mal world. The physicist, he observes, before deducing any result, takes into account the errors of his instruments. The scientist is always working with one certain instrument, the human mind. The errors of this ever-present factor in all work form a most important field of study.

In the study of instincts, such as those that direct birds in the building of their nests, insects in the formation of their communities, we often admire the wonderful resemblance of these complex acts to the results of reason. And yet we recognize an important distinction between them: their sphere is limited, their power of adaptation to new conditions is small. It is a remarkable mechanism, but has application to a limited number of movements. A bird shows remarkable skill in weaving the threads with which it builds its nest, fastening it to the limb of a tree, and adapting it to the shape of the twig. But tie the foot of a bird in a cage, and it cannot make use of its skill in weaving to untie the fastening, but struggles and flutters until it kills itself or is accidentally freed. Teleologically speaking, certain adjustments are ingrained in its nervous system; but these adjustments are special, not general. The more perfect the instinct, the more stable and invariable is it; the less rigidly the adjustments are ingrained, the more does the act resemble what we term "reason." Diversity and adaptability are the marks of rational development. The weakness of animal intelligence is always in the lack of ability to break away from routine associations; to proceed from two facts to a third. A dog will defend himself if you tease him, but he will not bite. He knows how to use his teeth well enough with his fellows, but towards man he has acquired an attitude of deference.

Animal instincts result from the environment, and must be judged in the environment. When looked at from a human standpoint, these actions seem foolish and irrelevant. We, too, have our rigid instincts, our reflex actions. The closure of the eyelids when an object threatens the eye is a useful protective mechanism; but when we are to undergo an operation, it may be harmful. None the less all the strength of the will is incompetent to keep the eye open. It acts according to its acquired habits. It is true that we are conscious of our error, which animals are probably not; but this is not an essential point. It is proposed to show that the typical kinds of error arise, as do these misapplications of instincts, from the unwarranted application of a general rule to a particular case.

The majority of sense-deceptions support this view. Irritation of any part of the retina arouses a sensation localized in space where an object causing such an irritation would ordinarily be found. In some cases we are freed from illusion by the remembrance of former experiences. Savages are apt to mistake an image in a mirror for a real object behind it: repeated experience allows us to see the image as an image in the plane of the mirror.

Here it is easy to distinguish between the sensory and the memory factors, but in some cases this may be difficult. If you draw a line on a sheet of paper, and cover it up with a second sheet so as just to conceal the end of the line, and show it to some one ignorant of the arrangement, he will be greatly surprised not to find the entire line longer than it is when you remove the second sheet. He does this because it is an uncommon experience to have so little of a line covered up. He cannot help forming a prejudgment on the basis of what is most probable. Is this an error of sensation, or of memory?

There are a host of similar deceptions. One need only refer to the tricks of the conjurer. He takes care to appeal to something true as a rule, but false in this particular case. Again: he directs his gaze towards his right hand, infallibly carrying the eyes of the observers to the same spot, while he is performing the trick with the unobserved left hand. Ordinarily we direct our attention to the point of the field of vision in which an action is going on, and we erroneously follow this rule when we should not. We as mechanically obey the general rule as we close our eyelids when an object threatens us.

The illusion consists in the observation of the general to the exclusion of the special. A high intelligence consists in the command of a wealth of associations, and thus a power of distinguishing between the two. A typical instance is that of the host of persons who religiously record the numbers drawn at the lottery, reasoning, that, inasmuch as all numbers have an equal chance of being drawn, numbers not drawn now must have a greater chance of being drawn later on. In all games of chance one hears the same argument. The luck must change: good fortune must be followed by bad, and *vice versa*. This common error, again, consists in overlooking the particular case; for while, in many cases, such reasoning would be entirely correct, in the case of the lottery and of games of chance it does not hold, because the numbers are all replaced, the cards newly dealt after each issue, thus making the chances of every lucky event just the same as before. It is a confusion of the case in which the ball is returned to the urn with the more frequent cases in which it cannot be returned. Of the same character is the belief in the luckiness or unluckiness of certain players; in the argument, that, because a person has happened to receive more than a normal share of lucky turns, he has a right to expect the continuance of such luck; or, again, the fancied relations between the weather and terrestrial events, etc.: in short, in many kinds of superstition.

More refined examples of the same kind of error can be found in the fields of art and science. When an architect supports a balcony upon two slender iron pillars, it does not appear pretty, because of the disproportion between the supports and the object supported. The origin of this judgment is to be traced to the fact that we have comparatively little experience with the strength of iron, and much experience with the weight of stone. In general, the impression of solidity carries with it the sentiment of beauty; while the use of iron, however convincing the calculations of the architect, does not carry with it this impression. In various forms of art we see the same association between the form and the material used. Our traditions and the experiences of the race thus play a *rôle* in our sentiments, and are a factor in the genesis of error. The Greeks built temples of marble in a style derived from times when wood was the building-material. Returning to science, we may examine the famous argument of Zeno for illustration of our main thesis. Achilles cannot overtake the tortoise if the latter is at all ahead of him, because, while Achilles makes up the distance, the turtle has advanced beyond it; and so on. We get the impression of infinite space by the infinite aggregation of finite spaces, because ordinarily such a sum would be infinite; but here the spaces tend to the infinitely small, and so their sum to a finite quantity. In spite of the ages of discussion spent over this problem, it still remains a real source of error; and from this puzzle of Zeno, down to the blind action of a humble animal, one can trace the genesis of error as a faulty application of a general law to a special case; as the instinctive action of an ingrained nervous adjustment to an environment different from the normal.

ABNORMAL SENSE-ASSOCIATIONS. — Increased attention has recently been given to a class of sensory associations of rare occurrence but extremely interesting. When a certain part of the body is hurt, some persons simultaneously feel a pain in a distant and disconnected part of the body: to these the name of "synalgia" has been applied. They are idiosyncrasies, and are of various kinds. So, too, there are "synæsthesias," or cases of an irritation in one place causing a sensation in another. Dr. Fromentel brings these into line with the common experience of sneezing in response to a glaring light stimulation. He does not regard this as reflex, but thinks it psychic in character, and due to the irradiation of a disturbance in the cortex of the brain. The explanation ascribing the connection to an anastomosis between various nerves is also rejected. The peculiar case of hearing colored sounds would also be susceptible to the same explanation. They would be more or less present in all persons, but would only be striking in peculiarly nervous individuals.

BOOK-REVIEWS.

Physical Realism. By THOMAS CASE. New York, Longmans, Green, & Co. 8°.

THIS work contains a criticism of philosophical idealism, or subjectivism, together with the presentation of a new theory which the author offers in its stead. According to the view of Berkeley and his followers, the external world of material things has no real existence, what we call a body being in fact nothing but a cluster of

ideas and sensations in our minds. This theory Mr. Case holds to be contradicted by physical science, which reveals to us certain objects, such as the waves of light, for instance, which are not and never can be objects of sense, but which are nevertheless known to exist. He takes up the works of the leading idealists, and makes an elaborate criticism of their views and of the arguments by which they sought to support them; and this part of his work contains much interesting and useful matter. He rightly regards Descartes as the real founder of idealism, because he assumed that the immediate objects of knowledge are ideas, although he endeavored to reach a knowledge of the external world by inference. This fundamental assumption of Descartes, which has been repeated by every idealist since, is justly treated by Mr. Case as a begging of the whole question; and the passages in which he criticises it are the best in the book. He does not confine his strictures to this one point, however, but deals also with Hume's theory of belief and association, Kant's doctrine of necessary truths, and other topics more or less nearly related to the idealistic view. Some of his remarks, especially on the subjects of induction and necessary truth, seem to us quite as doubtful as those he criticises; but the whole of this portion of his work is well worthy of attention.

Mr. Case has not confined himself, however, to criticism, but has presented a theory of his own in place of the one he criticises; and with regard to this we are obliged to dissent from him. Rejecting idealism as he does, he equally rejects the natural realism of the Scottish school, and maintains that the object of sense-perception is neither an idea nor a body outside of us, but an affection of our nervous system. "The sensible object," he says, "is the nervous system itself sensibly affected. The hot felt is the tactile nerves heated, the white seen is the optic nerves so colored" (p. 24). And again: "I perceive my nervous system, not so far as it is nervous structure moving, but so far as it is sensibly affected in different parts, the optic nerve so far as it is visibly white, the gustatory nerve so far as it is sweet to taste, and so on" (p. 151). Now, we think most people will deny this assertion outright. This reviewer, certainly, is not conscious of perceiving his own nerves sensibly affected, and it was only by studying anatomy that he learned that he had nerves. Besides, what does Mr. Case mean by calling the nervous system, as he repeatedly does, an "internal" object? "Internal," with reference to this question, means "in the mind;" and "external," "out of the mind;" and therefore my own nervous system is just as truly an external object as is the farthest star that I can see. For these reasons we cannot think that Mr. Case has solved the problem of perception.

The Development of the Intellect. By W. PREYER. Tr. by H. W. Brown. New York, Appleton. 12°.

SOME weeks ago we referred, on its appearance, to the first portion of Mr. Brown's translation of Preyer's great work, "Die Seele des Kindes," and expressed our gratification that it satisfactorily presented to the English reader the results of the Jena physiologist's researches in the field of child-psychology.

The second part, which is before us, is equally well done, and it fully sustains the reputation of the International Education Series, of which it forms Volume IX. A conspectus of Professor Preyer's results, prepared by the translator, greatly increases the value of the book to the average teacher and to the ordinary reader.

The author sees in the power of language and its development the safest and best guide to the tracing of intellectual development, and he traces the growth of this power with great caution and fulness of knowledge. We cannot in this brief space attempt to condense the argument of the book: we must be satisfied to repeat substantially what we said of "The Senses and the Will:" it is a safe companion for any teacher in her study of the unfolding of a child's mental power, and a stimulus to further research and investigation.

Political History since 1815. By CHARLES H. LEVERMORE and DAVIS R. DEWEY. Boston, W. J. Schofield. 8°. $1.25.

THIS book is an abstract of lectures delivered in the Massachusetts Institute of Technology: hence it is hardly adapted for reading, but it will serve admirably as a guide to historical students, and also to refresh the memory of those who have studied. It covers the political history of the whole world since the fall of Napoleon, with the exception of the United States, the history of our own country evidently being a separate study in the institute. The selection and arrangement of topics in the book seem excellent; and we are particularly pleased with the small attention given to military affairs, which in some books called histories overshadow every thing else. The opening lecture treats of the various races, governments, and religions of the world; and the remainder of the work presents the recent history of the various nations separately, beginning with England and her empire, and ending with the African continent. The dates of important events are given, and some statistical matter is introduced. A bibliography of the subject is given, and special authorities are cited on all important points. The book is well and carefully printed, and must, we should think, be very useful to students of the field it covers.

Shall We Teach Geology? By ALEXANDER WINCHELL. Chicago, S. C. Griggs & Co. 12°. $1.

IN this work Professor Winchell sets forth the claims of his favorite science to a more prominent place than it now holds in general education. He first inquires what education is, and comes to the conclusion that it includes both the training of the faculties and the acquisition of useful knowledge. He has an excellent chapter on the faculties themselves; and, while admitting that some of them are better developed by literature or mathematics, he insists that no study will develop them as a whole better than geology. Like most physical scientists, he is severe on the study of languages, especially of Greek and Latin; and, so far as the mere languages themselves are concerned, we incline to agree with him. But language is the medium of literature; and Professor Winchell seems to show an inadequate appreciation of literature, and of the moral and intellectual culture that it gives. But the principal defect of his work is its ignoring of the mental and social sciences. He seems hardly aware of their existence; for he mentions none of them but history, and mentions history only to slight it, declaring that it trains no faculty but verbal memory. His disparagement of history is peculiarly unfortunate, for history is to the evolution of man what geology is to the evolution of the earth and its flora and fauna; and it is surely as important for us to know how man has come to be what he is as to know how the earth's crust has come to be what it is. To this reviewer it seems that the most important study at the present day is that of man, his nature, his duties, and his history; and if this is so, it is hardly possible to give geology so much attention as Professor Winchell desires: for he is not satisfied with a year's study or so, but would have the subject taken up in the primary schools, and pursued every year as long as the student attends school. When we consider that geology is only one science out of fifteen or twenty, and when we further consider the importance of literature and the need of learning foreign languages early in life, it is evident that we cannot give so much time to geology alone. Nevertheless, we are glad to see the claims of the science so well presented, and we hope Professor Winchell's book will be read by educators everywhere.

A Historical Geography of the British Colonies. By C. P. LUCAS. Vol. I. Oxford, Clarendon Pr. 12°. $1.25.

WE noticed some time ago the little volume introductory to this work, and we are now glad to receive the first volume of the work itself. It contains a little less than two hundred pages, and treats of the European dependencies of Great Britain, and the minor dependencies in Asia and the Indian Ocean. In preparing the work, Mr. Lucas has had the assistance of various persons connected with the governments of the colonies in question, and the portions relating to Malta and Cyprus have been mainly written by one of his associates in the Colonial Office. The work has been prepared with care, and contains a large amount of information in comparatively small space. Each dependency is treated separately, while at the same time their relations to each other and to the home government, and their importance to the empire, are duly pointed out. The history of each is briefly recorded, and sometimes, as in the case of Malta and Cyprus, it makes interesting reading. Then the main geographical features are described, and an account is given