# 14.

# A Report on the Dental Pathology Found in Animals that Died in the New York Zoological Park in 1938.

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(Plates I-IX).

## INTRODUCTION.

It is very seldom that one finds a description of oral pathology in autopsy reports of animals in captivity. This is due to several factors; primarily inability to recognize or interpret lesions either in the living state or on the autopsy table, and secondly, the masking of these hard tissue lesions by apparently normal-appearing soft tissues, which effectively cover and hide any lesions present. It is not a widely known fact that the majority of oral lesions invariably affect the hard structures around the mouth—the teeth, which may present lesions of the enamel, dentine or cementum, and the surrounding bone, which indelibly bears the lesions of various oral diseases.

It is apparent that the study of oral lesions in the morbid state would materially augment autopsy reports. In addition this valuable information that would otherwise go unknown and undetected, may help solve some of the mysterious conditions often encountered.

As far as preparation of the material is concerned, the best means is maceration, preferably at body temperature, although room temperature, while slower, is suitable. If rapidity of preparation is desired, the specimens may be cooked down in soap solutions. Neither way will affect the hard tissues, or produce unrecognizable artifacts.

This paper covers the range of pathology found in the specimens collected at the New York Zoological Park Hospital during 1938. This includes dental caries, injuries of the teeth, mal-positioning of the teeth, dento-alveolar abscess, periodontal pathology, impacted teeth and other conditions.

The photography is the work of E. R. Osterndorff. The radiographs were taken by the author.

## 1. DENTAL CARIES.

Dental caries occurs in both wild and captive animals. Sir Frank Colyer has shown that the disease is more prevalent in captive animals than in wild animals. The term caries denotes a pathologic condition which results in the destruction of either enamel, dentine or cementum through the agency of specific, pathogenic micro-organisms. This condition is to be differentiated from loss of tooth structure by attrition or trauma. Although the cause of dental caries is still disputed, several important factors are to be considered: a, the action of micro-organisms; b, structural defects of

the teeth; c, traumatic fractures of teeth; d, mal-positioning of the teeth with resultant food impaction areas; e, a faulty diet, usually found to be rich in carbohydrate intake, and many other factors disputed or accepted by authorities. The following specimens illustrate some of these conditions.

*Primates.*

a. *Macacus rhesus* (immature).

This specimen presents a condition of incipient caries of the enamel on the distal surface of the maxillary right central incisor. The caries occurs at the point of contact between this tooth and the lateral incisor. The mesio-incisal corner of the lateral had been chipped, creating a wedge-shaped food impaction area which undoubtedly contributed to the carious process.

b. Hussar Monkey, *Erythrocebus patas*, M-234-38.[1]

This specimen shows caries that had occurred on the site of an old fracture of the maxillary left canine tooth. The carious process has hollowed out the crown of the canine. (Plate I, Fig. 1).

The exposed pulp present may have been due either to the original fracture or to caries following the fracture. Alveolo-dental abscess of long standing is present, with fistulation through the buccal plate of bone in the apical region.

*Rodentia.*

a. Woodchuck, *Marmota monax*, M-37-38. Plate I, Fig. 2b.

This specimen exhibits caries of the premolar and of the first and second molars. The disto-buccal cusp of the mandibular left premolar is completely destroyed, the carious process having extended below the cemento-enamel junction onto the disto-buccal root which has become exposed through alveoloclasia. The mandibular left first molar presents mesio-occlusal and disto-occlusal caries of the crown, and buccal caries at the cemento-enamel stagnation area. The mandibular left second molar likewise presents caries at the cemento-enamel junction. The carious process starts at the mesial surface and ends on the mesio-buccal apect. In addition there is deep and extensive pocket formation with much evidence of suppuration. (Plate I, Fig. 2).

b. Woodchuck, *Marmota monax*, M-38-38.

This specimen presents occlusal caries of the mesio-lingual cusp of the mandibular left first molar. The carious process is of the typical pit caries type, wherein the caries has penetrated and undermined the mesio-lingual cusp for a distance of two-thirds the length of the crown. The caries has not broken through the mesial plate of enamel, although a discoloration is seen through the enamel.

*Carnivora.*

In the wild state the Carnivora are relatively free from caries. However the Ursidae and Procyonidae show an increased caries susceptibility in captivity.

Raccoon, *Procyon lotor*, M-59-38.

This specimen shows interproximal caries involving the distal surface of the mandibular left first molar, resulting from a food impaction area. The second molar is tilted at an angle of approximately 30° with the horizontal plane of occlusion, and is situated on the ascending anterior curve of the coronoid process. This created a wide, wedge-shaped, food impaction area between the distal of the first molar and the mesial of the second molar. Food, wedged into this interproximal space, and acted upon by the lactic acid-producing organisms, undoubtedly caused the caries.

[1] This and subsequent numbers refers to the case history in the records of the Hospital and Laboratory, New York Zoological Park.

(Plate I, Fig. 2a). In addition bone resorbtion and pocket formation resulted from this food impaction area.

*Hyracoidea.*

Hyrax, *Procavia capensis,* M-138-38. Plate II, Fig. 3.

Heretofore, the Hyracoidea have been regarded as a caries-resistant type. Sir Frank Colyer records 300 specimens examined with none showing caries. Hence I believe that this specimen of hyrax presenting caries is the first to be described in the literature. This animal exhibits a very extensive and destructive type of caries, simulating the condition known as "rampant caries" in the human.

All the maxillary premolars and molars are involved, producing a continuous trough-like carious gutter running from the first premolar to the last molar. (Plate II, Fig. 3). The carious process has hollowed out the crowns, removing most of the coronal dentine, but has left the undermined buccal plate of enamel intact on each tooth. The lingual plate of enamel is missing from some of the teeth, but this appears to be due to the undermined, weakened, enamel plates having chipped off. The carious process has attacked the interproximal areas and the transverse occlusal fissures as well. The mandibular teeth show seven of the twelve posterior teeth involved. The mandibular incisor teeth show incipient caries in the form of interproximal discoloration and etching of the enamel below the contact points. The two central incisors show caries of the enamel at the contact point.

## 2. Injuries of the Teeth.

Plate II, Fig. 4.

*Carnivora.*

Coyote, *Canis latrans,* M-18-38.

The left maxillary fourth premolar of this specimen was injured in some manner during the formative stage, producing several interesting sequellae. The injury affected the mesial portion of the tooth, resulting in a haphazard calcification of dentine and enamel. The crown appears to be completely denuded of enamel in some parts, and composed entirely of enamel in other parts. The dentine and enamel calcification had become indiscriminately intermingled. It appears that the power of growth of both ameloblasts and ondoblasts is not affected by traumatic injury as in this instance.

The root portion was also affected: a gnarled, shortened, misshapen root resulted, with several "rootlets" having been created, particularly one rootlike spur on the buccal aspect which is 1 mm. wide and 2 mm. long. There was a definite ankylosis of root to alveolar bone. The apex of the mesial root had fused to the alveolar bone, and the mesio-buccal margin had fused to the buccal plate of bone. The X-ray indicates that a pulp was present in the distal portion of the tooth, both root and coronal pulp being present.

The effect on the maxillary and mandibular dental arch is interesting. The side opposite that of the injury shows the more severe mal-positioning of the teeth. The mandibular right canine protrudes horizontally at right angles to the long axis of the other mandibular teeth. The left mandibular canine tooth is likewise misplaced but not as severely as the right canine. The maxillary right canine has changed its axial inclination; the crown has been pushed anteriorly, and the root displaced posteriorly.

In spite of all this, the animal showed very little, if any, evidence of suppuration, and only slight alveoloclasia.

### 3. Dento-alveolar Abscess.

Dento-alveolar abscess is frequently found in wild animals kept in captivity. The usual causes are exposure of the pulp by means either of fracture of a tooth or severe attrition. Not all such cases result in abscess formation, however. Another cause of abscess formation, though relatively infrequent, is the result of infection of the peri-dental membrane progressing so far as to produce an abscess.

*Carnivora.*

Gray Wolf, *Canis nubilus,* M-61-38. Plate III, Fig. 5.

This specimen shows abscess formation following a fracture of the upper right central incisor, exposing the pulp chamber. The resultant pulp infection was followed by apical involvement indicated by fistulation and rarefaction of bone. The extreme of alveoloclasia is shown in this case with complete destruction of all alveolar bone, as is seen in the illustration. The pocket formation encircles the root completely. An unusual situation resulted from this condition, hypercementosis and root resorbtion occurring simultaneously.

*Marsupialia.*

Kangaroo, *Macropus robustus.*

This specimen exhibits abscess formation as a result of a fracture of the upper left second incisor. Fistulation took place with the pus pointing into the left nasal aperture. The fistulation resulted in extensive bone destruction with much evidence of suppuration.

*Primates.*

Hussar Monkey, *Erythrocebus patas,* M-234-38.

This specimen presents in addition to abscess formation a very unusual condition which will be fully described in the section dealing with periodontal pathology. The abscess formation followed as a result of exposure of the pulp of the maxillary left canine tooth. An old fracture of the crown was followed by caries. Whether the pulp exposure resulted from the fracture or from the caries is hard to say. However the pulp infection was followed by apical involvement and abscess formation. The resultant fistulous opening is in the bone of the maxilla at the apex of the canine. (Plate III, Fig. 7). Drainage was evidently by means of the soft tissues between the periosteum and the skin, into the oral cavity.

*Artiodactyla.*

Axis deer, *Axis axis,* M-221-38.

This specimen presents one of the rare cases of abscess formation following periodontal membrane infection. The entire condition will be discussed under the section dealing with periodontal pathology.

A severe food impaction area resulted in deep pocket formation between the distal root of the left mandibular second molar and the mesial root of the third molar. Even after maceration, fodder fragments are present interproximally and in the pockets. Suppuration hollowed out the lingual bone and left a definite lateral sinus. (Plate IV, Fig. 9). Fistulation is on the lingual surface of the mandible and is accompanied by a peculiar, raised osteoporosis surrounding the fistulous opening. Drainage was probably through the soft tissues of the floor of the mouth.

### 4. Periodontal Pathology and the Resultant Bone Lesions.

The majority of the specimens skeletonized exhibit evidences of periodontal disturbances.

*Carnivora.*

Gray Wolf, *Canis nubilus,* M-61-38. Plate III, Figs. 5, 6.

This specimen shows a fairly well developed periodontal disturbance. Alveolar bone destruction is marked throughout, slightly more severe in the upper jaw. The bone shows the characteristic signs of suppuration, rarefying osteitis pronounced throughout. Abscess and pocket formation around the upper right central incisor have been described in a preceding section. There is a deep food pocket present between the distal of the maxillary right fourth premolar and the first molar. The maxillary fourth premolar has a large deposit of salivary calculus (visible in the illustration as the projecting white mass under the zygomer, posterior to the canine. Plate III, Fig. 5).

There is also a severe food impaction area between the left mandibular first and second molars. The talonid or distal cusp of the mandibular left first molar has been broken off. The space created acted as a food impaction area, and the wedging of the food caused deep interproximal and lateral pocket formation. (Plate III, Fig. 6). There is much evidence of marginal suppuration in the form of a rarefying osteitis.

Paradoxure, *Paradoxurus jerdoni,* M-77-38.

Sir Frank Colyer reports a case of periodontal disease in *Paradoxurus larvatus* (masked paradoxure) which is similar to the condition found in M-77-38. The alveolar bone destruction around the maxillary teeth is highly advanced, more than one-half of the root surface being exposed. There is much evidence of a rarefying osteitis. The mandibular teeth, however, show a heavy marginal proliferation of bone instead of an alveoloclasia. This appears to be a slow response to a condition of long standing. (Plate V, Fig. 10).

*Artiodactyla.*

Axis Deer, *Axis axis,* M-221-38.

This specimen presents the last stages of periodontal disease, the stage preceding loss of teeth. There is a complete destruction of almost all alveolar bone, lateral as well as interproximal bone. The only means of retention of the teeth is by extreme hypercementosis. This is a response to the destruction of the alveolar bone and is retentive in function. The hypercementosis is so severe that the distal roots of the maxillary first premolars have fused with the mesial roots of the second premolars. (Plate V, Fig. 11b). The incisor teeth likewise exhibit this extreme deposition of cementum. The apical enlargements are thus two or three times the dimensions of the crowns of the teeth. (Plate V, Fig. 11a).

The alveoli show signs of extensive suppuration, a complete rarefying osteitis being present. Fistulation into the maxillary sinus has taken place. (Plate VI, Fig. 12). An unusual condition has resulted from the drainage into the left antrum. The best description seems to be a "suppurative blow-out" of the posterior wall of the left antrum. This is well seen in the inferior view of the skull, marked by the arrows. (Plate IV, Fig. 8). The discharge of pus was into the inferior orbital and infra-temporal region. The pus had distended the posterior wall of the sinus, resulting in a paper-thin, globular, bony swelling that ultimately "blew out." The degree of attrition and the amount of alveoloclasia is well depicted in the accompanying illustrations. (Plate VI, Figs. 12, 13).

*Primates.*

Hussar Monkey, *Erythrocebus patas,* M-234-38.

This specimen presents a very unusual condition: a severe unilateral alveoloclasia. For some reason this animal developed a unilateral mastication, the left side being used almost exclusively for chewing. As a conse-

quence, the degree of attrition is greater on the left side than on the right side. The left was in a fairly normal state, very slight alveolar bone destruction present. (Plate VII, Fig. 14). However, the right or atrophic side shows the extreme effect of alveoloclasia. As the illustrations show, there is complete destruction of all alveolar bone. (Plate VII, Fig. 15). The entire right side, maxillary and mandibular, exhibits a severe, progressive osteitis. The comparison of the photographs of the right and left sides presents the case graphically.

The premolars and molars of the right side have their root apices protruding into the maxillary sinus. See illustration—the arrows point to the sinus openings. (Plate VII, Fig. 15).

Plate I, Fig. 2, shows, beside the raccoon mandible with a carious molar, two examples of periodontal disease in the rodents.

*Rodentia.*

Woodchuck, *Marmota monax,* M-37-38.

In addition to caries this specimen exhibits a lateral pocket or suppurative sinus extending from the mesial of the left mandibular premolar to the distal of the second molar. There is a space of 3 mm. between the root surfaces and the buccal plate of bone. (Plate I, Fig. 2b).

African Ground Squirrel, *Geosciurus capensis.*

This specimen exhibits the end stages of periodontal disease. Only two of the teeth remain, the position of the lost teeth being indicated by the presence of an edentulous trough. (Plate I, Fig. 2c).

### 5. Impactions and Mal-positioning of Teeth.

Occasionally teeth are mal-occluded, mal-positioned or impacted. The cause of these conditions is still obscure, and many factors may be involved. The specimen included in this section is one of unusual interest. A very brief case history and autopsy report may be of value.

*Primates.*

Woolly Monkey, *Lagothrix humboldtii,* M-216-38. Young adult, male.

Partial right facial hemiplegia, cheek and lip principally—blindness—bilateral exopthalmia—weakness—unsteady gait—tarsi and carpi flexed—physically unable to extend limbs—oedema of extremities—eyes had much retro-bulbar fat surrounding optic nerve. The description of the specimen is augmented by photographs and radiographs.

The alveolar process and ridge is about three times that of normal, presenting a swollen, hypertrophic, maxillary alveolar process. The molars were the only teeth in functional occlusion. There are several visible impactions: two maxillary right premolar impactions, and one left maxillary premolar impaction. The maxillary deciduous canines were retained, while the permanent canines remained impacted. (See X-rays, Plate IX, Fig. 18). The maxillary third molars are seemingly horizontally impacted.

The mandible presents a somewhat similar picture. The permanent canines are impacted, but there are no retained deciduous canines. (Plate IX, Fig. 18a). The left mandibular second premolar is likewise impacted. The third molars are impacted horizontally, under the ascending portion of the coronoid process. (Plate IX, Fig. 18 b, c). Unfortunately, the calvarium and some of the teeth were lost in the preparation of the specimen. However, an examination of the long bones ruled out what appeared at first to be a case of Paget's disease. It would appear that this condition resulted from some complex glandular disturbance.

SUMMARY.

This paper is a report on the oral pathology observed in specimens received from the New York Zoological Park hospital for the year 1938. The specimens were skeletonized, and all observations were made from lesions as seen in the morbid state. This means of studying dental pathology should be invaluable in augmenting the autopsy reports of zoological collections. The pathology found includes dental caries, injuries of the teeth, mal-positioning of the teeth, dento-alveolar abscess, periodontal disease, osteitis and impacted teeth.

The following are the orders represented: Carnivora, Marsupialia, Rodentia, Artiodactyla, Hyracoidea and Primates.

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1930. Abnormal Conditions of the Teeth of Animals in their Relationship to Similar Conditions in Man. Dental Board of the United Kingdom.

## EXPLANATION OF THE PLATES.

### PLATE I.

Fig. 1. Occlusal view of skull and mandible of *Erythrocebus patas.* The left canine shows caries of the previously fractured crown. The right maxillary and left mandibular lateral incisor teeth are missing. The left maxillary premolars and first molar, and the left mandibular first molar, are missing.

Fig. 2. **a.** *Procyon lotor,* showing interproximal caries involving the distal surface of the mandibular left first molar.

**b.** *Marmota monax;* caries of the mandibular left premolar and first and second molars. Buccal to these teeth there is an extensive suppurative sinus.

**c.** Mandible of *Geosciurus capensis* with two teeth remaining. The rest have been lost through periodontal disease.

### PLATE II.

Fig. 3. Skull and mandible of *Procavia capensis,* showing extensive caries of the teeth.

Fig. 4. Mal-positioning of the teeth of *Canis latrans* as a result of an early injury to the left maxillary fourth premolar. Note the shifting of the teeth in both arches, and the misshapen mandible.

### PLATE III.

Fig. 5. Anterior view of the skull of *Canis nubilus.* The crown of the right maxillary central incisor had been fractured, exposing the pulp chamber. Fistulation and apical bone rarefaction followed the pulp infection. The infection likewise destroyed the periodontal tissues. The dark areas on the tooth indicate a resorbtion of the root.

Fig. 6. Lateral view of the left half of the mandible of the same specimen, *Canis nubilus.* The distal cusp of the first molar had been fractured, creating a food impaction area that resulted in deep pocket formation. The extracted tooth is the fractured incisor seen in Fig. 5.

Fig. 7. Abscess formation and fistulation at the apex of the maxillary left canine tooth in *Erythrocebus patas.*

## Plate IV.

Fig. 8. Inferior view of skull of *Axis axis*, showing the extent of alveoloclasia. Abscess formation and fistulation into the sinus resulted in a distension of the posterior wall of the left sinus (arrows).

Fig. 9. Abscess formation and fistulation on the lingual surface of the mandible of *Axis axis*, following infection of the periodontal tissues around the roots of the lower left second and third molars. The degree of alveoloclasia and attrition is well shown.

## Plate V.

Fig. 10. Periodontal disease in *Paradoxurus jerdoni*. The mandible shows a marginal proliferation of bone as a response to a periodontal disturbance of long standing.

Fig. 11. **a**. Extracted incisors of *Axis axis*, showing apical hypercementosis. **b**. Fusion of the distal roots of the maxillary first premolars with the mesial roots of the second premolars, through an increased deposition of cementum. This indicates the loss of the interproximal plates of bone. **c**. Hypercementosis of molar roots.

## Plate VI.

Fig. 12. Inferior view of the skull of *Axis axis*, showing the degree of attrition, alveoloclasia, evidences of suppuration and fistulation into the antrum.

Fig. 13. Left lateral view of the skull of *Axis axis*, showing the degree of attrition and the alveolar bone destruction.

## Plate VII.

Fig. 14. Left lateral view of *Erythrocebus patas*, showing the slight degree of alveolar bone destruction. The arrow indicates fistulation.

Fig. 15. Right lateral view of the same specimen. Compare this with Fig. 14. There is complete alveolar bone destruction, loss of teeth and fistulation into the antrum.

## Plate VIII.

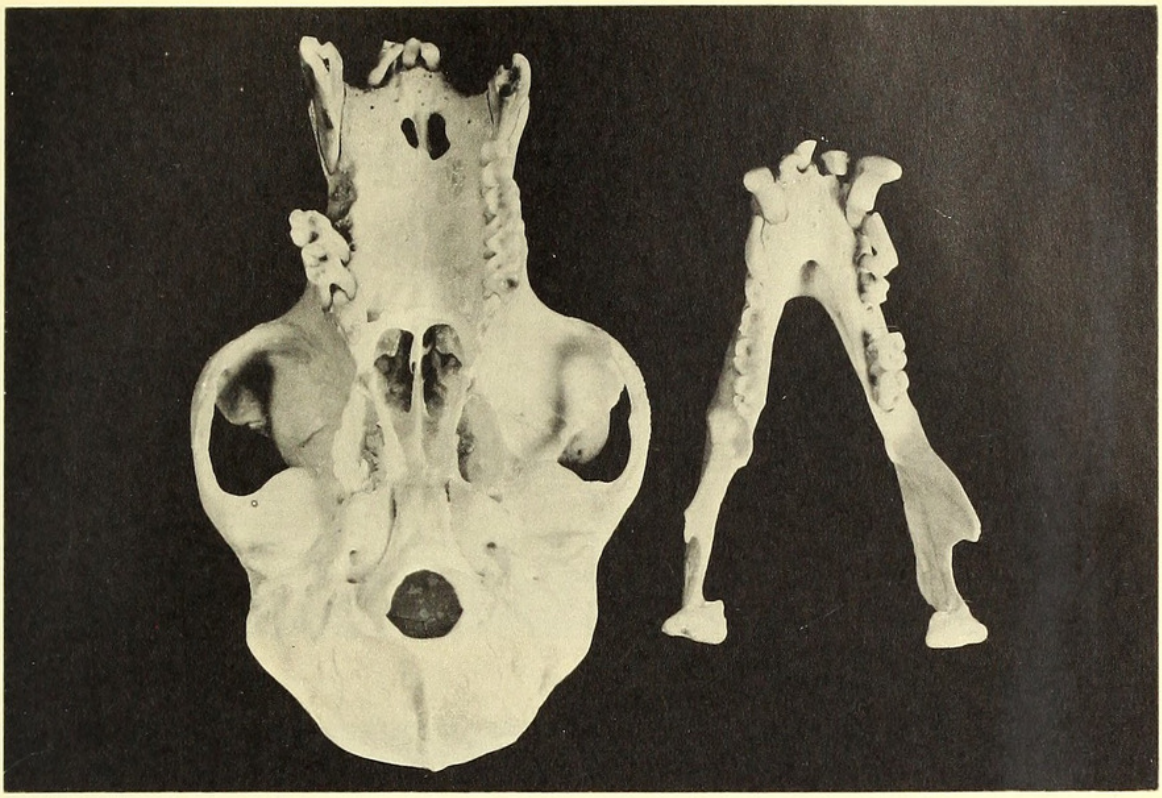
Fig. 16. Left lateral view of *Lagothrix humboldtii*, showing impacted maxillary and mandibular premolars. The only functional occlusion appeared to be between the molars. None of the other teeth exhibit wear facets.

Fig. 17. Occlusal view of *Lagothrix humboldtii*. Note the hypertrophic maxillary and mandibular processes. The missing teeth were lost in the maceration of the specimen.

## Plate IX.

Fig. 18. Radiographs of *Lagothrix humboldtii*.

**a**. X-ray of mandible. Note impacted canines, premolar and molars.
**b**, **c**. Lateral X-rays of mandible, showing impactions.
**d**. X-ray of skull. Note impacted canines, premolars and molars.



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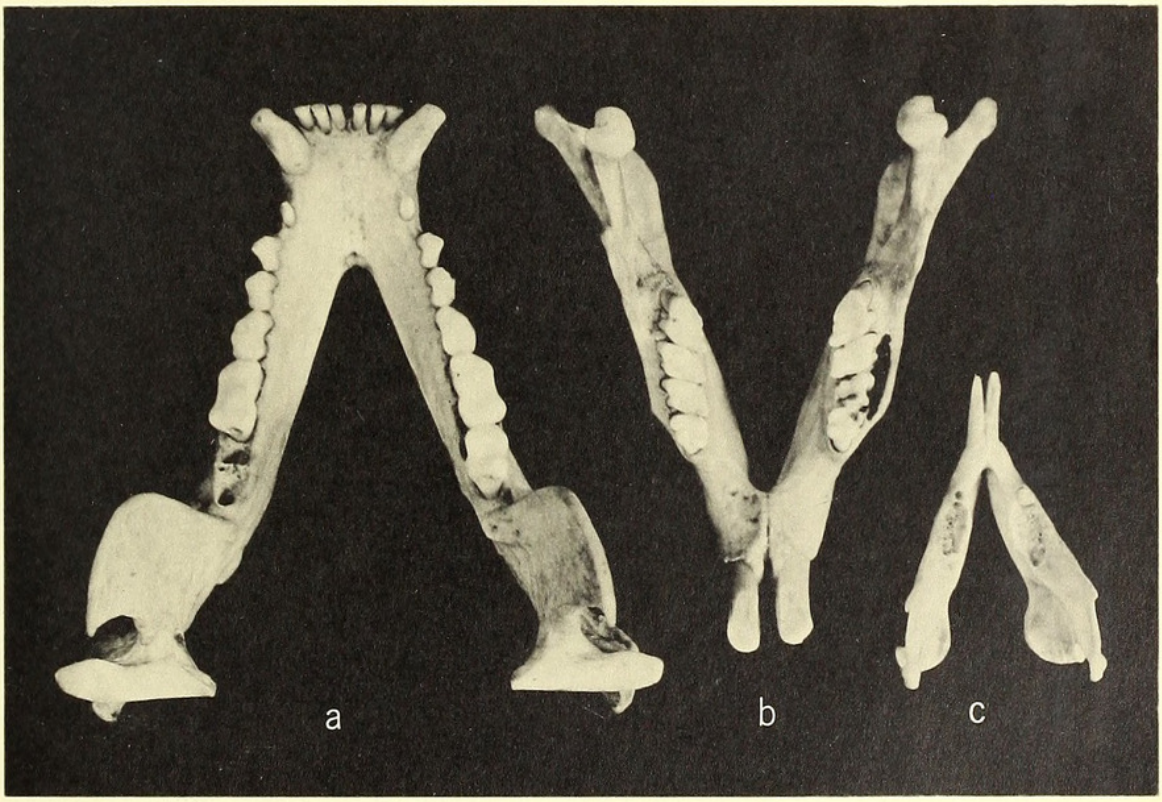
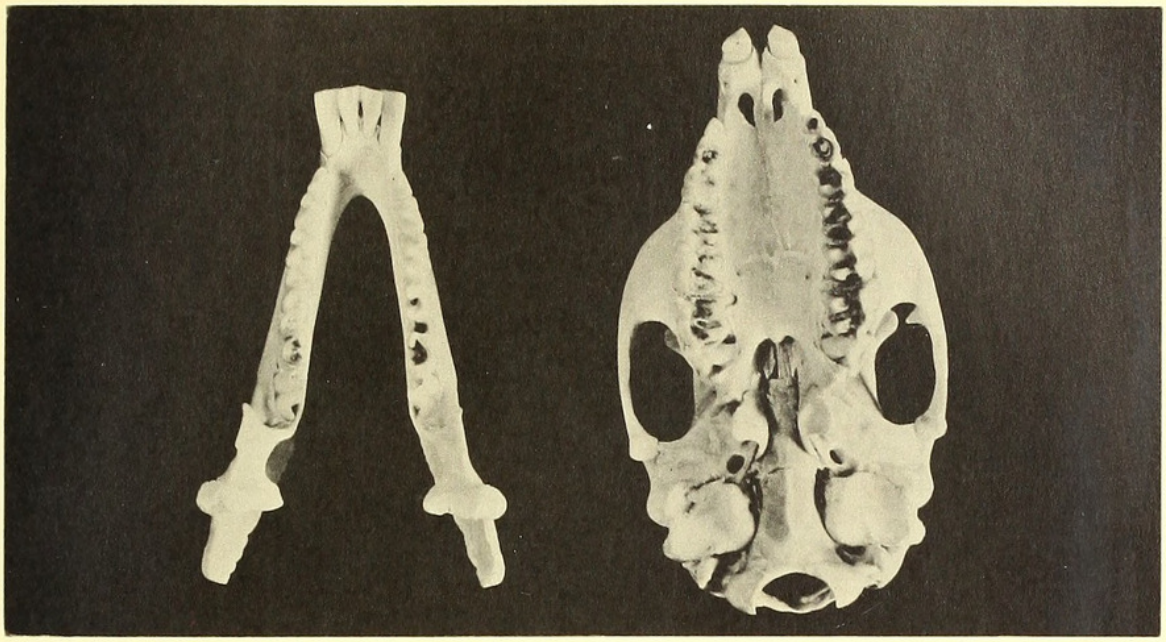



FIG. 2.

A REPORT ON THE DENTAL PATHOLOGY FOUND IN ANIMALS THAT DIED IN THE NEW YORK ZOOLOGICAL PARK IN 1938.



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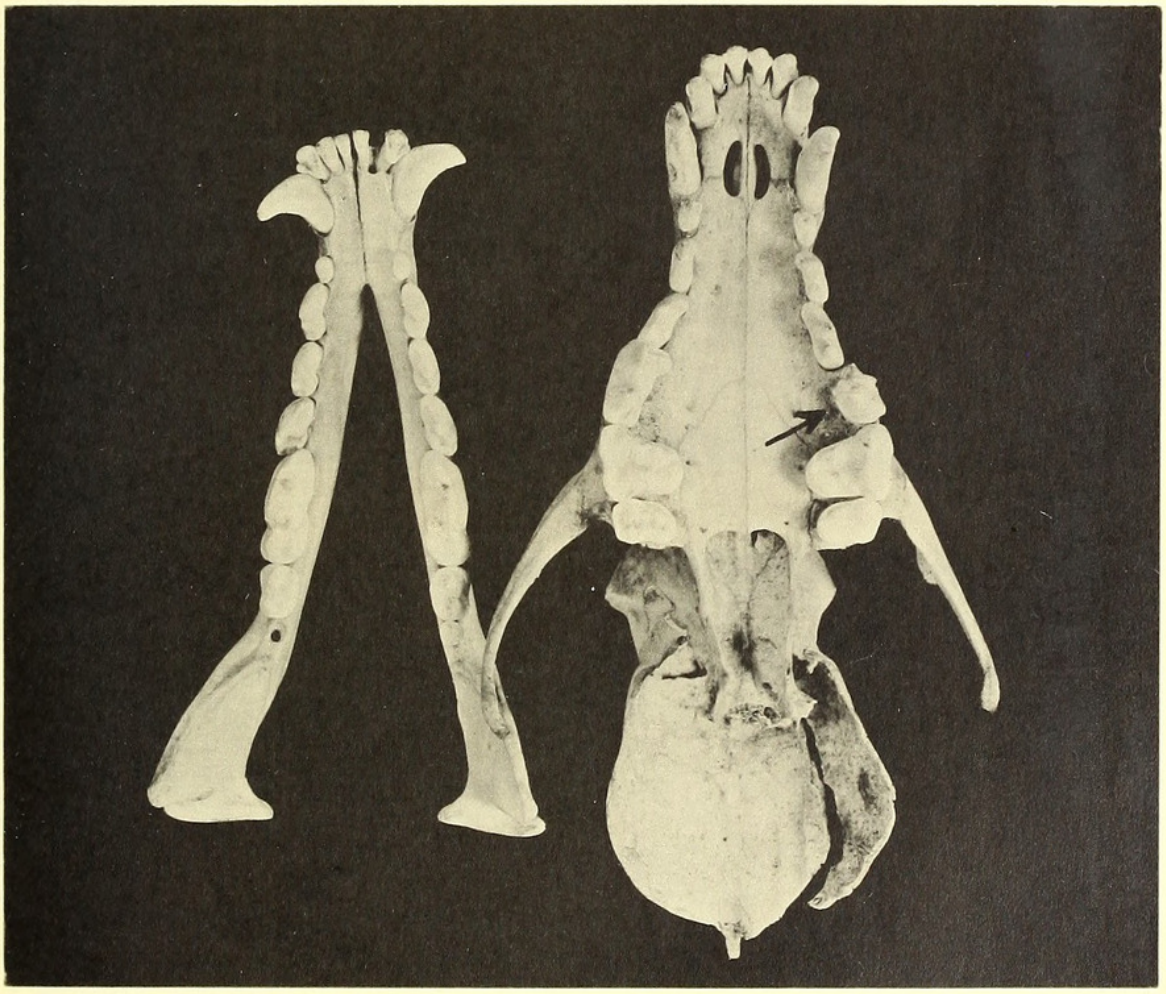

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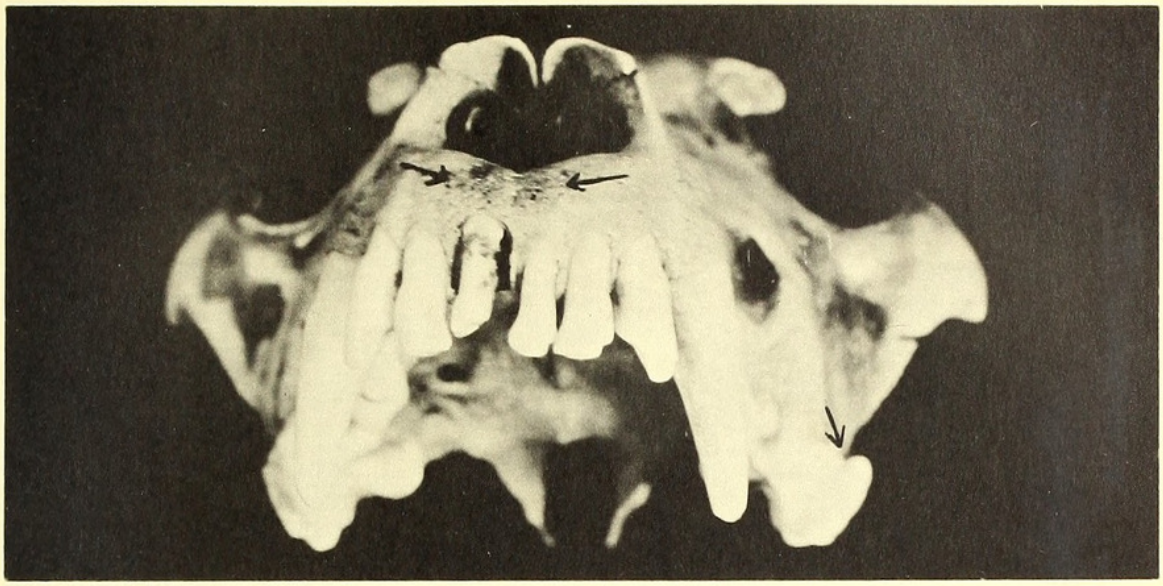

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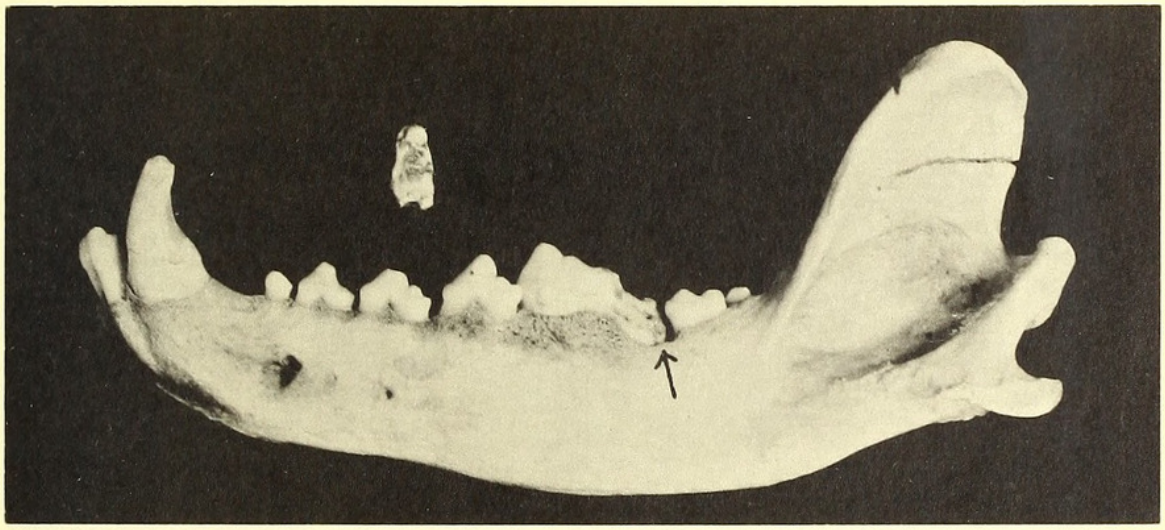

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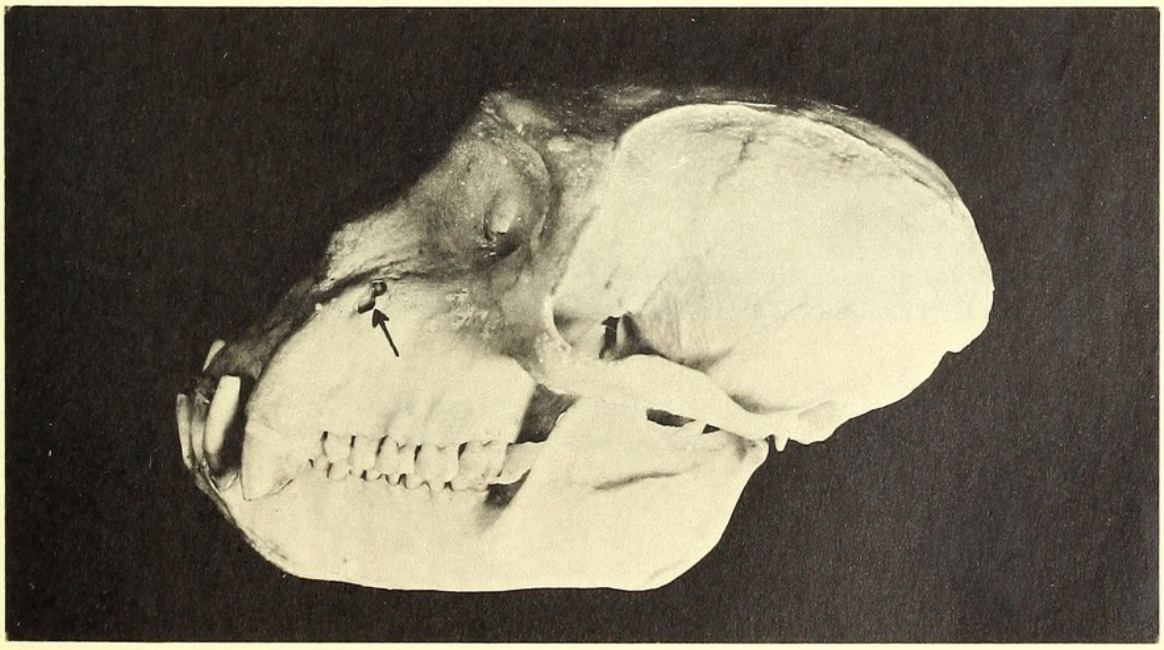

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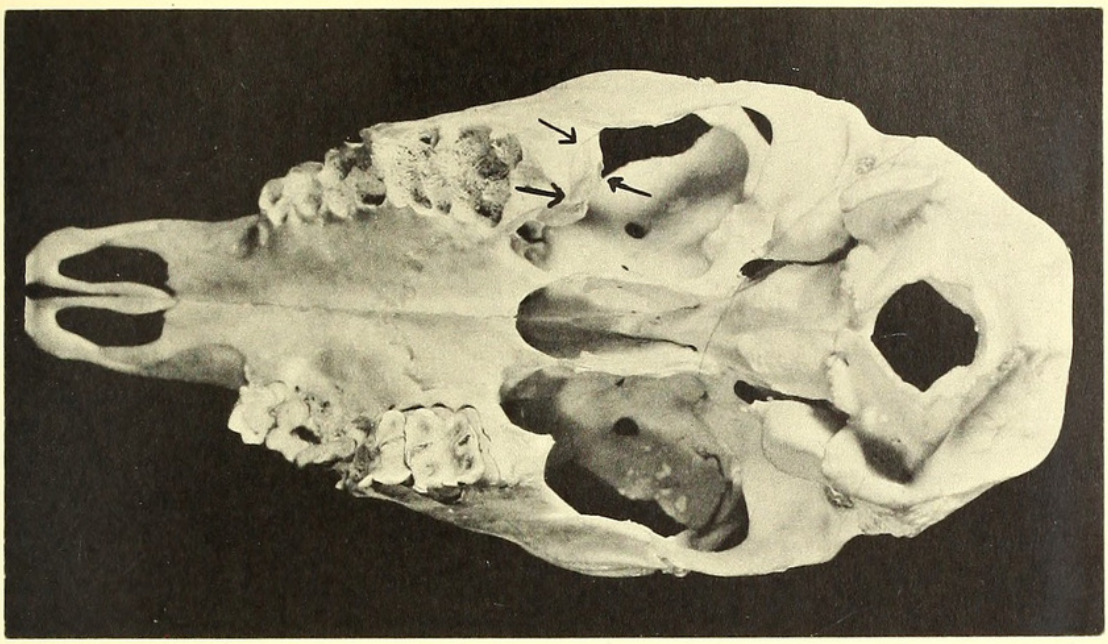

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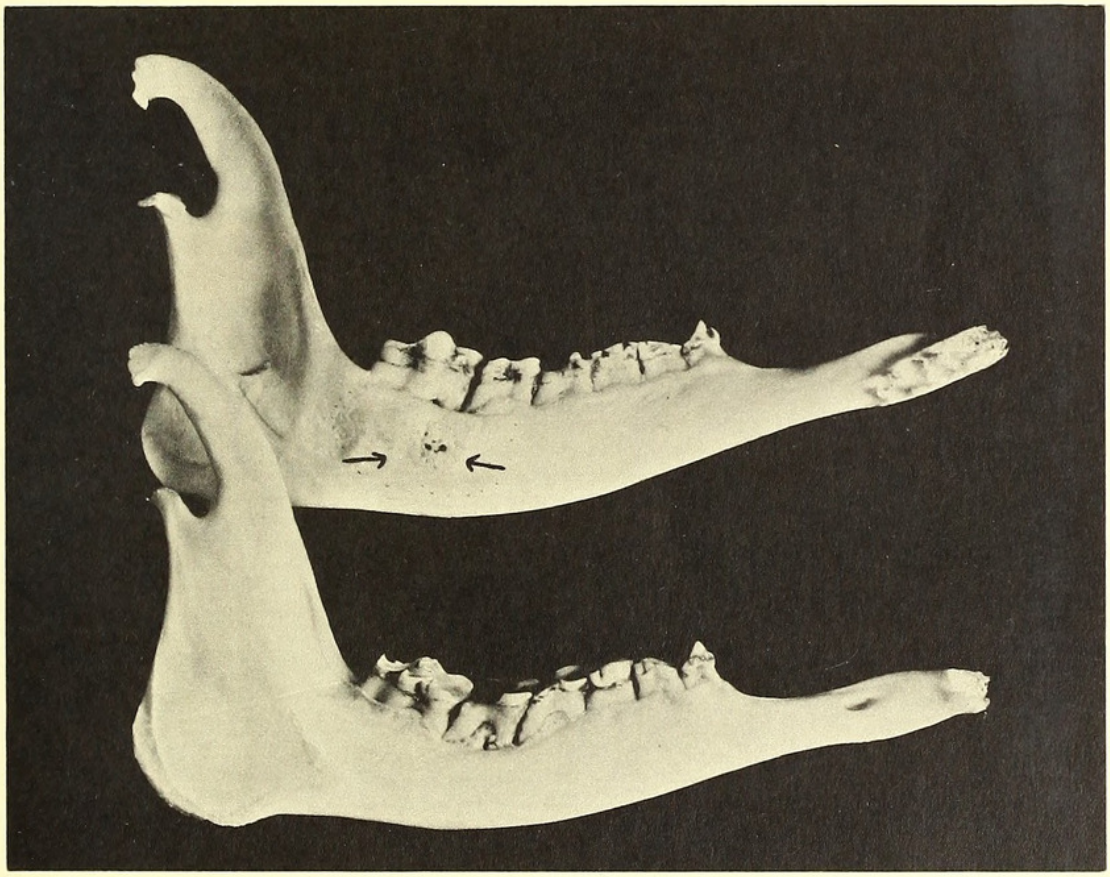

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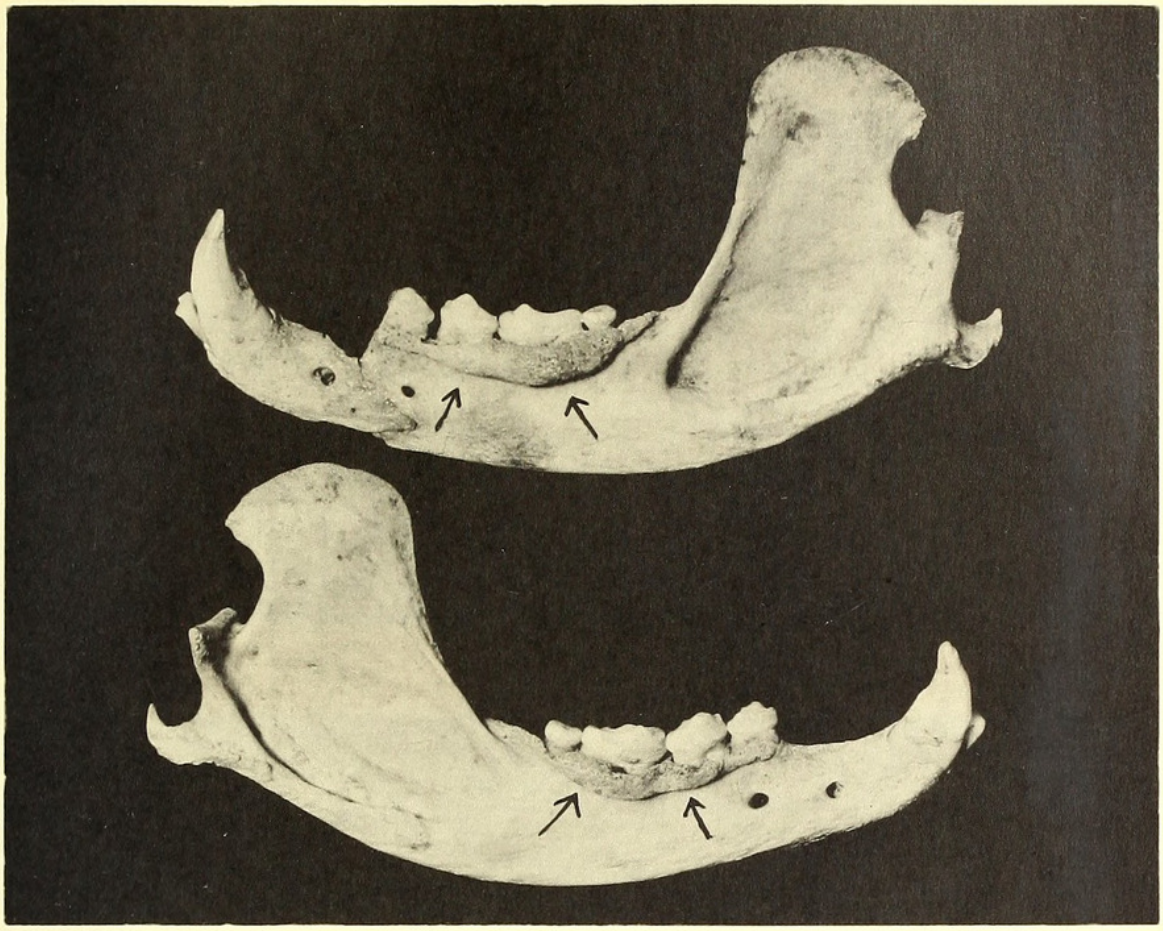

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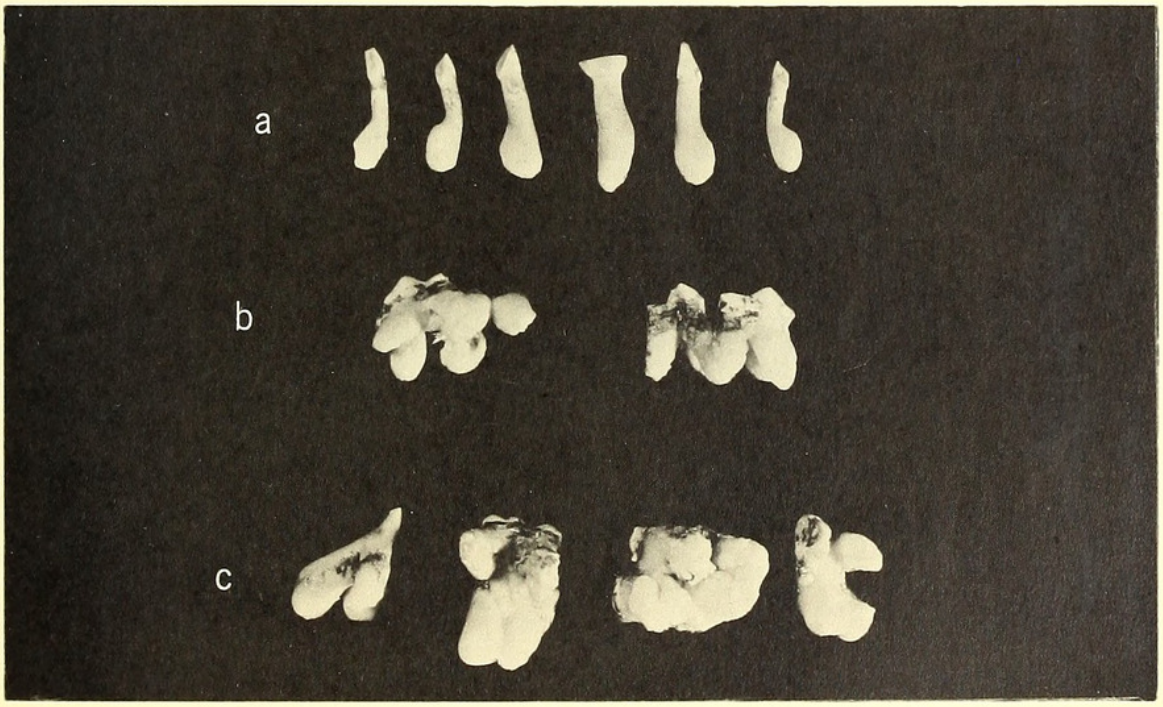


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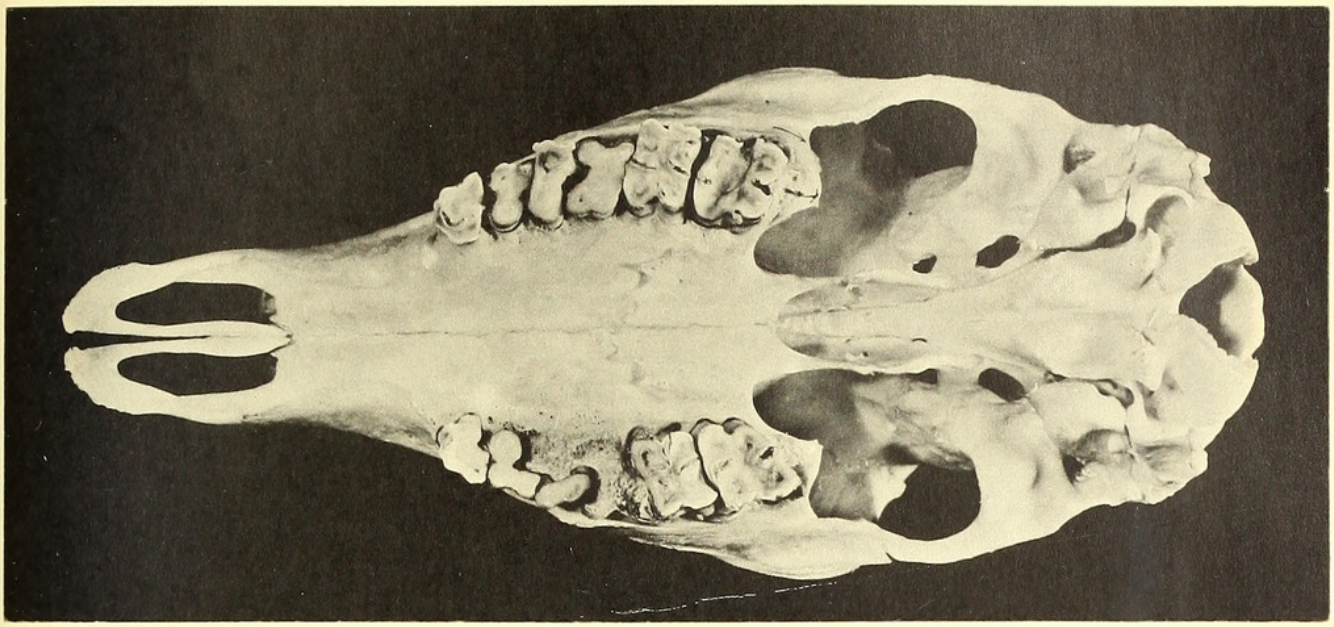

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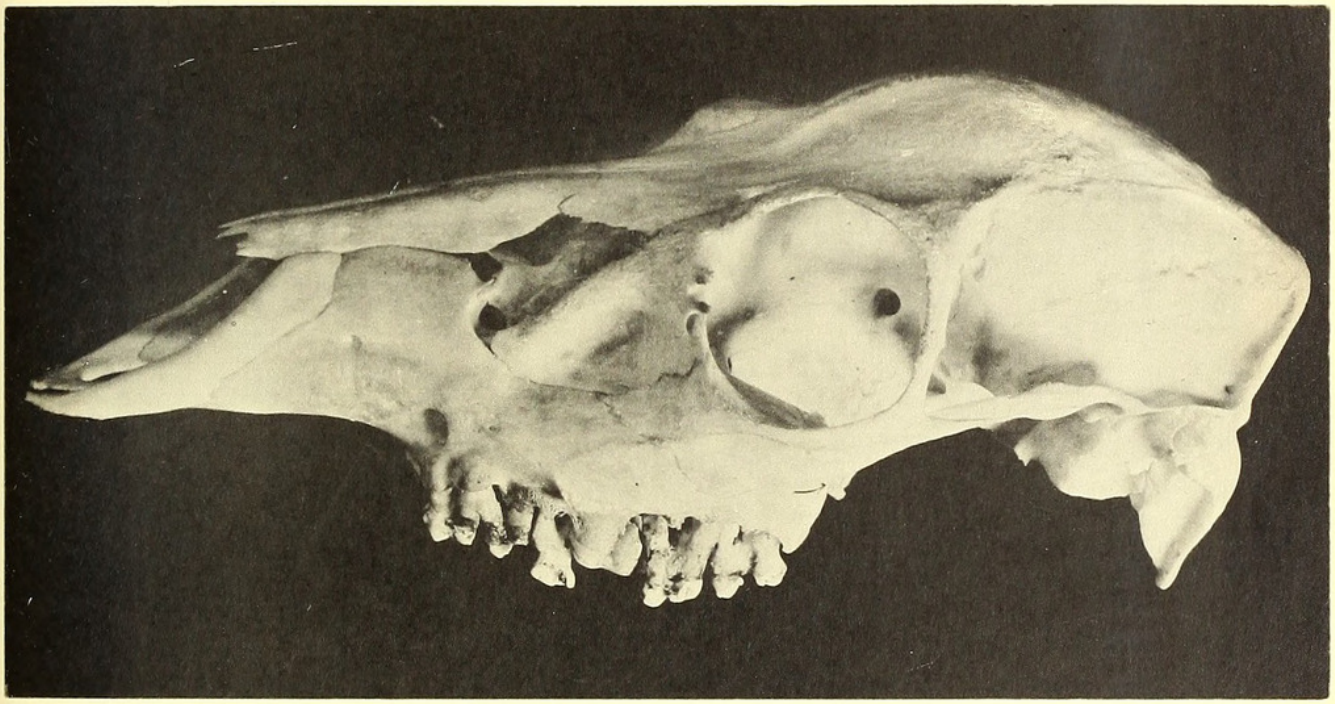

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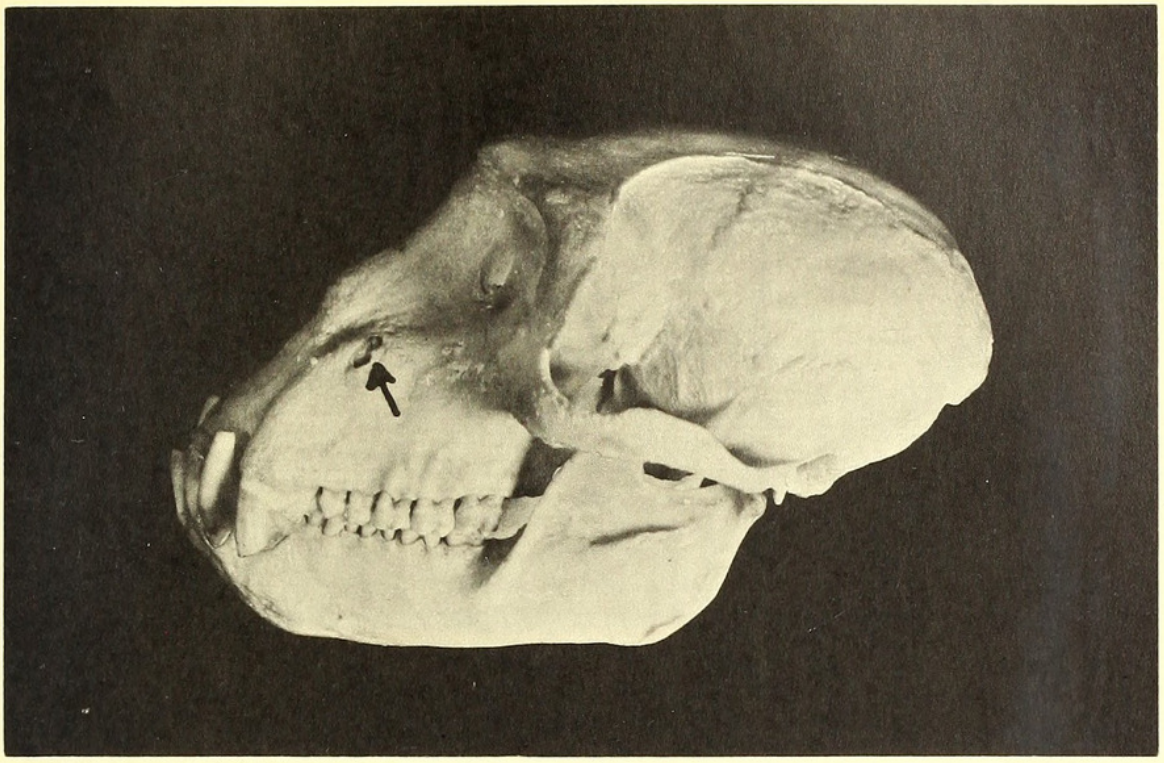

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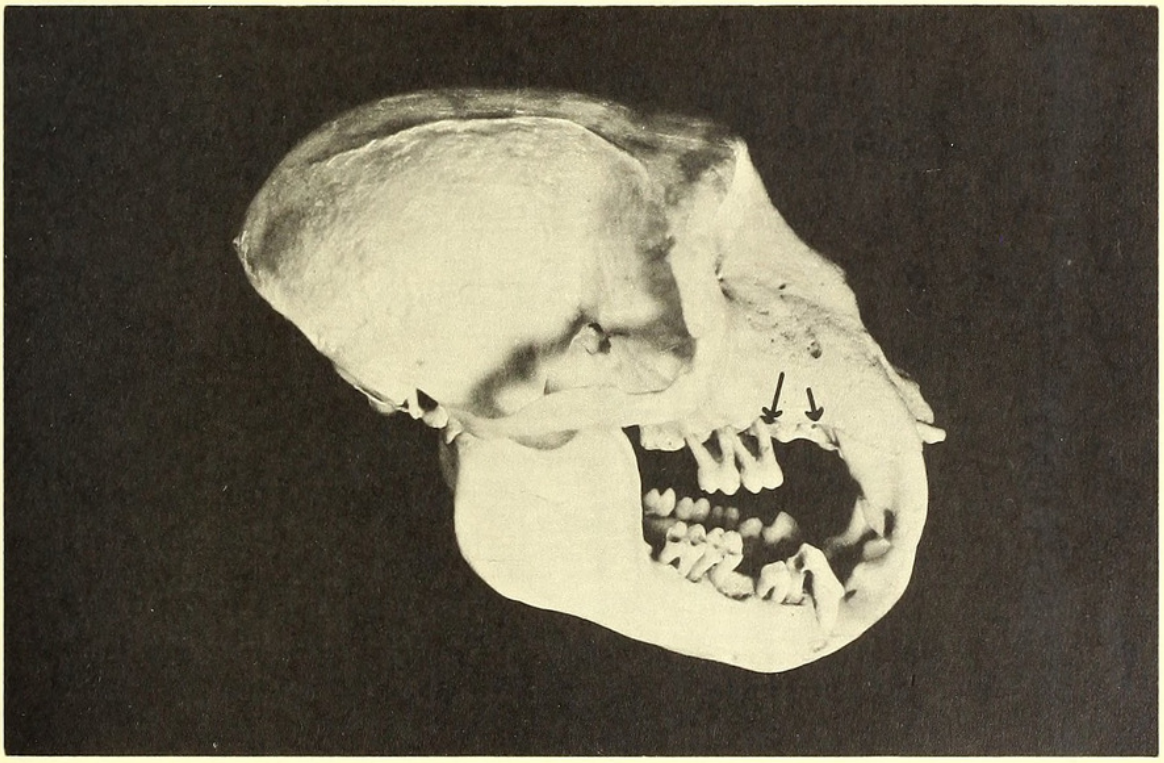

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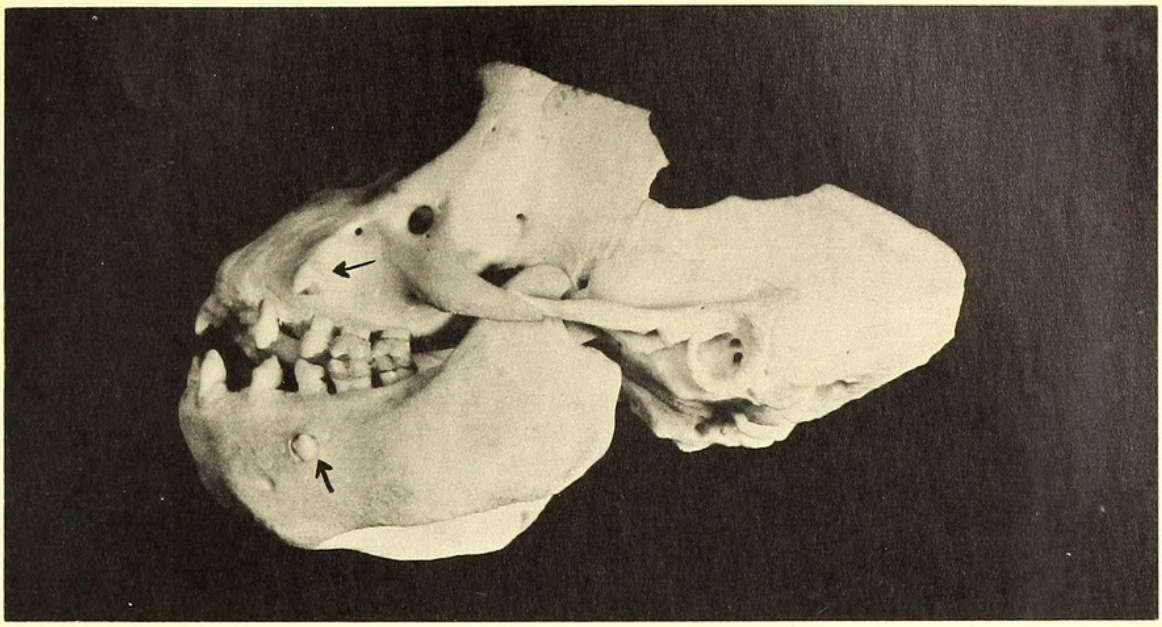


FIG. 16.

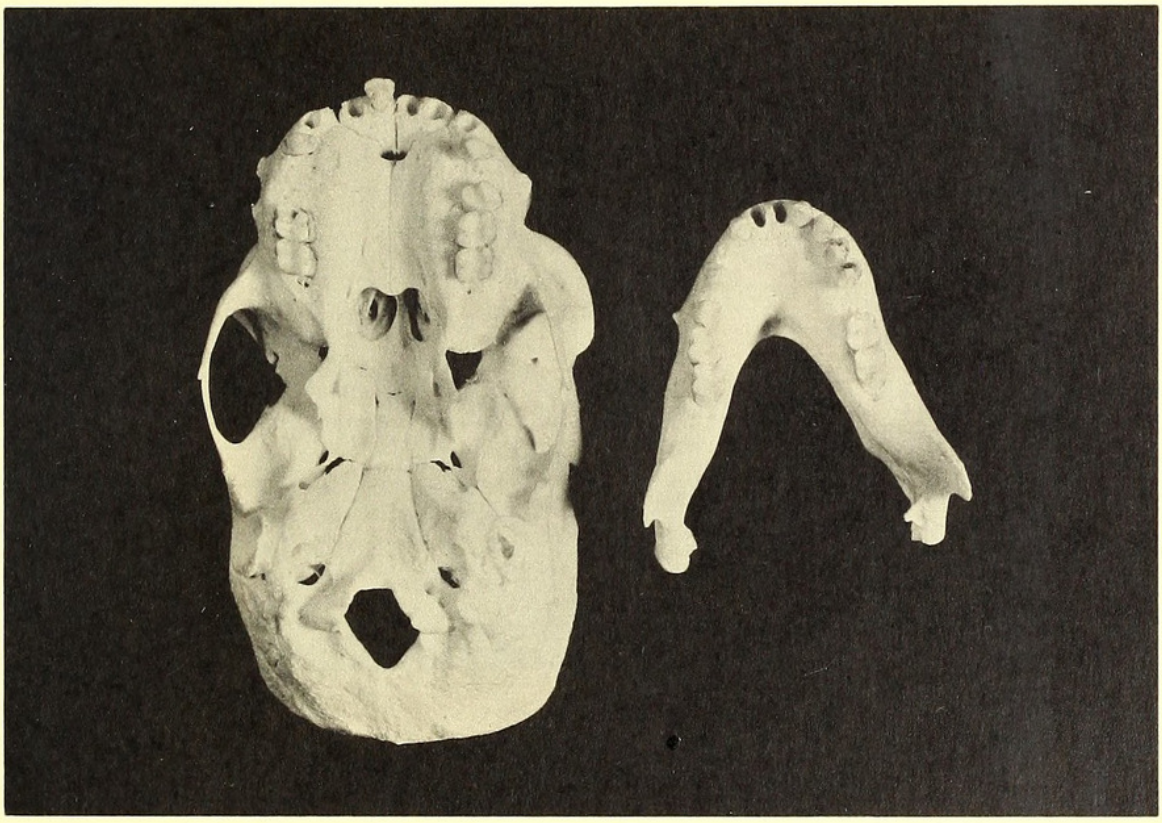
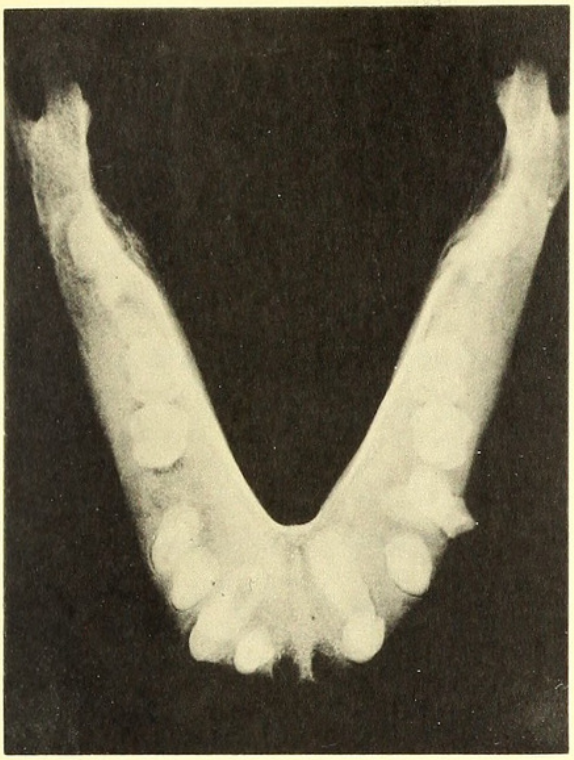
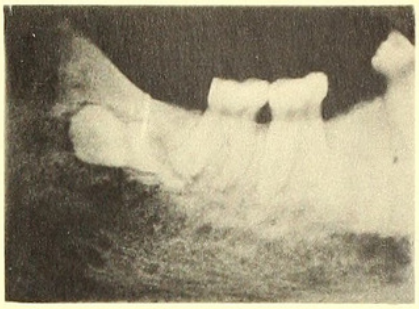


FIG. 17.

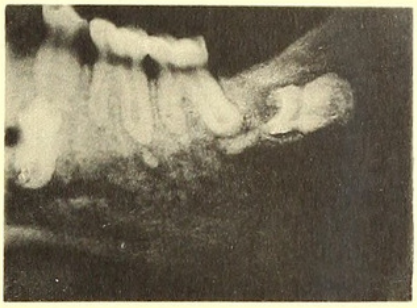
A REPORT ON THE DENTAL PATHOLOGY FOUND IN ANIMALS THAT DIED IN THE NEW YORK ZOOLOGICAL PARK IN 1938.



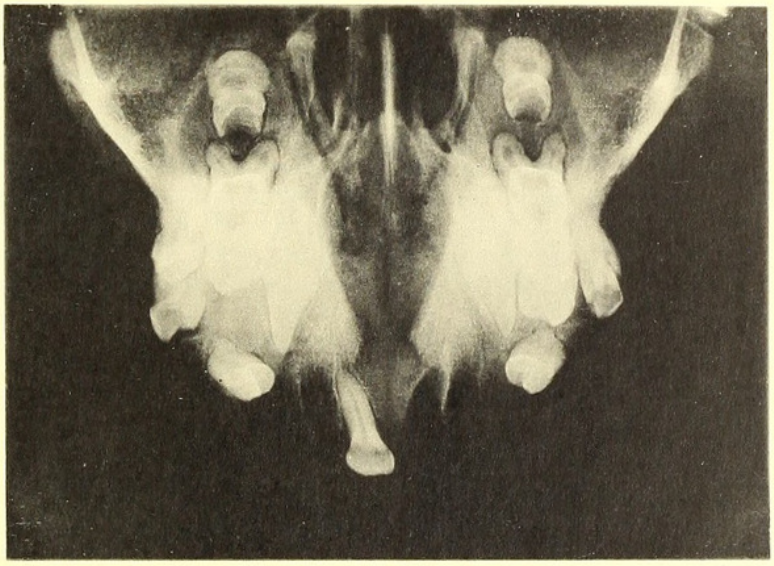
a



b



c



d

FIG. 18.

A REPORT ON THE DENTAL PATHOLOGY FOUND IN ANIMALS THAT DIED IN THE NEW YORK ZOOLOGICAL PARK IN 1938.