

REVIEWS

Crop Production and Environment. By R. O. Whyte. (Faber & Faber, London), 1946. Pp. 372. Price 25sh.

The ultimate aim of all botanical research is to so control and direct the behaviour of plants as to get the maximum benefit out of them. Several of the practices followed by farmers and horticulturists are based on developmental physiology although they have been evolved by long experience without an appreciation of the scientific principles involved. The work of the plant physiologists has been concerned with the most detailed possible objective description and interpretation of phenomena occurring in living organisms, and among the attempts to actually control the phenomena by subjecting their progress to the will of man, the discovery of the Russian botanist, Lysenko, might be considered the most important in recent times. This discovery known as 'Vernalization' or pretreatment of activated seed has been exploited with enthusiasm and great expectations all over the world, and considerable amount of literature has appeared on the subject. The present book has brought together "all the available scientific evidence and practical experience in order to show how and when crops react to environment and to indicate how this nature of reaction affects crop yields, distribution and general agronomic behaviour and techniques". A critical review of the earlier investigations which had formed the background for Lysenko's discovery forms part of the book. The earlier enthusiasm for vernalization as such has perhaps cooled down, and India is the only country outside U.S.S.R. that is still taking an active interest in pretreatment of seeds in various crops. The book should, therefore, be specially welcome to biological workers in India.

The first few chapters of the twenty contained in the book deal with growth and development, the distinction between which must now be familiar to those acquainted with vernalization literature, and the effect of environment like heat, light and darkness on these two phases. It is now recognised that every plant has its own specific requirements of temperature and light in the presence of which it proceeds to reproduction. The work of Gregory and his associates at the Imperial College, London, has led to a better understanding of the biological processes involved in vernalization and it has also established that Lysenko's postulates about the sequence of distinct phases and nonreversibility of the development process are untenable. Every physiologist is familiar with the pioneering work of Garner and Allard on photoperiodic reactions and their division of crops into short-day and long-day plants. Later work in America and Russia is indicating that it is darkness and not the photo-period which activates development

in short-day plants, and that it is not the magnitude of the proportion between daily darkness and light but the absolute length of the dark period which is important. Recent researches have also shown that the visible phase or stage of the formation of male and female gametes has environmental requirements of light, and probably also temperature, that differ from those which govern flowering of the plant. Valuable information has also become available on pollen viability in relation to the influence of heat and light.

Three of the chapters in the book deal with the location of response to vernalization and the action of hormones. The critical work at the Imperial College, London, has shown that the seat of response is the embryo and not the endosperm as was believed earlier. All investigations appear to indicate that the responses associated with the photo-periodic reaction are transmitted from one part of a plant to another by means of a substance of a hormonal nature. It is claimed that the hormone or hormones can even pass from one plant to another through a non-living diffusion contact. Even names like florigen and vernalin have been proposed for these hormones but it is not possible to draw any conclusions as they have not yet been identified.

Though investigations on plant physiology and metabolism at different developmental phases or when exposed to controlled environmental factors have not yet reached a stage warranting definite conclusions, the scattered results give an indication of the possible application of the results to the production of optimal yields, either grain or forage, and to the optimal utilization of fertilizers and other cultural measures. Comparing plants raised from vernalized and unvernallized seeds, it is found that while the intensity of photosynthesis is not affected by vernalization, the leaf area, the factor most closely connected with yield, is markedly affected by vernalization. Results of various experiments in cereals are given to show the scope for higher yields by seed treatment. In spite of the large amount of experimentation the practice of vernalization has not been taken up anywhere outside U.S.S.R., not even in Canada and N. America, where it should have been particularly valuable for extending the cultivation in the northern regions. The choice of suitable varieties or breeding special varieties is, however, widely practised and any necessary manipulation of growth or development has been resorted to by adjustments in agronomic practices.

The subject of resistance to adverse environment like cold, heat, drought, exposure to pests and diseases, etc., as related to developmental physiology, is dealt with in a chapter. One interesting phenomenon recorded in several crop plants is the occurrence of maximal infection by fungus diseases and insect pests

at a time when the part attacked has reached a peak in nutritive value or protein content. In most cases breeding and agronomic management offer the only practical means of avoiding damage.

The chapter on Crop Production and Geographical Distribution deals with the question of general application of experimental results in agricultural and horticultural practices. The most important factors as regards true development of crop plants are the seasonal and daily trends and the length of the daily period of light and darkness. The results of various experiments do suggest that it is possible to find and isolate strains with different critical day-lengths suitable for growing under appropriate conditions. Attention is drawn to the results often obtained by breeders, namely, that the habit of a strain in one environment is not predictable from its mode of growth in another, and that genotypic differences not apparent in one environment may be revealed in another. The close alliance of basic research to practical objectives is exemplified in the location of the new production of sugar-beet seed in U.S.A. making the country independent of the seed supply from Europe.

The review on the genetical aspects of the general problem of developmental physiology is the one that has aroused acute controversy between the Russian school, supporter of phasic development, and the school of formal mendelian genetics. The subject has been very ably dealt with by Hudson and Richens in a recent Agricultural Bureau publication entitled *Soviet Genetics*. The criticism about the inheritance studies of morphological expressions of a physiological condition, for example, earliness and lateness, on the basis of genes is not justifiable for the reason that practical and useful results have come out of such studies in India with special reference to rice. It is doubtful if the behaviour of the time-limited and season-limited rices grown in different parts of India could be satisfactorily explained on the basis of phasic development. It is not clear from the perusal of the publication *Soviet Genetics* if the Russian method of breeding on the basis of length of developmental phase has produced any outstanding results.

The last four chapters of the book which discuss all the results of experiments on the developmental physiology of various representative crops conducted since 1935, contain valuable information of practical importance. The chief crops dealt with are cereals (wheat, oats and barley), sugarcane, grain and fodder legumes, sugar-beet, potatoes, herbage plants and vegetables. There is also included a useful summary in a tabular form of results obtained in Ithaca, New York, on the optimal requirements of heat and light for a whole range of florist crops. The results on tropical and sub-tropical crops are dealt with under rice, wheat, mustard, gram, crotolaria, etc. In concluding the author pays a compliment to Indian workers and says that while the work at the Imperial College, London, may be expected to provide additional knowledge on the fundamental biological processes associated with vernalization, the work in India might provide data to fully assess the practical application of the methods of pre-treatment of

crops by temperature or light. It is surprising that the considerable volume of useful work done in India on cotton, with special reference to environment, has escaped the attention of the author.

There is no doubt that the book should prove an invaluable addition to the library of all biological workers. It contains practically all the available information on a subject of research a little over two decades old. In addition to several useful illustrations and charts reproduced from their original publications, there is an exhaustive bibliography given in the end. The author who has already to his credit several useful publications of the Imperial Agricultural Bureau can well be congratulated on this production. There is, however, one defect, if it can be considered a defect, namely, the repetition of information, but this was perhaps unavoidable in the plan he has adopted to deal with the extensive data.

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Caste in India—Its Nature, Function, and Origins. By J. H. Hutton, C.I.E., M.A., D.Sc. (Cambridge University Press), 1946. Pp 279. Price 18sh. net.

When at the present day, Mr. Gandhi has been persistently declaring, in season and out of season, that a caste-less and class-less India alone can afford to exist as an independent political entity, it is bound to be interesting and withal intriguing to note that what seems to me to be the most rational and scientific vindication of the caste-system proceeds from Dr. Hutton, Professor of Social Anthropology in the University of Cambridge, who, in the course of the volume under notice, has undertaken within a comparatively short compass, a masterly analysis of the conditions and circumstances responsible for the origin of the Caste-system and of those responsible for conferment on the said system scientific and sociological validity and sanction. In the brief "Foreword", Dr. Hutton explains in reference to the 5,000 and odd works computed to exist by an American Indologist on the subject of Caste, that he has made an endeavour in a comparatively new direction not merely to examine the origins of the caste-system but also to determine its place in the social, and economic structure of Hinduism and Hindusthan.

The work stands divided into four Parts. In the first entitled "The Background", which contains four chapters, Dr. Hutton has attempted a preliminary clarification of concepts relating to the origin, development, sociological and pragmatic sanctions of Caste system as it is actually found in Southern India (Chap. 2), Western, Central and Eastern India (Chap. 3) and "Northern India" (Chap. 4). In the "Introductory" chapter, it is pointed out that geographical circumstances have imposed unity on the peoples of this vast sub-continent. At the same time, diverse and different origins of peoples have emphasized variety and multiplicity. The thesis is argued that it is the caste system that has made it possible for harmonization of apparently irreconcilable requirements of geographical unity and variety of origins within a single social system which historically has been demonstrated to have been a stable one.

The second Part which also contains four chapters is devoted to an exposition and critical discussion of the "Structure", "Strictures", "Sanctions" and the "Functions" of the Caste-system, each topic getting a chapter.

The third Part arranged again into four chapters, contains an exhaustive examination of the "Origins" of the Caste-system with special reference to traditional accounts of indigenous and intrinsic origins, similar and analogous systems and institutions found elsewhere, and other theories advanced by Indologists and Comparative Sociologists.

The fourth Part contains two valuable "appendices", one on "The position of Exterior castes", and the other on "Hinduism in its relation to primitive religions of India" both of which have been reproduced with slight alterations verbal and punctuational in character from Dr. Hutton's *Report on the Census of India* (1931).

The fifth Part is made up of an exhaustive "Bibliography", "Glossary" and an "Index" which form the inseparable constituents of paraphernalia of modern publications, edited and planned on lines of scientific and critical investigation.

From the fore-sketched necessarily brief but, fairly exhaustive summary of the main features and contents of Dr. Hutton's work, it must be admitted that the author has been eminently successful in his able attempt to place the much-maligned system of caste in the focus of and proper perspective of sociological and anthropological consciousness, and I would particularly commend the author's judgment that "Indian society has survived a vast number of invasions, revolutions ... conquests ... this is largely due to the caste system ..." (p. 106) to the familiar type or pattern of the ultra-radicals and reformists who have been loudly proclaiming that the ills and troubles confronting the Indian nation directly spring from the accursed caste-system.

In the light of the latest and modernest pieces of legislative enactments such as the Laws relating to validation of *Sagotra*-unions, divorces, etc., Dr. Hutton's volume may be in a sense regarded as an anachronism, but, it would be impossible not to admit that the author has presented the problem of caste in an exceedingly understanding and penetrating manner purely from the standpoint of a disinterested student pursuing the modern scientific and critical methodology.

Dr. Hutton's volume illustrates in an illuminating manner some of the difficulties inseparable from attempts made by foreigners to understand the intricacies of the Sanskrit language. I shall just refer to some. (1) The term *Pravara* (pp. 50-53) printed with amusing and outlandish diacritical marks suggests a meaning quite different from that sanctioned by the context. (2) Likewise, the term *Satapatha* is severely man-handled (p. 258). (3) In the language of the *Gita*, the caste system has been definitely CREATED and brought into being by the Supreme Creator ("*Chatur-varnyam-maya-srishtam*", Chaps. 4-13). So, it is not quite correct to speak of the system as established by divine ordinance or divine approval. (4) The term

Dharmeswar is done into "The Righteous one" with interrogation mark on p. 164—and without it on p. 109. The correct rendering would be the Lord or Controller of a spiritual and moral order. These and similar instances have not been covered by the explanation attempted in the "Foreword" of "certain inconsistencies". In the "Foreword", the author has made a confession of his weakness or partiality for the fluctuating use of singular and the plural verbs when the nominative happens to be CASTE. Making the due allowance for his partiality, I slur over the usage, but, it must be passing strange that a singular verb should have been used when the subject stands in plural (not in reference to the dubious term *caste* however). Thus, you read on p. 95, "Purification and expiation IS followed by..." But none of these would adversely affect the uniform excellence of Dr. Hutton's work on which he deserves to be unreservedly felicitated.

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HORIZONS OF BIOCHEMICAL THOUGHT

Currents in Biochemical Research. Edited by David E. Green. (Interscience Publishers, Inc., New York), 1946. Pp. 8 + 486. Price \$5.00.

The science of biochemistry has profoundly directed and fertilised the progress of many other branches of scientific enquiry. It has enriched general biology, chemistry, pharmacology, chemotherapy, medicine, agriculture, nutrition and public health; more recently, biochemical science has invaded the field of genetics, which has resulted in the birth of *Biochemical genetics*, a branch of science which has already shown great promise of a bright and fruitful future. Biochemical science whose principles and techniques are so extensively invoked for the ever-increasing development and specialisation of other branches of scientific research, has been, in consequence, expanding at a terrific rate as can be gathered from even a casual perusal of the scientific literature. The imperative need, therefore, for a survey of the field with a view "to get at the simple essential concepts which are basic to their appreciation" has been generally felt.

Currents in Biochemical Research represents a unique venture in the successful presentation of this survey and in the satisfactory fulfilment of this need. In accomplishing this difficult task, Editor Green has been fortunate in securing the co-operation of the foremost authorities in their respective fields. To quote the prefatory words of the Editor, the volume "represents an attempt by some thirty research workers to describe in as simple language as possible the important developments in their own fields and to speculate a little on the most likely paths of future progress". The most important portion of the volume consists in the exciting glimpses into fascinating horizons of biochemical thought, to which the reader is introduced; not less interesting and valuable are the future trends and applications of biochemical research and experimental technique both of which tend to inspire new and expanding lines of work, and provoke fresh ideas of approach to old problems,

The thirty-one essays which comprise the volume cover a wide field, biochemical genetics, viruses, photosynthesis, plant biochemistry, vitamin research, nutrition, enzymes, intermediary metabolism, heterotropic assimilation of carbon dioxide, isotope technique, plant and animal hormones, immunochemistry and Chemotherapy. The two last chapters, one on Social aspects of nutrition and the other on Organisation and support of science in the United States, have a general interest. The volume is unique in its conception and exceptionally brilliant in its execution. It will command a wide circle of readers interested in the pure and applied aspects of biochemical science, and will be received by everyone of them with enthusiasm and gratitude.

Marine Microbiology. By Claude E. ZoBell. (Chronica Botanica Co., Waltham, Mass.; and Macmillan & Co., Ltd., Calcutta), 1946. Pp. xv + 240. Price \$5.00.

Micro-organisms play a fundamental and vital role in determining the marine environment; they are the dynamic agents which are intimately associated with the cycles of carbon, nitrogen, phosphorus and sulphur. They actively participate in the geological transformations and in the formation of deposits at the bottoms of the seas. In addition, their biochemical activities have a practical bearing on the fouling of the bottoms of ships and on the corrosion of iron and other metals. Exclusive types of micro-organisms are to be found in the sea by virtue of the fact that it represents a specialised type of environment with a high salinity. These marine organisms may, therefore, be expected to exhibit exceptionally distinctive biochemical functions yet undiscovered; they offer to the biochemist, in consequence, an unexplored and virgin field of research.

Marine micro-organisms have been traced to be directly or indirectly responsible for the formation of gases in the sediments of seas, for the conversion of organic matter into petroleum or proto-petroleum and for the deposition of sulphur. The gypsum type of sulphur deposits are believed to have resulted from the microbiological reduction of calcium sulphate associated with marine sediments. The author puts forth a significant suggestion that "Calcium sulphate is being reduced to sulphur at the expense of the buried organic matter which serves as a source of energy for microbial action." Continuing he adds, "Although conclusive proof is still lacking, it is generally believed by geologists and microbiologists that anaerobic bacteria are responsible for sulfur deposits of the gypsum type. Some of these sulfur deposits in Louisiana and Texas are a hundred or more feet thick. Unique sulfate-reducing bacteria, which appear to be indigenous species, have been isolated from sulfur-limestone-anhydrite formations from a depth of 1,550 feet. Hunt attributed the origin of the sulfur deposits of Sicily to the bacterial reduction of sulfates in ancient, shallow marine seas resembling present conditions in the Black Sea."

More recently, deposits of sulphur have been discovered in the coastal areas bordering the Bay of Bengal; these deposits which are con-

fined to the first three feet from the surface have been shown to be due to the action of bacteria which function in a salinity of 10-12 per cent. The subject of marine microbiology is thus one of great practical interest and also one of great theoretical significance.

The author has rendered a great service to the science of marine microbiology by presenting to all the interested investigators a comprehensive, logically arranged and well-documented account of the present status of the problems pertaining to marine microbiology. This volume will remain for a considerable time to come not only an illuminating compendium of reference but also a source of inspiration to all those interested in the development of this fascinating branch of microbiology.

Antibiotics—Parts I and II. By Werner W. Duemling and others. Edited by Roy Waldo Miner. (Annals of the New York Academy of Sciences, New York, Vol. 48), 1946. Pp. 31-218.

The New York Academy of Sciences has recently been publishing in its *Annals* a series of valuable records of Symposia held under its auspices, on subjects of topical interest and scientific value. These records contain critical reviews of thoughtfully selected subjects, indicate future lines of development and focus the attention of interested investigators on problems which await solution. The participants in the Symposium on Antibiotics are scientific celebrities in their respective fields and, therefore, entitled to speak with authority on the aspects of the subject which they have chosen to expound.

The present number of the *Annals* on Antibiotics is presented in two parts: (1) Microbiological and (2) Pharmacological. S. A. Waksman has spoken of the contribution of the microbiologist in discovering and developing antibiotic substances. The history of the development of penicillin production is closely associated with the wartime endeavour to produce regardless of cost an effective antibiotic for controlling certain important diseases of man. It was fortunate that penicillin production was undertaken as one of the wartime projects; research on antibiotics was generously financed and the industry was liberally subsidised. What was the result?

To quote Waksman, "The yield of penicillin in the medium, as a result of the growth of the fungus *Penicillium notatum*, was increased from 2-4 Oxford units per milliliter to 200 and 1,000 units per milliliter. New and very active strains of the penicillin-producing fungi were isolated. Finally, the deep or submerged method for the production of penicillin on a large practical scale was developed. Penicillin was isolated, crystallised, and its chemical nature determined. This remarkable development in the production of penicillin has, finally, led to a rapid rise in the use, on a scale never dreamed of even three or four years ago."

Vigorous search for other antibiotics particularly specific towards gram-negative pathogens led to the development of streptomycin.

Penicillin production became an economic reality thanks to the development of improved