial tunicates: protection against predatory cell lineages?" *Immunological Reviews* 167: 69-79. (PubMed)

212. Nonaka, M., Azumi, K., Ji, X., Namikawa-Yamada, C., Sasaki, M., Saiga, H., Dodds, A. W., Sekine, H., Homma, M. K., Matsushita, M., Endo, Y. and Fujita, T. (1999). "Opsonic complement component C3 in the solitary ascidian, Halocynthia roretzi." *Journal of Immunology* 162(1): 387-391. (PubMed)

214. Parham P. (editor) (1999). "Genomic organisation of the MHC: structure, origin and function." *Immunological Reviews* 167: 1-379. (Google Scholar)

215. Schatz, D. G. (1999). "Transposition mediated by RAG1 and RAG2 and the evolution of the adaptive immune system." *Immunologic Research* 19(2-3): 169-182. (Google Scholar | PubMed)

216. Schluter, S. F., Bernstein, R. M., Bernstein, H. and Marchalonis, J. J. (1999). "'Big Bang' emergence of the combinatorial immune system." *Developmental and Comparative Immunology* 23(2): 107-111. (Google Scholar | DOI | Journal | PubMed)

217. Smith, L. C., Azumi, K. and Nonaka, M. (1999). "Complement systems in invertebrates. The ancient alternative and lectin pathways." *Immunopharmacology* 42(1-3): 107-120. (PubMed)

218. Du Pasquier, L. (2000). "The Phylogenetic Origin of Antigen-Specific Receptors." *Origin and Evolution of the Vertebrate Immune System*. Edited by L. Du Pasquier and G. W. Litman. Berlin, Springer. 248: 159-185. (Library | PubMed | Amazon | Google Print)

219. Du Pasquier, L. and Litman, G. W., eds. (2000). *Origin and Evolution of the Vertebrate Immune System*. Current Topics in Microbiology and Immunology. Berlin, Springer. (Library | Publisher | Amazon | Google Print)

220. Flajnik, M. F. and Rumfelt, L. L. (2000). "Early and natural antibodies in non-mammalian vertebrates." *Current Topics in Microbiology and Immunology* 252: 233-240. (PubMed)

221. Flajnik, M. F. and Rumfelt, L. L. (2000). "The immune system of

222. Grosberg, R. K. and Hart, M. W. (2000). "Mate selection and the evolution of highly polymorphic self/nonself recognition genes." *Science* 289(5487): 2111-2114. (PubMed)

223. Gross, P. S., Clow, L. A. and Smith, L. C. (2000). "SpC3, the complement homologue from the purple sea urchin, Strongylocentrotus purpuratus, is expressed in two subpopulations of the phagocytic coelomocytes." *Immunogenetics* 51(12): 1034-1044. (PubMed)

224. Hansen, J. D. and McBlane, J. F. (2000). "Recombination-Activating Genes, Transposition, and the Lymphoid-Specific Combinatorial Immune System: A Common Evolutionary Connection." *Origin and Evolution of the Vertebrate Immune System*. Edited by L. Du Pasquier and G. W. Litman. Berlin, Springer. 248: 111-135. (Library | PubMed | Amazon | Google Print)

225. Hassanin, A., Golub, R., Lewis, S. M. and Wu, G. E. (2000). "Evolution of the recombination signal sequences in the Ig heavy-chain variable region locus of mammals." *Proceedings of the National Academy of Sciences* 97(21): 11415-11420. (PubMed)

226. Ishikawa, G., Azumi, K. and Yokosawa, H. (2000). "Involvement of tyrosine kinase and phosphatidylinositol 3-kinase in phagocytosis by ascidian hemocytes." *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology* 125(3): 351-357. (Journal | PubMed)

227. Laird, D. J., De Tomaso, A. W., Cooper, M. D. and Weissman, I. L. (2000). "50 million years of chordate evolution: seeking the origins of adaptive immunity." *Proceedings of the National Academy of Sciences* 97(13): 6924-6926. (PubMed)

228. Lee, S. S., Fitch, D., Flajnik, M. F. and Hsu, E. (2000). "Rearrangement of

229. Lewis, S. M. and Wu, G. E. (2000). "The old and the restless." *Journal of Experimental Medicine* 191(10): 1631-1636. (Google Scholar | DOI | Journal | PubMed)

230. Meister, M., Hetru, C. and Hoffmann, J. A. (2000). "The antimicrobial host defense of Drosophila." *Current Topics in Microbiology and Immunology* 248: 17-36. (PubMed)

231. Nair, S. V., Pearce, S., Green, P. L., Mahajan, D., Newton, R. A. and Raftos, D. A. (2000). "A collectin-like protein from tunicates." *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology* 125(2): 279-289. (Journal | PubMed)

232. Nonaka, M. and Smith, S. L. (2000). "Complement system of bony and cartilaginous fish." *Fish & Shellfish Immunology* 10(3): 215-228. (PubMed)

233. Nonaka, M. (2000). "Origin and evolution of the Complement System." *Origin and Evolution of the Vertebrate Immune System*. Edited by L. Du Pasquier and G. W. Litman. Berlin, Springer. 248: 37-50. (Library | PubMed | Amazon | Google Print)

234. Opal, S. M. (2000). "Phylogenetic and functional relationships between coagulation and the innate immune response." *Critical Care Medicine* 28(9): S77-S80. (Google Scholar | Journal | PubMed)

235. Richards, M. H. and Nelson, J. L. (2000). "The Evolution of Vertebrate Antigen Receptors: A Phylogenetic Approach." *Molecular Biology and Evolution* 17(1): 146-155. (Google Scholar | Journal | PubMed)

236. Roth, D. B. (2000). "From lymphocytes to sharks: V(D)J recombinase moves to the germline." *Genome Biology* 1(2): 1014.1011-1014.1014.

"V(D)J recombinase-mediated transposition of the BCL2 gene to the IGH locus in follicular lymphoma." *Blood* 96(5): 1947-1952. (Google Scholar | Journal | PubMed)

238. De Gregorio, E., Spellman, P. T., Rubin, G. M. and Lemaitre, B. (2001). "Genome-wide analysis of the Drosophila immune response by using oligonucleotide microarrays." *Proceedings of the National Academy of Sciences* 98(22): 12590-12595. (PubMed)

239. Du Pasquier, L. (2001). "The immune system of invertebrates and vertebrates." *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology* 129(1): 1-15. (Google Scholar | DOI | Journal | PubMed)

240. Flajnik, M. F. and Kasahara, M. (2001). "Comparative genomics of the MHC: glimpses into the evolution of the adaptive immune system." *Immunity* 15(3): 351-362. (PubMed)

241. Kairies, N., Beisel, H. G., Fuentes-Prior, P., Tsuda, R., Muta, T., Iwanaga, S., Bode, W., Huber, R. and Kawabata, S. (2001). "The 2.0-A crystal structure of tachylectin 5A provides evidence for the common origin of the innate immunity and the blood coagulation systems." *Proceedings of the National Academy of Sciences* 98(24): 13519-13524. (PubMed)

242. Kimbrell, D. A. and Beutler, B. (2001). "The evolution and genetics of innate immunity." *Nature Reviews Genetics* 2(4): 256-267. (PubMed)

243. Magor, B. G. and Magor, K. E. (2001). "Evolution of effectors and receptors of innate immunity." *Developmental and Comparative Immunology* 25(8-9): 651-682. (PubMed)

Medicine and Biology 484: 13-30. (PubMed)

245. Miyazawa, S., Azumi, K. and Nonaka, M. (2001). "Cloning and characterization of integrin alpha subunits from the solitary ascidian, Halocynthia roretzi." *Journal of Immunology* 166(3): 1710-1715. (PubMed)

246. Mushegian, A. and Medzhitov, R. (2001). "Evolutionary perspective on innate immune recognition." *Journal of Cell Biology* 155(5): 705-710. (PubMed)

247. Nonaka, M. (2001). "Evolution of the complement system." *Current Opinion in Immunology* 13(1): 69-73. (PubMed)

248. Nonaka, M. and Miyazawa, S. (2001). "Evolution of the Initiating Enzymes of the Complement System." *Genome Biology* 3(1): 1001.1001-1001.1005. (Google Scholar | DOI | Journal | PubMed)

249. Ramsland, P. A., Kaushik, A., Marchalonis, J. J. and Edmundson, A. B. (2001). "Incorporation of long CDR3s into V domains: implications for the structural evolution of the antibody-combining site." *Experimental and Clinical Immunogenetics* 18(4): 176-198. (DOI | Journal | PubMed)

250. Rumfelt, L. L., Avila, D., Diaz, M., Bartl, S., McKinney, E. C. and Flajnik, M. F. (2001). "A shark antibody heavy chain encoded by a nonsomatically rearranged VDJ is preferentially expressed in early development and is convergent with mammalian IgG." *Proceedings of the National Academy of Sciences* 98(4): 1775-1780. (PubMed)

251. Sahu, A. and Lambris, J. D. (2001). "Structure and biology of complement protein C3, a connecting link between innate and acquired immunity." *Immunological Reviews* 180: 35-48. (PubMed)

(PubMed)

253. Xu, Y., Narayana, S. V. and Volanakis, J. E. (2001). "Structural biology of the alternative pathway convertase." *Immunological Reviews* 180: 123-135. (PubMed)

254. Zarkadis, I. K., Mastellos, D. and Lambris, J. D. (2001). "Phylogenetic aspects of the complement system." *Developmental and Comparative Immunology* 25(8-9): 745-762. (Google Scholar | DOI | Journal | PubMed)

255. Banerjee-Basu, S. and Baxevanis, A. D. (2002). "The DNA-binding region of RAG 1 is not a homeodomain." *Genome Biology* 3(8): interactions1004.1001-1004.1004. (DOI | Journal | PubMed)

256. Beck, G., Ellis, T. W., Habicht, G. S., Schluter, S. F. and Marchalonis, J. J. (2002). "Evolution of the acute phase response: iron release by echinoderm (Asterias forbesi) coelomocytes, and cloning of an echinoderm ferritin molecule." *Developmental and Comparative Immunology* 26(1): 11-26. (PubMed)

257. Cannon, J. P., Haire, R. N. and Litman, G. W. (2002). "Identification of diversified genes that contain immunoglobulin-like variable regions in a protochordate." *Nature Immunology* 3(12): 1200-1207. (Google Scholar | DOI | Journal | PubMed)

258. Cohn, M. (2002). "The immune system: a weapon of mass destruction invented by evolution to even the odds during the war of the DNAs." *Immunological Reviews* 185: 24-38. (PubMed)

259. Du Pasquier, L. (2002). "Several MHC-linked Ig superfamily genes have features of ancestral antigen-specific receptor genes." *Current Topics in*

surprises and portents." *Nature Reviews Immunology* 2(9): 688-698. (Google Scholar | DOI | Journal | PubMed)

261. Fujita, T. (2002). "Evolution of the lectin-complement pathway and its role in innate immunity." *Nature Reviews Immunology* 2(5): 346-353. (PubMed)

262. Gellert, M. (2002). "V(D)J recombination: RAG proteins, repair factors, and regulation." *Annual Review of Biochemistry* 71: 101-132. (PubMed)

263. Greenberg, A. S., Avila, D., Hughes, M., Hughes, A., McKinney, E. C. and Flajnik, M. F. (2002). "A new antigen receptor gene family that undergoes rearrangement and extensive somatic diversification in sharks." *Nature* 374(6518): 168-173. (Google Scholar | DOI | Journal | PubMed)

264. Hoffmann, J. A. and Reichhart, J. M. (2002). "Drosophila innate immunity: an evolutionary perspective." *Nature Immunology* 3(2): 121-126. (PubMed)

265. Kaufman, J. (2002). "The origins of the adaptive immune system: whatever next?" *Nature Immunology* 3(12): 1124-1125. (Google Scholar | DOI | Journal | PubMed)

266. Krem, M. M. and Di Cera, E. (2002). "Evolution of enzyme cascades from embryonic development to blood coagulation." *Trends in Biochemical Sciences* 27(2): 67-74. (Google Scholar | DOI | Journal | PubMed)

267. Laird, D. J. (2002). "Immune System." *Encyclopedia of Evolution*. Edited by M. Pagel. Oxford, Oxford University Press. 2: 558-564. (Library | Publisher | Amazon | Google Print)

269. Marchalonis, J. J., Jensen, I. and Schluter, S. F. (2002). "Structural, antigenic and evolutionary analyses of immunoglobulins and T cell receptors." *Journal of Molecular Recognition* 15(5): 260-271. (Google Scholar | DOI | Journal | PubMed)

270. Marchalonis, J. J., Kaveri, S., Lacroix-Desmazes, S. and Kazatchkine, M. D. (2002). "Natural recognition repertoire and the evolutionary emergence of the combinatorial immune system." *FASEB Journal* 16(8): 842-848. (Google Scholar | Journal | PubMed)

271. Mayer, W. E., Uinuk-Ool, T., Tichy, H., Gartland, L. A., Klein, J. and Cooper, M. D. (2002). "Isolation and characterization of lymphocyte-like cells from a lamprey." *Proceedings of the National Academy of Sciences* 99(22): 14350-14355. (Google Scholar | DOI | Journal | PubMed)

272. Menezes, H. and Jared, C. (2002). "Immunity in plants and animals: common ends through different means using similar tools." *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology* 132(1): 1-7. (Journal | PubMed)

273. Neuberger, M. S. (2002). "Novartis Medal Lecture. Antibodies: a paradigm for the evolution of molecular recognition." *Biochemical Society Transactions* 30(4): 341-350. (Journal | PubMed)

274. Nurnberger, T. and Brunner, F. (2002). "Innate immunity in plants and animals: emerging parallels between the recognition of general elicitors and pathogen-associated molecular patterns." *Current Opinion in Plant Biology* 5(4): 318-324. (PubMed)

275. Suzuki, M. M., Satoh, N. and Nonaka, M. (2002). "C6-like and C3-like

276. Terado, T., Nonaka, M. I., Nonaka, M. and Kimura, H. (2002). "Conservation of the modular structure of complement factor I through vertebrate evolution." *Developmental and Comparative Immunology* 26(5): 403-413. (PubMed)

277. Uinuk-Ool, T., Mayer, W. E., Sato, A., Dongak, R., Cooper, M. D. and Klein, J. (2002). "Lamprey lymphocyte-like cells express homologs of genes involved in immunologically relevant activities of mammalian lymphocytes." *Proceedings of the National Academy of Sciences* 99(22): 14356-14361. (Google Scholar | DOI | Journal | PubMed)

278. Altmann, S. M., Mellon, M. T., Distel, D. L. and Kim, C. H. (2003). "Molecular and functional analysis of an interferon gene from the zebrafish, Danio rerio." *Journal of Virology* 77(3): 1992-2002. (PubMed)

279. Azumi, K., De Santis, R., De Tomaso, A., Rigoutsos, I., Yoshizaki, F., Pinto, M. R., Marino, R., Shida, K., Ikeda, M., Arai, M., Inoue, Y., Shimizu, T., Satoh, N., Rokhsar, D. S., Du Pasquier, L., Kasahara, M., Satake, M. and Nonaka, M. (2003). "Genomic analysis of immunity in a Urochordate and the emergence of the vertebrate immune system: "waiting for Godot"." *Immunogenetics* 55(8): 570-581. (PubMed)

280. Bartl, S., Miracle, A. L., Rumfelt, L. L., Kepler, T. B., Mochon, E., Litman, G. W. and Flajnik, M. F. (2003). "Terminal deoxynucleotidyl transferases from elasmobranchs reveal structural conservation within vertebrates." *Immunogenetics* 55(9): 594-604. (PubMed)

281. Clatworthy, A. E., Valencia, M. A., Haber, J. E. and Oettinger, M. A. (2003). "V(D)J recombination and RAG-mediated transposition in yeast." *Molecular Cell* 12(2): 489-499. (Google Scholar | DOI | Journal | PubMed)

Philadelphia, Lippincott Williams & Wilkins: 519-570. (Library | Amazon | Google Print)

283. Market, E. and Papavasiliou, F. N. (2003). "V(D)J Recombination and the Evolution of the Adaptive Immune System." *PLoS Biology* 1(1): 24-27. (Google Scholar | DOI | Journal | PubMed)

284. Messier, T. L., O'Neill, J. P., Hou, S.-M., Nicklas, J. A. and Finette, B. A. (2003). "In vivo transposition mediated by V(D)J recombinase in human T lymphocytes." *The EMBO Journal* 22(6): 1381-1388. (Google Scholar | DOI | Journal | PubMed)

285. Ohinata, Y., Sutou, S. and Mitsui, Y. (2003). "A novel testis-specific RAG2-like protein, Peas: its expression in pachytene spermatocyte cytoplasm and meiotic chromatin." *FEBS Letters* 537(1-3): 1-5. (PubMed)

286. Ota, T., Rast, J. P., Litman, G. W. and Amemiya, C. T. (2003). "Lineage-restricted retention of a primitive immunoglobulin heavy chain isotype within the Dipnoi reveals an evolutionary paradox." *Proceedings of the National Academy of Sciences* 100(5): 2501-2506. (PubMed)

287. Rothenberg, E. V. and Davidson, E. H. (2003). "Regulatory Co-options in the Evolution of Deuterostome Immune Systems." *Innate Immunity*. Edited by R. A. B. Ezekowitz and J. A. Hoffman. Totowa, NJ, Humana Press: 61-87. (Google Print)

288. Schluter, S. F. and Marchalonis, J. J. (2003). "Cloning of shark RAG2 and characterization of the RAG1/RAG2 gene locus." *FASEB Journal* 17(3): 470-472. (PubMed)

289. Sunyer, J. O., Boshra, H., Lorenzo, G., Parra, D., Freedman, B. and Bosch,

290. Adelman, M. K., Schluter, S. F. and Marchalonis, J. J. (2004). "The natural antibody repertoire of sharks and humans recognizes the potential universe of antigens." *Protein Journal* 23(2): 103-118. (Google Scholar | PubMed)

291. Anderson, M. K., Pant, R., Miracle, A. L., Sun, X., Luer, C. A., Walsh, C. J., Telfer, J. C., Litman, G. W. and Rothenberg, E. V. (2004). "Evolutionary origins of lymphocytes: ensembles of T cell and B cell transcriptional regulators in a cartilaginous fish." *Journal of Immunology* 172(10): 5851-5860. (PubMed)

292. Cannon, J. P., Haire, R. N., Rast, J. P. and Litman, G. W. (2004). "The phylogenetic origins of the antigen-binding receptors and somatic diversification mechanisms." *Immunological Reviews* 200(1): 12-22. (Google Scholar | DOI | Journal | PubMed)

293. Davis, M. M. (2004). "The evolutionary and structural 'logic' of antigen receptor diversity." *Seminars in Immunology* 16: 239-243. (Google Scholar | DOI | Journal | PubMed)

294. Du Pasquier, L., Zucchetti, I. and De Santis, R. (2004). "Immunoglobulin superfamily receptors in protochordates: before RAG time." *Immunological Reviews* 198: 233-248. (PubMed)

295. Du Pasquier, L. (2004). "Speculations on the origin of the vertebrate immune system." *Immunology Letters* 92(1-2): 3-9. (PubMed)

296. Eason, D. D., Cannon, J. P., Haire, R. N., Rast, J. P., Ostrov, D. A. and Litman, G. W. (2004). "Mechanisms of antigen receptor evolution." *Seminars in Immunology* 16: 215-226. (Google Scholar | DOI | Journal | PubMed)

297. Flajnik, M. F. and Du Pasquier, L. (2004). "Evolution of innate and

298. Flajnik, M. F. (2004). "Immunology: another manifestation of GOD." *Nature* 430(6996): 157-158. (Google Scholar | DOI | Journal | PubMed)

299. Fujita, T., Matsushita, M. and Endo, Y. (2004). "The lectin-complement pathway--its role in innate immunity and evolution." *Immunological Reviews* 198: 185-202. (PubMed)

300. Fujita, T., Endo, Y. and Nonaka, M. (2004). "Primitive complement system--recognition and activation." *Molecular Immunology* 41(2-3): 103-111. (PubMed)

301. Galaktionov, V. G. (2004). "Evolutionary Development of the Immunoglobulin Family." *Biology Bulletin* 31(2): 101-111. (Google Scholar | DOI | Journal | PubMed)

302. Girardin, S. E. and Philpott, D. J. (2004). "Mini-review: the role of peptidoglycan recognition in innate immunity." *European Journal of Immunology* 34(7): 1777-1782. (PubMed)

303. Gould, S. J., Hildreth, J. E. and Booth, A. M. (2004). "The evolution of alloimmunity and the genesis of adaptive immunity." *Quarterly Review of Biology* 79(4): 359-382. (Google Scholar | DOI | Journal | PubMed)

304. Haynes, M. R. and Wu, G. E. (2004). "Evolution of the variable gene segments and recombination signal sequences of the human T-cell receptor alpha/delta locus." *Immunogenetics* 56(7): 470-479. (PubMed)

305. Holmes, E. C. (2004). "Adaptation and Immunity." *PLoS Biology* 2(9): 1269-1269. (Google Scholar | DOI | Journal | PubMed)

306. Jones, J. M. (2004). "The taming of a transposon: V(D)J recombination

307. Kasahara, M., Suzuki, T. and Du Pasquier, L. (2004). "On the origins of the adaptive immune system: novel insights from invertebrates and cold-blooded vertebrates." *Trends in Immunology* 25(2): 105-111. (PubMed)

308. Khalturin, K., Panzer, Z., Cooper, M. D. and Bosch, T. C. (2004). "Recognition strategies in the innate immune system of ancestral chordates." *Molecular Immunology* 41(11): 1077-1087. (PubMed)

309. Miyazawa, S. and Nonaka, M. (2004). "Characterization of novel ascidian beta integrins as primitive complement receptor subunits." *Immunogenetics* 55(12): 836-844. (PubMed)

310. Nonaka, M. and Yoshizaki, F. (2004). "Primitive complement system of invertebrates." *Immunological Reviews* 198: 203-215. (PubMed)

311. Nonaka, M. and Yoshizaki, F. (2004). "Evolution of the Complement System." *Molecular Immunology* 40(12): 897-902. (Google Scholar | DOI | Journal | PubMed)

312. Opal, S. M. (2004). "The nexus between systemic inflammation and disordered coagulation in sepsis." *Journal of Endotoxin Research* 10(2): 125-129. (PubMed)

313. Pancer, Z., Amemiya, C. T., Ehrhardt, G. R. A., Ceitlin, J., Gartland, G. L. and Cooper, M. D. (2004). "Somatic diversification of variable lymphocyte receptors in the agnathan sea lamprey." *Nature* 430(6996): 174-180. (Google Scholar | DOI | Journal | PubMed)

314. Poitrineau, K., Brown, S. P. and Hochberg, M. E. (2004). "The joint evolution of defence and inducibility against natural enemies." *Journal of Theoretical Biology* 231(3): 389-396. (PubMed)

Subcellular Biology 34: 165-182. (PubMed)

316. Rinkevich, B. (2004). "Primitive immune systems: are your ways my ways?" *Immunological Reviews* 198: 25-35. (PubMed)

317. Rothenberg, E. V. and Pant, R. (2004). "Origins of lymphocyte developmental programs: transcription factor evidence." *Seminars in Immunology* 16(4): 227-238. (Google Scholar | DOI | Journal | PubMed)

318. Schatz, D. G. (2004). "Antigen receptor genes and the evolution of a recombinase." *Seminars in Immunology* 16(4): 245-256. (Google Scholar | DOI | Journal | PubMed)

319. Stavnezer, J. and Amemiya, C. T. (2004). "Evolution of isotype switching." *Seminars in Immunology* 16(4): 257-275. (Google Scholar | DOI | Journal | PubMed)

320. Suzuki, T., Shin, I. T., Kohara, Y. and Kasahara, M. (2004). "Transcriptome analysis of hagfish leukocytes: a framework for understanding the immune system of jawless fishes." *Developmental and Comparative Immunology* 28(10): 993-1003. (PubMed)

321. van den Berg, T. K., Yoder, J. A. and Litman, G. W. (2004). "On the origins of adaptive immunity: innate immune receptors join the tale." *Trends in Immunology* 25(1): 11-16. (PubMed)

322. Xiao, Y., Hughes, A. L., Ando, J., Matsuda, Y., Cheng, J. F., Skinner-Noble, D. and Zhang, G. (2004). "A genome-wide screen identifies a single beta-defensin gene cluster in the chicken: implications for the origin and evolution of mammalian defensins." *BMC Genomics* 5(1): 56. (PubMed)

| PubMed)

324. Alder, M. N., Rogozin, I. B., Iyer, L. M., Glazko, G. V., Cooper, M. D. and Pancer, Z. (2005). "Diversity and function of adaptive immune receptors in a jawless vertebrate." *Science* 310(5756): 1970-1973. (PubMed)

325. Cannon, J. P., Haire, R. N., Pancer, Z., Mueller, M. G., Skapura, D., Cooper, M. D. and Litman, G. W. (2005). "Variable Domains and a VpreB-like molecule are present in a jawless vertebrate." *Immunogenetics* 56(12): 924-929. (Google Scholar | DOI | Journal | PubMed)

326. Cohn, M. (2005). "The common sense of the self-nonself discrimination." *Springer Seminars in Immunopathology* 27(1): 3-17. (PubMed)

327. Czompoly, T., Olasz, K., Simon, D., Nyarady, Z., Palinkas, L., Czirjak, L., Berki, T. and Nemeth, P. (2005). "A possible new bridge between innate and adaptive immunity: Are the anti-mitochondrial citrate synthase autoantibodies components of the natural antibody network?" *Molecular Immunology*. (PubMed)

328. De Tomaso, A. W., Nyholm, S. V., Palmeri, K. J., Ishizuka, K. J., Ludington, W. B., Mitchel, K. and Weissman, I. L. (2005). "Isolation and characterization of a protochordate histocompatibility locus." *Nature* 438(7067): 454-459. (DOI | Journal | PubMed)

329. Du Pasquier, L. (2005). "Germline and somatic diversification of immune recognition elements in Metazoa." *Immunology Letters*. (PubMed)

330. Du Pasquier, L. (2005). "Meeting the demand for innate and adaptive immunities during evolution." *Scandinavian Journal of Immunology* 62(s1):

system: consequences for evolution of human autoimmune disease." *Nature Reviews Immunology* 5(5): 420-426. (PubMed)

332. Janssen, B. J. C., Huizinga1, E. G., Raaijmakers, H. C. A., Roos, A., Daha, M. R., Nilsson-Ekdahl, K., Nilsson, B. and Gros, P. (2005). "Structures of complement component C3 provide insights into the function and evolution of immunity." *Nature* 437(7058): 505-511. (Google Scholar | DOI | Journal | PubMed)

333. Kapitonov, V. V. and Jurka, J. (2005). "RAG1 Core and V(D)J Recombination Signal Sequences Were Derived from Transib Transposons." *PLoS Biology* 3(6): e181:0001-0014. (Google Scholar | DOI | Journal | PubMed)

334.* Klein, J. and Nikolaidis, N. (2005). "The descent of the antibody-based immune system by gradual evolution." *Proceedings of the National Academy of Sciences* 102(1): 169-174. (Google Scholar | DOI | Journal | PubMed)

335. Liddington, R. and Bankston, L. (2005). "Structural biology: origins of chemical biodefence." *Nature* 437(7058): 484-485. (PubMed)

336. Litman, G. W., Cannon, J. P. and Dishaw, L. J. (2005). "Reconstructing immune phylogeny: new perspectives." *Nature Reviews Immunology* 5(11): 866-879. (PubMed)

337. Litman, G. W., Cannon, J. P. and Rast, J. P. (2005). "New insights into alternative mechanisms of immune receptor diversification." *Advances in Immunology* 87: 209-236. (PubMed)

338. Litman, G. W. (2005). "Histocompatibility: colonial match and

innate immune systems from fruit flies to man: lessons and questions." *Journal of Endotoxin Research* 11(4): 243-248. (PubMed)

340. Pancer, Z., Saha, N. R., Kasamatsu, J., Suzuki, T., Amemiya, C. T., Kasahara, M. and Cooper, M. D. (2005). "Variable lymphocyte receptors in hagfish." *Proceedings of the National Academy of Sciences* 102(26): 9224-9229. (PubMed)

341. Plouffe, D. A., Hanington, P. C., Walsh, J. G., Wilson, E. C. and Belosevic, M. (2005). "Comparison of select innate immune mechanisms of fish and mammals." *Xenotransplantation* 12(4): 266-277. (PubMed)

342. Prugnolle, F., Manica, A., Charpentier, M., Guegan, J. F., Guernier, V. and Balloux, F. (2005). "Pathogen-driven selection and worldwide HLA class I diversity." *Current Biology* 15(11): 1022-1027. (PubMed)

343. Schatz, D. G. and Spanopoulou, E. (2005). "Biochemistry of V(D)J recombination." *Current Topics in Microbiology and Immunology* 290: 49-85. (Google Scholar | Journal | PubMed)

344. Sunyer, J. O., Boshra, H. and Li, J. (2005). "Evolution of anaphylatoxins, their diversity and novel roles in innate immunity: insights from the study of fish complement." *Veterinary Immunology and Immunopathology* 108(1-2): 77-89. (PubMed)

345. Suzuki, T., Shin, I. T., Fujiyama, A., Kohara, Y. and Kasahara, M. (2005). "Hagfish leukocytes express a paired receptor family with a variable domain resembling those of antigen receptors." *Journal of Immunology* 174(5): 2885-2891. (PubMed)

346. Yoshizaki, F. Y., Ikawa, S., Satake, M., Satoh, N. and Nonaka, M. (2005).

347. Belov, K., Deakin, J. E., Papenfuss, A. T., Baker, M. L., Melman, S. D., Siddle, H. V., Gouin, N., Goode, D. L., Sargeant, T. J., Robinson, M. D., Wakefield, M. J., Mahony, S., Cross, J. G., Benos, P. V., Samollow, P. B., Speed, T. P., Graves, J. A. and Miller, R. D. (2006). "Reconstructing an Ancestral Mammalian Immune Supercomplex from a Marsupial Major Histocompatibility Complex." *PLoS Biology* 4(3): e46. (PubMed)

348. Boehm, T. (2006). "Co-evolution of a primordial peptide-presentation system and cellular immunity." *Nature Reviews Immunology* 6(1): 79-84. (DOI | Journal | PubMed)

349. Cohn, M. (2006). "What are the commonalities governing the behavior of humoral immune recognitive repertoires?" *Developmental and Comparative Immunology* 30(1-2): 19-42. (Google Scholar | DOI | Journal | PubMed)

350. Cooper, M. D. and Alder, M. N. (2006). "The Evolution of Adaptive Immune Systems." *Cell* 124(4): 815-822. (Google Scholar | DOI | Journal | PubMed)

351. Danilova, N. (2006). "The evolution of immune mechanisms." *Journal of Experimental Zoology, Part B: Molecular and Developmental Evolution*. (Google Scholar | DOI | Journal | PubMed)

352. Fugmann, S. D., Messier, C., Novack, L. A., Cameron, R. A. and Rast, J. P. (2006). "An ancient evolutionary origin of the Rag1/2 gene locus." *Proceedings of the National Academy of Sciences* 103(10): 3728-3733. (DOI | Journal | PubMed)

353. Joly, E. (2006). "Various hypotheses on MHC evolution suggested by the

354. Joly, E. and Rouillon, V. (2006). "The orthology of HLA-E and H2-Qa1 is hidden by their concerted evolution with other MHC class I molecules." *Biology Direct* 1(1): 2. (Google Scholar | DOI | Journal | PubMed)

355. Marchalonis, J. J., Adelman, M. K., Schluter, S. F. and Ramsland, P. A. (2006). "The antibody repertoire in evolution: Chance, selection, and continuity." *Developmental and Comparative Immunology* 30(1-2): 223-247. (Google Scholar | DOI | Journal | PubMed)

356. Pancer, Z. and Cooper, M. D. (2006). "The Evolution of Adaptive Immunity." *Annual Review of Immunology* 24. (DOI | Journal | PubMed)

357. Wagner, C. and Hansch, G. M. (2006). "Receptors for complement C3 on T-lymphocytes: relics of evolution or functional molecules?" *Molecular Immunology* 43(1-2): 22-30. (DOI | Journal | PubMed)

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