Sommerfeld: '... in the last month I had one of the most stimulating, exhausting times of my life, indeed also one of the most successful. I could not think of writing' (28 November 1915); '... You will be convinced of the general theory of relativity when you have studied it. That is why I am not mentioning a word in its defense' (8 February 1916).

Karl Schwarzschild's exact solution for the field of a gravitating mass came soon after Einstein's work; and the latter's appreciation of the result was thus expressed: 'I would not have expected that the exact solution to this problem could be formulated so simply. The mathematical treatment of the subject appeals to me exceedingly'. This incident really seems a precursor to C. G. Darwin's finding the exact solution to the relativistic wave equation for the electron in a Coulomb field, which Dirac had left undone after discovering the equation itself! Of Hermann Weyl's systematic exposition of the general theory in his book *Space, Time, Matter*, Einstein had this to say: 'I am reading with genuine delight the correction proofs of your book, which I am receiving sheet by sheet. It is like a symphonic masterpiece. Every word has its relation to the whole, and the design of the work is grand. What a magnificent method the infinitesimal parallel displacement of vectors is for deriving the Riemann tensor! How naturally it all comes out' (8 March 1918); 'Busily involved in studying the details of your book, I constantly admire anew the beauty and elegance of your derivations' (18 April 1918).

There is some correspondence with the great Swiss-French writer Romain Rolland (who incidentally was so drawn to India), on matters of war, politics, conscience and the role of the intellectual in trying times. These remind us of the backdrop against which the scientific advances were being made. On 15 September 1915, Einstein wrote to Rolland: 'One of the most disheartening phenomena of this terrible time is that in many cases intellectuals have completely lost their composure'. And in a 23 August 1917 letter Rolland says: '... Evil spreads like a splotch of oil... . I am awaiting salvation (if it is meant to come) from other – social – forces; and if it does not come, ... by God! it will not have been the first time that a powerful civilization has crumbled. Life will know very well how to blossom again from the ruins .... The soul is never conquered – except when it consents to it. It is ahead of its times'. In a public appeal to Hilbert and many others on these issues, Einstein proclaims: 'This serious situation places those, who through fortunate intellectual achievements have gained an elevated position among scholars throughout the entire civilized world, before a mission they must not evade: They must make a public declaration that could serve as support and consolation for those who in their solitude have not yet lost their belief in moral progress'.

So many names who have passed into the history of physics and other realms come alive in these pages. For those of an older generation, here is proof that with the current decline in the art of correspondence, the expression and hammering out of profound ideas through such dialogue is likely to suffer. One is also left with a strong impression of a supremely gifted intellect having to concern itself also with the petty and the mundane concerns of life. Grappling with the profoundest questions of nature is no insurance against having to also deal with and resolve personal relationships, and arrange one's material affairs with some degree of satisfaction. A complete, a full life is made up of all of these.

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Annual Review of Plant Physiology and Plant Molecular Biology 1998. Annual Reviews Inc., 4139, El Camino Way, Palo Alto, CA 94603-0139, USA. Vol. 49. 832 pp. Price: Individuals, US $65. Institutions, US $130.

Like children who look forward to receiving a gift on their birthday, many of us look forward to seeing the new *Annual Review of Plant Physiology and Plant Molecular Biology*.

The present volume has 28 chapters and a prefatory chapter by Sussex on 'Plant Development'. In fact, there are four other chapters that also deal with the same theme. Mandoli discusses the body plan and development in Acetabularia, an organism that has fascinated developmental biologists for a long time. This chapter describes in detail the spatial and temporal controls in development and is one among the few chapters in this volume with good explanatory and summary figures. Koonneef *et al.* have summarized the work on flowering, especially its onset and the timing. They clearly emphasize the importance of molecular genetics in understanding this complex developmental process. Figure 2 in this chapter amply demonstrates how different gene products, and their interaction with each other is essential to convert a vegetative meristem to a reproductive one. Gasser *et al.* have described the genetic regulation of ovule development in sexual plant reproduction.

Leon *et al.* have discussed the overriding influence of nucleus in the development of mitochondria and chloroplasts. In fact, during the last few years many new genetic loci have been defined whose function in early chloroplast development is not known. In another chapter, the role and functions of brassinosteroids during plant development is discussed by Clouse and Sasse. Although research on brassinosteroids was started 3 decades ago, and a review on this was published in this series in 1988 by Bhusan Mandava (an Indian scientist working at the USDA, Beltsville), yet it is only during the last few years, through the application of molecular genetics, that the importance of this group of regulators has been convincingly shown in normal plant development. In *Arabidopsis*, brassinosteroids signal transduction has been elucidated and is well described in this chapter.

Besides these topics, there are six more chapters that deal with signal transduction, development and gene expression. Schwechheimer *et al.* deal with plant transcription factors. The mechanism of ABA-mediated signal transduction is covered by Leung and Giraudat. ABA is an important hormone having a role in seed maturation and mediates many stress-related responses. Although ABA receptor is not yet known, the intermediates in ABA-signal

transduction and ABA-responsive *cis*-elements have been well characterized. The chapter on DNA methylation as a mechanism of gene control, by Finnegan *et al.* from Peacock's laboratory, Canberra, clearly brings out the data related to the loss of DNA methylation affecting plant development. It is becoming increasingly clear that in addition to other mechanisms, DNA methylation causes transgene silencing and this aspect too is covered in this chapter. Signalling mechanisms in relation to hormone-induced development in mosses is reviewed by Schumaker and Dietrich. Even in these lower organisms, calcium seems to play an important role in development. In a separate chapter, Zielinski has emphasized the role of calcium as a signal in higher plants and brought out the importance of regulation of calmodulin binding proteins. Argüello-Astorga and Herrera-Estrella provide an interesting review on the evolution of light-regulated plant promoters. Light is one of the important factors affecting plant development and this is achieved via modulating the expression of genes. A detailed analysis of various light regulatory *cis*-elements has been reported for a number of genes. While the evolution of a gene across various phyla has been discussed earlier, in this chapter, with the help of a few studies, the authors have attempted to describe how the promoter functions would have evolved from primitive land plants to an angiosperm ancestor and then diverged to monocot and dicot plants.

There are about a dozen chapters that broadly deal with signal transduction, gene expression and development. Rightly so, the prefatory chapter of this volume is written on 'Themes in Plant Development'. In his concluding remarks, Sussex writes 'there is huge increase in the number of scientists working in the fields that can broadly be defined as developmental plant biology. In my early years, it was rare to find another person working on the same question that I was. Now it is usual to find several labs working on the same genes in the same plant'.

Somewhat related to the area of developmental biology and gene expression, there are three other chapters. One is on plant pre-mRNA splicing mechanism by Brown and Simpson. The other, which is well-timed, is on *Synechocystis* by Kotani and Tabata. The entire genome of this cyanobacterium has been sequenced and it carries a total of 3168 protein coding genes. All the information about this is available at http://www.kazusa.or.jp/cyano. Recently, using this data bank similar genes for two-component signalling system were reported in *Arabidopsis* and tomato. In fact, the translated amino acid sequence of str 0473 was found to be similar to photochrome *c* in higher plants and the gene product has been found to have kinase activity. An analysis of the whole sequence of *Synechocystis* will take time; nevertheless, this is an important chapter to draw the attention of plant biologists to the area of bioinformatics and functional genomics. The chapter by Dawe on meiotic chromosomal organization has brought together various results in this area of research. While there is an increase in research activity towards understanding of mitotic cell cycle controls at the molecular level, yet meiotic programme is still not well worked out in plants. A number of plant homologs of meiotic regulatory and functional genes have been found, but the molecular basis of switching off mitosis and switching on meiosis is hardly known. I am sure that in view of its importance in engineering apomixis in crops, this field will elicit further interest.

A number of chapters deal with photosynthesis, chlorophyll and carotenoids. Merchant and Dreyfuss discuss the assembly of chloroplast iron–sulfur centres, plastocyanin, Mn-centre and cytochromes. Details of photosynthetic cytochrome *c* are given in a review by Kerfeld and Krogmann. The reader is also referred to an article by Suzuki *et al.* on chlorophyll biosynthesis in *Annual Review of Genetics* (1998). Schnell has very nicely reviewed the present concepts of protein targeting to thylakoid membranes. There is a chapter on the regulation of genes of carotenoid biosynthesis by Cunningham and Gantt. It encompasses the structure and function of genes involved in the biosynthesis of carotenoids and also focuses on the possibility of metabolic engineering to modify carotenoid content and composition. This is beautifully reflected in Figure 1 of the chapter where the bacteria were made to write the carotenoid they had accumulated. The other chapters dealing with biosynthesis are those of Benning on sulfolipid sulfoquinovosyl diacylglycerol, plant cell wall proteins by Cassab; lignin biosynthesis by Whetten *et al.* and fatty acid modification by Shanklin and Cahoon. In his article on Plant P-450's, Chappe has listed all the cloned genes encoding Plant P-450-dependent monooxygenases, which are a large group of heme-containing enzymes that generally catalyse NADPH- and O_2-dependent hydroxylation reactions. It may be relevant to mention that some of the products of P-450 genes are involved in biosynthesis of brassinosteroid and gibberellins which have a major role in regulating plant development. One of the important areas of research in plants is to understand the mechanisms they adopt for their survival under stress conditions. In this context, Noctor and Foyer have discussed the role of ascorbate and glutathione as antioxidants under oxidative stress.

There are a few chapters on ions transport and phytoremediation. The role of boron, a very important element for many plant responses, is reviewed by Blevin and Lukaszewski. The review by Fox and Guerinot takes stock of genes whose products are involved in the transport of K^+, Ca^{2+} and Cu^{2+}, Mn^{2+} and Zn^{2+}. It is now shown that the level of calcium, which as an important second messenger in plants, is regulated by different transport systems. In *Arabidopsis*, 5 genes have been identified which code for calmodulin stimulated Ca^{2+}-ATPase, calmodulin insensitive Ca^{2+}-ATPase and Ca^{2+}/H^+-Antiporter and these are localized on chloroplast, endomembrane, ER or tonoplast. The review also includes a compilation of a list of genes whose products are involved in micronutrient transport in plants. Most of this work so far seems to be restricted to *Arabidopsis*, barley and rice. In their review, Rea *et al.* have discussed the transport of other substances like sugars, peptides, alkaloids, lipids, etc. It has now been shown that plants do have proteins belonging to the ABC (ATP-binding cassette) superfamily. In this context two classes have been identified, viz. multidrug resistance proteins (MDR) and multidrug associated proteins (MRP). This review

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