

are carefully recorded. We can heartily congratulate the author and the museum authorities on the publication of this authoritative memoir. More information would, however, be welcome as to the precise part taken by the several social groups of the Arapaho in this national festival, as this is usually an important element in social ritual. Apparently the ceremony may take place at any time, but it is generally during the winter. It is performed in compliance with a vow.

Many ceremonies are performed in connection with a Rabbit-tipi (or tent), which is erected on the first day, and the men who perform the rites are known as Rabbit-men; the origin of the name is due to a myth. On the second day a sweat-lodge is built, not only as a means of bodily purification, but because they want to be cleansed from former sins, evil desires, and to be protected from all kinds of plagues. Next, a bison should be caught and killed; now they have to content



FIG. 1.—The straight-pipe being smoked by the Sun Dance priests and dancers.

themselves with any old buffalo robe that is available, and this skin has to be painted. On the fourth day the centre-pole for the Offerings'-lodge is cut down by two women, and brought into the camp and erected in its midst with great ceremony; as this new lodge is being completed, final rites are held within the Rabbit-tipi. In this very large lodge is the altar, and here dancing takes place, which is at the present day of a simple character. Near midnight of the second and fourth days a remarkable symbolic ceremony takes place between the grandfather and wife of the Lodge-Maker. The former personifies the sun and the latter the moon, and the ceremony brings strength to the people and increase to the tribe. The sixth day is known as "Medicine Day"; the dancers have now fasted for about forty hours, and it is supposed that by this time their minds are in a proper condition to be

susceptible to the influence of the sun, and they are exhorted to be of a reverent frame of mind. The rising sun is greeted with a dance. During this most important day of the series new chiefs are inaugurated and names changed. There is a considerable amount of evidence that in former times unbridled license prevailed throughout the camp on this night, which was taken advantage of by all, as it was considered one of the rites of the ceremony; in more recent years this has been entirely given up, but the occasion is utilised for courting. The seventh day commences and ends with sun dances, and then takes place the ceremony with the symbolic sun-wheel. The dancing is particularly fatiguing, and finally, in the ceremony witnessed by Dr. Dorsey, a great shout was sent up by all, for the ceremony had come to a happy termination without anyone falling by the way and without a mishap. This impressive exhibition of endurance and faith is termed "gambling against the Sun." It expresses on the part of each dancer his earnest prayer and effort to conquer, to survive, and to complete his three days' fast without falling, in spite of the opposition of the intense heat of the sun; to survive means to win benefit. Then follow the bathing and purification of the dancers.

On the last day of the sun dance ceremony there takes place the final dancing out to meet the sun; the method of advancing by degrees outside the lodge is a form of asking the Man-Above and the Grandfather to listen to their prayers; it also typifies the going after something which is good. A shaking of blankets which takes place may be regarded as a purification rite whereby sickness and sorrow are shaken off. The smoking of the straight-pipe (Fig. 1) at this time, on the part of all, which forms the final performance in the ceremony, is to the effect that all might follow a straight road, that all might be protected, and that the families of those who have fasted and taken part in the ceremony might be guarded from harm, inasmuch as they have performed the ceremony according to the orders of the Man-Above.

Before dispersal, parents, often accompanied by their children, enter the Offerings'-lodge, and after praying, tie on to the centre-pole the clothes discarded by their children during the year. One of these prayers is as follows:—"White Man-Above, my Father, here are the clothes of my child. I am going to deposit them. They are no longer good for my child. By doing this I ask you to watch over him from day to day and keep him from temptation. May he grow up to be a man, to understand your teachings which we have just gone through! I hope you will hear our prayer for my child."

A. C. HADDON.

THE UNGULATE MOLAR.¹

IN the course of his attempt to solve the puzzle of the homologies of the cusps in the more complicated types of ungulate molars, the author of this bulky memoir takes the opportunity of directing attention to certain points with regard to mammalian dentition in general, and also comments on the exceeding intricacy and difficulty of several of the problems presented thereby. The solution of one difficulty, he observes, not unfrequently gives rise to a whole crop of fresh problems, and, paradoxical as it may seem, every increase in our knowledge serves only to reveal the depth of our ignorance.

With the enormous amount of variation displayed

¹ "Recherches de Morphologie phylogénétique sur les Molaires supérieures des Ongulés." By F. Ameghino. *An. Mus. Buenos Aires*, ser. 2, vol. iii. Pp. 541, figures.

by the molars of the numerous types of ungulates peculiar to the Tertiary formations of South America, Dr. Ameghino has almost a superfluity of material upon which to work. So vast, indeed, is his subject, that it would be impossible, within the limits of our space, to follow him in his survey from one type to another, or, indeed, to discuss his general conclusions, and I shall therefore confine myself to directing the attention of my readers to certain points of special interest in the author's work.

In the first place, it may be noted that Dr. Ameghino reiterates his opinion as to the falsity of the tritubercular theory of molar development, tritubercular molars, instead of being the primitive type, having been derived, on his view, from those with four or six cusps. Whether this opinion is in any way biased by the author's contention that the earlier Patagonian mammals are of Cretaceous age may be worth consideration.

Of greater importance is the support given by Dr. Ameghino to the view that the molar formula of the placental and marsupial carnivores is numerically identical, that is to say, that there are three true molars in both (when the full series is developed) instead of three in the one and four in the other. He consequently regards the replacing marsupial premolar as the third instead of the fourth, and the tooth behind it as a persistent milk-molar. The numerical identity

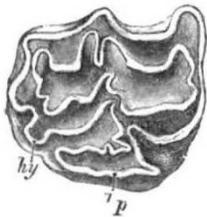


FIG. 1.—Right upper molar of horse. *p*, antero-internal pillar; *ky*, postero-internal pillar.

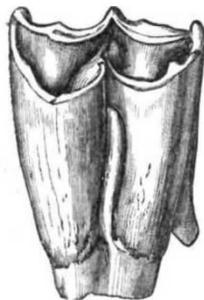


FIG. 2.—Left upper molar of Nilgai to show accessory pillar between the two main inner crescents.

of the marsupial and placental series was urged long ago by Prof. Gaudry, and this view was more fully developed a few years since by the present writer, when evidence in favour of the above-mentioned homology of the marsupial replacing tooth and the one behind it was likewise adduced. Although it has subsequently received the assent of Dr. Wortman, this view has not, however, yet been accepted by zoologists generally. It may be added that it is a question on which only those with a considerable amount of palæontological knowledge are competent to form an opinion.

Another point of great interest referred to in Dr. Ameghino's memoir is the alleged occurrence in Nesodon and certain other Patagonian Tertiary mammals of three distinct dentitions. Since the existence of this remarkable phenomenon is stated to have been accepted by Dr. Scott, it may apparently be taken as fully authentic. The "pre-lacteal" cheek-dentition, according to the figure given, consists of three very small teeth, differing somewhat in form from their successors of the milk-series. Dr. Ameghino, whose view is almost certainly in this instance influenced by his opinion as to the age of the Patagonian mammals, regards the "pre-lacteal" dentition as a direct inheritance from reptilian ancestors. In view, however, of the specialised characters of Nesodon and its allies, and the absence

of a functional "pre-lacteal" series in any other mammals, it would seem much more probable that it is a superadded feature.

The last point to which we have space to allude relates to the homology of two of the cusps in the equine molar. To render this point clear, two figures have been introduced into this notice.

Since the date of publication of the first part of Gaudry's "Enchainements," the antero-pillar of the equine molar (*p* in Fig. 1) has been almost universally regarded as one of the primitive constituents of the tooth, corresponding to the inner extremity of the anterior transverse ridge (protocone) of the rhinoceros or anchitherium molar. From comparison with a large number of extinct forms, Dr. Ameghino comes, however, to the conclusion that this antero-internal pillar (which is detached in *Hipparion* but joined to the body of the tooth in *Equus*) is really a superadded element, derived from the cingulum, and corresponding to the "accessory pillar" of the molars of many ruminants (Fig. 2). Consequently, the protocone will be represented by a part of the anterior inner crescent of the horse's molar. Apparently Dr. Ameghino has made out a very strong, if not a conclusive, case for the new interpretation; I may add that the same opinion was independently arrived at and published by Dr. Forsyth-Major so long ago as 1873, but has been generally neglected in favour of the Gaudrian theory.

Without in any way endorsing all his views, it may be confidently stated that in this memoir Dr. Ameghino has made a very important contribution to mammalian odontology.

R. L.

DR. ISAAC ROBERTS, F.R.S.

THERE is one class of scientific amateurs which seems to be the peculiar product of English society. Dealing with astronomy alone, and confining our attention to those who have passed away, we have such men as Lassell, Barclay, De La Rue, &c., all of whom, after amassing a considerable fortune in commercial pursuits, have devoted the evening of their lives to furthering the interests of their favourite science. The latest example of this earnest attachment to this particular branch of science was Dr. Isaac Roberts, whose death we record with profound regret. It is possible that he may be nearly the last of a distinguished series, for it is not unlikely that, as science tends to specialise in particular directions, such instances will become less and less frequent. The wealthy amateur, it may be, will continue to provide the means for others, but the requirements for the production of valuable work tend to become more and more severe, and the actual prosecution will soon be reserved to those who have been able to give up their whole life to special study. But Dr. Roberts was fortunate in finding a subject at which he could work with effect personally, and his own exertions were rewarded with valuable results.

For some years Dr. Roberts seems to have wavered between geology and astronomy as a congenial pursuit in his leisure hours. But possibly it was the application of some form of mechanical inquiry that attracted him in either direction. Among his early papers are the results of investigations affecting the circulation of underground water and the filtering and hygroscopic properties of Triassic sandstone. In studying the movements of underground waters, of which the observations were carried on with great regularity, he employed mechanical contrivances which he designed himself. Similarly, in practical questions such as the determination of the pressure of grain on the walls of lofty warehouses, when stored to great height, the mechanical side of the question seems to