

savours, to say the least of it, of improbability. In any case I do not recognise it as my own view. I hold as strongly as Mr. Thorndike that the efferent impulse (as an organic link) is a *sine quâ non* in every case of association in animal psychology, and that no animal can supply it "at will."

A very interesting series of experiments were made with a view to extracting an answer to the question, Do animals imitate? The question is not so easy to answer as it looks. No one with adequate experience can doubt that young birds and mammals perform actions which, from the observer's point of view, are imitative. The sight of an animal performing some simple action is the stimulus which prompts to the performance of a similar action. This I have termed "instinctive imitation." And this Mr. Thorndike would not deny to animals, though he would, I take it, deny (and not without psychological justification) its right to be spoken of as imitation, properly so-called. On this basis are founded the numerous cases of imitation by suggestion where the sight of an action performed is the stimulus to the performance of a similar action. A more complex case is that of the bird which, hearing certain sounds, is not only stimulated to make sounds itself (like a laughing jackass to which one whistles), but gradually to make its own sounds resemble those which afford the stimuli (like the parrot which "draws a cork"). Here it seems that the resemblance itself gives satisfaction—in any case the factor of experiential selection is introduced. In these cases imitation by suggestion is supplemented by a tendency to more exactly reproduce the sound which affords the stimulus—a tendency which seems to be based upon the innate satisfaction which accompanies the act of reproduction. Thus far, in my opinion, animals can certainly go; but even this, it may be urged, is only pseudo-imitation. True imitation is seen only where a being of set purpose copies a given model, not only reproducing, but intending to reproduce. And it is the presence of true imitation of this type which Mr. Thorndike's experiments were designed to test. They afford, however, no evidence of it. Cats were allowed to see others do the trick of the box-cage. But they themselves, when placed in the cage, took the usual time to effect their escape. Their exit was no quicker from seeing others get out by the performance of certain clawings or pushings. The experiments do not carry complete conviction to my mind, though I regard the conclusion to which they lead as probably correct.

Mr. Thorndike thinks it likely that the primates stand at a higher level in this respect than dogs or cats. "If it is true," he says, "that the primates do imitate acts of such novelty and complexity that only this out-and-out kind of imitation can explain the fact, we have located one great advance in mental development. Till the primates we get practically nothing but instincts and individual acquirement through impulsive trial and error. Among the primates we get also acquisition by imitation, one form of the increase of mental equipment by tradition." My own observations on imitation in monkeys are too few and inconclusive to justify more than a very guarded expression of opinion. I lean to the view, however, that there is, even in them, little evidence of true imitation of the higher psychological type; and that the observed facts may be accounted for by a great extension of "instinctive imitation" suggestion, and behaviour directly founded thereon. I hope Mr. Thorndike will put the matter to the test of well-devised experiment.

Several interesting problems connected with the psychological interpretation of animal behaviour are briefly discussed, but can only be mentioned here. Mr. Thorndike accepts the conclusion that in animals "memory" is simply what has been termed "reinstating," and involves no true localisation in time or space. "The

animal's self is not a being looking 'before and after.'" "Memory in animals, if one still chooses to use the word, is permanence of associations, not the presence of an idea of an experience attributed to the past." This is precisely the conclusion to which the present writer has been led. On the question whether animals are aware of the pleasure or pain that others are feeling, he says that the conduct of animals "would seem to show that they do not. For it has given us good reason to suppose that they do not possess *any* stock of isolated ideas, much less any abstracted, inferred or transferred ideas. These ideas of others' feelings imply a power to transfer states felt in oneself to another, and realise them as there." As thus stated I think his conclusion is correct, though he quotes me in an opposite sense. In my later discussion ("Introduction to Comparative Psychology," p. 320) I expressly exclude any such ejective transference.

In conclusion, some apology is perhaps demanded for reference to my own observations and conclusions in the same field of study. But it is well to preserve historical continuity in a topic, and it so happens that Mr. Thorndike's work has carried further and extended some of my own; and that his leading conclusions are in the main confirmatory of those which I have reached. In the general trend of our opinions we are perhaps more essentially in accord than, in some cases, he seems to suppose. Even our illustrations are sometimes closely similar; both utilising, for example, the consciousness of a man when he is playing tennis as illustrating the probable subjective condition of the conscious but not yet self-conscious animal. And this substantial agreement is not a mere personal matter. Were it such there would be no justification for drawing attention to it. It shows that the method of observation and experiment, on different but parallel lines, has led two independent investigators to results which are on the whole harmonious; and it affords some ground for the hope that comparative psychology has passed from the anecdotal stage to the higher plane of verifiable observation, and that it is rising to the dignity of a science. In any case Mr. Thorndike's research is one of no little value, and will, I trust, be supplemented by further investigations.

C. LLOYD MORGAN.

#### THE FLORA AND FAUNA OF BRITISH INDIA.

NO portion of the earth's surface surpasses the British Empire in India in the wealth and importance of its vegetable and animal life. Not only is there no other equally large tropical area that has received the same amount of exploration from naturalists, but the territories and dependencies of British India comprise regions with a marvellous variety of climates, from tropical islands like the Andamans and hot plains like the Carnatic, to the snows of the Himalayas and the frigid plateaus of Tibet; whilst the rainfall varies from the "record" 600 inches or more on the Khasi hills to the meagre supply that occasionally damps the arid sands of the Sind desert, where, frequently, for years in succession, rain is unknown. The remarkable antiquity of the Indian peninsula, the greater part of which appears to have been land from the earliest geological times, adds greatly to the scientific importance of the fauna and flora.

Under these circumstances it is not surprising that the variety of plants and animals occurring in India should be very great. There is no other large tropical region with which comparison is possible, because, as already mentioned, there is none of which the natural productions are as well known. Europe (3,800,000 square miles) has more than twice the area of India (1,750,000 square miles), but it has a far poorer flora and fauna, only about 9500 flowering plants being known to occur against 14,500 Indian species; whilst British India and its dependencies contain more than twice as many

species of mammals, nearly three times as many birds, considerably over four times as many batrachia, and about eight times as many reptiles as the whole of Europe. The moths known to be found in Europe are 3040 in number, those of India 5600; and in this case there is no doubt that the Indian list is far from complete.

The interest attaching to the botany and zoology of India makes the circumstance noteworthy that two important works published by order of the Government of India, and at its cost, have been completed within the last six months. These works are the "Flora of British India" and the vertebrate section of the "Fauna of British India." In neither case is the work exhaustive, but each deals with the most important group of plants or animals respectively, the "Flora" containing descriptions of all flowering plants, and the "Fauna" accounts of all vertebrate animals. It is scarcely necessary to say that flowering plants form a much larger proportion of the whole flora, than vertebrate animals do of the entire fauna; but some progress has already been made with an addition to the "Fauna" as originally planned, and with the description of the huge mass of Indian Invertebrata. Except that the plants of the Malay peninsula are included in the "Flora," whilst the animals are omitted from the "Fauna," the British India of the two works is the same, and includes all India proper with the Himalayas, Ceylon, Assam, and Burma.

The "Flora of British India" is a work to which Sir J. D. Hooker has devoted many years of his life, and it is chiefly written by him, portions having been contributed by other botanists, amongst whom are Mr. Thiselton-Dyer, Mr. C. B. Clarke, Dr. Maxwell T. Masters, Mr. J. G. Baker, and the late Dr. T. Thomson and Dr. T. Anderson. The undertaking may be said to have commenced originally by the publication of the first (and only) volume of Hooker and Thomson's "Flora Indica" in 1855; but the present work, which is on a smaller plan, has been brought out in parts, of which the first appeared in 1872, and the last, containing the index, in November 1897. The whole consists of seven thick octavo volumes, comprising altogether over 5000 closely printed pages, and containing descriptions of 14,520 species.

The "Fauna of British India" is on a different plan, and the completed portion, containing the Vertebrata, consists of eight octavo volumes and of over 4100 pages. Of the eight volumes, one contains the Mammals (402 species), four the Birds (1626), one the Reptilia (534) and Batrachia (130), and two the Fishes (1418). The whole is edited by Mr. W. T. Blanford, who is also the author of the volume of Mammals and of two volumes of Birds, the remaining two volumes of the latter being the work of Mr. E. W. Oates; whilst Mr. G. A. Boulenger has contributed the part containing the Reptilia and Batrachia, and the late Dr. F. Day wrote the account of the Fishes. The first part appeared in 1888, and the last volume of Birds has just been issued from the press.

As already mentioned the "Fauna," as originally projected, was intended to contain an account of the Vertebrata alone, and this is now complete. But some years ago the Government of India authorised an extension of the work, on the same plan and under the same editor, to certain Invertebrate groups, with the result that up to the present time four volumes on Moths, by Sir G. F. Hampson, have been published, with descriptions of 5618 species; and one volume on Bees and Wasps, by Colonel C. T. Bingham, containing descriptions of 995 species. Thus at present the series of the Fauna comprises thirteen volumes. No intimation has been given of any additional parts being in preparation. It may be hoped, however, that further additions will be made, and that, so far as is practicable, both the Flora and Fauna may be completely described. A thorough knowledge of the productions of India is as important for economic reasons as for scientific inquiry.

#### A. KERNER VON MARILAUN.

WE regret to announce that Dr. Anton Kerner von Marilaun, Professor of Botany in the University of Vienna, died suddenly on June 21 in that city from apoplexy. He was born at Mautern, Lower Austria, on November 13, 1831. He acquired at a very early age a considerable knowledge of the flora of his native province, and had already a good reputation as a botanist when still a student of medicine in the University of Vienna. After having taken his degree as Dr. Med. et Chir., he practised for a short time in one of the Vienna hospitals; but finding the medical career not to his taste, he accepted a professorship in the Josef's Polytechnicum at Ofen, Hungary. In 1861 he was called to the chair of Botany in the University of Innsbruck, which he occupied till 1878, when he succeeded Eduard Fenzl as Professor of Botany and Director of the Botanic Garden and Museum at Vienna, in which position he remained up to his death. In 1875 he was elected a member of the Imperial Academy of Science of Vienna; he received the order of the Eiserne Krone in the following year, in recognition of his achievements as a teacher and man of science, and was knighted in 1877, when he added the title "von Marilaun" to his name. When Eichler, the eminent morphologist, died, the University of Berlin invited him to the vacated chair; but Kerner, who had always been a staunch Austrian, declined.

Kerner's principal claims as one of the most prominent botanists Austria has produced, rest chiefly on his researches in phyto-geography and biology—this term to be understood in the narrower sense, in which it is so often used in Germany. Trained from early youth to observation in the field, thoroughly familiar with the Central European flora, gifted with a keen eye for the salient features of vegetation and, at the same time, with an analytic mind ready to break up the general aspect in which a given vegetation presents itself into its elements, he was eminently fitted to develop that particular branch of phyto-geography which deals with the association of plants in so-called plant-formations. This doctrine had just then assumed a definite shape through Grisebach's investigations, although it may well be traced back to Alexander Humboldt. In his book, "Das Pflanzenleben der Donauländer" (1863), Kerner applied with great success the new method to the vegetation of the Eastern Alps and a large part of Hungary, which he had explored in numerous excursions. In a contribution to "Die Oesterreichisch-Ungarische Monarchie im Wort und Bild," which was published under the auspices of the late Crown Prince Rudolf, he worked out in a general way the distribution of the various floras within the monarchy, their principal subdivisions and their history, and he added soon afterwards an excellent map, under the title "Florenkarte von Oesterreich-Ungarn." If he was early a master of descriptive phyto-geography, he was by no means indifferent to the historical side of the science, as his paper, "Beiträge zur Geschichte der Pflanzenwanderungen" (1867), in which he sided with Forbes and against Grisebach and his creation theory, an interesting essay, "Studien über die Flora der Diluvial-Zeit in den östlichen Alpen" (1888), and several more show. Of his biological researches the most remarkable are those dealing with the relations of flowers and insects.

His splendidly illustrated book, "Schutzmittel der Blüten gegen unberufene Gäste" (1876), was translated into English ("Flowers and their unbidden Guests"), and, no doubt, gave a powerful impetus to the development of one of the most fascinating chapters in biology. In fact, I believe, nothing appealed more to his constitution of mind than investigations of this kind; for he was endowed with a wonderful amount of imagination which, in that inexhaustible field, found ample