GIBBS, M., LATZKO, E. (ed.): PHOTOSYNTHESIS II. Photosynthetic Carbon Metabolism and Related Processes. Encyclopedia of Plant Physiology, New Series, Volume 6. — Springer Verlag, Berlin—Heidelberg—New York 1979. US $ 108.90.

Those who have anxiously awaited the somewhat delayed appearance of the second volume devoted to photosynthesis in the new series of Encyclopedia of Plant Physiology have been amply satisfied. A brilliant treatment of carbon metabolism joined that of electron transport and thus we have now a complete and up-to-date encyclopedic picture of the photochemical and biochemical aspects of the process on which our existence in the biosphere depends. The last statement may appear trite and trivial, but scientists who are well aware of all the threatening problems that this dependence urges them to solve in the nearest future, eagerly look for every important step made towards a better understanding and control of photosynthesis.

If we compare the photosynthetic volumes in the new series of Encyclopedia with those published in 1960 we can appreciate what an enormous progress has been accomplished in this field. A number of questions of fundamental importance that just showed up and were highly controversial twenty years ago have been answered meanwhile and their basic outline can be formulated in a unambiguous language of a textbook. Looking at the topics dealt with in the reviewed volume it is enough to mention just three examples: photosynthesis in C_4 and CAM plants, photorespiration and glycolate metabolism, and properties and regulation of ribulose bisphosphate carboxylase — oxygenase. In spite of all these achievements — and, in part, through them — new problems turn up and there is certainly no unhealthy stagnation of photosynthesis research within sight.

The editors of the volume are to be admired how they managed through selection of topics and authors to find proper balance between the two trends: to compile in a concise form the vast amount of well proven facts and, at the same time, to leave enough space for presentation of interesting problems and controversial issues so that curiosity of prospective investigators be stimulated.

The book is logically divided into the following broad sections: The reductive pentose phosphate cycle; The C_4 and CAM pathways; Factors influencing CO_2 assimilation; Regulation and properties of enzymes of photosynthetic carbon metabolism; Metabolism of primary products of photosynthesis; Glycolic acid and photorespiration, and Ferredoxin linked reactions (including various important reductive processes not directly involving carbon, such as nitrate and sulphate reduction, N_2 fixation *etc.*). In the following comments I shall group the chapters in a way different from the arrangement adopted in the book.

1) The pathways and enzymes of carbon fixation and reduction. The reductive pentose phosphate cycle is the basic biochemical pathway whereby CO_2 is converted to sugar phosphates and ribulose-1,5-bisphosphate carboxylase catalyzes its key carboxylating reaction. Bassham was the obvious choice to review the former and Akazawa the latter. Bassham has naturally included an extensive section on metabolic and light-dark regulation of the RPP cycle, while Akazawa covered in a truly encyclopedic manner everything on RuBP carboxylase including biosynthesis, an aspect missing in the treatment of most other enzymes turning up in the book. Enzymes playing part in the RPP cycle are dealt with by Latzko and Kelly; they have collected all data available up to the beginning of 1978 with a particular emphasis on correct evaluation of the extent to which any of the enzymes might govern the flux through the cycle.

The descriptions of the C_4 pathway by Ray and Black and of the flow of carbon in CAM plants by Kluge show clearly how the system of auxiliary CO_2 fixation reactions is used to serve the same purpose in two different ways operating in a spatial compartmentation in one case and in a temporal sequence in the other. Both texts are excellent as are also Kluge's diagrams. The diagram for the C_4 pathway in the chapter by Ray and Black does not seem to be the best choice particularly since it lacks any indication of the coupling of photochemistry with the path of carbon. This chapter also contains a most valuable section on C_3—C_4 intermediate plants and on criteria for the presence of C_4 photosynthesis, but the subdivision of C_4 plants into different types according to the decarboxylation mechanisms and the compounds used for CO_2 transport is only cursorily mentioned. The peculiarities of the compartmentation of the C_4 metabolism are recapitulated by Edwards and Huber in addition to their detailed account what specific information on the C_4 pathway can be extracted from experiments using isolated cells from C_4 plant leaves and their protoplasts. Incentives for future research along these lines that are summarized at the end of the chapter are particularly useful. Coombs deals with enzymes of the C_4 pathway which, as he points out, have been only scantily studied, much less than enzymes of the RPP cycle. The same applies to enzymes of crassulacean acid metabolism reviewed by Dittrich.

Carbonic anhydrase seems to be exceptional in that it is the only enzyme of wide occurrence in photosynthetic tissues whose exact role in the carbon flow in photosynthesis keeps eluding

our understanding. In the chapter devoted to this enzyme Poincelot could perhaps be less restraint in presenting various hypotheses on carbonic anhydrase function. Also, he does not mention the membrane bound activity whose presence in algae has been proved quite convincingly.

There is little doubt that the Calvin cycle is the major pathway of CO_2 assimilation in photosynthetic prokaryotes. On the other hand in several groups of these organisms the existence of alternative mechanisms of CO_2 fixation is well documented. In some of them such as green sulfur bacteria, the dominant role of the RPP cycle is still a matter of controversy; in others, the reductive carboxylic acid cycle has at least an auxiliary role under certain conditions. Ohmann has fulfilled admirably the difficult task of reviewing the contradictory evidence concerning the major carboxylation pathways in different taxonomic groups with particular attention to regulatory aspects. Buchanan describes in detail the ferredoxin-linked carboxylation reactions and the properties of their enzymes and he outlines the functional variations of the reductive carboxylic acid cycle. A field in which most varied modifications of the classical schemes and a number of little investigated interactions between the phototrophic and heterotrophic pathways can be expected is photoassimilation of organic substrates by some algae. Wiesner has prepared a well arranged account on this topic in which unsolved problems predominate, and pointed out the interesting fact that the photoheterotrophic mode of nutrition may alter markedly the functions in the thylakoids. Another specific case of CO_2 entering the "dark metabolism" is presented by Miyachi who reviews mostly his own work concerning light enhanced dark CO_2 fixation in both C_3 and C_4 plants.

2) Regulatory interactions. Although the problems of regulation of enzyme action are taken up in many chapters, some specific cases are considered under separate headings. Changes of stromal H^+ and Mg^{++} concentrations brought about by the photochemical functions of thylakoids are of vital importance for activation of RuBP carboxylase, while fructose and sedoheptulose bisphosphatases respond mainly to ATP and NADPH levels. Anderson analyzes the possible mechanisms of light-mediated modulation of enzyme activity and Held shows how H^+ and Mg^{++} concentrations in the stromal space can be exactly determined. Much less exact biochemical evidence is available to speculate on the mechanism which brings about the effect of spectral composition of the light on further fate of the primary photosynthetized carbon compounds as well as on chloroplast structure. It is therefore very valuable that Voskresenskaya presents in a concise form most of the recent information concerning specific features of the blue light effect and the possibility of direct regulation of some enzymes by the action of blue light. The nightmare of all scientists interested in exact evaluation of photosynthesis efficiency, as Rabinowitch put it, *i.e.* the interactions between photosynthesis and respiration are thoroughly analyzed in two chapters. Graham and Chapman deal with higher plants where they cannot evade the problem of photorespiration and, accordingly, they consider the problem separately in C_3 and in C_4 plants. Their general conclusion is that initially in the light the tricarboxylic acid cycle is inhibited, but subsequently it can operate at a rate comparable with that in the dark thus providing carbon skeletons for synthetic reactions. While emphasis in this chapter is more on the side of carbon dioxide turnover and carbon metabolism, Evans and Carr considering photosynthetic microorganisms focus attention more on the possible interactions involving oxygen and those realized on the level of electron transport. This is quite natural since photosynthetic microorganisms offer ideal models for such investigations. In some of the prokaryotes both photosynthetic and respiratory electron transport occurs most probably on the same membrane. Nevertheless, surprisingly similar types of interaction are often observed with prokaryotes as with eukaryotic cells in which photosynthetic and respiratory reactions are confined to spatially separated organelles. Even if some of the problems taken up by Evans and Carr fall somewhat outside the scope of Volume II, the chapter is a very valuable supplementation of what has not been covered in Volume I.

An interesting type of regulation is considered by Queiroz, who deals with circadian rhythms of enzyme capacity and activity in CAM plants. The chapter well demonstrates the complexity of the problem and correctly emphasizes the necessity to distinguish between enzyme quantity and activity, but I wonder whether it has clarified the question of possible mechanisms that could effect the rhythmical control.

3) Glycolic acid and photorespiration. Although in the text above I have, optimistically, ranked the photorespiration problem among the solved ones, this classification would be most probably rejected by those intimately engaged in investigation of this process, which still exposes some controversial facets. General consensus exists, however, that photorespiration starts with glycolate formation in the chloroplast and results from its metabolism involving other compartments of the cell. The former process is analyzed by Beck who favours the concept that more than one glycolate producing reaction exist and that the relevant question reads: to what extent may each of them contribute to total glycolate production. He reviews

evidence to this obtained in experiments with C_3 and C_4 plants and points to open questions raised by contradictory results concerning inhibition of glycolate formation. Tolbert presents a lucid survey of the reactions involved in glycolate metabolism in photosynthetizing cells of higher plants and algae and he concentrates on the enzymology of these processes. The main physiological difference between algae and higher plant cells is that a substantial portion of the glycolate from algae chloroplasts is excreted to the surrounding medium and does not enter other cellular compartments. An important biochemical difference is in the enzyme oxidizing glycolate to glyoxylate; the glycolate dehydrogenase of algae is not directly linked to oxygen uptake and it has been located in mitochondria. What is the quantitative proportion between glycolate formation and metabolism and CO_2 fixation by the PPR cycle and how far can photorespiration be suppressed by tricks invented by the plants themselves or by applying various inhibitors, are problems of paramount importance for assessing maximum possible efficiences of photosynthetic carbon fixation. They are taken up, from somewhat different viewpoints, in the two chapters by Zelitch and Canvin. Both authors start with analyzing the intricate problem of reliable assessment of photorespiratory CO_2 evolution and O_2 consumption. Zelitch then elaborates on the problem of photorespiration control and on results obtained with inhibitors of glycolate synthesis and oxidation. He concludes that photorespiration has not an indispensable function in a photosynthesizing cell and that chemical or genetic regulation of some metabolites can produce plants with higher rates of net photosynthesis. In laboratory experiments slowing down various steps in the glycolate pathway may result in a decreased rate of glycolate synthesis for long periods. Canvin compares the characteristics of photorespiration in C_3 and C_4 plants in detail and shows that there is no definite consistent proof from gas exchange data for the existence of photorespiration in C_4 plants. This is in agreement with various pieces of indirect evidence and with the statement that treatments which suppress or enhance photorespiration in C_3 plants have no equivalent effect in C_4 plants. Thus the conclusion seems highly justified that photorespiration in bundle sheath cells of C_4 plants (where it only could occur) is inhibited or suppressed.

4) Synthesis and degradation of starch and sucrose. Starch is the main form in which the newly photosynthesized organic material is stored, and sucrose, apart from playing the same role for some species of plants, is the main form for carbon transport in higher plants. Both form huge reservoirs in intimate contact with the carbon dioxide assimilating machinery and their synthesis and degradation are likely to influence photosynthetic function. Thus both the chapter on metabolism of starch in leaves by Preiss and Levi and that on enzymology of sucrose synthesis in leaves by Whittingham *et al.* are likely to be very useful sources of information and reference for the users of the handbook. In both chapters the authors try to answer the question which of several possible alternatives represents the main pathway of synthesis, what are the properties of the enzymes involved and the mechanisms of their regulation. In spite of the vast amount of information available on starch synthesis and degradation the most exciting discoveries are still ahead: the complete formation of a starch granule *in vitro*, as well as initiation of starch synthesis in the absence of a primer have not yet been demonstrated.

5) Ferredoxin-linked reductions involving other than carbon containing compounds. At present it is well established that a number of reductive processes which do not involve carbon compounds but are, nevertheless, of vital importance for photosynthetic organisms derive reduction power directly from the photochemical activity of the thylakoids. These are, first of all, the reductive assimilations of nitrogen and sulfur which introduce these elements into the plant metabolism.

Vennesland and Guerrero have produced an exceptionally clear and well arranged review of both firmly established facts and controversial issues concerning nitrate reduction primarily in algae and in higher plants. Enzymes reducing nitrate to nitrite are in part NADH dependent and are most probably localized in the cytoplasm. Nitrite reductase transfers six electrons from reduced ferredoxin to nitrite, presumably in one step, and is situated in the chloroplast being bound to the thylakoids. Reaction mechanisms, inhibitors, the possible ways of regulatory control, biogenesis and genetic studies of the two enzymes are discussed. The other gate through which nitrogen enters life processes is N_2 fixation. While highly controversial some ten years ago, the fundamental facts concerning this process in blue-green algae have now been clarified, and Stewart presents a most competent cross-section through our present knowledge. Distribution of nitrogenase among photosynthetic prokaryotes, the properties of this enzyme and requirements for its efficient function as well as its regulation are covered. The extensively studied nitrogen fixing system of heterocysts is discussed in detail. It is to be regretted that the complementary chapter by Quebedaux on symbiotic N_2 fixation and its relationship to photosynthetic carbon fixation does not offer such a clear insight into the biochemical mechanisms mediating this intricate interaction, as one would desire. It appears from the review that we have much less exact knowledge of symbiotic N_2 fixation than of the process in blue-green algae.

Although sulfate activation by ATP-sulfurylase was first described in Lipmann's laboratory in the mid-fifties and it has been known for some time that sulfate reduction in algae and in higher plants is enhanced by light, it is only during the last decade that the biochemistry of the process in photosynthetic cells has been thoroughly investigated. As a result it appears that APS or PAPS are used for sulfonation of an as yet unknown protein and the sulfite residue in this complex is then reduced by a six electron one-step reaction involving ferredoxin, very akin to nitrite reduction. Our present state of knowledge is nicely reviewed by Schmidt who also points to the main open questions.

A topic of great interest in connection with the efforts to design biophotolysis systems, *i.e.* hydrogen metabolism by photosynthetic microorganisms, is dealt with by Ben-Amotz. Starting with a brief historical introduction the author reviews hydrogenase properties in these organisms and then considers both H_2 evolving and consuming reactions. — As soon as the natural acceptor, NADP, fails to withdraw electrons from ferredoxin at a rate corresponding to the rate of their supply by the photosystems, electrons may be switched over to effect monovalent oxygen reduction. This process generates activated oxygen and superoxide dismutase is one of the tools which help photosynthetic cells to get rid of this dangerous radical. Consequently, this enzyme is an obligatory component of chloroplasts, where it is found in a soluble and in a membrane-bound form as shown in a brief but informative review by Elstner. — The last chapter to mention under this heading is that by Böger on transhydrogenase. It presents a very detailed account of the most interesting properties of both soluble and membrane-bound species of this enzyme associated with the photosynthetic apparatus in various organisms. A non-initiated reader misses, however, any statement or speculation concerning the roles of these activities under various conditions.

6) Methods. Although a detailed description of methods does not fit the general plan of the Encyclopedia, the methods of obtaining a suitable experimental material have proved to be of such a vital importance for the acquisition of the results reported in the volume that they were alotted separate chapters. In recent years our knowledge of the pathways of CO_2 fixation and reduction has expanded proportionately to the increasing degree of perfection in isolating intact chloroplasts, often substantially aided by a preceding isolation of intact leaf cells and protoplasts. In view of this fact the treatment of the successful procedures by Jensen could be, perhaps, even more extensive and should compare representative methods in terms of maximum rates and reproducibility achieved. The reconstituted chloroplast system happens to be another tool that has helped to provide invaluable proofs of operation of the partial reaction sequences assumed to constitute the PPR cycle. Lilley and Walker review briefly how such systems are obtained and then deal with the individual reactions and regulation mechanisms that have been studied in this way. All basic reactions of the PPR cycle have been reproduced in reconstituted systems and although the details of kinetics differ in several cases from those in intact chloroplasts, the deviations can be satisfactorily explained from specific conditions prevailing in the system and the expected properties of the enzymes. — The carboxylation reactions of photosynthesis are the major site of carbon isotope discrimination in higher plants. $\delta^{13}C$ values proved to be of great value in detecting the carboxylation reaction through which CO_2 enters photosynthetic reactions, *i.e.* in discriminating between C_3 and C_4 plants. In some specific cases the results are, however, still controversial. Troughton reviews the vast number of papers that have appeared in the short time since the method became fashionable and points out that at present the most serious defficiency is the absence of a detailed biophysical description of the mechanism of carbon isotope fractionation on the enzyme level.

I. Šetlík (*Třeboň*)

Bidwell, R. G. S.: Plant Physiology. Second Edition. — Macmillan Publishing Co., Inc., New York; Collier Macmillan Publishers, London 1979. 726 pp., US $ 13.95 paper, 26.05 hardback.

Professor of Biology of the Queen's University at Kingston (Ontario, Canada) prepared a new edition of the introductory textbook for one- or two-semester courses of plant physiology for undergraduate students. The author divided the text into 30 chapters of various volume and extent, grouped into 6 sections. Four chapters of the first section review the theoretical background and serve as a concise reference to the classification and occurrence of biological chemicals, plant cell structures, basic mechanisms of water movement and metabolisms in the cells and related topics. Five chapters of the second section are devoted to basic processes of plant metabolism *i.e.* energy metabolism, respiration, photosynthesis, nitrogen metabolism, polymers and large molecule metabolism on cellular level. The third section deals in six chapters with the

whole plant metabolism and nutrition and with relationships with internal and external nutrient sources *i.e.* soil, water and air. The most voluminous fourth section including 8 chapters covers plant growth, development, reproduction and behaviour. Four chapters of the fifth section summarize the basic knowledge of physiology of trees, marine algae, pathogens and symbiotic organisms. In the last section, there are concentrated chapters on the physiology of plants under different types of stress, factors affecting plant distribution, and on physiological principles of interaction between plants and man.

The book offers a wide selection of instructive illustrations (377) and tables (64) with very detailed legends. In the references for further reading (205) preference was given to the English literature; apart from these items articles published in the Annual Review of Plant Physiology are cited and strongly recommended. The textbook is supplied by well arranged, detailed author and plant names and general indexes. In spite of the careful preparation of the book a few inaccuracies have slipped into the text, for instance the definition of stomata hydropassive control, state frontiers in fig. 29.2, and in many cases other units than SI are used. The division, set up and presentation of the text reflect the many years' teaching practice of the author. It is one of the best basic textbook of plant physiology and will be useful not only to students but to everyone who wishes to acquire basic knowledge in plant physiology.

JARMILA SOLÁROVÁ (*Praha*)

KLUGE, M., LORENZEN, H. (ed.): BIOCHEMISCHE GRUNDLAGEN ÖKOLOGISCHER ANPASSUNGEN BEI PFLANZEN. Biochemical Basis of Ecological Adaptations in Plants. — Gustav Fischer Verlag Stuttgart—New York 1979. 296 S. 93 Abb. 39 Tab. DM 75,—.

Das Buch ist ebenfalls als Sonderausgabe der Berichte der Deutschen Botanischen Gesellschaft, Band 92, Heft 1, 1979 mit gleicher Paginierung erschienen. Es fasst in 22 Beiträgen die Ergebnisse des Schwerpunktprogrammes der Deutschen Forschungsgemeinschaft „Biochemische Grundlagen ökologischer Anpassung bei Pflanzen" in den Jahren 1973 bis 1978 zusammen. Die im Buche enthaltenen Arbeiten sind Herrn Prof. Dr. Otto Stocker zum 90. Geburtstag gewidmet und der Band enthält ebenfalls einen Überblick über das wissenschaftliche Lebenswerk des Jubilanten.

Folgende Themenkreise wurden im Rahmen des genannten Schwerpunktprogramms der DFG bearbeitet: 1. Anpassung an Trockenheit (C_3-C_4 Pflanzen, Sukkulente, Osmoregulation, Biochemie der Austrocknungsresistenz), 2. Salzresistenz, 3. Kälteresistenz, 4. Hitzeresistenz, 5. Anpassung an verschiedene Lichtfaktoren, 6. Resistenz gegen natürliche Noxen (Schwermetalle — SO_2), 7. Submersionsresistenz und 8. Anpassung an besondere edaphische Verhältnisse, wobei die meisten Beiträge des Bandes die ersten drei Richtungen betreffen. Das Buch schliesst mit einer Bibliographie der im Rahmen des erwähnten Programmes bisher veröffentlichten Arbeiten.

Die einzelnen Artikel sind meist in Form von Originalarbeiten, einige mehr in Form von Review, in Deutsch mit umfangreichen englischen Zusammenfassungen verfasst und tadellos auf Kreidepapier gedruckt worden. Ein Sachregister wäre zu begrüssen. Das Buch stellt einen wichtigen Beitrag zur biochemischen Ökologie der Pflanzen dar.

INGRID TICHÁ (*Praha*)

MILBURN, J. A.: WATER FLOW IN PLANTS. — Longman, London—New York 1979. 225 pp. £ 6.75.

This book brings an excellent survey of up-to-date knowledge of the main qualitative aspects of water transport in plants. It begins conventionally with the physico-chemical properties of water and with mechanisms involved in water flow. Further, it deals with transport of water on the cellular level. Measurement of the water potential and its components is also included. In the following chapters the author successively explains the uptake of water from the soil, water flow through the roots, the stems and the leaves and the efflux of water vapour to the atmosphere. The attention is paid to the mathematical description of the transport processes, to the anatomy and ultrastructure of transport pathways and to the physiological and ecological conditions influencing the water flow. A separate chapter is devoted to the control of flow rate by the stomatal apparatus. Transport of water or better of solutions, in floem, latex ducts, resin canals and so on is also considered. In addition to the transport of water, development of

water stress and its effects on growth and other physiological processes are taken into account.

Many illustrations (models, experimental data, micrographs) and tables make the rather complicated text well understandable. The reader will certainly appreciate that each equation is supplied by a little table where the used symbols are listed together with SI-units. Author and subject indexes are included.

Plant-water relations have wide implications in many disciplines ranging from the more efficient production of crops to the protection of natural environment from adverse influences. Therefore this book will certainly find a broad spectrum of readers.

JANA POSPÍŠILOVÁ (*Praha*)

BELL, E. A., CHARLWOOD, B. V. (ed.): SECONDARY PLANT PRODUCTS. Encyclopedia of Plant Physiology. New Series. Vol. 8. — Springer-Verlag, Berlin—Heidelberg—New York 1980. 674 pp. DM 198,—. US $ 110.90.

Volume 8 of the New Series of the Encyclopedia of Plant Physiology concerning secondary plant products is the result of cooperation of 20 contributors from five countries (U.K., U.S.A., G.D.R., the Republic of South Africa and Canada). As the editors write in the Preface "it is a pity indeed that the term "secondary" should have ever been applied to those compounds as the word gives the unfortunate impression that they are all relatively unimportant. By definition they do not play a role in the primary metabolic processes essential for the maintenance of life in an individual plant, nevertheless many may be absolutely essential to the survival of the species as a whole in a given natural habitat".

The book starts with some general chapters on the history of secondary plant products investigation, their significance in plants and the control of secondary metabolism. The following parts of the book deal with individual groups of secondary compounds, providing information on their chemistry, biochemistry, taxonomic significance and probable ecological roles. So alkaloids, the isoprenoids including carotenoids, plant phenolic compounds, non-protein amino acids, amines, cyanogenic glycosides, glucosinolates, betalains, lipids of taxonomic significance and carbohydrates are treated. Individual chapters of the book are excellent reviews bringing a lot of up-to-date information. They contain many figures, tables and references. Author and subject indexes facilitate manipulation with the book. In a future edition of the volume some misprints should be corrected, *e.g.* on p. 549 (Fig. 3) Claviceps instead of Clavaceps, on p. 614 Vereš instead of Veveš (reference Kutáček *et al.*).

The book is a basic manual and source of information for plant physiological laboratories and universities and should not be missing in any library concerned with plant investigations.

INGRID TICHÁ (*Praha*)

KUČERA, J.: POLYPLOIDIE (STUDIJNÍ ZPRÁVA) [POLYPLOIDY (REVIEW)]. — Institute of Scientific Information for Agriculture. Praha 1979. 126 pp. Kčs 20,—.

Many important food and cash crops like wheat, potato, cotton, tobacco and sugar-cane are polyploids and an understanding of the advances and disadvantages caused by the polyploid state is hence important. The introductory chapter of this review deals with the terminology and division of various types of polyploidy. This is followed by a comprehensive chapter on autoploidy, covering autotriploidy, autotetraploidy and further ploidy levels, their segregation and peculiarities in the course of meiosis, endoploidy and the occurrence of aneuploidy in autoploid forms. The section on alloploidy presents data on wheat, on *Triticale*, the first new species produced by man and on the amphidiploid *Raphanobrassica*. Two other chapters concern pseudoploidy and polyploid complexes.

Under the heading: Induction of polyploidy, the effects and methods of application of various mitotic poisons like colchicine, N_2O *etc.* are briefly discussed. During evolution, polyploidy has led to the formation of many new related species, particularly in angiospermous plants. Its role in animals is obviously much less important. In vertebrates it is limited to the lower development stages, *i.e.* fish and amphibians. This subject is covered in the last chapter of the review.

Polyploidy research has been very intensive especially in higher plants during the past decades; more than 8000 papers were published in this field (Gottschalk 1978). The present review could of course cover only a very small part of them (236). However, the most relevant papers seem to be included. Readership: all those interested in genetics and evolution.

T. GICHNER(*Praha*)

Seed Protein Improvement in Cereals and Grain Legumes. (Proceedings of a Symposium, Neuherberg, 4—8 September 1978.) Vol. I, II. International Atomic Energy Agency, Vienna, 1979. 421 + 472 pp., US $ 45.00 + 50.00.

It is well known that more than a third of the world's population suffers from serious malnutrition. The main nutritional deficiences affecting populations in developing countries is protein deficiency. In view of the increasing importance of seed proteins to human nutrition, the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture established in 1968 an international programme to improve the protein content and quality in seed crops by application of mutation breeding and analytical techniques for mass-screening of proteins. Seven reports of previous meetings of the Co-ordinated Research Programme were published by the IAEA, the 8th report on the meeting in Neuherberg representing the formal end of this programme. The introductory paper of the proceedings presents data on the world protein and nutritional situation and is followed by contributions on the results of plant breeding for seed improvement of crops, mainly cereals. The new cereal varieties of the Green revolution provide high yield per hectare but generally have low protein contents. This stresses the need for new varieties with a higher protein content to improve their nutritional values. High lysine genotypes of maize, barley and sorghum have been recently produced. The quality of opaque-2 maize is approx. similar to that of milk, being twice as high as that of common maize. Although most of the traditional crops with seed high in protein belong to legumes, cereals supply more than half the protein consumed by people. In several parts of the world cultivation and breeding of legumes are neglected. Papers on breeding of legumes are therefore also included in the proceedings. Under the heading: 'Genetics, biochemistry and seed storage proteins', contributions on the inheritance of amino acids contents, synthesis of storage proteins in *Pisum*, *Zea*, *Phaseolus*, wheat and barley and on the localization of genes determining protein quality and quantity are presented. Four papers deal with the analytical and nutritional techniques for seed proteins. Under the heading: 'Prospects for the future', papers on cell culture and plant transformation are presented. While the development of both methods will greatly aid certain physiological and genetic investigations, their application to plant breeding is, in the present state, dubious. Apart from papers published in full, abstracts of papers presented in the form of posters are published. Readership: plant breeders, geneticists, organic chemists.

T. GICHNER (*Praha*)