damaged. 'They who go down to the sea in ships' assume the perils of the voyage, among which is this occurrence of finding themselves on an infected vessel, and being compelled to undergo a cleansing; for they have no right to bring their perils ashore and endanger others." The ship, with those on board, is held ten days for observation, and then allowed to proceed to the upper station, where she undergoes further treatment, and then goes to the city.

The methods practised by Dr. Holt are very thorough, and in their application, a tugboat, fitted up with all the necessary machinery, is employed. The bedding of the vessel, together with cushions, mattresses, carpets, rugs, etc., is removed from the ship to a commodious building in close proximity to the disinfecting wharf, where they are treated by moist heat at a temperature of not less than 230° F. During this process of steaming, every article is perceived to be saturated and intensely hot, the steam freely penetrating to the interior of mattresses, double blankets, etc.; but so great is the heat in the texture of the fabrics as to immediately expel all moisture upon drawing the racks and exposure to the open air. Shirts and collars instantly assume the crisp dryness they possessed before exposure, losing the musty smell of long packing in a trunk. Silks, laces, and the most delicate woollen goods show no signs of injury whatever from the treatment. Articles of leather, rubber, and whalebone would be injured by the heat, and are therefore disinfected with the bichloride-of-mercury solution. The time required to charge the chamber with apparel for disinfection is thirty minutes; time required for action of moist heat, twenty minutes; for removal of articles, fifteen minutes, — a total of sixty-five minutes.

The report of Dr. Holt is amply illustrated with figures of the apparatus used in disinfection, and the method of its application, and should be in the possession of every sanitarian as furnishing a model which can be adapted to the requirements of every quarantine station.

MENTAL SCIENCE.

Ideas of Number in Animals.

The study of comparative psychology labors under two difficulties: the facts upon which it is to build cannot be accurately ascertained without great difficulty; and the intrepretation of the facts is a still more delicate and laborious task. Civilized man has looked upon the facts of nature with so entirely a modern mind, that it is a rare gift to be able to appreciate the elementary thought-processes of uncivilized communities or of animals. Every attempt at improving the methods of presenting these phenomena should be received with sympathetic consideration, without regarding as final what is probably only a step to something better. Mme. Clemence Royer has recently made a study of the mathematical powers of animals that deserves the consideration of all students of psychology.

Among men we find all grades of mathematical ability, from that of a Newton and Laplace to that of one who cannot conceive the abstract notion of number. What the savage lacks is not the knowledge of the difference between three men and ten men, but the power to abstract the notion 'three' from men, trees, hands, and so on. The first step in this process is the distinction of unity from plurality, then of duality, etc., from plurality. The relic of this appears in the prevalence of the dual number in rudimentary languages.

What impresses itself upon the primitive mind is the sensory images of objects: he knows the difference between four trees arranged in a quadrilateral and in a row, between the general look of three trees and of four trees, but cannot see any thing in common between four trees and four stones. He is a poor arithmetician, but a good geometer; he is impressed by space relations, not by numerical characteristics. He can judge of distance, of the outlines, of the sizes of objects, but all by an instinctive visual talent. If, then, arithmetical notions appear late in human development, we can hardly expect it to be prominent among animals, lacking an intellectual language. What we can speak of as the language of animals is limited to the expression of the emotions. Their mathematical distinctions are sensory in nature. They distinguish between unity and plurality of certain objects, but we cannot credit them with abstract notions of 'one' and 'two.' They have a kaleidoscopic, photographic memory, not an abstract verbal one. All the wonderful powers of animals finding their way, of regularity in time, must be accounted for by an accuracy in the perception of outlines, and the unconscious registration of general intervals by feelings of fatigue, number of steps, and so on.

There is no unit of distance or time. Distance is to them a perception, not an idea. Just so a dog, in attacking a boar, accurately judges the length of his leap, the size and strength of the enemy; but this does not involve any mathematical calculations. The apparent understanding of language by trained dogs comes under the same head. The dog does not appreciate the phonetic value of the words, but takes his clew from the intonation, the little gestures, and the like. The horse understands the 'language of the bit' better than that of his master. Animals, in brief, have their geometrical sense of relations well developed (better than men in some respects), but are not arithmeticians.

They do not, however, lack all appreciation of number. They do distinguish between numbers, for this is necessary to their existence; but their distinction, when it goes above a few simple units, is in the form of a bunch-estimate, depending as much on the arrangement of the group as on its size. They cannot estimate as we do when we divide an army into regiments, into companies, and so on, and thus estimate the number of men.

Birds, it is true, are much alarmed if an egg be removed from their nests, but they are equally alarmed if the arrangement of the eggs be disturbed; thus indicating that it is the general disturbance that causes the alarm, not a counting of the eggs. The mother recognizes her young individually, and thus can notice the absence of one; but she probably sees no more difference between the eggs than we do, and judges their number only by their arrangement. Cats probably distinguish their young by differences in the fur, and so on: they are little affected if one kitten be removed; but, if more than four be taken away, they are greatly disturbed, and especially so if but one be left. If the kittens are weaned, the loss is not taken so seriously.

Dogs notice the absence of one of their number; but that they recognize each other individually is shown by their preferences and jealousies, both among themselves and towards men. Shepherds' dogs do not count their fold, but simply have a general picture of its size. Likewise trained dogs do not count, but have simply learned to associate mechanically certain geometrical forms with certain actions. Sir John Lubbock's dog, that brings a different label according as it wants something to eat, to go out, and so on, does not appreciate the intellectual value of the letters, but regards the label as an artificial means for gaining certain ends. The dog's faculties in these respects, however, seem to be not inferior to those of the Bushmen, who count only to two, and call all above that 'many.' Number is here concrete only with reference to objects where plurality is a useful trait: it is never abstract, and so can no more reach the stage of mathematical art than can their emotional language reach the stage of ideational abstraction to which ours has attained. By this is not meant that animals can form no abstract notions, but that their general notions are very limited in scope, and are along the line of directly useful interests only. The animal thinks by generic images, does not err in its judgments, is not liable to fallacies, all of which are distinctly human because we think by the intervention of words; and this difference forms the difficulty of our communication with them.

Animal-trainers have ignored these facts, not recognizing that geometry is more fundamental than arithmetic, and have attempted to make animals arithmeticians when nature has made them geometers. Ourselves accustomed to look on every thing from its numerical aspect, we fail to see how trivial a part this plays in animal life.

There remains the consideration of number, not of objects in space, but of succession in time. This faculty has been claimed for the higher animals. There are many stories of pets keeping up the same action at regular intervals, and always the same number of times per day or per week, — the story of a dog who always wanted three pieces of sugar, of the dog who would always keep out of the way on Sunday, and so on. Mme. Royer explains this as due to ordinary associations without the intervention of abstract

notions of time-units. Houzeau took his dogs out walking every alternate day, and after ten walks did not notice a spontaneous desire of the dogs to go out, although they enjoyed the walk. The dogs did not estimate the interval, but took hints from trifling indications. They notice the return of a complex series of circumstances. On the other hand, Houzeau ascribes an instinctive time-sense to the crocodile that comes back to its eggs after a definite interval, varying from ten to fifteen days in different species. The mules on the horse-cars in New Orleans make five trips a day, and are always very restless on completing their fifth trip. Such facts need more exact experimentation before they can be ascribed to real counting on the part of the animals.

THE INFLUENCE OF SENSATIONS ON ONE ANOTHER. — Under this head Dr. Urbanschitsch of Vienna reports some curious experiments, the value of which must be left to future research to decide. His general conclusion is, that the excitation of one sense-organ increases the acuteness of the others. If a disk be regarded at such a distance that its color is indistinct, the hearing of a sound will bring out the color. The beating of a watch is heard more clearly with the eyes open than with the eyes closed. Red and green increase auditory perceptions; blue and yellow weaken them. The fact that we listen to music with our eyes closed is due to other reasons, and also to the fact that the *ensemble* appears best when the tones are not at their clearest. Smell, taste, and touch are open to the same influence. Red and green increase the sensitiveness of each of these senses; yellow and blue weaken their sensitiveness. Touch and temperature have a reciprocal influence. If one tickles the skin and plunges it into warm water, the tickling ceases; if into cold water, the tickling brings out the feeling of cold. These observations are regarded as showing the same re-enforcing action between sensations as has been shown to exist between motions, and as offering a mode of explanation of those curious associations between colors and sounds so insistent in some minds.

BOOK-REVIEWS.

Greek Life and Thought, from the Age of Alexander to the Roman Conquest. By J. P. MAHAFFY. New York, Macmillan. 12°. $3.50.

THIS work is in the main a continuation of the author's previous volume, 'Social Life in Greece from Homer to Menander,' though somewhat wider in its scope. It lacks the absorbing interest that belongs to the history of the great days of Greece, but it has a new interest of its own in the spread of Hellenic civilization in Egypt and western Asia. The work is not confined to the moral and social life of the times, though this is the most prominent feature, but contains a great amount of information and discussion on almost every phase of Hellenic life. The political interest of the age immediately succeeding the death of Alexander centres partly in the division of his empire into various kingdoms, and partly in the struggles of the cities in European Hellas to recover their independence. Of the various kingdoms of the Hellenistic world, Egypt was, in Mr. Mahaffy's opinion, the most important and the most prosperous, — a fact which he attributes in great part to the statesmanlike genius of its founder, the first Ptolemy. In dealing with the cities of Greece, the author shows a lack of sympathy with the spirit of freedom and local patriotism which is not quite creditable in a citizen of a free country and a historian of Hellenism. It is true, the struggles of the cities to regain their autonomy proved unavailing, and perhaps they were not sufficiently cosmopolitan in their views; yet freedom is better than empire, and, while we acknowledge the defects and the failure of the patriots, we cannot but sympathize with their misfortunes.

Of the moral life of the period, we get glimpses from many points of view, and yet, as a whole, it is somewhat difficult to judge. The sins of the royal courts, especially the frequent murders, the use of torture, and the perpetual wars, are sufficiently prominent; yet Mr. Mahaffy thinks that the morality of private life was purer and more refined than it was in earlier times. In one respect there was certainly a real moral advance: it was during this period that the great schools of ethical philosophy were founded, and men came to regulate their lives by reason instead of by tradition and custom. The author gives an interesting account of the philosophical schools at Athens, which were established by law as religious corporations with regular endowments; and he shows clearly that during most of the period under review they were highly respected and influential.

The intellectual life of the Hellenic world is treated by the author with considerable fulness. The history of physical and mathematical science is omitted, on the ground that the author lacks the special knowledge requisite for treating it. In art the Rhodian and Pergamene schools are of course the most conspicuous; and Mr. Mahaffy shows, that, though this was an age of decadence, the number of excellent artists was by no means small. In literature, after the decline of the New Comedy at Athens, the chief interest centres in Alexandria. The establishment of the Museum and the great library in that city, and the liberal patronage of both by the Ptolemies, made the place the chief seat of literature, as it afterwards became of philosophy. Of the quality of this literature, Mr. Mahaffy expresses the opinion usually held of it by modern scholars. It was distinguished by erudition and imitation of earlier models rather than by original genius or power of style. It is worthy of note, however, that it was at Alexandria that the practice arose of writing poems, and afterwards prose fictions, on the theme of romantic love, — a theme which has since become the most prolific in literature.

The concluding chapter of the book gives an account of the introduction of Hellenic civilization into Rome consequent on the conquest of Greece by the Roman arms; but the subject is only just introduced, as the author intends writing another work on the spiritual life of Hellenism in the Roman Empire. Those who have read his other works will look with interest for the promised volume.

Mount Taylor and the Zuñi Plateau. By Capt. C. E. DUTTON. Washington, Government. 4°.

STUDENTS of American geology who have learned to expect in Captain Dutton's contributions important results ably elaborated, and presented in a style which is simply fascinating, — clear and graphic, and worthy of the geological wonderland in which it has been his fortune to work, — will experience no disappointment in this paper. The district to which it relates (longitude 107° to 109°, and latitude 35° to 36°) lies in the western part of New Mexico, and in the south-eastern corner of the great plateau country, and embraces two distinct geological problems of the first order, — the volcanic region of which Mount Taylor is the culmination, and the Zuñi Plateau. Captain Dutton's previous studies, as well as those of Gilbert, Powell, and others, were confined mainly to the western side of the plateau province, and especially to the portion traversed by the Grand Cañon of the Colorado. But although no geologist possessing any breadth of comprehension could enter the plateau country, and, after gaining an extended knowledge of its physical features, fail to perceive that it is a great unit, and sharply delimited from every thing which surrounds it, it was still extremely desirable to study the south-eastern extensions of these vast masses of strata and the features carved out of them, in the hope that problems which could be only half solved on one side of the plateau could be completely solved on the other. It was felt that the history and evolution of this unique region could be ascertained satisfactorily only by knowing the whole. The survey, therefore, embraced the first opportunity of attacking it from the eastern side; and the admirable monograph before us sufficiently attests the wisdom of this policy.

With the view of putting this new field at once into its natural relations with the whole of which it forms a part, Captain Dutton begins with a summary account of the plateau country in its entirety. The area of the plateau country, south of the Uinta Mountains, is about one hundred and thirty thousand square miles. A shaded map shows its form and its position with reference to the other portions of the western United States. The topographic features and extraordinary scenery of this region have been described many times, and it is deemed needless to descant upon them; but several pages are devoted to the general geologic features underlying these wonderful reliefs. The strata are normally approximately horizontal; and such slight inclinations as occur are very persistent, car-