

A Comparative Study of the Dentition of  
Some Common Mammals.

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Some Common Mammals.

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1. General Characteristics, Individual Variations and
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1. General Characteristics.
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It is perhaps only natural that one who has made no special study of animal life, fails to realize fully the importance of the dental system. Not only are the teeth of animals vital to the species but also in many cases are they absolutely essential to the <sup>life of the</sup> individual. This of course is the most important factor in the consideration of the economy of teeth but not alone in this respect are they important. From the naturalist's point of view, the dental system furnishes a very valuable and often the only means of classification and identification of animals both living and extinct.

To go into this subject to any great depth one must first be thoroughly acquainted with the types with which he is dealing and even then, to make an exhaustive and scientific treatise on the subject one must give it close study and close observation for years. Therefore, in this necessarily brief discussion, we will confine ourselves to the working out of the most striking variations and peculiarities found in a few types with which we are most familiar.

In only a few mammals are teeth entirely absent. In the whalebone whale the germs are found in the embryonic state but they never rise above the gums and disappear entirely before birth. The ant eaters and pangolins are examples of a few species in which no teeth are present in any stage. The young duck-bill has well developed molars but these have entirely disappeared in the adult animal. In many of the lower vertebrates the gradations from the horny skin of the head and jaws into well defined teeth gives evidence of the nature of those organs and is sufficient, were no other evidence available, to classify teeth as modified dermal organs. Although they are present in many of the lower vertebrates, it is only in the mammals that they reach their highest development and are found definite in numbers, conformation and arrangement. In mammals these



characteristics are comparatively fixed for any given species but in the different species we find wide variations.

We have stated that teeth are often vital to the existence of the animal. This is because the prehension and mastication of food is a vital process. It is chiefly, although not alone as a part of the digestive system that teeth are necessary organs. In all mammals this is their most important function but numerous minor uses are found for them in different types of animals. The beaver with his great incisors cuts the wood to build his dam; the animal of the cat tribe defends its young or destroys its enemies with its needle canines; the trained elephant uses his enormous tusks in carrying heavy burdens; the home builders of all species find the teeth convenient tools in preparing and carrying their materials.

Most mammalian teeth are not homogeneous or simple in their structure but are composed of several distinct tissues. In the young tooth the pulp is the most important part. This is a soft gelatinous mass, abundantly supplied with blood vessels, and gives the tooth its vitality. From it the other tissues are formed by the calcification of the outer layers. In the fully developed tooth, the pulp cavity may grow very small or entirely disappear. In growing teeth it is open at the root and furnishes an entrance for the nerves and blood vessels which nourish it.

The dentine or ivory is a hard translucent substance, yellowish-white in color and somewhat elastic. It is composed chiefly of calcium phosphate and resembles bone although it is by no means identical with it. It is nourished by a system of nearly parallel tubes which permeate it, running from the pulp cavity to the outer portions where they terminate in closed ends or loops.



Over the exposed surface of the dentine is a thin glistening white and exceedingly hard covering called the enamel. It contains from 95% to 97% mineral substances and is the hardest of the tissues found in the animal body. When once destroyed it is not again replaced and thus forms a center for decay.

The cement is a substance almost identical with bone and is found covering the roots and sometimes filling the interstices between the folds of enamel of a complex-crowned molar tooth.

The enamel germ is the first rudiment of the future tooth, even in animals in which the enamel is not found as a constituent of the perfectly formed tooth. The bulk of the tooth is developed from a structure called the dental papilla. This structure consists of a portion of the vascular areolar tissue, which separates from that which surrounds it and assumes a distinct form, which is that of the crown of the future tooth. From this dentine germ the dentine is formed, the inner uncalcified portion remaining as the pulp. By the hardening of this dental papilla from the outside inward, the shape and size of the future crown is permanently fixed. By the calcification of a part of the cells of the enamel organ, the enamel coating of the crown is formed and adapts itself to fit the dentine which has meanwhile developed. While this process has been going on, a capsule called the dental follicle, has formed about the tooth and within this follicle the tooth develops. When the tooth becomes calcified to such an extent as to enable it to bear the pressure to which it must later be subjected, it pushes its way through the gum, which is gradually absorbed by the pressure of the crown upon it.

There are in most mammals two sets of teeth-- the milk or deciduous teeth and the persistent or permanent set. The permanent teeth are like the milk teeth in structure and disposition. The



principal differences are in size and numbers and often these are not marked. In the milk set the true molars are absent.

Some mammals have but one set of teeth, those appearing first becoming the permanent set, never being replaced in nature or when destroyed by accident. Animals of this class are called monophyodont.

When a deciduous tooth is shed, the process takes place by the absorption of the root and the ultimate falling out of the crown or rather the pushing out of the crown by the crown of the permanent tooth which succeeds it, No mammal is known to have more than two sets of teeth and in these the order of appearance and replacement is a definite process rather than the indefinite and continuous succession which is found in some of the lower vertebrates. Animals possessing two sets of teeth are called diphyodonts. It must not be understood that the change in this class takes place concurrently throughout the whole dental system nor does it come anywhere <sup>near</sup> it. One tooth may have its full growth long before another of the same set has made its appearance.

Teeth have a great variety of shapes. In general a completely developed tooth is an elongated polyhedron, with sometimes a conic, pyramidal or parallelepipedal form. They may be long and slender or short and bulky; smooth and regular or folded, irregular and tuberculated, in fact, of almost any shape, but the general plan is always the same.

A portion of the tooth is firmly imbedded in the alveolar cavities of the maxillary bones; this part is known as the root or fang. The free portion projects into the mouth and is known as the crown. The constriction between the crown and the fang is called the neck. A much greater variety of conformation is found



PLATE I



fig. 1

fig. 2.



fig. 3.



fig. 4.



fig. 5.

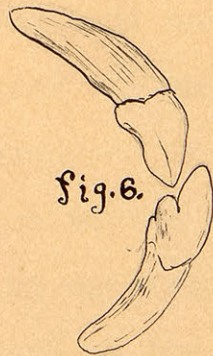


fig. 6.

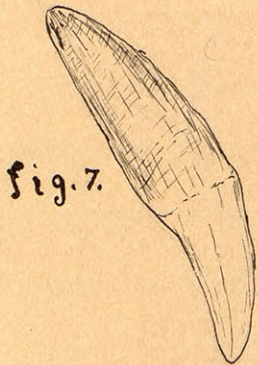


fig. 7.



fig 8



fig. 9.



fig. 10.



fig. 11.

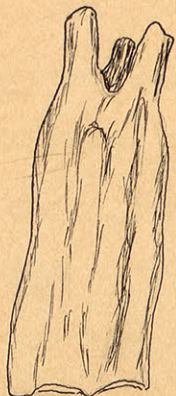


fig 12

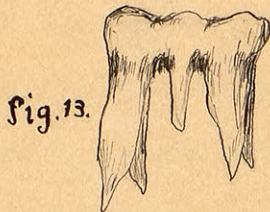


fig. 13.

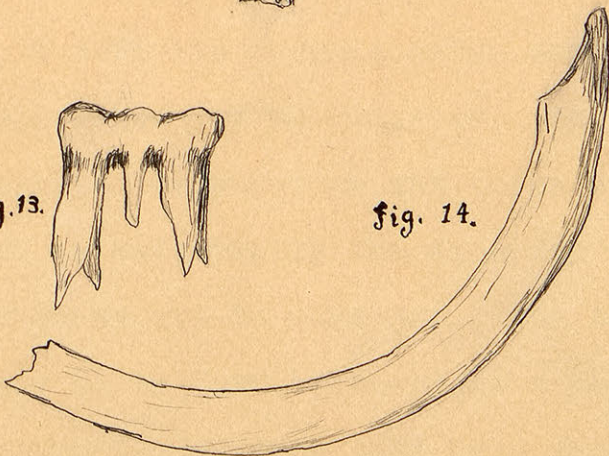


fig. 14.



in the crowns although the roots present some very striking and radical differences.

It is by a study of the shape more than any other factor that we are able to determine the use of a tooth and the nature of the animal to which it belongs. It is one of the most certain indices although not always reliable, to the natural habits of the animal. Many characteristics are found which have persisted in their effort to cling to the primitive type so well that very slight changes from the teeth of their ancestors are found. On the other hand, many changes have been brought about to meet the demands of the animal in its present habitat and environment and so pronounced have been these changes that in many cases the resemblance to the primitive form has been almost obliterated and only in the earlier stages of development are the likenesses to the ancestral type at all indicative of the derivation of the species. The importance of teeth to the animal may be again shown by the rapidity with which these changes have taken place, with comparatively little change in other structures. Thus animals of widely separate relationship have acquired striking resemblances in regard to dentition.

In the arrangement and disposition of teeth, the variations are comparatively slight, a definite formula being easily laid down as a basis to which all types may be compared. The teeth of the upper jaw are designated as superior and those of the lower jaw as inferior. The plan is essentially the same for both jaws and for all the animals which we are to consider. The teeth are ranged together in such a way as to form in each jaw a parabolic arch, open behind and interrupted on each side by a gap known as the diastema or inter-dental space. They are firmly set



in the alveolar cavities of the maxillary bones in which we found located the germs from which the tooth has developed. Each tooth may have one or more roots each with its pulp cavity, but these cavities all join the common pulp cavity in the body of the tooth. Some teeth are called rootless, which simply means that their pulp cavity remains open and that by constant growth from the root, the other extremity of the tooth is kept "up in wear." Other teeth reach their growth and the pulp cavity loses its vitality, thus leaving the crown of the tooth subject to wear with no provision for renewal. Both types serve a distinct purpose and it is difficult to say that one is a higher form than the other.

The teeth of both jaws are designated according to their position. Beginning forward and going toward the back of the mouth, we find in order the incisors, canines, premolars and molars. The teeth of the two sides of the jaw are always alike in numbers and character (except in case of accident or abnormality) and seldom vary in this respect in animals of the same species. The incisors and molars are always present; the canines and premolars may or may not be found. The incisors are simple and one-rooted and are adapted for cutting, hence the name. The canines are longer and more pointed and adapted for tearing or holding a prey. The cheek teeth have broader, more complex crowns, are ridged or tuberculated and have two or more roots. Their office is to crush and grind the food. A dentition with its component parts so widely different in form that these distinctive forms are applicable to them, is called heterodont. The dental formula which is taken as a base includes forty-four teeth, eleven in each half jaw, above and below. Of the eleven there are three incisors one canine, four premolars and three molars. The dental system of



the pig gives an example of a complete formula. Many other animals show various alterations such as the absence of incisors in the upper jaw of the bovine family.

Having now become somewhat familiar with dentition in general, we may now be able to discuss more intelligently the dental systems of a few examples of the most common types of mammals, seeing wherein they agree or differ.

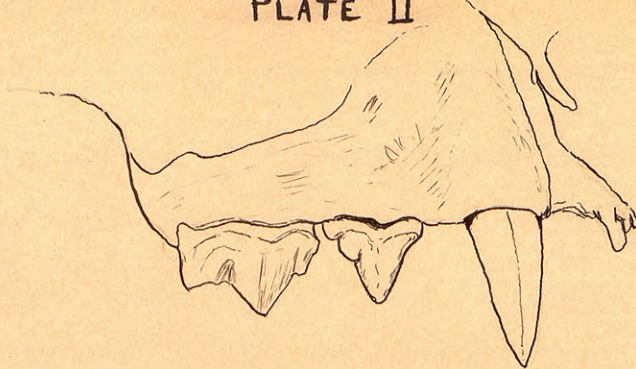
The Carnivora or flesh eating animals are a widely distributed group but cannot be mistaken even if the inspection of their teeth be only momentary. They are diphyodont and heterodont and their teeth are always rooted. The incisors are small and pointed usually three in number in each half jaw, of which the first is the smallest and the third the largest, the difference being most marked in the upper jaw. The canines are strong, conical, pointed and recurved. The cheek teeth are variable but are more or less pointed especially anteriorly.

There is always one tooth in each jaw to which the name carnassial has been applied. The teeth anterior to this are more or less sharp pointed and compressed, while those posterior to it are broad and tuberculated. The upper carnassial is the most posterior of the teeth which has a predecessor and is therefore reckoned as the fourth premolar of the typical dentition. It consists essentially of a more or less compressed blade supported by two roots, and an inner tubercle supported by a distinct root. The blade when fully developed has three cusps or lobes, the anterior being always small and often absent. The middle lobe is conical, high and pointed; the posterior lobe has a compressed, straight, knife-like edge. The inner tubercle varies very much in extent, but is generally placed near the mouth



PLATE II

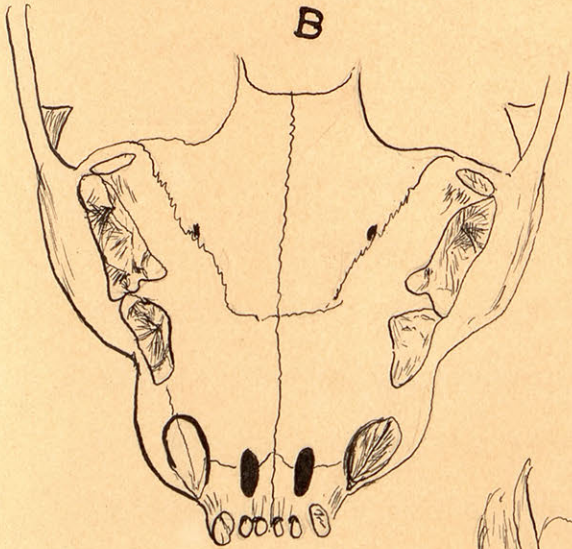
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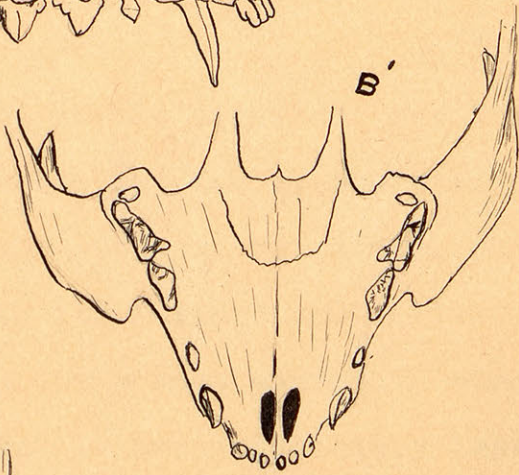
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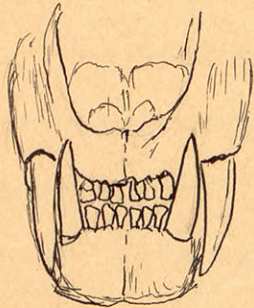
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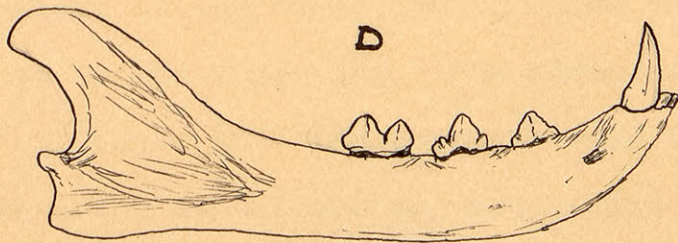
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C



D





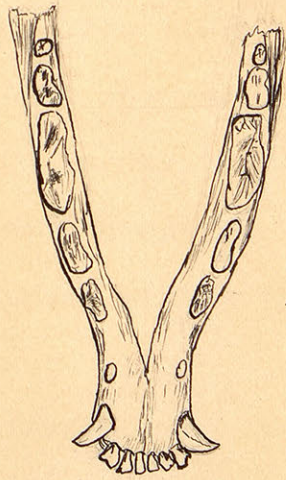
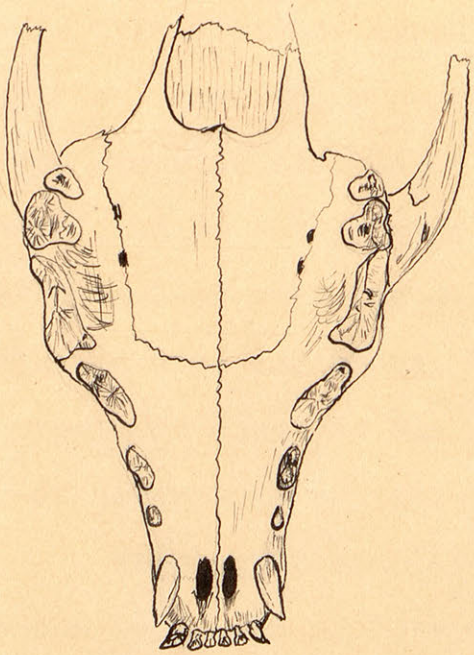
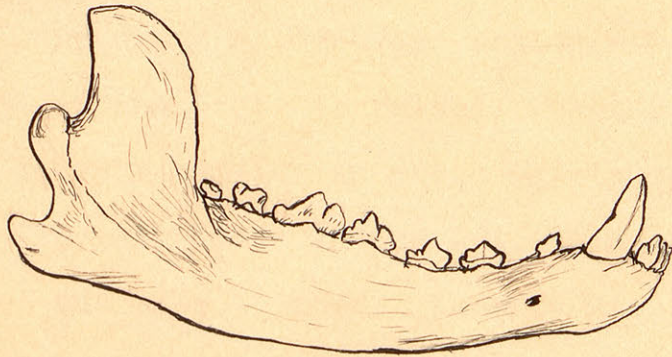
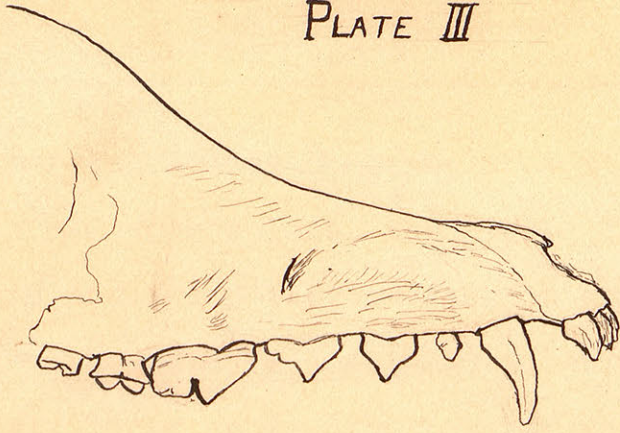
anterior end of the blade. The lower carnassial is the most anterior of the teeth without predecessors in the milk series and is therefore reckoned as the first true molar. It has two roots supporting a crown which consists of a compressed two-lobed blade, a heel or talon and an inner cusp. The lobes of the blade are separated by a notch which is generally prolonged into a fissure. In the cat family the blade alone is developed, the talon and inner cusp being absent or rudimentary. In others as the bear, the heel is broad and tuberculated.

The most common examples of the carnivora are the members of the cat and dog families. In the cat family, the wild cat and domestic cat are easily obtainable subjects for study, and are examples of the carnivorous type in its fullest perfection. In these two species there is very little difference except in size. The inter-dental space in the wild cat is proportionately less and the first superior premolar is absent. This tooth in the domestic cat is rudimentary and sometimes absent and is not therefore regarded as of any great importance. The canines of the wild species are somewhat stronger and have the neck less well defined. In the lower jaw the dentition as far as conformation goes is almost identical, but the greater extent of the inter-dental space in the domestic species is as marked as in the upper jaw. The formula for the family is  $i \frac{3}{3}, c \frac{1}{1}, p \frac{4}{4}, m \frac{2}{3}$ ; total 30. The large canines are the most striking feature of the cat's dental system, being with such rare exceptions as those of the elephant and walrus, the most highly developed canines possessed by any of the mammals.

The canine family has the dental formula,  $i \frac{3}{3}, c \frac{1}{1}, p \frac{4}{4}, m \frac{2}{3}$  total 42. The third upper molar is occasionally present in one species and in another, the third lower molar is absent.



PLATE III





The upper carnassial consists of a stout blade of which the anterior lobe is almost obsolete, the middle lobe large, conical and pointing backward and the posterior lobe in the form of a compressed ridge. The inner tubercle is small and anteriorly placed. The tooth is proportionately large as is also the inferior carnassial. The first inferior molar is much wider than it is long, consisting of two conical cusps and a low broad prolongation, with two cusps. The inner border of the tooth is raised, forming a sort of parapet. The next molar is very similar in shape but is smaller. The lower carnassial is the largest tooth in the set; it has two lobes, the posterior being larger and more pointed. There is also a small cusp back and to the inside of the posterior cusp, and behind these is a broad low tuberculated heel, occupying about one-third of the whole length of the tooth. The second inferior molar is much smaller. It has four more or less distinct cusps arranged in pairs, the anterior pair being the larger and much more distinct. The third molar is single-rooted, circular and with a tuberculated crown. The first premolar in both jaws is small, single-rooted and with but one cusp. The other premolars with the exception of the upper carnassial are very similar in size and shape, the posterior members being the larger. The prominent cusps of all point slightly backward giving the impression of an arrangement for holding and tearing.

Although the dentition is highly representative of the carnivorous type, the members of the dog family are not strictly flesh eating. It is however their natural habit and has been overcome only by force of circumstances.

There is very little variation in the dentition of the wild and domestic species. In the specimens of the domestic dog and the grey wolf studied, the differences seem but slightly more <sup>marked</sup> than those



occurring in different specimens of the dog, seeming to be more of an individual than a generic variation. The wolf has perhaps less well defined cusps and tubercles on the molars and premolars, especially is this true of the inner tubercle of the upper carnassial. The third incisor more nearly approaches the shape of the canine and is comparatively larger in the wolf.

As compared with the feline dentition, we have a larger number of teeth present and a corresponding decrease in size. The dog family has in addition to the teeth possessed by the cat family one upper and two lower premolars and the same number of extra molars. The arch is comparatively longer and narrower and more nearly continuous.

The raccoon, having the dental formula, 
$$\begin{matrix} 3 & 1 & 4 & 2 \\ i & c & p & m \\ 3 & 1 & 4 & 2 \end{matrix}$$
 presents an interesting type for study and comparison. Although somewhat omnivorous, the dentition is still typical of the carnivora. The incisors are more nearly chisel shaped and the molars more nearly approach the molars of the rodents and ruminants. The upper carnassial has three cusps along the outer margin and two well defined cusps on a broad inner tubercle. The blade of the lower carnassial is small and not well defined. The molars in both jaws are strongly tuberculated and well adapted for grinding. The upper molars are almost quadrate; the lower are somewhat narrower and considerably longer. There are forty teeth in all.

The otter and skunk have a very similar dental systems, the dentition of the lower jaw being almost identical, the only important difference being in the carnassial. This tooth in the skunk is much more simple, consisting of three poorly defined cusps and a broad low prolongation behind occupying nearly half the length of the tooth. The cusps of the inferior carnassial of the otter are



PLATE IV.

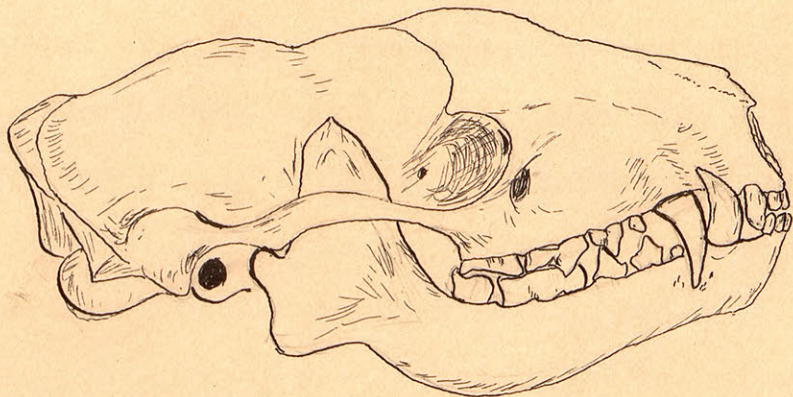


fig. 1.

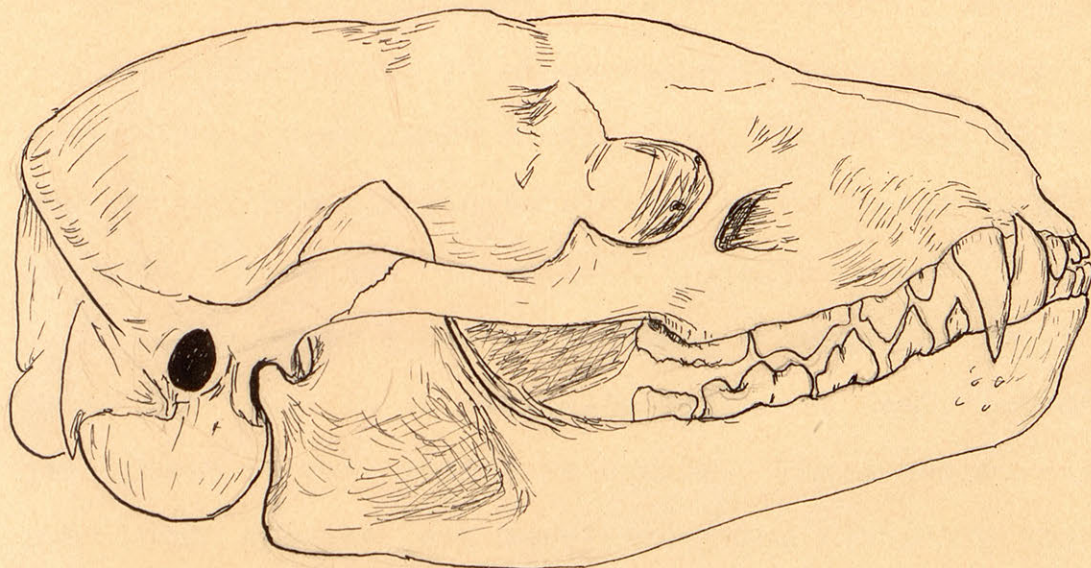


fig. 2.

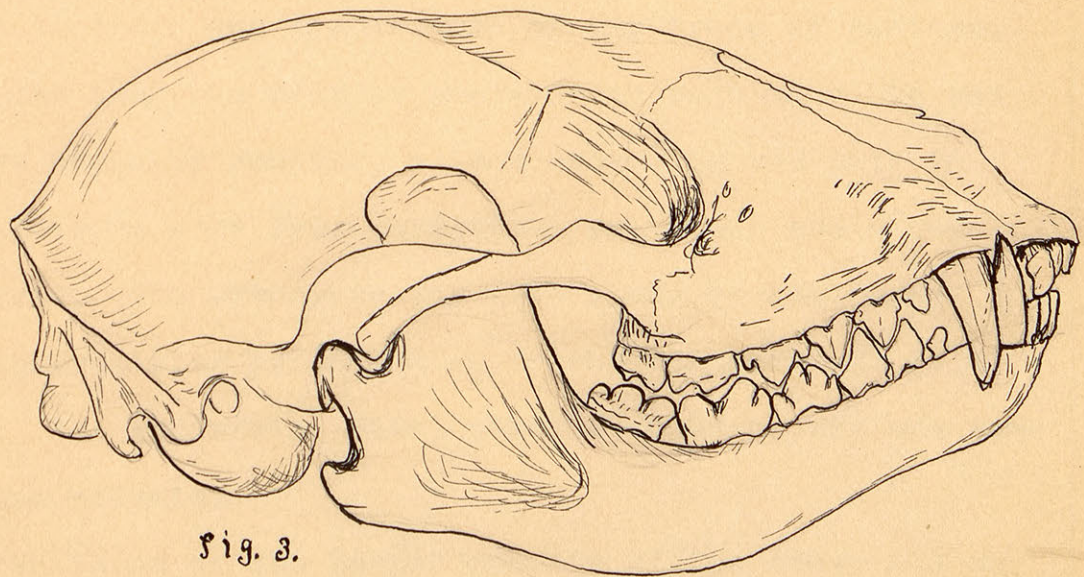


fig. 3.



much better defined and the prolongation behind them has three well defined cusps. The upper carnassial of the otter has three cusps along the outer margin and a large inner lobe with two cusps. The upper molar in both is a large pear shaped tooth, strongly tuberculated and set well into the jaw. The last lower molar is smaller and more regular. The dentition of the skunk is exhibited by the formula,  $i \begin{smallmatrix} 3 \\ 3 \end{smallmatrix}, c \begin{smallmatrix} 1 \\ 11 \end{smallmatrix}, p \begin{smallmatrix} 2 \\ 3 \end{smallmatrix}, m \begin{smallmatrix} 1 \\ 2 \end{smallmatrix};$  total, 32. The otter has in addition two upper premolars the first of which is very small or absent altogether. The third incisor is large resembling closely the third incisor of the dog. In other respects both the skunk and the otter present some remarkable similarities to the dog, while the raccoon and the dog are still more closely alike except in the shape of the incisors, which are radically different.

The order Rodentia includes a large number of small animals whose dentition is so radically different from that of the carnivora that there is very little in common. There are more than nine hundred known species, all herbivorous and gathering their food by gnawing. The dentition of the order is characterized by the very large scalpiform incisors and the absence of any trace of canines. There is never more than one pair of incisors in each mandible and the premolars are commonly wanting, seldom exceeding one pair in each jaw. The incisors grow from persistent pulps and are always more or less curved. The premolars and molars may be rooted or rootless, with tuberculated or laminated crowns and arranged in an unbroken series. The squirrels, rats, rabbits, beavers etc are some of the most common rodents.

The beaver is one of the larger members of the order and on account of its woodsman's habit, has very strong incisors. These are large and very long extending so far back into the jaw as to



give one the impression of an endless as well as a rootless tooth. A cross section gives the form of a closed parabolic arch with the closed end anteriorly posed and forming almost a straight line. The tooth is almost uniform in dimensions throughout its length and of about the same size and shape in both jaws excepting in length, the inferior being considerably longer than the superior. The molars are rootless, almost quadrate in shape and exceedingly strong. The anterior molar is the largest, the three behind it gradually decreasing in size. Although the first of the series must be considered a premolar on account of its predecessor in the milk set, it has no features that would in any way separate it from the three true molars. The cheek teeth are well adapted for grinding resembling closely the molars of the elephant or the horse in this respect. On the inner margin of the upper molar and on the outer margin of the lower set is a deep groove, most marked in the lower teeth, running lengthwise of the tooth almost median in position. On the opposite side of each tooth are three definite although less well defined grooves of a similar nature. The crowns exhibit from two to four enamel folds each, usually four, one folding from the interior and three from the exterior of the upper molars and the opposite arrangement in the lower molars.

The squirrel family exhibits the same strong incisors as the beaver although they are used for a somewhat different purpose. The upper incisors are almost like those of the beaver in shape. The lower incisors are comparatively narrower and thicker from front to back. The points are sharper and the angle formed by the bevel backward from the point is much more acute; the curvature is less but the length greater than in the upper jaw as in the beaver.

The molars unlike those of the beaver are rooted and have



tuberculated crowns instead of folded ones. There are two premolars above and one below, only the first of the upper series showing any marked difference from the true molars. This one is often absent and when present is much smaller and single rooted. The true molars have three roots in the upper jaw and four in the lower jaw. The first premolar of the lower jaw has a strong forward root and two smaller roots behind. The other three-rooted teeth have a strong root on the interior and two lesser roots on the exterior margin. On the inside of the crown of the upper cheek teeth is a well marked cusp, and two lesser ones are on the outer margin, connected to the inner one by two transverse ridges. The lower teeth have as a rule two small but well defined cusps on the inner and outer margins, surrounding a hollow surface.

The prairie dog is closely related to the squirrel and in general bears a close resemblance to it as regards dentition. The incisors are not so well developed, due no doubt to the nature of its food. The first premolar of the upper series, commonly absent in the squirrel, is in the prairie dog well developed. The cheek teeth are rooted but have instead of tuberculated crowns, a well marked although very irregularly folded surface. The folds consist of three transverse grooves. The molars are remarkably well developed. The arches of both jaws are strongly convergent behind.

The various species of rats and mice form a distinct group, differing from those preceding in the absence of any premolars. The incisors are strong, the upper being shorter and heavier than the lower, which are strongly compressed. There are three molars in each half jaw, the first of which is the largest and the third the smallest. They are rooted and tuberculated, resembling very much the molars of the squirrel.



PLATE V.

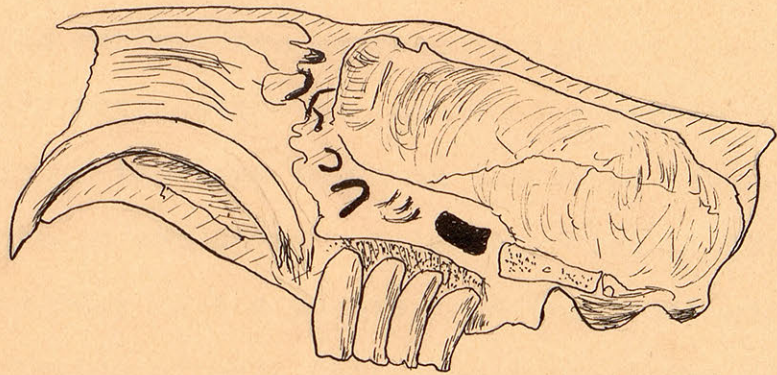


fig. 1.

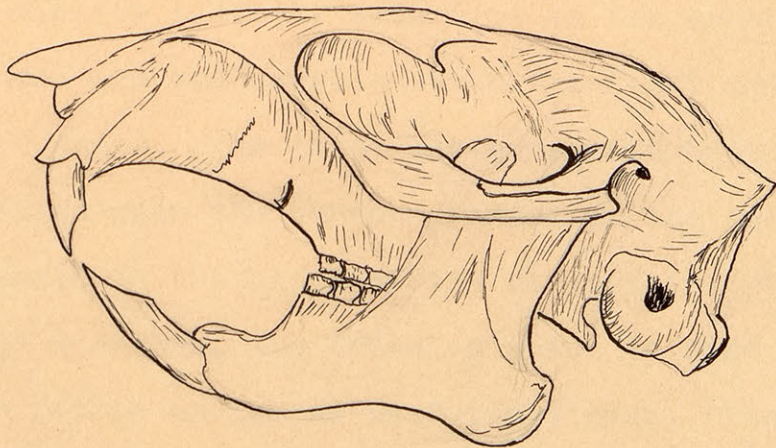


fig. 2.

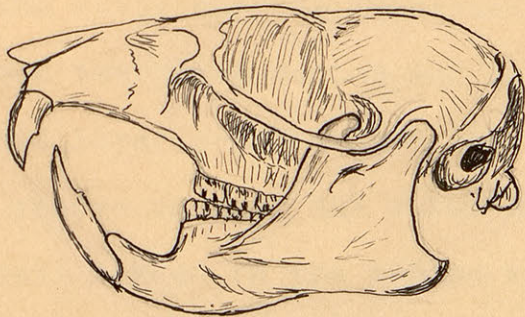


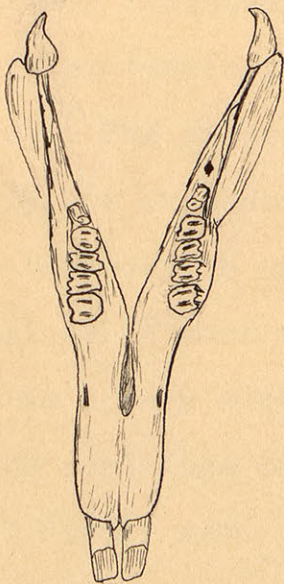
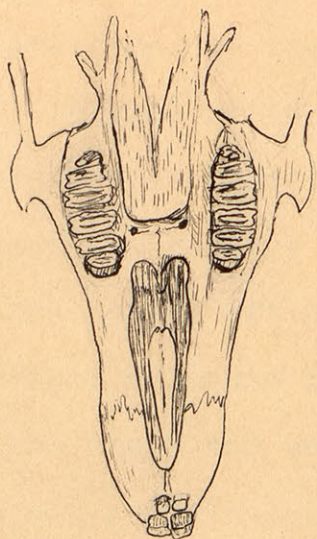
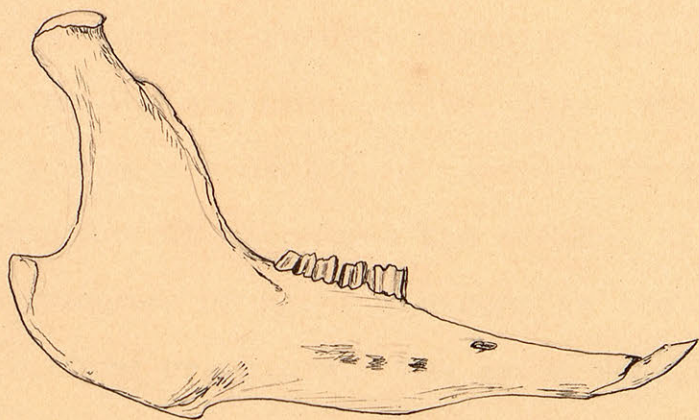
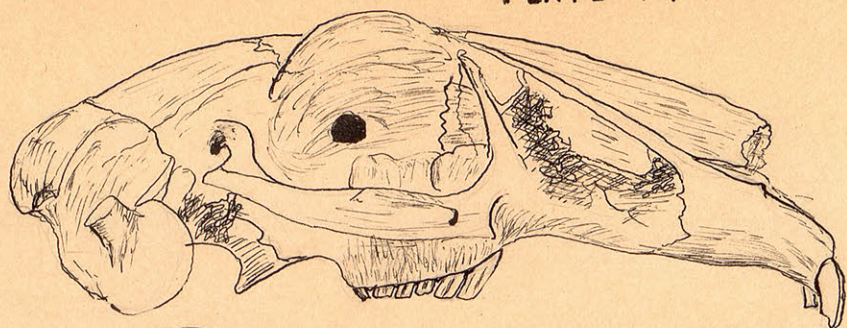
fig. 3.



The rabbits are representatives of a type whose dental system is very interesting and somewhat remarkable on account of the extra pair of incisors found in the upper jaw. The first pair of upper incisors are quite widely separated at the roots but converge until they meet at the points. On the front side, a deep groove runs lengthwise of each tooth about one-third of the way from the inner margin. On the back side of each edge is a shelf upon which the edges of the lower incisors close. Back of this shelf and with their crowns sloping slightly toward it is the second pair of upper incisors. These are much smaller than the first pair and are nearly cylindrical in shape. The lower incisors have broad chisel-shaped edges which close upon the surface formed by the second upper incisors and the shelf on the backs of the first pair. There are at birth three pairs of incisors, the third of which is lost early in life and count for little as far as usefulness goes. There are three premolars above and two below, resembling the molars in all essential points, those of the lower jaw being larger than the molars. The first inferior premolar is semicylindrical with the inner surface smooth and the outer surface traversed by two longitudinal grooves. The cheek teeth are rooted and have transversely folded crowns. The second lower premolar and the three lower molars each have one similar groove on both the outer and inner surface. This feature is also well marked in the second and third premolars and the first and second molars of the upper jaw. These teeth each have two well defined grooves running transversely across their crowns, which is also a feature of all the lower teeth. The third and last molar of both jaws is very small and rudimentary, especially in the upper jaw, consisting of a small rounded blade with a cup shaped face. These molars in both jaws point forward; the upper set with



PLATE VI.





this exception are inclined backward and the lower set stand nearly straight.

The large class of animals known as ruminants includes such common examples as the ox, sheep, deer, goat, etc. They are strictly herbivorous and have a dentition peculiar to themselves, the principal characteristics of which are the absence of incisors in the upper jaw, the presence of eight incisors in the lower jaw, and the absence of caniniform premolars. The extra pair of inferior incisors may be regarded simply as incisiform canines. The dental formula therefore is,  $i \frac{0}{3}, c \frac{0}{1}, p \frac{3}{3}, m \frac{3}{3}$ , total 32. Exceptions to this formula are found in the deer where the upper canines are commonly present. Instead of incisors in the upper jaw there is a thick cartilaginous pad against which the lower incisors close. By this arrangement the herbage upon which the ruminants feed, is broken rather than bitten off as in the horse. The strong lips and tongue are important adjuncts to the teeth in the prehension of food.

The shape and setting of the incisors is quite remarkable. They are not set firmly in the alveoli as in most animals, but have a certain freedom of movement, which is a very wise provision as it prevents in this way any injury to the cartilage of the upper jaw which might take place were the teeth firmly set. The incisors are somewhat shovel-shaped, the root representing the handle. The interior face of the free portion is flattened, the anterior face rounded thus making the tooth thinnest at the edges and thickest in the middle portion. The root is much narrower than the crown and is almost cylindrical in form. The incisors are set nearly horizontally in the jaw, thus exposing the whole flat upper surface to wear. In old age these crowns become worn away so badly that only the ends of the roots appear above the gums, which gives the impression of



a shrinking and a divergence.

The domestic sheep and cattle are the common representatives of the ruminants. The above description applies more nearly to the ~~bock~~ than to the other members of the group. The most marked difference between the sheep and ox is the shape and setting of the incisors. Instead of being posed horizontally, they stand nearly ~~straight~~ straight and are much more firmly set than in the ox. They are also much narrower and have a very poorly defined neck, resembling very much in shape the incisors of the horse; they are, however, very like the incisors of the ox in the shape of the crown.

The lower premolars of the ox, three in number, are of a very different shape from anything we have yet met. The first is much smaller than the other two and consists of a conical crown with grooves running from the apex toward the neck. The second and third consist of complex folds, the grooves separating them being very deep. Of these there is one on the outer face and three on the inner, much more sharply defined in the third tooth. The bearing face of the tooth, therefore, consists of a series of irregular ridges highest in the middle of the outer face. The upper premolars are entirely different, differing from the upper molars very little except in size. The lower molars, of which there are also three in each half jaw, consist of two main trunks, each supported by a root and joined by a constriction in the fold which bounds the face of the tooth. On the face of each trunk there is a more or less semicircular fold of enamel within which is the exposed pulp cavity. On each side of this fold lies a dish-shaped depression circular or oval in outline. On the exterior face of the first and second molars is a fold running out from the constriction. This is almost absent in the third molar, but is replaced by a much larger fold behind the second trunk



PLATE VIII.

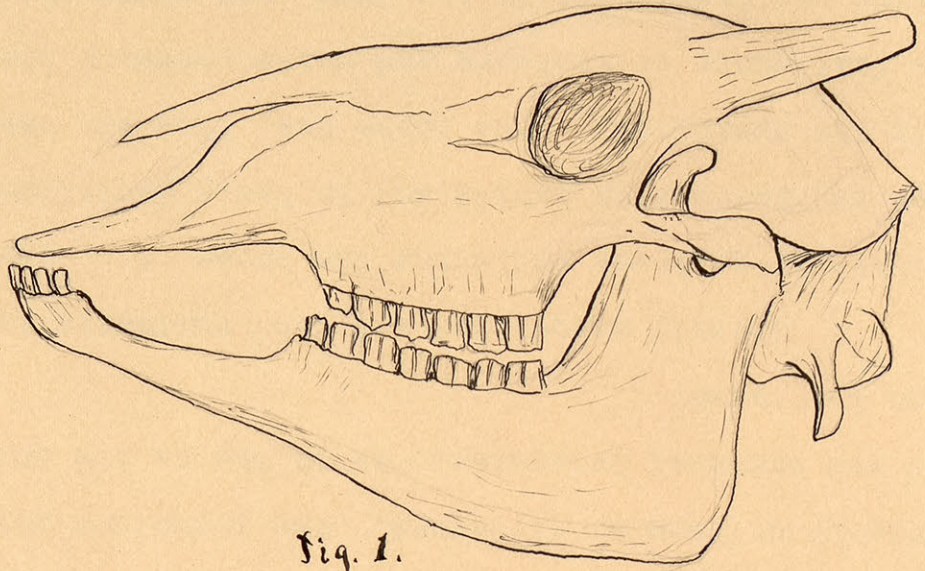


fig. 1.

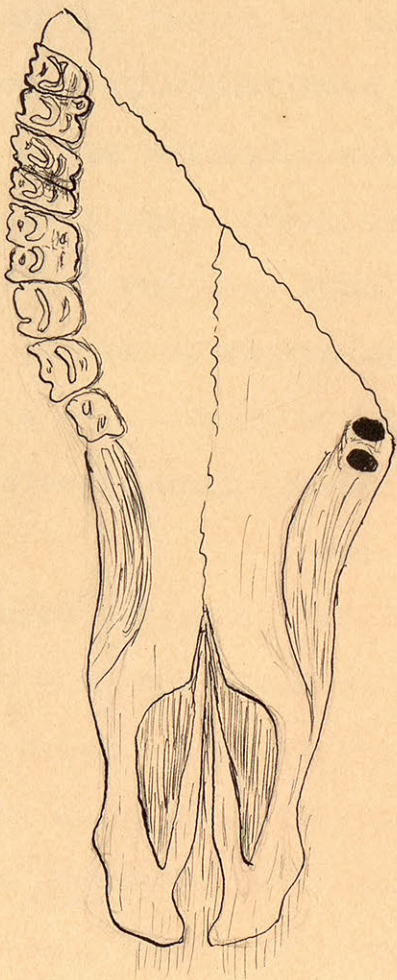
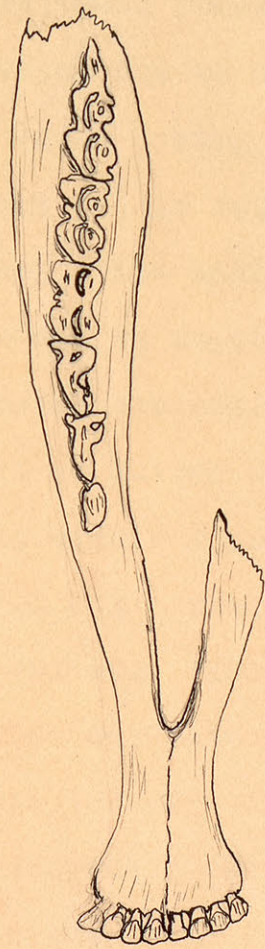


fig. 2.





which gives this tooth a much greater length than the ones preceding it. The first and second molars are about twice as long as wide while the third is about three times as long as it is wide. The upper cheek teeth are almost quadrate and much heavier than the ~~upper~~<sup>lower</sup> molars but have the same general structure. The constriction which in the <sup>lower</sup> molars nearly separated the tooth into two parts, is in the upper set much less prominent. The face of the tooth, however, has the same folds and depressions. The premolars differ from the molars essentially in consisting of a single trunk instead of two.

The molars of the sheep vary somewhat from those of the ox. The lower premolars approach more nearly the form of the molars and the constriction in the body of the upper molars is almost as marked as in the lower set. However, it folds only from the interior, and on the outside of the tooth opposite this inward fold is a corresponding outward fold. These also occur at the posterior and anterior ends of the tooth on the outward face. This peculiarity is found in the first and second premolars as well but in the third, the middle ridge is absent. The molars stand almost squarely in the jaw and are remarkably uniform in structure. The premolars point slightly backward and are somewhat irregular. As in the ox the upper set are much wider than the lower.

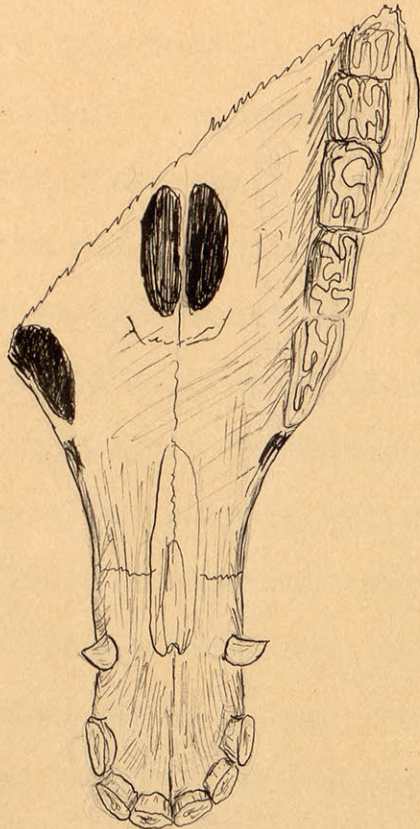
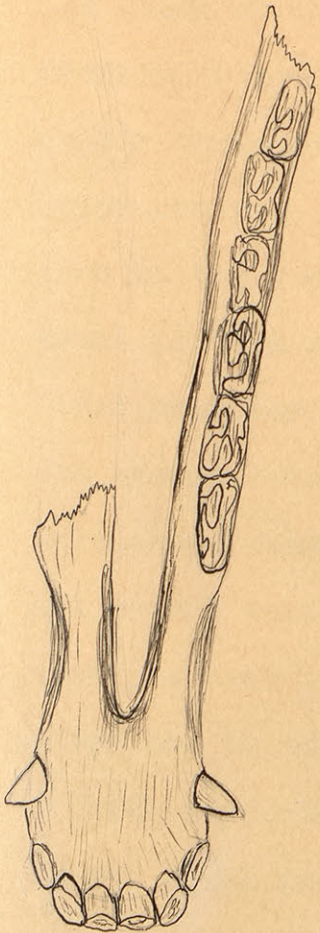
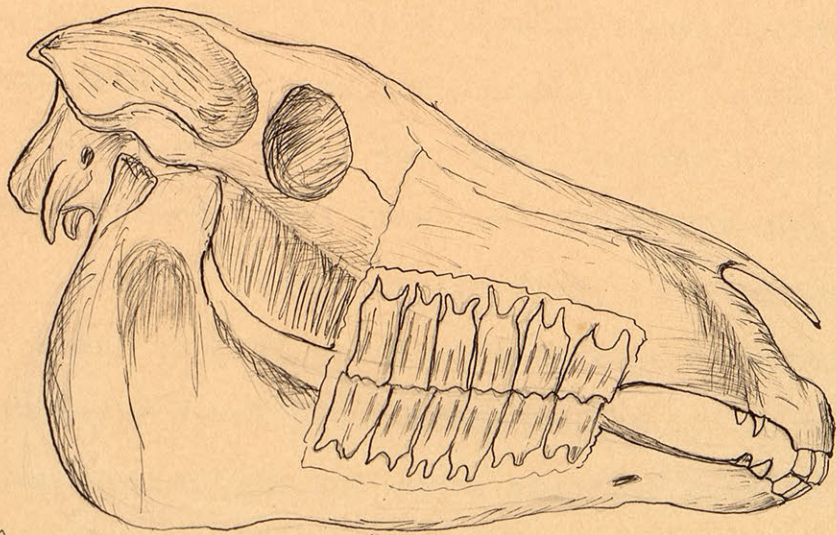
Closely associated with the ruminants is the class of equine animals or solipeds including the horse, ass, zebra etc. They are also herbivorous in habits, and in their dentition have much in common with the ruminants. The horse has, like the carnivorous animals, his full quota of incisors and quite commonly the canines. The incisors are firmly set in the jaws, are sharp and chisel-like and very strong. They resemble in this respect the incisors of the rodents but are comparatively much smaller and less uniform in dimensions.



They are broadest at the edge and taper gradually toward the root. They are set closely together and form a pair of nicely fitting arches. The canines are present in the male and sometimes in the female. They are separated from the incisors by a gap of about two inches and curve slightly away from them. They are conical in shape, strong and thick and about the size of the incisors. The premolars are identical with the molars in shape and structure and slightly exceed them in size. There are three premolars and three molars in each half jaw and occasionally one supplementary premolar in front of the usual number one, but it is always small, has little resemblance to the others, is usually shed early, and is not replaced. The cheek teeth at first are rootless and by continuous growth keep the grinding edge always at the same level. Later in life, however, a neck and roots are formed. The first premolar is triangular in form; the remaining teeth of the series are quadrate or nearly so, the lower ones being somewhat narrower than the upper and the last molar approaching a triangular shape. They are nearly uniform in dimensions throughout their length, in this respect resembling the molars of the rabbit and beaver. A young molar has a grinding face covered with enamel but when, through constant use this is worn off, the surface presents only the intricate inward and outward folds of enamel with the softer dentine exposed between them. In the lower teeth this enamel forms a boundary about the tooth and by kinks and folds of this covers the face of the tooth with ridges. In the upper teeth in addition to this are two interior folds in no way connected with each other or with the outer folds. These we saw also in the molars of the ruminants. The constriction in the sides of the molars is here also present although rather obscure. Taken in all they are well adapted to the grinding of the harsh and dry vegetable food as well as the more succulent herbage that makes



PLATE VIII.



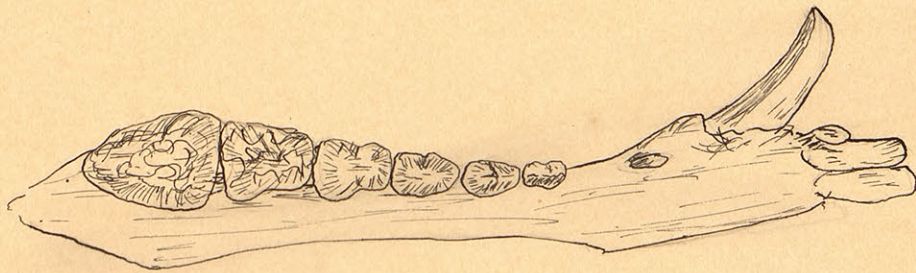
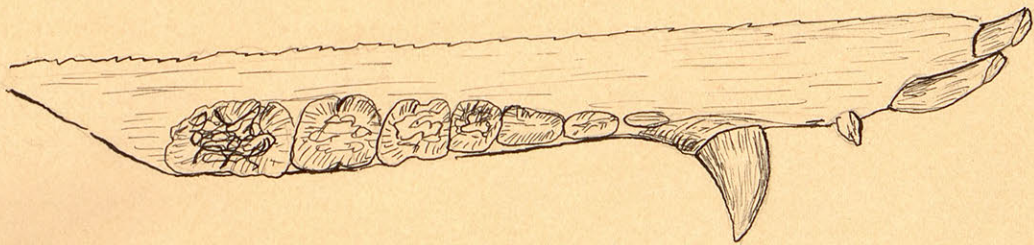
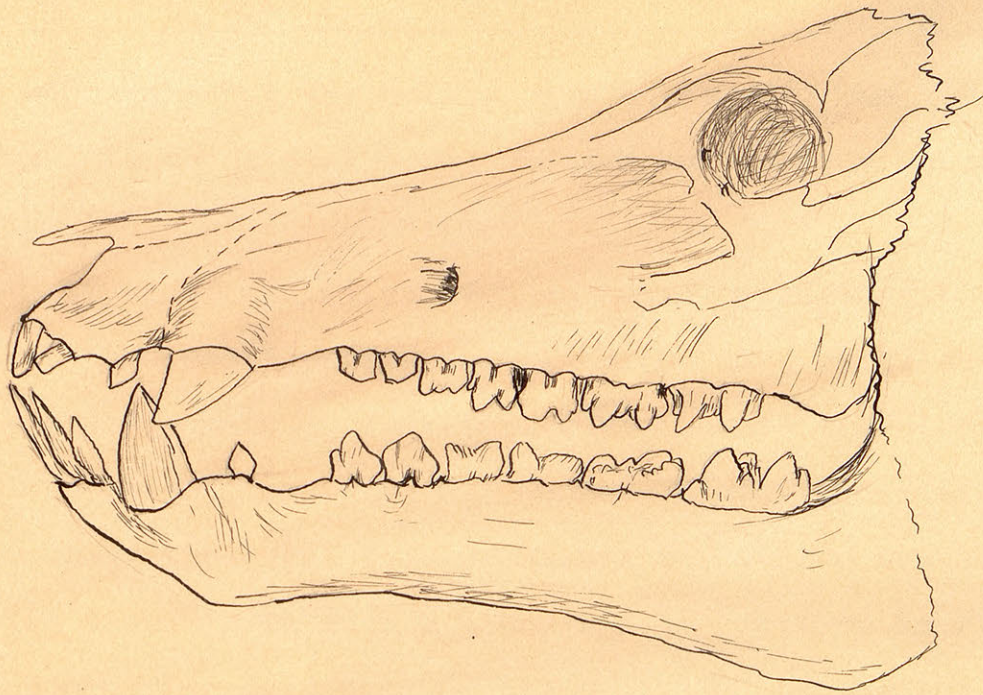


up the food of the horse, both in the wild and the domestic state.

The hog is a representative of a type bearing many resemblances to both the carnivorous and herbivorous animals and is omniverous in his habits, eating flesh as naturally as roots, grains and other vegetable foods. Although somewhat variable the usual dental formula is  $\begin{matrix} 3 & 1 & 4 & 3 \\ i & c & p & m \\ 3 & 1 & 4 & 3 \end{matrix}$ ; total 44. The incisors are long and narrow, pointing slightly inward. The first two lower incisors are nearly uniform in size while of the upper the first is much the larger and the third very small in both jaws. The canines have persistent roots and are very strongly developed. Those of the upper jaw do not have the usual downward direction but curve strongly outward, upward and finally inward. Those of the lower jaw curve outward, upward, and gently backward, the back edge wearing against the front edges of the upper canines. They are much more strongly developed in the males than in the females. The cheek teeth gradually increase in size from front to back and are arranged in contiguous series except that the first premolar is separated by a short gap from the second. The first and second have two roots and compressed crowns; the third and fourth have these roots and an inner lobe developed on the crown. The first and second true molars have quadrate crowns with four large conical cusps, around which are grouped numerous smaller cusps. The third molar has in addition to these four cusps, a large posterior talon or heel supported by several extra roots. This makes the third molar almost equal in length to the first and second combined. Its crown is generously provided with small conical cusps. The lower teeth are narrower but in other respects are like the upper set. This type of dentition is very interesting on account of the manifold features which it embodies. The middle incisors are like those of the horse, the corner incisors like those of the rodents. The canines are strong like



PLATE IX.





those of the carnivora but are unlike them in shape. The molars are broad and flat like those of the rodents and herbivorous animals but are cusped like those of the carnivoreus.

Other types of dentition such as those belonging to the fish eating and the insect eating animals might also be taken up, but these types are not common or familiar to us and are therefore beyond the scope of our present discussion. We have simply endeavored to climb one branch of the great tree of nature and take a casual glance at a few of its tips. In such a study who can fail to be struck by the manifold concurring evidences of the evolution of species from a common type and the wise provisions of nature which makes possible the adaption of organs to suit the environment and thereby the survival of the creatures which inhabit the earth.

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