led men's minds astray from the path where only they could find the truth they were earnestly seeking.

Those who desire to believe nonsense at all hazards and in the face of the clearest possible proofs, and indeed like it rather the better because it is so, can of course continue in their fool's paradise. Who can doubt that they see the paragon of animals in the author of the passage we have been criticising, and that he sits at the centre—the "focal point" is the choice expression, we believe—of a select circle of admiring "pectoral sucklers" the very "hub of the universe," as our American friends might say? The Report of the last Local Examination Syndicate of one of our Universities speaks of Zoology as follows:—"The general character of the work in this subject is, perhaps, even worse than it was last year. In many cases the teaching appears to have been faulty or defective; there was a general ignorance of the principles of zoological classification; and a great number of candidates sent up answers so full of confusion and error as to lead to the opinion that they had only prepared for the examination by a hurried attempt to learn portions of a text-book by rote." Who can wonder at this prevalent "ignorance of the principles of classification" when a zoologist in a position to give instruction to youth and encourage their devotion to the study of nature utters absurdities such as we have just been noticing? We fear that he is not alone in his mischievous folly.

LECTURES AT THE ZOOLOGICAL GARDENS*

VII.

June 10.—*Prof. Mivart on Kangaroos.*

AFTER pointing out the external and osteological characters of the Kangaroo, the lecturer proceeded to consider the question, What is a Kangaroo? what its place in the scale of animated beings; as also its relations to space and time? At birth the Kangaroo is strangely different from what it ultimately becomes. It is customary to speak of the human infant as exceptionally helpless at birth and after it, but it is at once capable of vigorous sucking, and very early learns to seek the nipple. The great Kangaroo, standing some six feet high, is at birth scarcely more than an inch long. Born in such a feeble and imperfect condition, the young Kangaroo is not able to suck of its own accord. The mother places it on one of the nipples and squeezes its own milk-gland by means of a muscle which covers it, in such a way that the fluid enters the mouth of the young one. In most animals, man included, the air-passage opens into the floor of the mouth behind the tongue, and *in front* of the opening of the gullet. Each particle of food as it goes towards the gullet passes over the entrance to the windpipe, but is prevented from falling in by the action of the epiglottis, which stands up in front of the opening and closes over it when food is passing. But in the young Kangaroo, the milk being introduced, not by any voluntary act of the recipient, but by the action of the mother, it is evident that some special mechanism is necessary to prevent choking. This is found in the elongation of the upper part of the windpipe, which projects up into the nasal passage, and is embraced by the soft palate in such a manner that the food passes on each side of it, whilst the air does not enter the mouth at all.

The Kangaroo browses on the herbage and bushes of more or less open country; and, when feeding, commonly applies its front limbs to the ground. It readily, however, raises itself on its hind limbs and strong tail, as on a tripod, when any sound, sight, or smell alarms its natural timidity. Mr. Gould tells us that the natives sometimes hunt them by forming a great circle around them, gradually converging upon them and so frightening them by cries that they become an easy prey to their clubs. The Kangaroo is said to be able to clear even more than fifteen feet at one bound. It breeds freely in the Society's Gardens, many being reared to maturity. They have been also more or less acclimatised in the grounds of Glastonbury Abbey, in the parks of Lord Hill and the Duke of Marlborough, and elsewhere.

* Continued from p. 114.

It is just upon one hundred and five years since the Kangaroo was first distinctly seen by Englishmen. At the recommendation and request of the Royal Society, Capt. (then Lieutenant) Cook set sail in 1768, in the ship *Endeavour*, on a voyage of exploration, and for the observation of the Transit of Venus of the year 1769. In the spring of the following year the ship steered from New Zealand to the eastern coast of New Holland, visiting, among other places, Botany Bay. Afterwards, when detained in Endeavour River, an animal as large as a greyhound, of a slender make, a mouse colour, and extremely swift, was seen more than once. On July 14, "Mr. Gore, who went out with his gun, had the good fortune to kill one of these animals," adding, "This animal is called by the natives *Kangaroo*." Kangaroos, however, had been seen by earlier travellers, and these may even be the animals referred to by Dampier when he tells us that on the 12th of August, 1699, "two or three of my seamen saw creatures not unlike wolves, but so lean that they looked like mere skeletons."

The whole animal population of the globe is termed the Animal Kingdom, in contrast with the world of plants, or Vegetable Kingdom. The highest sub-kingdom of this is that of the Vertebrata, of which the Mammalia form the highest class, to which class the Kangaroos belong. Of these animals there are many species arranged in some four genera; the true Kangaroos forming a genus, *Macropus*, which is very nearly allied to three others, namely, *Dorcopsis*, with a very large first grinding tooth; *Dendrolagus* (Tree Kangaroo), which frequents the branches of trees, and has the fore limbs but little shorter than the hind; and *Hypsiprymnus* (Rat Kangaroo), which has the first upper grinder compressed and vertically grooved. The species all inhabit Australia and the adjacent islands. They all agree in having the second and third toes slender and united in a common fold of skin; the hind limbs longer than the fore limbs; no inner metatarsal bone; all the fore toes provided with claws; and six upper together with two lower incisors. These five characters coexist in no other animal.

The family Macropodidæ is one of six which, together with it, make up the larger Kangaroo Order, the exact relations of which necessitate a cursory view of the others being taken. The Bandicoot plainly differs from the Kangaroo in external appearance, but resembles it in having the hind limbs longer than the fore, and also in the structure of the hind feet, which are similarly modified, but to a less degree, a rudimentary inner toe being present. It is an example of the family Peramelidæ, one member of which, *Chœropus*, is very exceptional, in that the hind toes, except the fourth, are exceedingly reduced and functionless, at the same time that its anterior digits are only two in number. The Phalanger is a type of the Phalangistidæ, arboreal, nocturnal animals, in which the limbs are of nearly equal length, with the second and third hind toes united, and a large opposable thumb. Some have prehensile tails, others expansions of the skin in the flanks to act as a parachute in leaping. The Koala (*Phascolarctus*) and *Tarsipes* are aberrant members; the former without a tail, the latter with minute and few teeth. The genus *Cuscus* is found in New Guinea and Timor. The Wombat (*Phascolomys*) forms a distinct family. It is a burrowing, nocturnal animal, the size of a badger, with a rudimentary tail, as well as peculiar feet and rodent-like teeth.

The Dasyuridæ, or family of the native cat, wolf, and

devil, are so called from their predatory and fierce nature. They have large canine teeth and sharp molars. The second and third toes are no longer bound together, whilst the great toe is absent or small. Myrmecobius is a peculiar genus, remarkable for the great number of its back teeth. The Tasmanian Wolf is confined to that island, and will very probably soon become quite extinct, because of its destructiveness to the sheep of the colonies. It differs from all other members of the Kangaroo order in that cartilages represent the marsupial bones found in every other member of the order. The last family consists of the true Opossums, which differ from all above referred to in inhabiting America only, not Australia. They are called Didelphidæ; one species is aquatic in habit, and web-footed.

Such are the very varied forms composing the six families which together make up the Kangaroo order. What is its relation to those of the other Mammalia? Very noticeable in it is the very great diversity of form, dentition, and habit found in the order, some being arboreal and vegetarian, others terrestrial and carnivorous, &c.; nevertheless, these so varied marsupial forms possess in common important characters by which they differ from all other mammals. These characters, however, relate mainly to the structure of their reproductive organs, as to the great importance of which characters naturalists are agreed. The angle of the lower jaw is also peculiar. Almost every mammal which has marsupial bones has the angle of its jaw inflected, or else has no angle at all, whilst every animal which has both marsupial bones and an inflected jaw-angle, possesses also those other special characters which distinguish the marsupials from all other mammals. We have, therefore, at least two great groups, one non-marsupial, containing man, the apes, bats, cats, hoofed beasts, &c.—the Monodelphia; the other containing the marsupials only—the Didelphia. There is a third group containing only the Ornithorhynchus and Echidna, which form by themselves alone a third group, Ornithodelphia.

As to its zoological relations, we may therefore say that the Kangaroo is a peculiarly modified form of a most varied order of Mammalia (the marsupials), which differs from all ordinary beasts (and from man) by very important anatomical and physiological characters, the sign of the existence of which is the coexistence in it of marsupial bones with an inflected angle of the lower jaw. As to the geographical relations of the Kangaroo, a study of their distribution over the world shows that the Kangaroo is one of an order of animals confined to the Australian region and America, the great bulk of the order, including all the Macropodidæ, being strictly confined to the Australian region.

The lecturer concluded by explaining the geological relations of the Kangaroo and its order, pointing out that in Australia we have an instance of zoological "survival" connecting the existing creation with the triassic period.

*MAGNETO-ELECTRIC MACHINES**

II.

IN 1871 M. Jamin communicated to the French Academy of Sciences a short note by M. Gramme, on a magneto-electric machine which gave electrical currents always in the same direction by the revolution of an electro-magnetic ring between the poles of a permanent magnet. The construction of the electro-magnetic or ring armature in Gramme's machine differs in some mechanical details from that of the transversal electro-magnet of Pacinotti, and the serious mistake of applying the rubbers which carry off the current at the wrong place is avoided. We must therefore regard the Gramme machine as the first effective magneto-electric machine constructed to give continuous currents all flowing in the same direction. Before entering into the details of its construction it may be useful, even at the risk of some repetition, to describe as briefly as possible the principles on which the action of the electro-magnet or ring armature depends.

In its simplest form this armature consists of a ring of soft iron, round which is wound a single closed coil of copper wire or other metallic riband, covered with silk, except at a single point in each loop of the coil, which is left exposed in order to make contacts. In Fig. 4 such a ring is shown, placed between the poles of a permanent magnet. The parts of this ring contiguous to the poles N S of the fixed magnet will acquire respectively polarity of the opposite kind to that of the neighbouring pole, while the parts of the ring O O′, at the end of a diameter

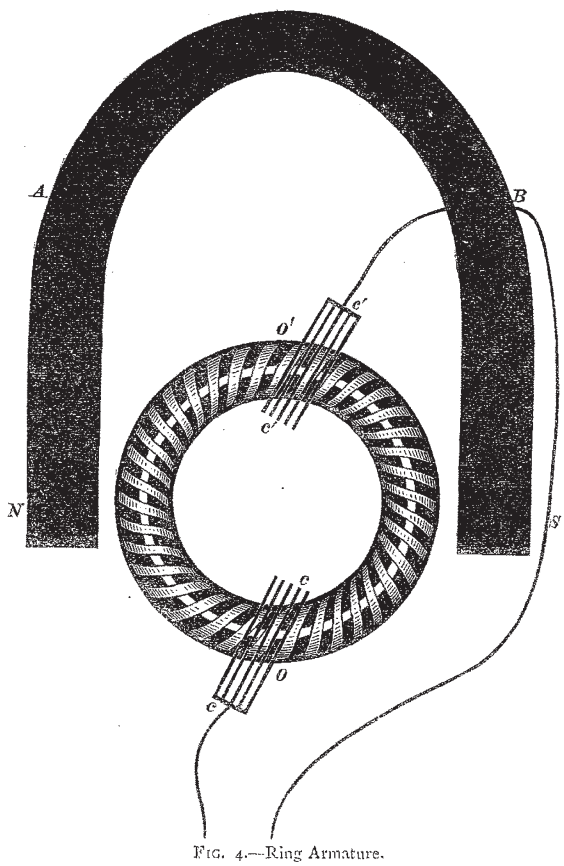

FIG. 4.—Ring Armature.

at right angles to the line joining the poles, will be neutral. If the ring is made of homogeneous metal, this statement will be strictly exact so long as it is at rest, but if it be made to revolve rapidly on an axis perpendicular to the plane of the fixed magnet, the poles of the ring, as well as the neutral points, will be slightly displaced, as M. Gaugain has shown, in the direction of the motion. This arises from what is called the coercive power of iron; that is, from the circumstance that even the purest iron will not acquire or lose magnetism in an inappreciably short period of time. The change in the distribution of the magnetism in the ring from this cause is, however, inconsiderable, and may easily be allowed for.

To make the explanation clearer, let us suppose that there is only one loop of wire, *a* (Fig. 5), upon the ring, and that this loop is moveable and in connection with a galvanometer *g*. If now the loop is moved along the ring (assumed to be at rest) from the neutral line O towards S′, a current will be developed in a certain direc-

* The substance of a Lecture, with additions, delivered at the Belfast Philosophical Society, March 17, by Dr. Andrews, F.R.S., L. & E. (Continued from p. 92.)