

is indeed a fundamental difference between the two cases. The colleges of the Victoria University are widely separated, and appeal to the strong local feeling of powerful and independent districts. A generous rivalry may therefore exist between them without ill result. Each should be left, as they have been left, to work out their own success with as little external interference as possible.

"It is sometimes argued that because the population of London largely exceeds that even of such districts as Lancashire or the West Riding, there ought to be room within it for the separate and independent institutions in which teaching of the highest type could be provided. This view ignores the importance of geographical separation, and unduly exalts that of the numerical magnitude of the population whose wants are to be met. If Manchester and Leeds were on opposite sides of the Irwell or the Aire, if they were connected by an elaborate system of over-ground and underground railways, then it would be more economical to concentrate, in one or the other, the higher teaching which must now perforce be given in both. The loss of time to the students in reaching the scene of their daily labours would be but imperceptibly increased, while the prestige of the colleges, great as it already is, their claims on the State, strong as they already are, would be enhanced in a proportion greater than that calculated by merely adding their separate reputations and resources. In a city of the size of London it is desirable to multiply institutions in which preparatory work of all sorts is undertaken, but I think it may be assumed as almost axiomatic that it is impossible, at present at all events, to create in one town more than one institution in which laboratories and lecture rooms and the other machinery of scientific instruction shall be provided on the large scale which the elaboration of the highest modern scientific teaching demands. In London, then, the teachers in almost all existing institutions feel the necessity for a combination of forces. They have expressed themselves as willing to be formed into battalions and regiments rather than to be left to carry on their work as isolated companies. I will not dwell on the fact that this desire could only be declared by men who were willing to risk their personal position for the public good, but I want you to observe how in this case also the work of decentralization, which began with the foundation of University College, London, has been followed and would have been far more effective had it been accompanied by a corresponding manifestation of centralizing force."

With these views we heartily agree.

If ever we are to have in London laboratories such as those which are to be found in Germany, it can only be if the higher teaching in each subject is concentrated in some one great central institution, and if rival colleges are allowed to combine their forces for the public good, instead of being compelled as at present to fritter them in suicidal competition.

Taking it for granted that all will admit that such an ideal would be the best if it could be realized, we believe that the possibility of its realization is chiefly doubted on two grounds, to neither of which any real importance is to be attached.

It has been supposed, in the first place, that those who advocate a policy of union among the London colleges think that this union must be carried out in all particulars immediately; and secondly that in order to secure this end it must be carried out by compulsion, even if the practical confiscation of the property of the existing colleges were necessary.

It need hardly be said that such a statement is a parody of the views of men who have had at least as much experience as their critics [of the tone of mind of the governing bodies of great educational institutions, and who therefore would be the first to anticipate the difficulties which such demands would inevitably cause.

No responsible body has, as far as we are aware, advocated more than the establishment of a University on a basis which would permit the union of the various colleges, in whose buildings the University teaching might at first be carried on, if the colleges were themselves willing that such a union should be effected. The advocates of union have all along been striving, not to attain an immediate and complete realization of their ideal University of London, but to prevent the Charter being drawn so as to make that realization impossible. It cannot be beyond the limits of human skill to frame a scheme which shall offer every inducement to the London colleges to effect an immediate fusion, and shall further provide that any approximation which may at first take place shall easily become closer in the future.

The Victoria University does not consist of competing colleges. A federal University of London would consist of colleges which from their mere local proximity would, whether they willed it or no, be necessarily antagonistic. Unless the Commissioners fairly grasp this fact and realize that they have it in their power to lay down the lines on which a great institution shall be founded in close connection with the State, which shall concentrate under one central directing power all the educational efforts which are at present partly wasted through want of joint action, they will have failed to make the most of a great opportunity, and will have frittered the forces which, if allowed free play, are competent to do for the higher education of London all that the best friends of London can desire.

THE STUDY OF ANIMAL LIFE.

The Study of Animal Life. By J. Arthur Thomson, M.A., F.R.S.E. "University Extension Manuals." (London: Murray, 1892.)

THE chief aim of an "Extension Manual" as of "Extension lectures" is to stimulate interest and to spread information. In natural science, at any rate, it is impracticable through the medium of either Extension lectures or Extension manuals, to give that training which the student, be he specialist or generalist, can obtain only by practical work, aided by practical instruction. But there are a great number of people, some already busily engaged, others on the threshold of their life's work, who possess some interest in, and some information about, those matters, with the study of which scientific men are occupied. For them Extension lectures and manuals are a great boon; and to them Mr. Thomson's work on "The Study of Animal Life" may be cordially recommended. We trust it will stimulate them, as he would desire, to become themselves observers.

The work is divided into four parts, of which the first, entitled "The Everyday Life of Animals," deals with the wealth of life, the web of life, the struggle of life, the shifts for a living, the social life of animals, the domestic life of animals, and the industries of animals. The second part, on "The Powers of Life," contributed by Mr. Norman Wyld, treats of vitality, the divided labours of the body, and instinct. The third part describes "The Forms of Animal Life" and includes chapters on the life-history of animals, and their past history as read in the geological record. The fourth and last part treats of "The Evolution of Animal Life" and, besides a discussion of the influence of habits and surroundings, and of heredity, gives a sketch of the evolution of evolution theories. Appendices on the relation of animal life to human life, and on some of the best books on animal life bring the work to a conclusion.

The general arrangement of the subject-matter is, as will be seen by the above summary, well and carefully thought out, and the facts given in elucidation of the varied tendencies of organic development are skillfully marshalled and are derived from the most trustworthy sources. The information given is therefore accurate and up to date. The only suggestion we have to offer in this connection is that a little more selective elimination might have been exercised. Some facts are given in so terse and condensed a form that no one but a zoologist could appreciate their value. If a considerable number of these had been struck out and the space thus gained had been utilized in expanding those that remained, the Extensionee would have been the gainer. "The Zoological Summary of the Animal Kingdom" (pp. 210-272) might by some such process have been replaced by a sketch with more life and go in it. As it stands it will, by many readers, be gracefully skipped.

In such a work style is an important element. Here Mr. Thomson is often exceedingly happy. He has imagination and a feeling for the poetic aspect of nature. But his imagination and poetry need at times just a little chastening. When he tells us that in birds "the breathing powers are perfected and economized by a *set of balloons around the lungs*," and that their brains "are not *wrinkled with thought* like that of mammals"; when he speaks of the sponge as "*a Venice-like city of cells*"; when he describes the ciliated cells of the windpipe as "*lashed cells*," or the embryonic membranes as "*birth-robes*," and when he says that in ponds subject to drought the organism often "*sweats off a protective sheath which is not a shroud*, and waits until the rain refreshes the pools"; in these and sundry other cases of which these are samples, one may question whether the expressions which we have underlined are justified either by special elegancy or by real helpfulness to a beginner. And this we say in no spirit of hypercriticism, but as desirous of aiding the author in what is by no means an easy task.

Somewhat deeper would be our criticism of sundry expressions which are of essentially human implication and which in our opinion should not lightly be applied to animal activities. Much is said of the "love" of animals for their mates when some such phrase as "sexual appetite" would be more appropriate. For example, concerning ants we read:—"After this midsummer day's

delight of love death awaits many, and sometimes most." And in the analysis of the forms of struggle for existence, we have the "struggle between rivals in love." Again, of the cuckoo it is said that, "in spite of the poets, the note of this 'blessed bird' must be regarded as suggestive of sin"! And again, "It is not quite correct to say that the cuckoo-mother is immoral because she shirks the duties of maternity; it is rather that she puts her young out to nurse because she is immoral." It is true that Mr. Thomson adds this footnote:—"The student will notice that I have occasionally used words which are not strictly accurate. I may therefore say definitely that I do not believe that we are warranted in crediting animals with moral, æsthetic, or, indeed, any conceptions." We are glad to be thus assured. But why implant notions in the text which have to be eradicated in a footnote? Does not Mr. Thomson know how easy it is to sow tares and how difficult to root them out?

Mr. Norman Wyld's chapter on "Instinct" is short, but quite to the point. We hope that he may further observe and experiment in the field of comparative psychology, for he is fully alive to the peculiar difficulties of the subject, and there is a wide field before him in which the scientific workers are none too many. In criticizing Mr. Lloyd Morgan's definition of instincts as "oft-recurring or essential to the continuance of the species," Mr. Wyld says:—"This is not quite satisfactory, for many actions that are instinctive are not oft-recurring, and many are not necessary to the preservation of the species." He does not show that there are any such actions which are neither the one nor the other. We have reason for supposing that he understood Mr. Lloyd Morgan to say that instinctive actions were "oft-recurring *and* essential to the continuance of the species." But this he did not say.

In conclusion we may repeat that "The Study of Animal Life," though by no means faultless, may be recommended to Extension students and the general reader as, in the main, accurate, readable, and suggestive.

C. LL. M.

VECTOR ALGEBRA.

Principles of the Algebra of Vectors. By A. Macfarlane, M.A., D.Sc., LL.D., F.R.S.Edin., Professor of Physics in the University of Texas. Reprint from the Proceedings of the American Association for the Advancement of Science, Vol. XL., 1891, pp. 65-117. (Salem Press, Salem, Mass., 1891).

THIS is a very suggestive contribution to the foundations of the Algebra of Vectors as recently so strongly advocated in America by Prof. Willard Gibbs, and in this country by Mr. Oliver Heaviside.

The extensive use of quaternions among physicists has been prevented by the fact that the meaning of a product of vectors has been made to depend on the use of a vector as a quadrantal versor, and by the fact that this method leads to the square of a vector being negative. The advocates of the new algebra define a product of vectors independently and in such way that the square of a vector is positive. Rotations are expressed by means of dyadics, or ratios between vectors