thought essential in preparing the way for a new era, but these institutions are seriously hampered by a narrow provincialism and are generally quite willing to sacrifice national interests to the interests of their own alumni.

The following letter has been written in the hope that those who read it may be induced to express their views upon the methods available for curing our universities of that infirmity of spirit which is a symptom of the national malady of general unpreparedness for either war or peace.

PRINCETON, N. J., October 1, 1915.

Dear Sir: The present crisis in civilization has brought this country face to face with many new and grave responsibilities. We have suddenly awakened to an increased sense of appreciation of the need of adequate protection against invasion, of greater facilities for insuring the scientific development and extension of industry and commerce, of promoting research and scholarship, and of eventually developing a culture which will contain dynamic power sufficient to hasten the spread of the spirit of malice towards none and charity for all.

The people of the United States are now vaguely considering the possibility of making a contribution of permanent value to the cause of civilization, but substantial progress in this direction can only be gained under other standards of leadership, and by the dissemination of higher ideals than those hitherto exhibited by older civilizations. The task is an enormous one. Advance towards a newer civilization will tax human intelligence to the uttermost.

What active preparation are our universities making to assume their share in this great movement?

An extraordinary opportunity exists—one rich in possibilities, not only for coordinating but for strengthening the intellectual forces of the nation. World-problems must be solved in a world-spirit. Is not this the moment to break away from the narrow provincialism which interferes with the active participation of our universities in the general advance?

This provincialism is manifested in the form of administration of university affairs which allows the imposition of ideals entertained by those alumni who appraise the value of their alma mater in terms of sentimental attachments without considering the relation of the institution to the nation and to the intellectual life of the people.

For some years I have been trying to analyze conditions which seem to handicap the universities seriously in their effort to stimulate and direct the thought of the nation. In this connection I should consider it a favor if you would reply to the following questions:

1. Can you suggest a method by which a freer interchange of opinion and criticism between universities might be effected?

2. How can we combat the obsessions and overvalued ideas that are the common accompaniments of emotional reactions associated with athletic contests and which make it extremely difficult to substitute the national for the provincial ideal in university administration?

3. Do you believe that a broader and more intelligent spirit would be introduced into the administration of affairs if the principle was carried into practise of adding faculty representatives, including those from other universities, to each board of trustees or overseers?

4. Have you any suggestion to offer in regard to the changes in the present form of organization so that the administration of the finances and the formulation of the educational policy should not be under the control of a single board of trustees?

Thanking you for the courtesy of a reply, I am,

Respectfully,

STEWART PATON

PRINCETON, N. J.

SCIENTIFIC BOOKS

The Mutation Factor in Evolution with Particular Reference to Œnothera. By R. RUGGLES GATES, Ph.D., F.L.S. London, 1915. Macmillan and Co. Pp. xiv + 353. Price $3.25.

Dr. Gates has been a prolific contributor to the already very extensive literature on œnotheras, and this book will be a welcome summary of his views as expressed and modified through a long series of papers.

Following the "Introduction" is a chapter, accompanied by a map, on the "Character and Distribution of the Œnotheras," in which structural features and life habits are described and a list of twenty-eight species given with synonymy and accounts of their distribution. The fact that twelve species are appended to this list without discussion indicates how rapid is the progress being made, chiefly through the studies of Bartlett, to our knowledge of the

Œnothera taxonomy and how circumscribed is our present horizon. Every years adds some new species which have been tested in the experimental garden, the only safe way of determining for most of the œnotheras their true characters and justifying the publication of species. With these conditions in the group some years must elapse before we shall be in a position to take a general survey of the field.

A chapter on "The Cultural History of Œnothera" presents an interesting account of the pre-Linnæan references to œnotheras with a number of figures reproduced from old works. This account leads up to a discussion of the origin and status of *Œnothera Lamarckiana,* a matter of fundamental significance in any consideration of the value of this plant as representative of a mutating species. Gates accepts without qualifications the opinion of De Vries that *Lamarckiana* was collected in America by André Michaux about the end of the eighteenth century. The evidence for this view rests on a specimen in the Muséum d'Histoire Naturelle at Paris. The photograph of this plant published by De Vries and only figured in part by Gates shows a plant with narrow-lanceolate leaves strongly petioled, narrow bracts, and very long sepal tips. That this plant could have been related to *Lamarckiana* with its ovate-lanceolate leaves almost sessile, broader bracts, and shorter sepal tips seems to me scarcely possible, and I venture to believe that neither Bartlett nor Shull, both *Œnothera* specialists, will follow De Vries in this identification.

Accepting this identification of De Vries, Gates finds no difficulty in believing that *Lamarckiana,* as a native American species, established itself on the Lancashire coast of England previous to 1800, and that the figure of Sowerby, 1806, is of this plant in spite of the fact that the flowers as drawn are not so large as those of *Lamarckiana,* the position of the stigma not so high, and that no mention is made in the description of the very conspicuous red papillæ upon the stem. An alternative possibility that the plant of Sowerby was a form related to *biennis* finds no favor with Gates. The chapter concludes with accounts of a number of races of *Lamarckiana* now in cultivation or otherwise recognized. Gates accepts with De Vries the suggestion that the source of the *Lamarckiana* introduced into cultivation by Carter and Company about 1860 may have been not Texas, as they state, but England.

Chapters IV. and V. give descriptions of the "mutation phenomena" in *Lamarckiana* and other species and include observations of his own as well as those of De Vries and other authors. There is also described in these chapters the results of many breeding experiments involving the "mutants" as parents. These chapters should be read with the following points in mind as reservations of prime importance for judgment on the deductions. Recent work has shown that the germination of very many seeds of œnotheras is usually delayed far beyond the time generally allowed by the preservation of seed pans. Although the facts of delayed germination and seed sterility have been recognized, few investigators have taken the trouble to make counts of the seeds sown and until recently none have obtained complete germination as established by experimental methods properly checked through the examination of the residue of sterile seed-like structures. Consequently we can not feel confident that the records of any cultures of *Œnothera* so far reported are complete for their possible progeny. The percentages calculated for "mutants" and the ratios of classes in breeding experiments can not be accepted as final in exact genetical work. We are not in a position even to guess what may be the changes of front when exact data become available.

In Chapter VI., on the "Cytological Basis of the Mutation Phenomena," will be found an account of Gates's own contributions in cytology which have been noteworthy. A good description of the reduction divisions in the pollen mother-cells paves the way for the discussion of irregularities in the distribution of chromosomes whereby gametic nuclei may be formed with more or with fewer chromosomes than 7, the normal number. From such gametes, fertile zygotes are occasionally formed that give rise to œnotheras with high counts of chromo-

somes of which the *lata* and *semi-lata* types with 15, the *semi-gigas* with 21 and the *gigas* with 28 chromosomes, respectively, are the best known. Gates gives a clear account of his important studies on *lata* and comprehensive discussions of triploidy and tetraploidy, the latter with a long list of genera with species in which the chromosome number has been doubled. It is not likely that there will be disagreement with Gates's chief conclusion that the characters of these plants are correlated to some extent with the peculiarities of their chromosome counts, which are above the normal 14, and that some of the variants from *Lamarckiana* and other species, called "mutations" are due to irregularities in the distribution of their chromosomes.

However, certain features of the chromosome behavior at the time of reduction in the species studied by Gates are not discussed from all points of view. Gates emphasizes the fact that in the œnotheras studied by him the pairing of the chromosomes previous to the reduction division is very loose, so that mechanical arrangements favor the irregularities of distribution which actually occur. In these observations other students of *Œnothera* cytology agree for *Lamarckiana* and some of its "mutants" and for certain other forms. But Gates assumes that this peculiarity, *i. e.*, a loose pairing of chromosomes, is a condition prevalent among œnotheras in general, including those which he believes to be pure species, and that the forms of this genus depart from the rule, supported by an overwhelming mass of evidence, that in pure species there is a very exact pairing of chromosomes previous to the reduction divisions. Studies among such animals and plants as have a series of chromosomes of different sizes and forms have shown a most remarkable association of these in strictly homologous pairs, and the presumption is justified that a pairing of homologous chromosomes at the time of reduction is the rule in pure species.

One *Œnothera* is known, namely, a line of *grandiflora*, in which the chromosomes following synapsis become associated very definitely into ring-shaped pairs which are assembled in a very orderly manner at the equatorial plate of the reduction division and are subsequently distributed in equal numbers by the separation of the members of each pair. This is a history entirely in accord with that generally reported for animals and plants and the conditions allow of little or no opportunity for irregularities of chromosome distribution. Now it also happens that the seeds of this line as recently tested are almost wholly fertile and that there is scarcely more than a trace of pollen sterility. In short, this line with respect to its fertility and to the regularity of its reduction process presents the behavior to be expected of a pure species. Since one line of *Œnothera* is regular in its behavior, there are probably other lines equally so, and these may prove to be the species purest of all the œnotheras in their genetical constitutions. They have not yet been studied either cytologically or through breeding experiments. On the other hand, *Lamarckiana* and certain of its derivatives, types of very low seed and pollen fertility, irregular in their reduction divisions, and extraordinary in their breeding habits, have been given much attention and assumed by the mutationists to be representative of pure species. In the face of these exceptional peculiarities the natural assumption until otherwise disproved should be that *Lamarckiana* and these derivatives are not pure species and that the irregularities of their cytological and breeding habits are the result of a hybrid constitution. This is a phase of the matter which Gates does not consider.

A long chapter on "Hybridization" and one on the "Relation between Hybridization and Mutation" discuss the nature of mutation crosses, Mendelian splitting, blending and modification of characters, twin hybrids, double reciprocal crosses, etc. There is summarized here the most important of Gates's breeding studies, including those between *grandiflora* and *rubricalyx*. So far as the statements of ratios and percentages are concerned, the criticism of course applies here as to all past *Œnothera* work that we have no assurance of complete results since there is no means of knowing what proportion of the seeds sown was fertile or how imperfectly representative

may have been the cultures due to incomplete germination. One can not feel confident that the results were more than glimpses of the genetical possibilities and under these conditions speculation loses its point. We are not likely to be in a position to discuss satisfactorily the problems of *Œnothera* genetics until new series of experiments are undertaken with methods whereby the germination of seeds is forced to a finish.

Gates makes an attack on the extreme views of certain Mendelian writers who have held so strongly to a principle of the conservation or fixity of factors that they do not allow of their modification even through crossing. It may be doubted whether this group of Mendelians is really a large one, but so far as they do exist the criticisms of Gates are likely to have the sympathy of his readers. It is, however, one thing to recognize the complexity and possible instability of protoplasm as to its stereochemistry and quite another to hold that stereochemical changes within a pure species can produce such great modifications of morphological structure as the mutationists would have us believe. And the œnotheras are so strongly under suspicion of genetic complexity through hybridism that we have a right to expect that evidence for mutation from this group will be most critically sifted and only employed where it is found in material of proven purity.

One may be Mendelian, firmly believing in the principle of segregation following an F_1 generation which is the principal tenet of Mendelism, and still admit the probability of modifications from time to time of the stereochemistry of germ plasm even in so-called "pure lines." That such changes may result in spontaneous modifications of structure seems reasonable on philosophical grounds and such modifications would constitute mutations since they are discontinuous. But it remains to be proven that such modifications affect changes in morphology to the degree claimed by the mutationists, although it may well be possible that numerous small mutations would in time have a cumulative effect readily recognized. Thus advances in evolution may come about through numerous small steps, as held by Darwin, and some of these may be mutations, but it seems probable, as so strongly argued by Weismann, Lotsy and others, that the chief causes of variation in higher animals and plants and the most important directions of evolution are determined through the mixing of diverse germ plasms with their complex interactions. Modifications of germ plasm through crossing, and mutations due to external chemical and physical factors, would be expected at times to work simultaneously, and in such cases it may become a difficult matter to distinguish their separate effects. Mutations even though small in degree would, however, if sufficiently numerous, work in time profound modifications of structure, and on this common ground the mutationists and the followers of Darwin seem to have the strongest hopes of reaching an agreement.

The final chapters, "A General Theory of Mutations" and "The Evolutionary Significance of Mutations," continue and elaborate the discussion which runs through the previous pages and thus largely summarize or expand the author's views. A bibliography of about 500 titles, of which 42 are by Gates, completes the work.

BRADLEY M. DAVIS

A Text-book of Zoology for Universities, Colleges and Normal Schools. By THOMAS WALTON GALLOWAY, Ph.D., Litt.D., Professor of Biology in the James Millikin University. Third edition, revised. P. Blakiston's Son & Company, Philadelphia.

It fell to the lot of the present writer to undertake a review of the first edition of this book[1] which was published in 1906. In paper, typography, binding, etc., the book is well made and attractive to look upon, a very deserved compliment to the publishers, who seldom allow anything inferior in the way of bookmaking to emanate from the house.

Intrinsically there is little change over the first edition, aside from the addition of some four chapters comprising about sixty-five pages more than the former book. The same plan

[1] SCIENCE, Vol. XXIV., p. 719.