quite apart from this, some of his own direct observations appear to tell strongly against it.

The development of the *sexual* organs in these lower plants is much less variably affected by the influence of the surrounding conditions (a very significant fact, even in these primitive forms) than is that of the non-sexual ones. Light, in greater or less intensity, is commonly essential, and, as has been said in connection with *Vaucheria*, it acts both directly as an initiating stimulus, and indirectly as affecting the function of assimilation. Again, cultivation in a small amount of water, together with the absence or at least scarcity of inorganic nutrient salts, encourages their formation; whilst the addition of the last-named salts commonly suffices at once to check the process, and frequently causes the resumption of vegetative activity.

The case of *Spirogyra* is of some special interest in this connection, owing to the remarkable disturbances which the addition of appropriate salts may effect in cultures in which conjugation is freely proceeding. These disturbances may take the form, in weak organic salt solutions, of partial arrest of conjugation, the gametes then clothing themselves with a wall while still within their own mother-cells, and finally growing vegetatively as any ordinary separated cell of a filament would do. If, however, the solution be sufficiently concentrated, the gametes develop to form parthenospores indistinguishable, when mature, from true zygospores. Similar effects can be brought about by sugar solutions of appropriate strength. It is important, however, to notice that it is only at certain stages in the development of the gametes that their further development can be arrested, and parthenospore-formation be induced; and this, taken together with the varied behaviour exhibited by the different species, emphasises what has already been said as to the need of taking due account of the "personal equation" of the individual in all inquiries of this kind.

A number of valuable observations on fungi are also recorded in the book; but space forbids further mention of them here, beyond the one fact, which may prove of practical use to teachers, namely, that bread-cultures of *Eurotium* can be made to produce archicarpus, &c., with certainty in about two days, if kept at a temperature of 28°–29° C.

Prof. Klebs, whilst mainly concerned with the problems of the physiology of reproduction, incidentally touches on several points of taxonomic interest, and, in particular, he clears up the difficulties which have often been felt with regard to *Botrydium*, by showing that two distinct organisms have been confounded under this name. He proposes to separate them into two genera, retaining one of them in the old genus *Botrydium*, and creating a new one—*Protosiphon*—to include the other.

It is quite impossible within comparatively moderate limits of space to do justice to the great wealth of observation and experiment recorded in the volume before us; the work is essentially one which everybody who is interested in the subject ought to study for himself; and if he finds it rather a bewildering treatise, he will, nevertheless, be amply repaid for his trouble, and may further take comfort from the fact that the author promises another volume in which the points of theoretical interest will be brought more nearly together, and their general bearings discussed. J. B. F.

SHAKESPEARIAN NATURAL HISTORY.

Natural History in Shakespeare's Time: being Extracts illustrative of the Subject as he knew it. By H. W. Seager. 8vo, pp. viii + 358. Illustrated. (London: Elliot Stock, 1896.)

WHETHER, as a student, absorbed in the dry details of systematic work, or whether, as a spectator, interested in the marvellous displays of our museums, we of the present day are too apt to forget that natural history has lost one of the greatest of all charms—the charm of the unknown and the mysterious. To us a new animal merely fills one more gap—it may be large or it may be small—in the chain of nature; its interest, unless it be of striking form and beauty, or have something out of the common in its structure, being generally confined to the specialist. Not so the naturalist (save the mark!) of Shakespeare's day. To him the voyager, on his return to his native land, brought some new legend of the cockatrice, the mermaid, the phoenix, or the unicorn, or told of creatures the like of which had never before been heard of in heaven or earth. It mattered not that *spolia opima*, in the shape of talons, skins, eggs, or feathers, were not to the fore to confirm the story; there the story was, and that sufficed.

Now that the cold light of science has thrown its ray upon the most remote parts of our globe, there is no longer room for legendary creatures—save the sea-serpent; and we are told that the mermaid is nothing more than a dugong, a unicorn either a rhinoceros or a Tibetan antelope, while the cockatrice, the phoenix, and the roc appear to be pure imaginations.

But in the Elizabethan age—an age when the dodo had but recently been discovered—these, and many other mythical creatures, were, if not living, at all events actual realities to the ordinary public, and as such were referred to in the works of the great dramatist and other contemporary writers. We meet, for instance, in the *Winter's Tale* the line, "Make me not sighted like the basilisk," and in the *Tempest*, "Now I will believe that there are unicorns." But not only was more or less of credulity given to the existence of these and such-like fabulous monsters, but a web of mystic lore encircled the most common and best known of beasts, birds, and fishes. Who, for instance, is forgetful of the popular superstitions connected with the salamander, the newt, and the blindworm, and who fails to remember White's account of the "shrew-ash" at Selborne? And if such superstitions still survive among uneducated peasants of the present day, we may be assured that two centuries ago they were fully believed by the higher classes.

As the author states in his preface, the work before us "presents in a convenient form for reference a collection of the quaint theories about Natural History accepted by Shakespeare and his contemporaries. . . . The plan of the book is to give some illustration of each word mentioned by Shakespeare when there is anything remarkable to be noted about it." It is added that the term Natural History is taken to include not only plants as well as animals, but likewise some precious stones. It is further stated, that although Shakespeare had a greater knowledge of natural history than many of his contemporaries, yet that even he gave credence to many

of the legends he quotes, especially in regard to the animals and plants of distant lands.

The early writers whom the author quotes as his authorities form a long list of names. Among them are Friar Bartholomew and his editor Batman, whose works seem to have been the standard natural history of Shakespeare's boyhood; Topsell, so beloved of the late J. G. Wood; Gerard and Parkinson, as known by their respective *Herbals*; Holland, in his translation of Pliny's Natural History; and Evelyn, of *Silva* fame. Long quotations from these and other writers are given under the heading of the more important animals, plants, and jewels; contemporary illustrations being in many instances reproduced.

Many of these latter are of the quaintest, and form puzzles for the naturalist to discover the animals from which they were compounded. The crocodile, for example, is represented as a very marvellous complex animal, having a head which can scarcely have been taken from aught else but a wild boar, while in the armature of its back and fore limbs it recalls a pangolin; and the panther (p. 131) is more like a spotted hyæna than the creature it is intended to portray. What can have been the origin of the eight-rayed crest on the head of the serpent (p. 280), it is hard indeed to guess. But the most marvellous creature of all is the reputed whale (p. 341), which is a pig-faced, four-legged, scaly animal, with a long tail ending in flukes; the creature being represented as having just climbed on the poop of a vessel, with its head high up among the rigging. It has surely much more connection with certain modern stories of the sea-serpent than with any whale that ever swam.

That the author has succeeded in producing a very delightful and, to a certain extent, an instructive volume, may be freely granted. At the same time, it would have been decidedly an improvement had he given some explanation of the legends connected with real animals and plants, and likewise have offered suggestions as to the origin of mythical ones. As it is, the reader is left almost or completely in the dark on both these points. It is not as if nothing had been written in modern times upon such subjects. For instance, we find on p. 11 the following sentence: "And it is said that in Ethiopia be Ants shap [ed] as hornets, and diggeth up golden gravel with their feet, and keep it that it be not taken away." Now if the author had consulted a paper by the late Dr. Valentine Ball, published some years ago, we believe, in the *Proceedings of the Royal Irish Academy*, he would have found some interesting information concerning these gold-digging ants, and also about many legends connected with other animals, both real and fabulous. Again, when treating of sirens, or mermaids, the non-scientific reader would probably like to have been informed that the legend almost certainly originated from dugongs having been mistaken for sea-maidens. All that the early writers have said of the unicorn is very fully given, but a few words as to what modern authorities think as to the origin of the myth would surely have been acceptable. As it stands, we can, however, confidently recommend the work to all who are interested in learning what were the views of our non-scientific ancestors of two centuries ago as to the habits and uses of animals and plants of their own and foreign lands.

R. L.

OUR BOOK SHELF.

Chapters on the Aims and Practice of Teaching. Edited by Prof. Frederic Spencer, M.A., Ph.D. Pp. viii + 284. (Cambridge: University Press, 1897.)

THIS book should be read by all who are interested in educational methods. With the chapters on the teaching of Greek, Latin, French, German, English and History, we are not much concerned; our only regret is that the methods of teaching languages described therein were not in use in our own schooldays.

As to the chapters on the teaching of various branches of science, we commend them to every earnest teacher. Geography is dealt with by Mr. H. Yule Oldham, who, beginning with the consideration of position, distance and area, as exemplified in the schoolground and parish, passes therefrom to the consideration of the British Isles and the earth as a whole. The plan of study he sketches makes geography a living science, instead of a demoralising exercise for the memory. Prof. G. B. Mathews plans an algebra course, and urges that the natural approach to the study of it is by the way of ordinary arithmetic. After simple arithmetical algebra come rules of sign, negative quantities, factors, geometrical progression, and then surds. The way to teach geometry is shown by Mr. W. P. Workman, whose many suggestive and practical hints will, perhaps, help teachers to see that the main function of the subject is intellectual discipline.

Methods of teaching physical science are described by Dr. R. W. Stewart. The method of teaching advocated involves theory, demonstrations, and individual laboratory work, but the research attitude of the learner is not advised; for, says Dr. Stewart, "Experimental work is of no value whatever unless the theoretical knowledge of the scholar is full enough to enable him to understand clearly the objects and the details of the experiment." Against this view we have Dr. H. E. Armstrong's remark, in his very helpful chapter on the teaching of chemistry, that "students are not to be *told* about things, or even to be *shown* things, but are to be trained to *solve problems* by experiment—that is to say, they are to be trained to *discover*; and their discoveries are to have reference to common objects and phenomena." Two brief chapters on the teaching of botany and physiology, by Prof. R. W. Phillips and Dr. Alexander Hill respectively, conclude the volume.

Education in this country will certainly gain by the publication of these chapters on pedagogic methods.

Star Atlas. By W. Upton. Pp. iv + 29, and plates. (London, and Boston, U.S.A.: Ginn and Co., 1896.)

THIS atlas is primarily intended as an educational guide for the amateur astronomer; and with this end in view, no stars fainter than the sixth magnitude have been charted, thus avoiding the crowding in of detail inseparable from more complete star atlases.

Stereographic projection is adopted throughout the series of six maps, two of which are circumpolar, showing northern and southern stars; the remaining four cover the regions lying between N. 40° and S. 40° declination.

In addition there are six key maps, plotted to half the scale of the principal series, showing only the chief stars, and having connecting lines drawn between the stars of each constellation. These will be found useful in passing from one constellation to another when searching for an object.

The explanatory text gives a brief outline of the history of the formation of constellation-areas, the names and designations of the stars, and the system of indicating magnitudes. Very representative and concise catalogues of double stars and nebulae are given, and following these are lists of variable and coloured stars. The lettering and outlining of the groups is very legible; but it still seems usual for the ancient constellation figures to mask somewhat the resemblance of a star chart to the sky as