Ob man solchen Zwerghund als Vertreter einer besonderen Rasse ansehen will, ist eine offene Frage. Vielleicht ist es so, wie von Haustierforschern mehrfach dargelegt wurde, daß die größeren Fundkomplexe einen gleitenden Übergang von mittelgroßen zu kleineren Hunden zeigen, und daß Zwerghunde sich gegenüber dieser Variation deutlich absetzen (Nobis 1955), daß man aber von einer allgemein verbreiteten Zwergrasse noch nicht sprechen könne.

Andererseits ist es doch wahrscheinlich, daß Hunde von so zierlichem Körperbau und zwergenhafter Größe ihre Eigenschaften bei geeigneter Zuchtwahl vererben. Warum sollte man nicht schon frühzeitig solche Spielerei versucht haben?

Daß man damals diesen Zwerghund als etwas Besonderes angesehen hat, beweist seine Bestattung zusammen mit einem kleinen Kinde.

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The Occurrence of Supernumerary Bones in Skulls of North American Brown Bears, *Ursus arctos* Linnaeus

By Charles A. Long

Eingang des Ms. 15. 11. 1963

I. Introduction

Roofing bones in the skulls of mammals are usually constant in number and similar in pattern or arrangement. In the summer of 1963, supernumerary or extra bones in the skulls of eight brown bears from southwestern Alaska caught my attention while working with Professor E. Raymond Hall, of the University of Kansas, on his investigation of the systematics of the subgenus *Ursus*. Dr. Richard F. Manville and Mr. John L. Paradiso of the U. S. Fish and Wildlife Service loaned me one of these skulls, which I have studied further. The extra bones are described below. It seems worthwhile to determine if these bones appear as mutations, with regular frequency in some populations of bears, and if they are vestigial bones homologous to certain bones in mammal-like or living reptiles. These extra bones in the skulls of bears might be anomalies of development or ontogeny. Each of the possibilities is discussed below.

II. Description of Supernumerary Bones

The supernumerary bones are paired, lying laterad and adjacent to the anterior processes of the frontals (Fig. 1). The maxillaries adjoin the lateral margins of these extra bones, and extensions of the maxillaries isolate the extra bones from the orbits. Each

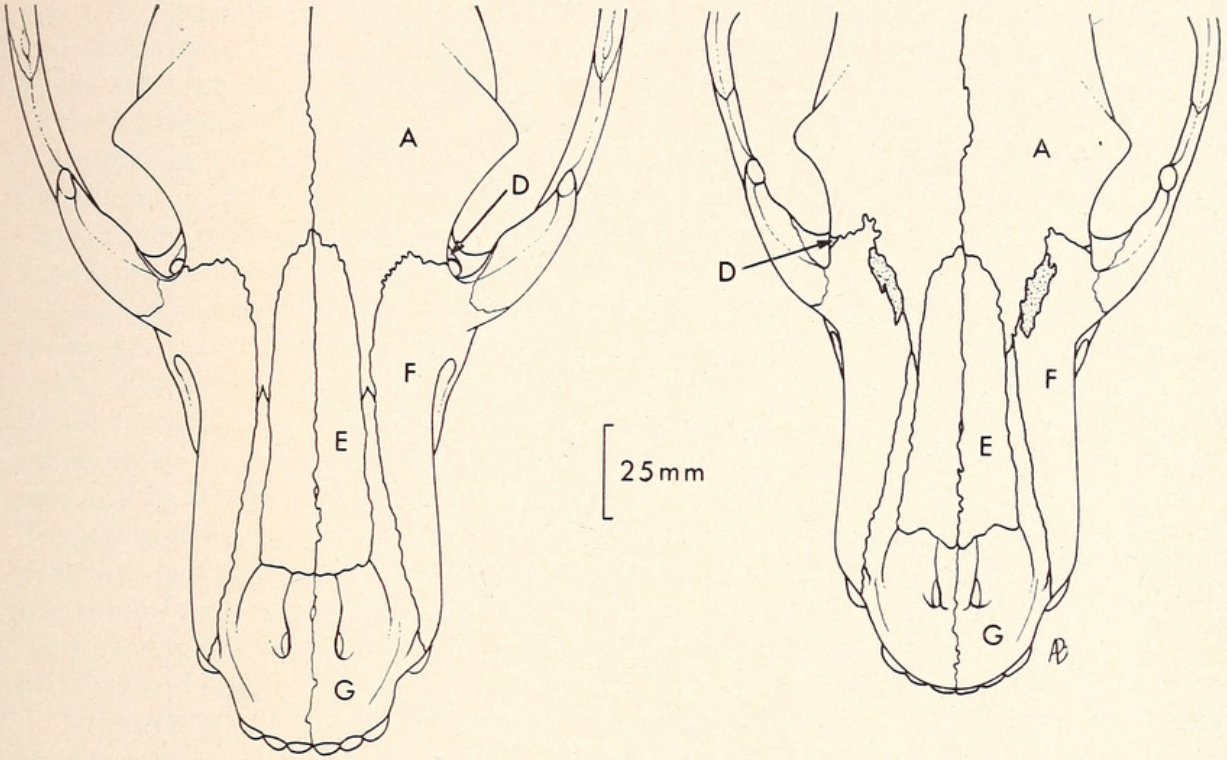

Figure 1. Roofing bones of normal and abnormal bears. Left, normal bear (U.S.N.M. 203526, young-subadult, male) from Snettisham, Alaska. Right, bear (U.S.N.M. 221613) possessing supernumerary bones (see text) from "Anklin" River. Letters refer to bones as follows: A, frontal; D, lacrimal; E, nasal; F, maxillary; G, premaxillary. Stippled bones are supernumerary bones. Figure drawn by ALICE BOATRIGHT.

of the extra bones has one conspicuous perforation or foramen. Some have two conspicuous foramina, one in front of the other. The shapes of the bones vary, but in small bears the shape of each bone is usually ovoid or spindle-shaped, whereas in larger bears it is more irregular. In a young, but large, male (U. S. N. M. 221613) from „Anklin" River some dimensions in millimeters of the extra bones are as follows: Greatest length, 21.0 right, 21.6 left; breadth, 5.9 right, 5.9 left. The bones are separated from one another by a distance of 31.6 mm.; from the nasals (by the anterior frontal processes) by a distance of 5.2 on the right, 5.6 on the left; and from the lacrimals of the orbits by a distance across a process of the maxillary of 12.8 on the right side and 13.0 on the left. The length of the nasal of this bear is 80.5. See Fig. 1.

An annotated list of specimens possessing supernumerary bones includes the following:

Young bear, unknown sex, U. S. N. M. 234064, from "near" Yakutat, Alaska.

Young, large male, U. S. N. M. 221613, from "Anklin" River, Alaska.

Young female, U. S. N. M. 223274, from Italio River, Alaska.

Young bear, unknown sex, U. S. N. M. 233743, from Alsek River "near" the coast. Extra bones well-developed.

Adult-subadult female, U. S. N. M. 228870, and two juvenile males, U. S. N. M. 228871—228872, shot on the same date (August 24, 1918) from the same place (Ground Hog Basin, 8 miles south of Stikine River, Alaska).

Subadult male, U. S. N. M. 227916, from Dry Bay, which place is probably at the mouth of the Alsek River instead of farther south.

The localities of occurence are mapped in Fig. 2. Probably the two male cubs from Ground Hog Basin were offspring of the female from there. If so, extra bones seemingly result from an hereditary mechanism. The right bone of the "mother" shows

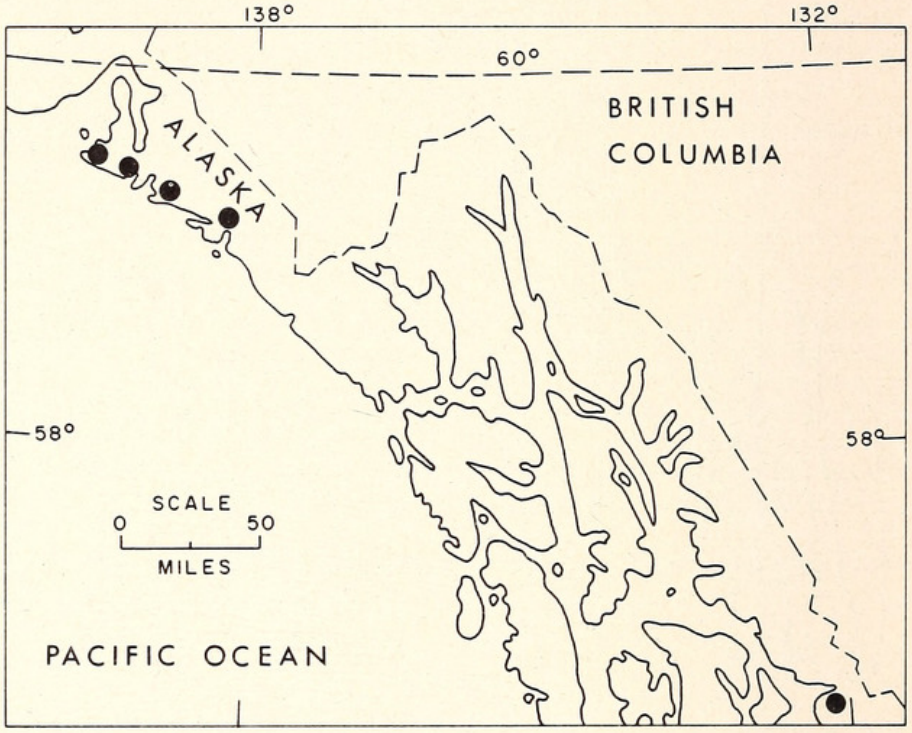

Figure 2. Distribution of bears possessing supernumerary bones. Black circles refer to localities of occurrence, north to south, as follows: "Near" Yakutat; "Anklin" (= Aantlen, Arn Klane, or Ahrn-klin) River; Italio River; Alsek River, "near" coast; Ground Hog Basin near Snettisham, 8 miles south of Stikine River; not plotted, Dry Bay (probably mouth of Alsek River). Figure drawn by ALICE BOATRIGHT.

some marginal fusion. Compared with the extra bones of the bear from "Anklin" River (see above), the bones of the cub (228871) differ in being relatively smaller and in having perforations situated more posteriorly. It must be noted that all of the bears observed possessing extra bones are of juvenile, young, or subadult-adult age; and that probably fusion obscures these bones in many adults from the geographic area of the occurrence of supernumerary bones. This is not surprising, for many cranial sutures become obliterated in old bears (MIDDENDORFF, 1851; RAUSCH 1961:10).

The known geographical extent or area of the occurrence of bears possessing extra bones is confined to coastal, southern Alaska. Bears with extra bones perhaps occur also in nearby British Columbia, Canada. The known area (Fig. 2) extends approximately 350 miles along the coast and is small in comparison with the entire geographic range of *Ursus arctos* (see ERDBRINK, 1953; HALL & KELSON, 1959).

III. Discussion

One possible explanation for the occurence of supernumerary bones in bears is that these bones are anomalies occurring during the rapid development of the frontal region. MERRIAM (1918:10) states that North American brown bears having highly

elevated frontal shields show maximum bulging or arching about the sixth year. Bears do not attain "mature" form until at least seven years.

SCHULTZ (1923:65) states: "In every fontanelle of the mammalian skull accessory bones, varying in size and number, may occasionally be met with. . . Of more common occurrence are small bones in the sutures, called Wormian bones, which are similar in origin to the fontanelle bones. . ." Extra bones known as Wormian bones "frequently" occur in developing human foetuses, appearing in the fontanelles (AREY, 1954:416), and they usually occur when union of frontals and parietals is delayed. Wormian bones are frequently associated also with "hydrocephalus" (AREY, 1954:499). Bregmatic fontanelle-bones show no correlation with age, sex, or place of origin of the specimens in the North American *Lynx* (MANVILLE, 1959:1254), but in porcupines (SCHULTZ, 1923:74) they occur more frequently in females; in humans they are nearly restricted to males. Bregmatic bones vary in number and symmetry, and as many as 13 have been counted in some mammals. Concerning bregmatic bones, SCHULTZ (1923:75) states that it is never justifiable to ascribe any phylogenetic or atavistic significance to them. He states further, "No one would ever attempt such an explanation of the small Wormian bones found in so many sutures. . ." I disagree with this opinion. SCHULTZ states ". . . in a few mammals they seem to be very common, while on the other hand, in a large majority of mammalian skulls their occurrence is exceedingly rare and in many others they have never been found at all." In bears the extra bones discussed herein are paired; the skulls possessing them are well-ossified, and two were nearly of mature size. None of the bears possessing extra bones shows any anomalous condition so poorly adapted as hydrocephalus. These extra bones in bears probably have genetic basis. To regard them as anomalous, of course, infers nothing about their heredity or homology.

SCHULTZ (1923:76) states that the bregmatic bones may be regarded as a "new acquisition in mammals, in which, here and there, the normal skull bones may prove insufficient to close the fontanelle in due time". By means of a mutation supernumerary bones might have appeared in the brown bear. If so, the mutation is interesting because of its spread or flow along the coast of southern Alaska. Such a mutation would also be notable in providing an exception to GREGORY's rule of reduction of number of bones in skulls in the phylogeny of the vertebrates.

GULLIVER (1890) regarded the occurrence of bregmatic bones in mammals as reversion toward ancestral types, but SCHULTZ (1923) doubts this to be the case. The most reasonable explanation to me for the occurrence of paired extra bones in the brown bear would be to regard them as homologous to certain bones characteristic of reptiles and some lower vertebrates. The supernumerary or extra bones in the bear may be actually vestigial organs, but seem rare in Recent bears and unknown in fossil bears. Perhaps these bones are products of vestigial genetic systems that have regained the capability to effect the formation of bones. A cursory review of numerous texts in comparative morphology or anatomy reveals that the prefrontals of reptiles would be suspectable as homologs of the extra bones in bears. Such a review reveals also that the fate of the reptilian prefrontals is usually not mentioned in the discussion of the reptilian or mammalian skull, and occasionally the prefrontals (and postfrontals) are said to be wanting in mammals (for example, ROMER, 1933:242). Absence of the prefrontals in the most primitive Recent mammals is suggestive that they will also be absent in higher mammals, although an example to the contrary is the presence of the lacrimal which is lacking in the primitive *Ornithorhynchus*. The brown bear, compared for example with the opossum *Didelphis,* would seemingly be too specialized to regain or retain reptilian characters lacking in the lower mammals. But are these reptilian characters actually lacking in the lower mammals?

ROMER (1933:243–244) mentions that prevomers occur as occasional "rudiments"

in mammals. WORTMAN (1920:1–52) found "certain supernumerary osseous elements" and other reptilian characters in numerous insectivores, in some marsupials, and in other orders (including Carnivora, genus *Ursus*, see below). His numerous findings should be significant to studies of phylogeny and taxonomy of mammals, but, nevertheless, seem to have been largely overlooked.

In the "insectivore" *Tupaia*, WORTMAN has found bones thought homologous with the prefrontals and postfrontals of reptiles (Fig. 3). In the insectivore *Rynchocyon petersi* (Fig. 4) sutures delimiting prefrontals are present as also are sutures delimiting another small pair of bones, tentatively referred to by him as the septamaxillae, slightly anterior to the lacrimal (which is situated laterad and anteriad to the prefrontal). The bones referred to provisionally as septamaxillae are especially interesting with regard to the extra bones in the bear, for in *Ursus* they are similar in shape and in position. In *Ursus* slender posterior processes of the premaxillae extend to the slender anterior processes of the frontals (see Fig. 1), and the extra bones of *Ursus* occur beside the latter mentioned processes. In *Rynchocyon* the processes of the premaxillae hardly extend posteriorly at all, but the small extra bones do occur adjacent to the anterior parts of the frontals. If the extra bones in the bear are homologous to these bones in *Rynchocyon* the bones of the bear would not be prefrontals. Unless, following another possibility, each prefrontal is divided in two by a process of the lacrimal (in *Rynchocyon)* or of the maxillary (in *Ursus)* and the anterior fraction of the divided bone is considered prefrontal instead of septamaxilla.

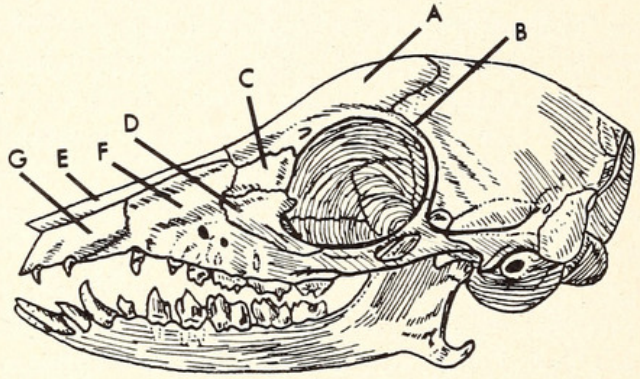

Figure 3. Supernumerary bones in the primate *Tupaia*. Letters identifyng bones are defined in the legend of Figure 1, except B (refers to postfrontal) and C (refers to prefrontal). 1.3 X. After WORTMAN.

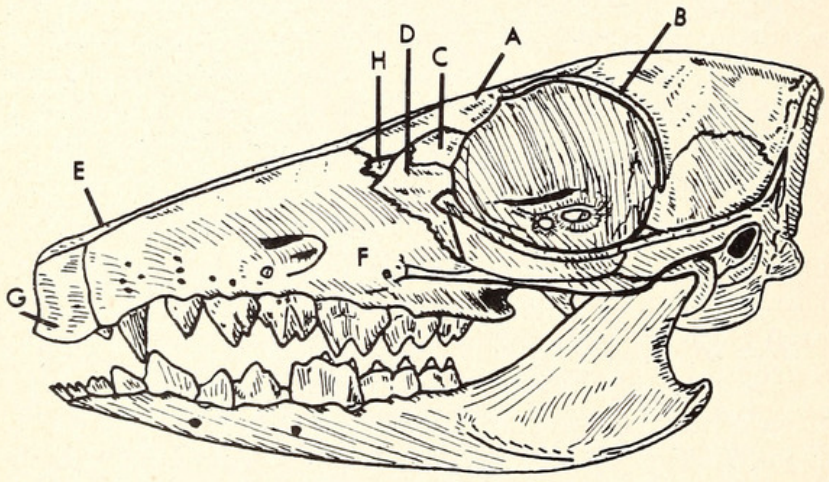

Figure 4. Supernumerary bones in the insectivore *Rynchocyon*. Letters identifying bones are defined in the legend of Figure 1, except B (refers to postfrontal), C (refers to prefrontal), and H (refers to "septomaxilla?"). 1.3 X. After WORTMAN.

It seems likely that the extra bones in the bear are homologous to the small bones in *Rynchocyon* tentatively designated by WORTMAN as septamaxillae. Strange shifts in bone patterns must have preceded any occurrence of the septamaxillae so close to the orbit and isolated so far from the snout, and I doubt if the supernumerary bones in bears are septamaxillae. But if the extra bones of the bear be considered prefrontals, their position isolated from the orbit is also difficult to appreciate.

The presence of a "reptilian" character (or perhaps an insectivoran one) in bears would indicate that in this condition they are primitive. The presence of another bone, common in bears and occurring also in insectivores and marsupials, has been mentioned by WORTMAN (1920:17). He, unfortunately, named this bone the "*paramastoid*" apparently unaware that SCHÄFF (1889:256, 263) previously figured and described this bone and at the same time used the term *paramastoideus* in relation to another bone. I suggest that the small bone connected to the mastoid, and known by WORTMAN as the paramastoid, be known as SCHÄFF's bone or structure. This bone may be a vestigial "reptilian" bone according to WORTMAN.

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I thank Professor E. RAYMOND HALL for encouragement and for suggesting that I note abnormalities in the many bears that we examined in connection with his research in the U.S. National Museum. I am also grateful to Dr. RICHARD F. MANVILLE, Mr. JOHN L. PARADISO, and Dr. DAVID H. JOHNSON, of the U.S. National Museum, for permission to examine specimens in their care, and for assisting me in many ways. Professor DONALD F. HOFFMEISTER, of the University of Illinois, has also assisted me in many ways.

Summary

Supernumerary bones in eight bears are described, and their geographic extent is shown. These bones occur in pairs, exemplifying bilateral symmetry, and are known in subadult-adult or younger bears of both sexes. Bears possessing extra bones are known only from coastal, southern Alaska. Two cubs and a bear thought to be their mother all possessed these extra bones. The extra bones may be anomalies of growth with genetic basis. The bones may result from a relatively recent mutation and may be in the process of spreading throughout a population of bears. Or the extra bones may be vestigial, either actually vestigial (which is doubtful) or products of a vestigial genetic system that has regained the capability of producing "reptilian" bones. The bones are probably homologous to bones seen in the skull of *Rynchocyon*. They may be prefrontals, but only if they have migrated or have been isolated from the orbits. Whether new bones or vestigial bones, they are noteworthy, especially inasmuch as uncommon bones, such as the prevomers, SCHÄFF's bone, the prefrontals, and the postfrontals, have also been described in other mammals. It is incorrect to say that bones in the skulls of mammals are constant in number and arrangement, and statements to the effect that certain bones of the skull are lacking in mammals should be made with reservation.

Zusammenfassung

Bei 8 Braunbären werden überzählige Schädelknochen beschrieben und die Herkunft dieser Bären auf der Karte gezeigt. Diese Knochen sind bilateral symmetrisch und wurden bei subadulten und jüngeren Bären beider Geschlechter gefunden, und zwar nur bei solchen aus der Küstenregion von Süd-Alaska. 2 Jungbären und eine als ihre Mutter angesehene Bärin hatten alle drei diese Extraknochen. Überzählige Schädelknochen können Wachstumsanomalien auf genetischer Basis sein; sie können eine relativ junge Mutation sein, die sich in der betreffenden Bären-Population allmählich ausbreitet. Oder die Extraknochen könnten rudimentär sein, entweder tatsächlich rudimentär (was zweifelhaft ist), oder Produkte eines rudimentären genetischen Systems, das die Fähigkeit, „reptilienartige" Knochen hervorzubringen, wieder aktiviert hat. Die Knochen sind wahrscheinlich homolog zu Knochen, die man am Schädel von *Rhynchocyon* findet. Sie könnten Praefrontalia sein, aber nur wenn sie gewandert oder von den Orbitae isoliert wären. Ob nun neue oder rudimentäre Knochen — bemerkenswert sind sie auf jeden Fall, zum mindesten als ungewöhnliche Knochen, wie z. B. der Praevomer, SCHÄFF's Knochen und die Postfrontalia bei andern Säugetieren auch beschrieben wurden. Es ist nicht korrekt, zu sagen, daß die Knochen des Säugetierschädels nach Zahl und Anordnung konstant seien; und Feststellungen, daß gewisse Schädelknochen bei Säugetieren fehlen, sollten mit Vorbehalt gemacht werden.

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Zur Variabilität des Molaren-Schmelzschlingenmusters der Erdmaus, *Microtus agrestis* (L.)

Von Hans Reichstein und Detlef Reise[1, 2]

Aus dem Institut für Haustierkunde der Christian-Albrechts-Universität Kiel, Direktor: Prof. Dr. W. Herre

Eingang des Ms. 1. 3. 1964

Einleitung

Untersuchungen zur Variabilität morphologischer Strukturen stellen eine der wesentlichen Grundlagen taxonomischer Arbeiten dar. Die genaue Kenntnis aller möglichen Formen individueller Variabilität ist unerläßlich, „whenever the taxonom is forced to make decision as to whether certain specimes represent a different species or individual variant". (Mayr, Linsley, Usinger 1953). Als strukturelle Bildungen von taxonomisch hohem Range gelten die Schmelzschlingen-Muster der Wühlmausbackenzähne. Dem Studium ihrer Variabilität kommt daher besondere Bedeutung zu, und das um so mehr, als sich vielfach allein auf solchen (oder ähnlichen) Gebißbesonderheiten Artkennzeichnungen gründen (Pleistozäne Kleinsäugerforschung). Es ist das Ziel vorliegender Arbeit, zur Klärung eines Problemes beitragen zu helfen, das in jüngster Zeit durch Herre (1962) erneut und mit neuen Akzenten zur Diskussion gestellt wurde, das Problem nämlich des „Verhältnisses von innerartlichen Ausformungen zu zwischenartlichen Umbildungen", das in engster Beziehung zum Evolutionsgeschehen steht. Das Molarengebiß der Mäuse ist seit langem schon Gegenstand stammesgeschichtlicher Forschung. Eine erste zusammenfassende Darstellung zu diesem Themenkreis verdanken wir Hinton (1926). Seitdem haben die Bemühungen um eine Klärung der Microtinenevolution auf der Grundlage des Strukturwandels der Backenzähne zu weiterreichenden Einblicken in den Entwicklungsablauf geführt (Kretzoi, 1963). Ar-

[1] Herrn Prof. Dr. K. Zimmermann mit den besten Wünschen zum 70. Geburtstag zugeeignet.

[2] Mit Unterstützung der Deutschen Forschungsgemeinschaft.