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AN ENDOCRANIAL CAST OF THE BRIDGER MIDDLE EOCENE PRIMATE, SMILODECTES GRACILIS

(With 2 Plates)

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AN ENDOCRANIAL CAST OF THE BRIDGER MIDDLE EOCENE PRIMATE, *SMILODECTES GRACILIS*[1]

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INTRODUCTION

Included among the materials collected during the 1959 field season in the Bridger Basin of southwest Wyoming is the cranial portion of a skull belonging to the small notharctid primate, *Smilodectes gracilis* (Marsh). Disappointment in not finding the remaining rostral portion was short-lived upon realizing that a suitable, undistorted specimen was now available that could be spared for bone destruction in order to reveal a natural cast of the endocranium, sometimes referred to as a "fossil brain."

The specimen was discovered by my wife, Elisabeth, while collecting with Franklin Pearce and me in an area of badlands between Summer's Dry Creek and Little Dry Creek to the north of Cedar Mountain. The locality is in or near section 29, T. 16 N., R. 110 W., and in beds beneath a thin but conspicuous and widespread sugar-white layer well down in Bridger "B." It has received the U. S. National Museum catalog No. 23276.

Identity of the specimen was readily established by comparison with nearly complete skulls of the species in the collections of the U. S. National Museum. Relevant diagnostic features, particularly in the basicranium of these skulls, were discussed by me in 1958 and illustrations of the better material were included in plates 1-3 of that paper. The synonymy for *Smilodectes gracilis* is there listed, and included is the name *Aphanolemur gibbosus* Granger & Gregory.

[1] Study of early Tertiary mammals is currently aided by a grant from the National Science Foundation.

The natural cast was developed through flaking off of pieces of bone by careful use of needle and dental tools. This was made possible by the fineness and induration of the internal matrix which revealed a cleavage at contact with the endocranial surface. While essentially all of the dorsal portion and left side of the cast was exposed in this way, the bone on the right side in the ear region was preserved in place for reference purposes. For the latter use, moreover, it was found possible to reassemble portions of the parietal and supraoccipital material removed. Fortunately, an appreciable part of the left temporal area was removed intact without damage to the cast. The only portion of the cast missing is the anterior segment representing the olfactory lobes, presumably included with the unrecovered rostral portion, so that the cast is complete only to the olfactory roots or peduncles.

Information on endocranial casts of fossil primates from the Tertiary of North America is extremely meager. Cope early (1884, p. 246) reported exposure of the natural cast of the left cerebral hemisphere in the skull of *Tetonius homunculus,* stating that he was leaving further examination of it for a future time. So far as I am aware, however, he made no further study of it, although in the following year (1885) he noted a resemblance in the size of the brain and hemispheres to those of *Tarsius.* In 1959 Le Gros Clark also commented on the *Tarsius*-like appearence of the cast. A partially exposed natural cast of *Notharctus "tyrannus,"* together with certain details of brain cavity in other notharctid specimens, was reported by Gregory (1920). His description of this material, including comparison with *Adapis parisiensis,* is rather brief and only the *Adapis* endocranial cast is figured (after Neumayer). Most recently, at the 1964 annual meeting of the Society of Vertebrate Paleontology, Dr. John A. Wilson reported on the discovery of a remarkably good primate skull from the early Tertiary of Texas, which has exposed part of the dorsal surface of the endocranial cast. Further information on this interesting specimen is anxiously awaited.

The pencil-shaded drawings of the *Smilodectes gracilis* endocranial casts included with this report were prepared by Lawrence B. Isham, scientific illustrator for the Department of Paleobiology of the U. S. National Museum. I am indebted to Dr. Tilly Edinger for suggestions and information on undescribed related materials, and to Dr. Malcolm C. McKenna for having the plaster cap removed from the *Notharctus* endocranial cast.

DESCRIPTION OF THE ENDOCRANIAL CAST

The *Smilodectes* endocranial cast is short and relatively very broad, but no doubt the most striking feature is the remarkable development indicated for the cerebral cortex or neopallium, relatively greater than in any other middle Eocene mammal for which such information is available. Its surface extent, allowing for marked differences in proportions, is nearly comparable to that in the modern lemurs and the lateral extent is entirely comparable, exclusive of folding in such forms as *Lemur*. Except possibly for a very narrow band adjacent to the anterior poles of the mantle, the rhinencephalon would not be visible dorsally. The temporal lobe of the neopallium extended so far ventrally that in lateral view only the tip of the pyriform lobe would be visible. The posterior poles extended well over the mesencephalon, nearly or quite to the cerebellar portion, but as in *Lemur* the vermis and lateral lobes were not overlapped by the cerebrum. The vermis and lateral lobes of the cerebellar portion of the brain were prominently developed, but the cerebellum in general was short and relatively narrow in comparison with the cerebral width.

Cerebral portion.—Concerning ourselves for the most part with such details of the neocortical surface that can be inferred from the cast, it is observed that the position indicated for the rhinal fissure is very low on the side of the specimen. Posteriorly it would apparently correspond with the depression occupied by representation of a vascular sinus that extended forward through the cranio-orbital foramen into the orbital fossa (Gazin, 1958, p. 37), much as seen in endocasts of modern *Lemur*. Somewhat forward the fissura rhinalis would apparently rise above the level of the vascular sinus, extending anteromedially, then outward and dorsally as well as forward. At this point it should be noted that there is little or no evidence of a sylvian or pseudosylvian fissure, so that about even with the vallecula sylvii the rhinal fissure, lacking this flexure, turned decidedly outward and upward toward the dorsal surface, rather than more forward as in modern forms. This abrupt rise is, of course, correlated with the shortness of the forebrain. The anterior margin of the neopallium on the dorsal surface is indistinctly shown on the cast but evidently the frontal lobes extended forward nearly to the narrowly constricted portion of the olfactory peduncles. Posteriorly there is no evidence of a floccular notch in the neopallium and the posterior or occipital lobes extended essentially or nearly to the lateral lobes of the cerebellum. Between the posterior poles on the cast a "V"-shaped interval anterior to the vermis exposes representation of the longitudinal

sinus, which is much less distinct forward along the midline. Posteriorly it terminates in a small, prominent knob, evidently homologous with the torcular Herophili in man, but lodged in the parietal rather than in the occipital portion of the skull. From here the lateral sinuses are not represented on the cast until their emergence is noted near the anterolateral margin of the lateral cerebellar lobes.

The surface of the cerebral portion of the cast, owing to the nature of the matrix, shows remarkably fine though incomplete detail of the network of meningeal blood vessels in the dura mater. The surface of the neopallium, as interpreted from the surface of the cast, which strictly speaking represents only the surface of the dura mater with its vascular detail, was evidently nearly, but not quite, lissencephalic. A very shallow, broadly concave depression extends along both sides of the midline in a slightly arcuate, medially convex, path from about even with the frontoparietal suture to approximately the posterior lobes. At the anterior extremity the depression becomes appreciably deeper where it is joined by another feeble depression extending posterolaterally, approximately paralleling the anterolateral margin of the hemispheres. It is observed moreover that the two sides are not quite symmetrical with respect to these features, as the longitudinal depression is a little better defined but not so elongate on the left. Also, the anterolateral depression is better defined on the left, appearing somewhat discontinuous on the right. Presumably these are representations of incipient sulci forming in the neopallium, possibly in response to stresses set up in the transversely already widely expanded mantle in accordance with Le Gros Clark's (1945a) concept, although this would be disputed in favor of a more intrinsic explanation by Connolly (1950). The absence of transverse depressions would seem in keeping with the small freedom of expansion still remaining at the anterior and posterior poles, in the phylogenetic development.

Speculation as to the possible homologies of these shallow depressions in terms applicable to the sulci of the neopallium is perhaps unwarranted; nevertheless, one is tempted to suggest possible correlations. There seems some likelihood that the anteroposterior depression near the midline is related to the sulcus lateralis or the intraparietal, as this is described as one of the more stable and earlier to appear in the various Mammalia. By itself the more anterolateral depression suggests the coronal or rectus, as it appears along this margin in *Lemur,* but its relation to the presumed sulcus lateralis would appear anomalous since they converge forward rather than

approach the alignment seen in modern lemurs. Perhaps a more plausible suggestion would be that the anterolateral depression paralleling the outer margin represents the suprasylvian sulcus, which in the absence of a sylvian or pseudosylvian fissure might be relatively undeflected. In a possibly comparable situation, but in a more complex setting Tilney (1931, fig. 32) has interpreted a pair of forward converging fissures on a oreodon endocast as the lateral and ectosylvian. Nevertheless, reviewing Edinger's (1948) presentation of the endocranial casts of early horses, something of a parallel is exhibited in Oligocene and somewhat later forms with relatively complex patterns wherein the sulcus cruciatus extended anteromedially from the median part of the suprasylvian, but generally, as in *Mesohippus,* the lateralis falls short of a union with it. Early horses, however, reveal such differently proportioned endocasts, indicating relatively elongate forebrains, that comparison here with a much shortened endocast and in an entirely different mammalian line leaves much to be desired.

Implications as to development or progress in the *Smilodectes* brain that are possibly evident from the cast representation of the neopallium seem in part correlated with osteological structures. For example, the strikingly expanded temporal lobes would among other things suggest significant neocortical location of the acoustic centers. The importance of hearing is, of course, clearly indicated in the tympanic portion of the skull. Moreover, early expansion, for middle Eocene time, of the occipital lobes of the mantle well over the midbrain would seemingly point to increasing relative importance for the cortical area related to vision. The large forward facing orbits, an adaptation to an arboreal habit, testify to the importance of this sense. Other implications of neocortical expansion are, of course, not evident in bone structure, but no doubt dexterity in an arboreal habit is critically involved, although it is understood that correlation is largely a function of the cerebellum.

Cerebellar portion.—The cerebellar portion of the *Smilodectes* endocranial cast, as already noted, is anteroposteriorly short and noticeably narrower than the cerebral portion. The vermis cerebelli extended prominently above the general level or surface of the posterior lobes of the cerebrum, somewhat as in *Lemur* but with relatively a little greater development. No fissura prima is evident although such a structure might be suggested by a slight imperfection across the vermis. This is a trace of the parieto-occipital suture which extends laterally on the cast just anterior to the lateral lobes of the cerebellum. There appears to be a slight offset or fracture of the above along this sutural surface. On a second specimen (U.S.N.M.

No. 17997, pl. 2, fig. 1), however, which has preserved little more than the cerebellar portion of the endocast, there is suggestion of a subdued fissura prima, but this may also correspond to the parieto-occipital suture. The cast shows the paramedian fissure to have been very well developed lateral to the vermis and the cerebellar hemispheres are represented prominently displayed but not nearly as elevated as the vermis. They projected very little above the general level of the cerebral hemispheres and were somewhat elongate transversely but with their long axis slightly oblique as seen from above. There is no indication of a parasaggital fissure but the cast surface of the lobes as well as of the vermis shows traces of the vascular network of the dura mater.

Petrosal fossa.—Immediately anteroventral to the cerebellar hemisphere, on the surface of the cast formed by the dorsomedial surface of the petrosal, is indicated the root portion of the flocculus of the cerebellum which occupied a deep floccular or subarcuate fossa in the petrosal. Of about the same size, directly below and medial to the indicated flocculus and on the same surface of the petrosal fossa of the cast is the impression of the aperture of the internal auditory meatus. Immediately behind the position of the flocculus and very close to the posterior bulge representing the lateral sinus can be seen a small, flattened projection which corresponds to the slitlike aperture of the aquaeductus vestibuli. Similarly placed with respect to the pedestal representing the internal auditory meatus but somewhat closer to the latter is a moderately large aperture filling which represents the foramen lacerum posterius. Moreover, further preparation of the corresponding bone surface reveals the presence of the aquaeductus cochleae confluent with the cranial aperture of the foramen lacerum posterius. Just posterior and slightly medial to the position of the foramen lacerum posterius the small pyramidal form with its apex directed somewhat forward is the filling of the condylar or hypoglossal foramen.

The surface of the cast formed by the anterior facing surface of the petrosal, which limited posteriorly the lateral portion of the cerebral hemisphere, is very nearly at a 90° angle from the ventrolateral surface formed by the petrosal. The principal structure evident on this surface is the bulge at the ventral margin representing the internal aperture of the foramen ovale which, incidentally, deeply notches the petrosal. Also distinctive is the posterior termination, at the ventrolateral margin of the surface, of the ridge representing the vascular sinus that appears to follow the rhinal fissure. Directly

above the position of the foramen ovale and nearer the acute angle between the faces of the petrosal fossa is a small flattened prominence which is the filling of the hiatus Fallopii through which the superficial petrosal nerve entered the petrosal.

Evidence may be seen on the cast of a part of the vascular system which essentially surrounded the petrosal. Anterolateral to the cerebellar hemisphere the lateral sinus, at the position of emergence represented on the cast, divided and the lateral sinus proper turned posteriorward where it is represented on the cast by a prominent shelf-like ridge extending along the outer margin of the lateral lobes. It then turned downward to the foramen lacerum posterius. The other branch entered directly a foramen, evidently on the suture between the petrosal and parietal, possibly involving the squamosal, the aqueduct of Verga as used by Saban (1963), that extends slightly forward and outward as well as downward, paralleling the lateral margin of the petrosal fossa. Partway down its course, apparently in the petro-squamosal suture, this duct is joined by an adjacent tube that extends ventrally from the parietosquamosal foramen, permitting vascular communication with the temporal fossa. Just above the outlet of this system through the postglenoid foramen, the canal is joined forward from within the cranial cavity by the vascular representation seen on the side of the pyriform lobe of the cast at about the rhinal fissure. The latter vascular sinus, as has been noted, communicated forward through the cranio-orbital foramen with the orbital fossa and is believed to have included the stapedial artery as well as veins.

A conspicuous ridge on the cast extending anteromedially from the position of the foramen lacerum posterius is seen from the bone to occupy a canal along the suture between the basioccipital and petrosal to near the fossa for the hypophysis. This is no doubt the inferior petrosal sinus. A very short distance anteromedially along this ridge of the cast is an indistinct rise which represents an aperture much better observed on the bone. It corresponds to the forward opening of a canal following the suture between the basioccipital and petrosal or bulla (in part). It opens posteriorly adjacent and medial to the foramen lacerum posterius, and anterior or anteromedially adjacent to the condylar foramen (see Gazin, 1958, pl. 3, fig. 2). This is almost surely the foramen "Fx" in Hürzeler's figures of *Necrolemur* (1948, figs. 27 and 28). I suspect that it served to unite a part of the venus system at the inferior petrosal sinus to the sinus of the vertebral column through the condylar foramen and foramen magnum. It corresponds to the larger and more importantly developed canal in

Lemur which extends from the inferior petrosal sinus to its posterior opening adjacent and essentially confluent with the condylar foramen. Except for relative proportions, the cranial circulation noted in the vicinity of the petrosal was essentially like that in modern lemurs.

Ventral surface.—The shortness of the rhinencephalon and wide spacing of the prominent, ovate pyriform lobes is particularly evident in the ventral view of the cast. The rhinencephalon tapered sharply forward toward the roots of the olfactory lobes that are missing on the cast. It is of interest to note that the diameter of the posterior or basal portion of the olfactory roots, partially represented on the cast, appears relatively unreduced in comparison with many later primates, suggesting retention of the importantly developed sense of smell. A transversely elongate ridge, slightly concave forward and truncated at each end represents the optic chiasma with its pedicles for the optic nerves at the rather widely separated lateral extremities. Its position is near the olfactory roots and about in line with the anterior margins of the pyriform lobes. Widely spaced crests including representation of nerves III to VI (except V_3) bound medially the form of the anterior part of the pyriform lobes. These originate just anteromedial to the pedestal representing the foramen ovale and extend forward nearly to the position of the optic nerve, although the crest on the left side of the cast is broken partway back. Separation between the contents of the sphenoidal fissure and foramen rotundum (V_2) is not evident in the cast, although these foramina are distinct, opening close together and close to the optic foramen in the orbital fossa of the skull.

In almost the exact center of the ventral surface of the cast representation of the hypophysis or pituitary body, with its midpoint about 7½ mm. posterior to the anterior margin of the optic chiasma, is seen as a small, ventrally protruding, nearly hemispherical structure. Its posterior margin superiorly is rather sharply deflected and appears slightly "undercut" by bony projections, the posterior clinoid processes of the basisphenoid. Posterior to this there is slight damage to the cast but the superior surface of the basioccipital and basisphenoid posterior to the clinoid plate and between the inferior petrosal sinuses shows no important deviation from a relatively even surface. There is no indication of the pons as a distinct structure other than a gentle longitudinal convexity not separately defined or distinguished from the inferior surface for the medulla oblongata. A small projection on the cast, however, is observed immediately posterolateral to the position of the hypophysis and about at the anterior extremity of

the ridge representing the inferior petrosal sinus. This is believed to represent a part of the internal carotid artery as it entered the cranial cavity. It occurs nearly at the anterior extremity of the petrosal and is formed by the aperture of a canal that when traced within the bone seems almost certainly continuous with the canal for the arteria promontorii. This branch of the internal carotid was evidently a little larger than in *Lemur* and emerged relatively farther forward, better separated from the hiatus Fallopii.

Measurements of the Smilodectes endocast.—The total length of the preserved portion of the endocast (U.S.N.M. No. 23276) is 36 mm. The combined length of the cerebral and cerebellar portions from the anterior margin of the neopallium, so far as can be determined, to the posterior surface of the vermis as represented is about 32.5 mm. The length of the neopallium alone would be about 24 mm. The width of the cast across the temporal lobes of the neopallium, excluding the marginal vascular sinus, is about 29.7 mm., whereas the width of the cerebellar portion excluding the lateral sinus is about 20 mm. The width across the olfactory roots is estimated to be 9 mm. The transverse diameter of the cast representation of the medulla oblongata at the foramen magnum is about 10 mm. It is estimated, from other material of this species that the length of the skull to which this cast belonged was about 68 to 70 mm. from the anterior margin of the premaxillae to the posterior margin of the occipital condyles.

COMPARISON OF *SMILODECTES* WITH *NOTHARCTUS* AND *ADAPIS* ENDOCRANIAL CASTS

Notharctus.—The most closely related form with which comparison of the endocranial casts might be made is, of course, *Notharctus,* but known comparable material of the latter is rather inadequate. In the principal specimen that Gregory (1920) cited, *Notharctus "tyrannus"* (=*N. tenebrosus*), American Museum No. 11478, the endocast is rather poorly delineated. The top of the cast is exposed from near the anterior margin for the frontal lobes to about the top of the vermis posteriorly, and something of the general proportions can be ascertained. The texture of the cast, however, is rather coarse grained so that essentially no detail is evident although as Gregory noted there are "vague indications of the sulcus intraparietalis." There seems, moreover, suggestion of a feeble sulcus (suprasylvian?) parallel to the anterolateral margin, but only on the right side. There is no evidence for a pseudosylvian sulcus, but the lateral margins of the

cast are concealed by the squamosal or are damaged so that its outline can only be approximated; nevertheless, its form was evidently very close to that of *Smilodectes*. Its length seems very nearly the same but its width may be a little less, although there is some distortion evident in the *Notharctus* cast. It cannot, however, be regarded as narrow (see Gregory, 1920, p. 168) in comparison with *Lemur*. The extent of the neopallium was presumably much like that in *Smilodectes*. Representation of the anterior part of the vermis cerebelli is in view and was noted by Gregory to be exposed as in *Lemur*. It is essentially like that in *Smilodectes*. While no mention is made by Gregory of the cerebellar hemispheres, representation of that on the right is faintly discernible, although the one on the left is completely concealed.

The exposed portion of the *Notharctus tenebrosus* endocast is about 30 mm. long by 25 mm. wide. It is estimated, however, that the total length over the cerebral and cerebellar lobes may have been between 32.5 and 35 mm., and the width over the temporal lobes between 27.5 and 30 mm.

Comparison of the *Smilodectes* endocranial cast with endocranial detail reported by Gregory for the fragmentary skull of *Notharctus venticolus* (A.M. No. 14656) could not be made inasmuch as this Wasatchian skull has since been restored for exhibition. The *"N. matthew"* specimen (A.M. No. 13030) cited by Gregory includes a petrosal which contributed to his study. This, however, represents *Smilodectes* and closely resembles the petrosal belonging to U.S. National Museum No. 23276.

Adapis.—A comparison of the *Smilodectes* endocast with that described for later Eocene *Adapis parisiensis* was greatly facilitated by Neumayer's excellent appearing figures (1906, pl. 5), reproduced in Gregory's monograph on *Notharctus* (1920, fig. 63), and by the photograph provided by Hofer (1962). From these it is seen that the details of the short and relatively very broad cranial cavity of *Smilodectes* are very unlike those of the *Adapis* specimen, further emphasizing the distinctness of the Notharctidae. However, this is not in agreement with Gregory's unaccountable statement that the endocast of *Notharctus* "is obviously of the same general type, save that in *Adapis* the temporal lobes are more expanded transversely . . ." The cerebral hemispheres of *Smilodectes,* as well as being relatively shorter and broader than in *Adapis,* show evidence of incipient sulci presumed to be lateral and suprasylvian. These are not indicated in Neumayer's figures for *Adapis,* but of more significance, the anterior

and posterior fissura of *Adapis,* which Edinger (1929) has interpreted as the ff. praecentralis inferior and sylvian, were not developed in *Smilodectes.* These greatly affect the outline and form of the *Adapis* endocast. It should be noted, nevertheless, that a small notch far forward on the anterolateral margin of the *Smilodectes* endocast may be in the position of the praecentralis inferior but more probably corresponds to the rhinal fissure.

A particularly striking detail apparent in Neumayer's ventral view of the *Adapis* endocast is the markedly obtuse angle between the faces of the petrosal fossa, with the posterior surface of the temporal lobes facing decidedly outward. In *Smilodectes* this surface is nearly perpendicular to the median vertical plane of the skull. Also noticeable in this view and perhaps better demonstrated in Hofer's photograph (1962, fig. 2c), is the relatively much longer rhinencephalon anterior to the pyriform lobes and much greater separation between the optic chiasma and hypophysis in *Adapis.* Moreover, the pedestals representing the apertures of the floccular fossa and internal auditory meatus are relatively larger in proportion to the size of the cast than in *Smilodectes gracilis* whose brain size is seen to be actually larger than in *Adapis parisiensis,* as determined by the scale of Neumayer's illustrations.

Illustrations by Le Gros Clark (1934, fig. 48; 1945b, fig. 1; and 1959, fig. 121) of an endocranial cast in the British Museum, evidently of a different individual than that figured by Neumayer, show some detail possibly not evident in the other cast. These include representation in the dorsal view (1945b and 1959) of a lateral sulcus as well as of the pseudosylvian, and possibly better development of the anterior lobes of the neopallium (1945b). Moreover, the proportions of the cerebellum are more clearly depicted in Le Gros Clark's figures, showing that the cerebellum was relatively more elongate than in *Smilodectes.* The actual size of the British Museum specimen is not evident as the indicated scales for Le Gros Clark's figures are not in agreement.

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ABBREVIATIONS FOR ILLUSTRATIONS

a.	Broken surface through olfactory roots.
a.p.	Promontory ramus of internal carotid artery.
a.v.	Aquaeductus vestibuli.
b.	Internal cast of tympanic bulla (incomplete).
c.	Vascular canal between cranio-orbital foramen and postglenoid foramen.
c.f.	Contents of condylar foramen (incl. hypoglossal (XII) nerve and veins).
d.	Contents of sphenoidal fissure or foramen lacerum anterius (incl. nerves III, IV, V, and VI, and ophthalmic vein) and foramen rotundum (incl. nerve V_2).
e.a.m.	External auditory meatus.
ExO.	Exoccipital.
f.i.c.	Foramen for internal carotid artery.
fl.	Flocculus of cerebellum.
f.l.p.	Contents of foramen lacerum posterius (incl. nerves IX, X, and XI, and internal jugular vein) plus aquaeductus cochleae.
f.m.	Broken surface through medulla oblongata at foramen magnum.
f.o.	Contents of foramen ovale (incl. nerve V_3).
f.p.	Fissura prima?
f.rh.	Fissura rhinalis.
f.sty.	Stylomastoid foramen.
h.f.	Greater superficial petrosal nerve at the hiatus Fallopii or canalis facialis.
hy.	Hypophysis.
i.a.m.	Contents of internal auditory meatus (incl. nerves VII and VIII).
i.p.s.	Inferior petrosal sinus.
l.l.	Lateral lobe of cerebellum or cerebellar hemisphere.
lat.s.	Lateral or transverse sinus.
long.s.	Longitudinal or saggital sinus.
M.	Mastoid portion of periotic.
m.o.	Medulla oblongata.
O.C.	Occipital condyle.
o.ch.	Optic chiasma.
o.f.	Optic nerve (II) at optic foramen.
p.f.	Paramedian fissure.
p.l.	Pyriform lobe.
p.s.f.	Parietosquamosal foramen.
p.s.s.	Trace of parieto-supraoccipital suture.
Sq.	Squamosal.
s.l.	Sulcus lateralis.
s.s.	Sulcus suprasylvius?
t.h.	Torcular Herophili or confluens sinuum.
Ty.	Tympanic bulla.
v.c.	Vermis cerebelli.
x.	Anterior aperture of canal between inferior petrosal sinus and "Fx" of Hürzeler.

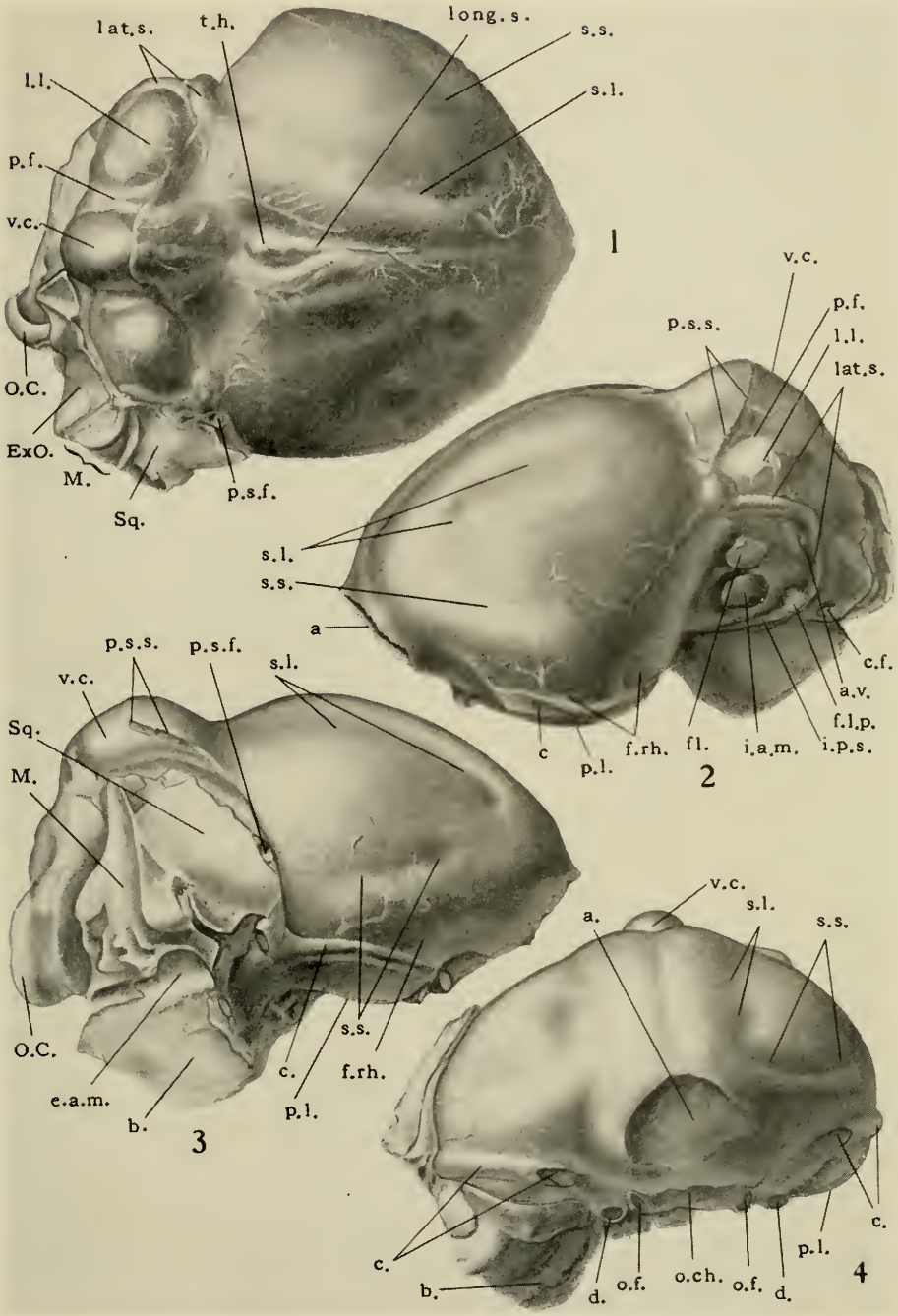

PLATE 1. Endocranial cast of Smilodectes gracilis

Figs. 1, 2, 3, 4. *Smilodectes gracilis* (Marsh). Endocranial cast (U.S.N.M. 23276): 1, dorsal view; 2, lateral view, left side; 3, lateral view, right side; 4, anterior view. Twice natural size. Bridger Basin, Wyoming.

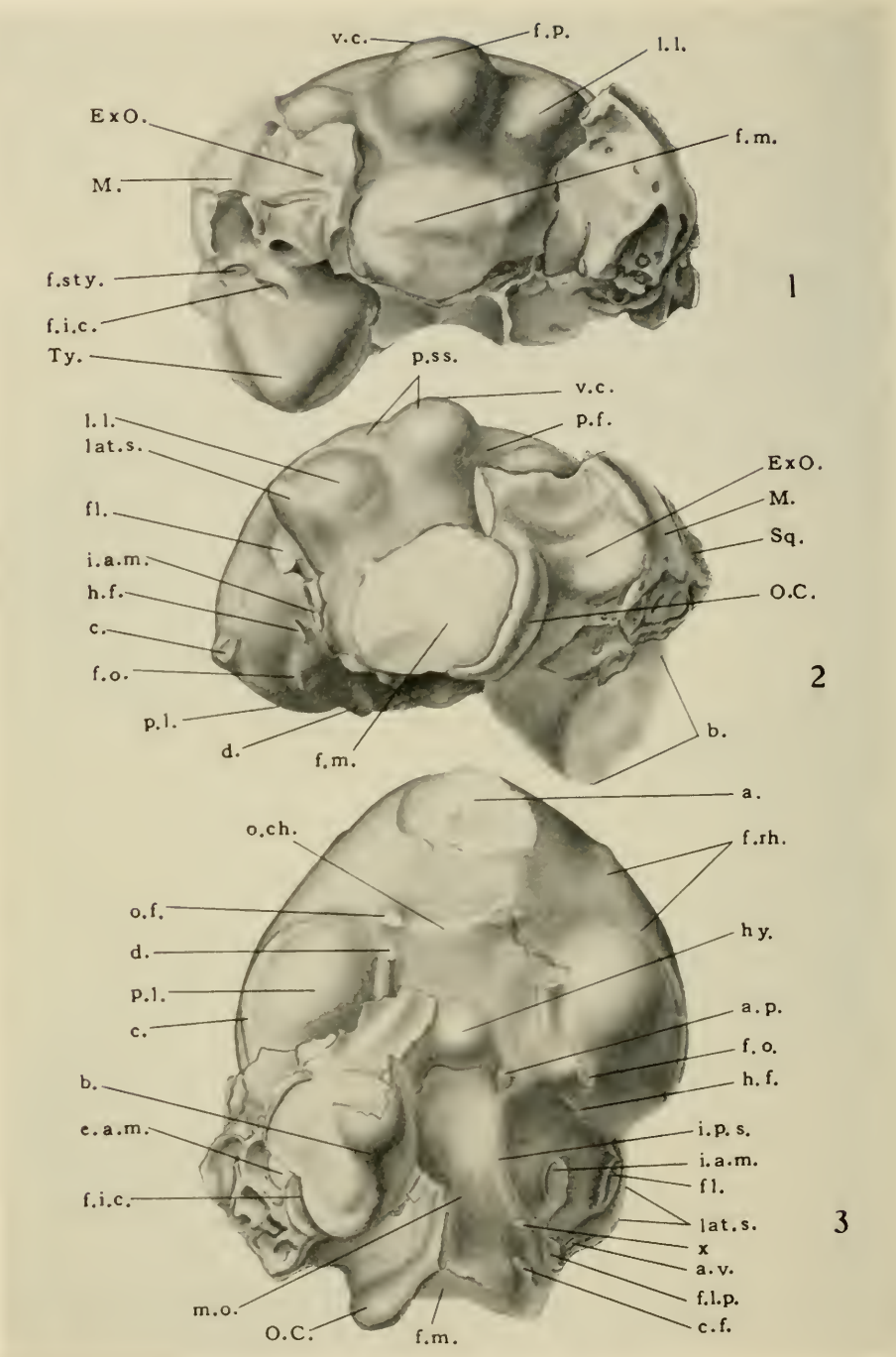

PLATE 2. Endocranial casts of Smilodectes gracilis

Figs. 1, 2, 3. *Smilodectes gracilis* (Marsh). Endocranial casts: 1 (U.S.N.M. 17997), posterior view; 2 (U.S.N.M. 23276), posterior view; 3 (U.S.N.M. 23276), ventral view. Twice natural size. Bridger Basin, Wyoming.