

Brahmans, contending that they have not systematically cultivated learning, and that they have not made any appreciable progress in its pursuit, is absolutely false in the light of our present knowledge of Sanskrit literature. A mass of scientific literature (on grammar, astronomy, medicine, philosophy) is there to contradict such a statement.

The Abbé's knowledge of Buddhism is derived from very secondary sources—evidently from accounts given by the most passionate opponents of the Buddhists. Hence he speaks of "this odious doctrine" of "pure materialism," and of "this abominable school" (p. 415) with utter contempt. Had he known Buddhism from its own literature, and been able to acquaint himself with Buddhist ethics, or had he known only the older and purer Sanskrit literature (which, indeed, in his days was scarcely accessible), his judgment of the moral character of the Hindus would probably have been less partial, and his picture of the Hindus as a nation would have shown brighter features than is the case now.

The editor and translator has performed his task very creditably. We should only have wished that the Sanskrit quotations had been given in a more correct form, and a more modern spelling of the Sanskrit names and terms substituted for the spelling used by the Abbé. The index (of six pages to 724 pages of text!) is rather too meagre for a work of such an extent, and treating on such a variety of subjects. But these are minor faults in a work for which every Indologist and Ethnologist will be thankful.

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#### FOSSIL PLANTS.

*Fossil Plants for Students of Botany and Geology.* By A. C. Seward, M.A., F.R.S., F.G.S. Vol. i. Pp. xviii + 452. (Cambridge University Press, 1898.)

THE botanical side of palæontology has been passed over in general treatises and text-books in a manner that shows the authors had little, if any, personal knowledge of fossil plants. This has been due to the want of any trustworthy elementary manual on the subject. Mr. Seward's admirable book, of which only the first volume is published, will supply this want. Though addressed to students of botany and geology, it must be regarded mainly as a guide to palæobotany for the benefit of the former, since no one not well versed in botany could follow the technical descriptions of such structures, for example, as the Calamites. On the other hand, introductory chapters on geology and the conditions under which fossil plants are preserved, enable the botanical student to read the book with no previous study of geology.

Mr. Seward, while not going so far as the late Prof. Williamson, who would diagnose no fossil plant which did not exhibit internal structure, lays great stress on the pitfalls in the way of those who have to determine fossil plants in which no structure is preserved. The group of jointed stems on p. 95, belonging to Cryptogams, Gymnosperms, Monocotyledons and Dicotyledons, is scarcely a happy illustration of the danger of trusting to superficial resemblances, since hardly any one at the present day would be likely to base determinations on such material without collateral evidence. In collecting and studying fossil floras, if these are at all extensive, it is easy to

perceive whether they are from damp or dry stations, from temperate or warm climates, and so on; and such considerations would materially help in ascertaining whether Equisetum or Casuarina and Ephedra would be likely to be present. The worker, however, is rarely obliged to rely on isolated leaves or twigs, and an examination of the matted masses in which Equisetum is usually fossilised, is convincing as to the real nature of the plants. In dealing with late Cretaceous and Tertiary plants it may be well to remember that continental floras, now held to be indigenous to certain regions, have formerly been migratory over wide areas, and are probably now but sojourners on the spots they occupy. The genera composing them were associated together in the past much as they are now, a fact that may assist in their determination. Floras of oceanic islands have probably been indigenous from remote periods, as with the Tertiary plants of Madeira, which comprised few exotics.

Palæontologists may hardly agree as to the propriety of adding the terminations "ites" or "opsis" to recent genera when they have been proved to have existed in the fossil state, unless the nomenclature of plants is to differ from that of animals, otherwise we should have Nautilites, Terebratulites, Ostreites. Such terminations are more useful when implying doubt as to the actual identity of the recent and fossil genera. These, however, are minor matters, and the introductory chapters are on the whole so lucid and sufficient, presenting all requisite information in so concise and reasonable a manner, that there is little room for criticism.

Almost 300 pages of the first volume are devoted to the "systematic" description of fossil plants, beginning at the lowest and leaving off in the midst of vascular cryptogams. The lowest forms of plant life, unless partly siliceous or calcareous, are rarely preserved, and are of little interest to the geologist or palæontologist. The completeness with which even the largest seaweeds decay, especially the brown algæ, leaves little hope that many can have been preserved; and there can only be one opinion as to the wisdom of discarding all problematical markings. The ancient and gigantic Nematophycus is almost the only one determined with certainty. It was remotely allied to Laminaria, and is met with in Silurian and Devonian rocks. The Diatoms, so far, do not appear to be more ancient than the Lias. The Siphonææ are a group of exceptional palæontological interest, and though most of the Caulerpires of old authors are passed over, the minute and often beautiful calcareous organisms so familiar to collectors of Eocene mollusca receive adequate attention. The very ancient Corallinacææ, the plant nature of many of which has only recently been admitted, are fully dealt with, and the extensive part they are now known to have played as reef-builders is recognised. The Characææ form a distinct group, the Charophyta, the fruits of Chara, so abundant in the Eocenes, first definitely appearing in the Jurassics, if not indeed in Palæozoic rocks.

The fossil Hepaticæ are of little interest, being so poorly represented in the fossil state, and of those recorded the author scarcely accepts any except the Marchantites of Sezanne and some of the fragments preserved in amber. Though it seems so probable that mosses must have been well represented in carboniferous

forests, no unmistakable specimen of that date has yet been discovered.

The concluding chapters are devoted to vascular cryptogams, over 140 pages being assigned to the Equisetales, chiefly to the remarkable group of Calamites, which must have been so conspicuous an element of carboniferous vegetation. Though cryptogamic, they formed large trees forty or fifty feet high, with woody trunks of exogenous growth. For this reason a section of the Calamites named *Camelodendron* have been and are even yet regarded as Gymnosperms by some French writers. The genera and species of this group are peculiarly difficult to diagnose, every organ being detached and preserved in a different manner. Internal casts of pith cavities in sandstone are the most familiar objects, but the more valuable specimens are those which preserve their internal structure, so ably deciphered by Williamson and others. The foliary organs are found separately in the shales and ironstone nodules; and the strobili in various conditions, which have permitted their internal and external structure to be examined. The roots of several kinds are also found detached from the stems. The author, without attempting to unite these scattered organs into specific wholes, has grouped the facts in the clearest manner. The variety presented prove that several distinct generic types existed, and as each variety of each separate organ was first described in ignorance of its probable relationship to the other, a complicated nomenclature has resulted. The Calamites, well represented in the Devonian, did not survive the Permian, though represented in the newer rocks by the closely related Equisetum.

The second important carboniferous group, Sphenophyllum, is also placed in a separate class, the Sphenophyllales, as a type that cannot be assigned to any existing group. Its leaves are wedge-shaped, with one or several veins and disposed in whorls, the strobili long and narrow, and the stem slender and woody. It was probably a climbing plant, and is regarded as linking the Calamites and Lycopods.

In so brief a notice it is difficult to do justice to a work so full of matter and observation. Botanists and geologists must equally congratulate themselves on having so obscure and difficult a subject put before them for the first time in a really lucid and comprehensive manner.

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#### INFINITESIMAL CALCULUS.

*Infinitesimal Analysis.* By William Benjamin Smith. Vol. i. Pp. xvi + 352. (London: Macmillan and Co., Ltd., 1898.)

IT may be assumed that the contents of this volume represent, on the whole, the author's conception of a reasonable first course for the average University student. Judged from this point of view, the work certainly deserves approval, and is a favourable specimen of the class to which it belongs.

In the first two chapters the processes of differentiation and integration are explained, with appropriate graphical illustrations. No attempt is made to discuss all the subtleties which modern function-theory has

shown to be involved in the assumption of the possibility of differentiation and integration, but the analysis, so far as it goes, is sound, and something is done to guard the student from making false generalisations.

The next four chapters deal mainly with applications. These have been judiciously selected, and are of practical importance as well as theoretical interest. Kinematical applications might have been advantageously included; in fact, considering the general character of the book, it is strange that kinematical considerations have been almost entirely ignored.

Chapter vii., on partial integration, concludes with Green's theorem; it is a pity that Stokes's theorem was not also included. A short but useful chapter on definite integrals, and another on curve-tracing, conclude the volume.

On pp. 18-20 there are some remarks about velocity with which we profoundly disagree. After allowing that "according to the most familiar notions"  $\Delta s/\Delta t$  "is the *average speed* (or velocity) during the time  $\Delta t$ ," and that "if the space be a function of the time" (it is difficult to see how any other assumption could be made) then in general  $\Delta s/\Delta t$  has a definite limit  $ds/dt$  when  $\Delta t$  becomes infinitesimal, Prof. Smith proceeds:—

"Mechanically, however, this limit is not itself an average speed at all, it is not of the same nature as the variable difference-quotient  $\Delta s/\Delta t$ . For this quotient *never* assumes this limiting value, no matter how small  $\Delta t$  be made. And this is quite what we should expect and what the nature of the case demands. For motion implies duration, however small, of time, and change, however small, of place. When there is no lapse of time and no displacement there is no motion, and hence no speed (or velocity). In all strictness, there can be *no motion at an instant* and hence *no speed* (or velocity) *at an instant*. The concept of speed (or velocity) or motion will not combine with the concept of instant (or point of time) to form a compound concept."

Surely Prof. Smith has here confounded the concepts of motion and displacement. If we allow that motion at an instant is impossible, how are we to escape Zeno's paradoxical conclusion that all motion is impossible? How can I move from one place to another during a minute, say, if *at every instant* of that interval motion is impossible? The remark, later on, that "this limit of the average velocity, characterises not the action but the state of the body, and is itself *not* a velocity though everywhere named so," does not improve matters, and is really irrelevant. The definition of velocity is quite independent of such question-begging terms as "action" and "state." Each of these terms, as applied to velocity, is just as good and just as bad as the other: it is when we add the words "of the body" that the metaphysical difficulty comes in, on account of the relativity of motion. But assuming that we can form a clear concept of a continuous displacement expressed by a law  $s=f(t)$ , there is neither a logical nor a metaphysical difficulty in proceeding to  $\dot{s}=f'(t)$  and saying that this is the velocity at time  $t$ , if we have already agreed that when  $s=at+b$ , the velocity is  $a$  ( $a, b$  being constants): that is, in whatever sense  $a$  measures the velocity for the law  $s=at+b$ , then *in precisely the same sense*  $f'(t)$  measures the velocity at time  $t$  for the law  $s=f(t)$ .

Another passage to which we feel bound to call