essentially focuses on the role and function of MRPs. Now, the role of MDRs is also being analysed in detail in plants. It is remarkable that certain plants have the ability to take up, concentrate and metabolize toxic heavy metals and organic pollutants in soil and water. The field of photoremediation is growing for obvious benefits. Research in this will not only provide solutions to environmental and health problems, but will also give an insight into the physiology of these plants that make phytoremediation possible. This and many other related issues are reviewed and discussed by Salt, Smith and Raskin.

As in previous issues, this volume also has a wealth of recent information on important topics. It is becoming absolutely clear that for a deeper understanding of various phenomena, in plant physiology and development, greater input from genetics, molecular biology and recombinant DNA technology will be required. An era of plant genomics has already set in and we look forward to an exciting phase in plant research in the next decade. Presently I recommend that this volume should find a place on the personal book-shelf of all plant biologists.

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Annual Review of Immunology 1998. William E. Paul (ed.). Annual Reviews Inc., 4139 El Camino Way, Palo Alto, CA 94303-0139, USA. Vol. 16. 714 pp. Price: Individuals, US $69; Institutions, US $138.

The 1998 issue of the *Annual Review of Immunology* contains several interesting articles on different areas of active research in immunobiology. These may be grouped under the following headings: cytokines, cell surface receptors, transcription factors, immune response to disease, signal transduction and interactions of T cells with antigen presenting cells (APC).

Reviews on cytokine research covered articles on IL-12, TGF-β and the role of IL-1 antagonist. IL-12 is composed of two subunits, p35 and p40, and is important in mediating Th1-mediated responses to pathogens and some diseases. Using mice that lack each subunit, recent evidence points to different effects of individual IL-12 subunits. For example, p35-/- mice are resistant to infection by Listeria whereas p40-/- mice are susceptible to infection by Listeria, suggesting that p40 alone may have independent functions. Mechanisms responsible for the suppression of inflammatory responses are being identified. A review on TGF-β discussed the myriad activites mediated by this cytokine as well as the description of a unique population of Th3 type of T cells that secrete TGF-β, IL4 and IL-10. Different forms of IL-1 receptor antagonists are found which bind to IL-1 receptors and appear to be important in reducing inflammatory reactions and endotoxin-induced injury.

The importance of CD40–CD154 interactions in B cell responses is well known, and the importance of these interactions in T cell priming and differentiation, enhancing macrophage function, activation of NK cells and controlling infections were highlighted in a chapter by Grewal and Flavell. Levy *et al.* reviewed information on CD81, a cell surface molecule with four transmembrane spanning domains, which is part of the complex that lowers the threshold for activation on B cells. Although different antibodies to CD81 have effects on T cell development, the phenotype of CD81-/- mice suggests that the primary role of CD81 is in B cell activation but not in T cell development or activation.

Mammals contain large amounts of natural antibodies (i.e. predominantly IgM antibodies produced by the body in the absence of an immune response) that play an important role in innate immunity. Recent data suggest that complement binds to natural antibody immune complexes and plays an important role in determining host resistance to pathogens. On the other hand, Fc receptors bind to IgG immune complexes and play an important role in mediating inflammatory responses. Complement links the innate immune system with adaptive immune system as Ag-complement complexes are recognized by the complement receptors, CD21 and CD35, which are expressed on follicular dendritic cells (FDCs) and B cells. CD21 is also a part of the B cell receptor (BCR) and responsible for lowering the threshold of B cell activation. This may explain an old observation that antigen complexed to complement is several-fold more immunogenic than antigen alone. Recent data also suggest that complement and its receptors are important in the elimination of self-reactive (autoimmune) B cells.

In a well-written overview on B cell development, recombination of Ig genes, somatic mutation, the significance and roles of different transcription factors were discussed by Henderson and Calame. Some transcription factors, e.g. PU.1, Ikaros, play an important role during development whereas others, e.g. Oct-2, Ets-1, have redundant functions. The transcription factor NFkB plays an important role in the immune response from *Drosophila* to mammals. Two recent discoveries have enhanced interest in this field: first is the discovery of the IkB inhibitor kinase, which phoshorylates IkB in an inducible manner. After phosphorylation, IkB is degraded and NFkB enters the nucleus and activates several immune function-related genes. The second discovery centres around the anti-apoptotic function of NFkB. Most current volumes contain an article on apoptosis and this review is not an exception. The Bcl2 family of molecules which are important in cell death were discussed by Chao and Korsmeyer. It appears that the ratio of molecules that act as death agonists compared to the levels of death antagonists determine susceptibility to death stimulus. There is also interesting data suggesting that Bcl family of proteins belong to a family of pore forming proteins.

Systemus lupus erythromatosus (SLE) is caused when the body produces antibodies to host DNA and other self proteins. It is a complex disease and both major histocompatibility complex (MHC) and non-MHC genes are involved in disease progression. Genome wide linkage studies have identified twelve non-MHC disease loci in a mouse model of SLE and the identification of the actual genes will help in understanding the contributions of these

genes in disease. Hogdkin's disease is a common malignant lymphoma; current evidence suggests that these lymphomas predominantly arise due to clonal proliferation of germinal B cells and infection by Epstein–Barr virus (EBV) plays an important role in this process. Genetic variations in human leukocyte antigen (HLA), tumour necrosis factor, chemokine receptors, vitamin D3 and interferon-γ receptors have been implicated in affecting progression of several infectious diseases. Whole genome analysis will reveal additional loci of importance and these studies may be important in designing effective protective mechanisms in combating various diseases which is an exciting prospect.

Xenotransplantation, the transplantation of organs/tissues between members of different species, has received attention due to the growing needs for additional organs. Recent progress in making xenotransplantation possible involves the modulation of key molecules responsible for initiating immune responses, the removal of preformed natural antibodies and the use of genetically engineered organs that lack key molecules responsible for hyperacute rejection. Research in this area may increase the chances of xenografts to be accepted by recipients. Waldmann and Cobbold discuss an interesting research area on the use of non-depleting monoclonal antibodies to different lymphocytic cell surface markers (CD4, CD11a, etc.) to induce tolerance. This strategy has the potential to be used to treat autoimmune diseases and transplantation. Current evidence suggests that regulatory T cells may be induced by these antibodies, resulting in tolerance.

There has been progress in elucidating TCR–MHC structures and role of oligomers of TCRs (minimum number is 3) in stimulating T cells. Mark Davis *et al.* discuss a new model to explain how immunoglobulins and TCR interact with antigens especially with emphasis on the diversity of the CDR3 regions of immunoglobulins and TCRs. Dimerization between proteins occurs in several biological systems, including cell surface receptors (TCRs, BCRs, TGF-β receptors) and transcription factors (e.g. BCL-2). Approaches to study the role of dimerization between proteins include the use of CID (chemical inducers of dimerization) which are low molecular weight organic molecules that enter cells and induce dimers of two protein targets – these approaches may help in studying signal transduction pathways *in vitro*.

In addition to the excellent reviews mentioned above, a wide variety of areas ranging from T cell memory, development of a malaria vaccine, Janus family tyrosine kinases (JAKs) and signal transducers and activators of transcription (STATs), MHC class I antigen processing, NK receptors, positive and negative signalling in lymphocytes have been covered. Finally, the autobiographical piece by Metzger makes for compelling reading. He muses over the early influences that shaped his scientific career and foray from protein chemistry to immunology, especially the characterization of IgE and its receptor. He is most optimistic of those who are beginning their scientific career now and says, 'I feel they will have a fantastic voyage and am confident they will not fall off the edge; not because I think the universe of knowledge is round but because I think it is unbounded'. This volume lives up to its reputation and offers plenty of knowledge and interesting reading.

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