ACTA ZOOL. CRACOV.	26	7	229—240	KRAKÓW, 31. XII. 1982

Teresa CZYŻEWSKA

Natural Endocranial Casts of the *Cervidae* from Węże I Near Działoszyn (Poland)

[With 1 text-fig. and pls. II—V]

Naturalne odlewy endocranium *Cervidae* ze stanowiska Węże I koło Działoszyna (Polska)

Abstract. This work presents a description of the endocranial casts of *Procapreolus wenzensis* (Czyż.) and *Cervus warthae* Czyż. It makes the basis for reconstructing some characters of the external structure of the brain of these two species and comparing them with those of the roe-deer, red deer and *Muntiacus*. Conclusions concerning the efficiency of the sense organs, behaviour and affinities are also given.

INTRODUCTION

A very rich fauna of vertebrates has been found at the locality Węże I in the nature reserve at Zelce near Działoszyn in the Sieradz Province (Poland) (SAMSONOWICZ, 1934). In addition to bones there were also natural endocranial casts belonging to many mammalian species there. The endocranial casts of *Desmana kormosi* SCHREUDER (SYCH & RZEBIK-KOWALSKA, 1972) *Mustelidae* (CZYŻEWSKA, 1981b) and *Canidae* (CZYŻEWSKA, 1981a) have already been examined and described.

The objective of this work was to describe the endocranial casts and on the basis of these descriptions to characterize the external structure of the brains of *Procapreolus wenzensis* (CZYŻEWSKA 1960) and *Cervus warthae* CZYŻEWSKA 1968, whose remains were accumulated in large numbers at Węże I. *Procapreolus wenzensis* shows a close relationship with *Capreolus* as regards the structure of the skull, dentition and antlers, and *Cervus warthae* is a primitive species of the genus *Cervus* (CZYŻEWSKA, 1959, 1960, 1968).

A part of the old cave at Węże I was filled with a bone breccia (SAMSONOWICZ, 1934; SULIMSKI, 1959). The deposit of this cave was formed in various sedimentary cycles (GŁAZEK et al., 1973; SAMSONOWICZ, 1934). The remains of *Procapreolus wenzensis* and *Cervus warthae* were embedded in the Pliocene deposit (? Lower Villafranchian).

BRAUER and SCHOBER'S (1970) and STELMASIAK'S (1958) terminology was used in describing the brain and its vessels and the names of regions of the

cerebral hemispheres were adopted after STEPHAN (1951). Skulls of *Cervus elaphus* L., *Capreolus capreolus* L. and *Muntiacus muntjac* (ZIMMERMAN) were were used for comparison. Endocranial casts of latex were made for these species.

No endocranial casts of fossil cervids have been encoutered hitherto, and thus there are no similar descriptions of species closely related to *Procapreolus wenzensis* and *Cervus warthae* to be employed for comparison.

Measurements were taken as follows: anterior width of cerbral hemispheres, at the level of the rostral ectosylvian sulcus, in its posterior portion; posterior width of cerebral hemispheres, the greatest width in the temporal lobe; overall length of brain, from the anterior margin of the cerebral hemispheres to the posterior surface of the cerebellum; height of cerebral hemispheres; the greatest heigth, from the top of the hemispheres to the caudal rhinal sulcus; greatest height of brain, between the top of the cerebral hemispheres and the lower surface of the pyriform lobe. The indices have been calculated in percentages.

This study of the natural endocranial casts of the *Cervidae* from Węże I has been carried out under the scheme of the Interdepartmental Project MR II 3. The endocranial casts used in the study are in the possession of the Muzeum of Earth, Polish Academy of Sciences, in Warsaw (MZVIII-Vn-361 and 362).

The photographs presented in this paper were taken by Mrs. B. Drożdż, to whom I owe heartfelt thanks.

DESCRIPTIVE PART

Family *Cervidae* GRAY 1821
Subfamily *Cervidae* BAIRD 1857
Genus *Procapreolus* SCHLOSSER 1924
Procapreolus wenzensis (CZYŻEWSKA 1960)
(Pl. II, Tables I and II)

Material: 19 fragments of natural endocranial casts.

Description. There being no complete casts, it is impossible to establish all the proportions of the endocranial casts of *Procapreouls wenzensis* exactly. The following details of the structure of the *Procapreolus wenzensis* brain can be seen on the casts.

In *Procapreolus wenzensis* the degree of narrowing of the cerebral hemispheres relative to the greatest width of the hemispheres was not great; the hemispheres, seen from above, were ovate in shape, narrowing gradually but slightly towards the front (Table II, 1).

The proportions of the anterior and posterior parts of the cerebral hemispheres of *Procapreolus wenzensis* in relation to the overall length of the brain

Table I

Dimensions of endocranium of *Procapreolus wenzensis*

Ser. No.	Dimension	*Procapreolus wenzensis* (Czyż.) MZVIII—Vn—361/3
1.	Greatest posterior width of cerebral hemispheres	+54
2.	Anterior width of cerebral hemispheres	40.4
3.	Length of cerebral hemispheres	c. 78
4.	Overall length of brain	c. 92
5.	Distance of anterior margin of cerebral hemispheres from sylvian fissure	40.5
6.	Distance of sylvian fissure from posterior margin of cerebral hemispheres	49

differ little, the anterior part being somewhat shorter (Table II, 2 and 3), while the ratios of the anterior and the posterior greatest widths of the cerebral hemisphares to the overall length of the brain (Table II, 4 and 5) indicate a slight widening of the hemispheres in the frontal and temporal regions (fairly long but not very wide hemispheres). The cerebral hemispheres of *Procapreolus wenzensis* were flattened in the frontal region and as whole generally low, e. g. in relation to the large pyriform lobe.

Table II

Indices of cerebral hemispheres

Ser. No.	Indices	*Procapreolus wenzensis* MZVIII—Vn—361/3	*Muntiacus muntjac*	*Capreolus capreolus*
1.	2 : 1	c. 75	70	65.6
2.	5 : 4	c. 43.8	43.5	37.6
3.	6 : 4	c. 53	48	54.5
4.	2 : 4	c. 43.6	40.4	49.9
5.	1 : 4	c. 58.4	31.5	89.2

The rostral rhinal sulcus is relatively distinct. The sylvian fissure is short and the rostral ectosylvian sulcus has no visible communication with the suprasylvian sulcus. The caudal ectosylvian sulcus is seen only in fragments. Sulci with a nearly parallel arrangement prevail in the peripheric area of the cerebral hemispheres. The suprasylvian sulcus is the longest longitudinal furrow, its middle segment is bent towards the longitudinal fissure and the posterior segment does not turn on to the lateral and lower surfaces of the hemispheres. The lateral sulcus is shorter than the previous one, its anterior part being also turned towards the longitudinal fissure of the brain; the ecto- and endolateral sulci are short. The splenial sulcus is seen at the back

of the hemispheres. The coronal sulcus is short and connected with the suprasylvian sulcus, and the ansate sulcus is marked very indistinctly, presumably it is connected with the suprasylvian sulcus. The presylvian sulcus is bent upwards and forwards; it is relatively short.

The narrow and elongate precentral region is bordered by the coronal sulcus. The anterior part of the frontal cortex, situated rostro-medially to the presylvian sulcus, is conspicuous. The parietal region, bounded by the suprasylvian and rostral ectosylvian sulci, is small and narrow, while the postcentral region, lateroexternal to the coronal sulcus, is larger. The surface of the cerebral cortex between the splenial sulcus and the caudal suprasylvian sulcus is also large (striate, occipital and preoccipital areas). The suprasylvian sulcus has no downward bend caudally and in consequence the temporal area, limited dorsally by the caudal suprasylvian sulcus, is quite small.

The pyriform lobe of *Procapreolus wenzensis* is large and it bulges downwards and to the sides. Its outer portion is flatter and bulges less than the inner portion. The observable height of this lobe comes close to the height of the cerebral hemispheres in this place.

The olfactory bulbs of *Procapreolus wenzensis* are probably pushed close to the anterior edge of the cerebral hemispheres and the frontal bones are strongly thickened above the base of the bulbs to form the comparatively conspicuous jugum limitans fossae olfactoriae. The cerebellum of *Procapreolus wenzensis* is pushed backwards rather far beyond the cerebral hemispheres; the vermis is large and strongly bent and the upper surface of the cerebellum is at the level of the posterior edge of the cerebral hemisphares.

Apart from numerous small blood-vessels, the transverse sinus, between the cerebral hemispheres and the cerebellum, and the longitudinal sagittal sinus occur in *Procapreolus wenzensis.*

Comparison (Table II)

The size of the skull and dentition indicate that *Procapreolus wenzensis* was somewhat smaller than *Capreolus pygargus* PALLAS and larger than *Muntiacus muntjac.* The frontal bones of *Procapreolus wenzensis* are broad and rather short, especially in males, poorly arched, so that the profile of skull is almost even, the endocranial casts being corresponsingly relatively little narrowed in the front and flattened and low in the frontal region. Behind the orbits the skull of *Procapreolus wenzensis* is elongated, the parietal bones are relatively long, but in the endocranial casts this character is not clearly manifested. The brain-box of *Procapreolus wenzensis* is high, which would agree with the high endocranium, Its brain must have been fairly high and so were, above all, the pyriform lobes.

The brains *of Procapreolus wenzensis* and *Capreolus capreolus* differ chiefly in the degree of the anterior narrowing of the cerebral hemispheres; in the latter species it is larger and the temporal region of the hemispheres is more expanded to the sides. The proportions of the rostral and caudal parts of the

cerebral hemispheres are also different, in the roe-deer the rostral region being comparatively shorter (Table II, 1—4). In the roe-deer the cerebral hemispheres and their frontal region are considerably higher and the coronal sulcus is not parallel to the longitudinal cerebral fissure, as it is in *Procapreolus wenzensis*, but bent outwards, while the ecto- and endolateral sulci are short and split into small grooves (RONNEFELD, 1970, BRAUER & SCHOBER, 1970). Lastly, in the roe-deer the precentral region and the frontal part, bounded by the coronal sulcus, are large and in the shape of a rhomb.

The olfactory bulbs of *Procapreolus wenzensis* and *Capreolus capreolus* are similarly situated close to the anterior edge of the cerebral hemispheres (the frontal bones of the roe-deer form the conspicuous jugum limitans fossae olfactoriae above the base of the bulbs).

The brains of *Procapreolus wenzensis* and *Muntiacus muntjac* differ, above all, in the greatest posterior width of the cerebral hemispheres, which in the latter is very small, its brain being narrow and elongate (Table II, 5). In addition, its olfactory bulbs are narrow and pushed away far from the anterior edge of the cerebral hemispheres and, correspondingly, the frontal bones above the bases of the olfactory bulbs are thin and the jugum limitans fossae olfactoriae is poorly developed. The above-mentioned characters of the brain of *Muntiacus muntjac* of the family *Cervidae* give evidence of a certain degree of primitiveness.

The brain of *Procapreolus wenzensis* is similar to the brain of *Muntiacus muntjac* chiefly in that it is comparatively elongated and narrow, although not so much as in this last species, and at the same time its cerebral hemispheres are low, especially in the frontal region. The shape of the frontal part of the cerebral hemispheres between the coronal sulcus and the longitudinal fissure are also similar. In adult *Muntiacus muntjac*, as in young *Procapreolus wenzensis*, there is no connection between the rostral ectosylvian sulcus and the rostral suprasylvian sulcus. The arrangement of sulci in both species is simple.

Genus *Cervus* L.

Cervus warthae CZYŻEWSKA 1968
(Pls. III—V, Tables III and IV)

Material: 11 fragments of natural endocranial casts.

Description. Since the material contains no complete casts, only a partial estimation of the proportions of the endocranial casts is possible. The following structural details of the brain of *Cervus warthae* have been preserved on the casts (Fig. 1).

The index of the posterior width of the cerebral hemispheres to its width at the base of the olfactory bulbs indicates that these bases of *Cervus warthae* were relatively narrow. The degree of narrowing of the cerebral hemispheres,

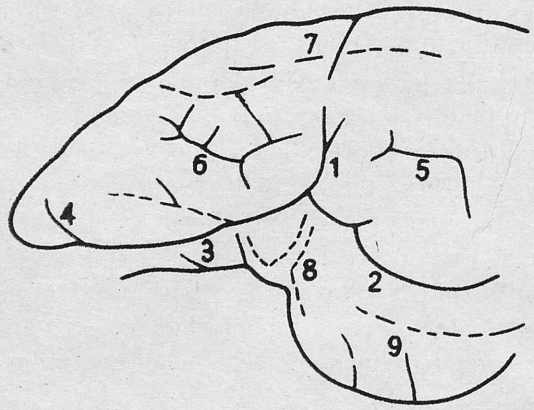


Fig. 1. A diagram showing part of the endocranial cast of *Cervus warthae* Czyż., seen from the left side (MZVIII—Vn—362/1), X c. 1. 1. Sylvian fissure, 2. caudal rhinal sulcus, 3. rostral rhinal sulcus. 4. presylvian sulcus, 5. caudal ectosylvian sulcus, 6. rostral ectosylvian sulcus, 7. suprasylvian sulcus, 8. medial cerebral artery, 9. pyriform lobe

Table III

Dimension of endocranial casts of *Cervus warthae*

Ser. No.	Dimensions	362/1	*Cervus warthae* MZVIII—Vn— 362/4	362/370
1.	Greatest posterior width of cerebral hemispheres	67.7	—	c. 74
2.	Anterior width of cerebral hemispheres	40	45	43
3.	Width of base of olfactory bulbs	21.6	—	—
4.	Overall lenght of brain	—	104	c. 75
5.	Distance of anterior edge of cerebral hemispheres from sylvian fissure	40	43	40
6.	Distance of sylvian fissure from posterior edge of cerebral hemispheres	—	47	—
7.	Greatest height of cerebral hemispheres	32	—	—
8.	Greatest height of brain	52	—	—
9.	Height of cerebral hemispheres at the base of olfactory bulbs	12.4	11	—

represented by the ratio of the posterior width of the cerebral hemispheres to the anterior width, is great. The cerebral hemispheres were low in relation to the greatest height of the brain (Table IV, 1—3), their flattening in the frontal region being characteristic. Seen from above, the cerebral hemispheres of *Cervus warthae* narrow gradually and distinctly towards the front.

The operculization of the insular area of the cerebral hemispheres includes a part of the rostral sylvian gyrus, this part being narrower than the posterior. The broader caudal sylvian gyrus is also somewhat pushed down on to the pyriform lobe. The sylvian fissure is short, the caudal rhinal sulcus bent back-

Table IV

Indices of endocranial casts

Ser. No.	Index	*Cervus warthae* MZVIII—Vn—362/1	*Cervus elaphus*	*Muntiacus muntjac*	*Capreolus capreolus*
1.	3 : 1	31	34.9	33.9	32
2.	2 : 1	57.4	83	70	65.6
3.	8 : 7	61.5	63	63.2	73.7

wards and the rostral rhinal sulcus bent medially. The rostral and caudal ectosylvian sulcus are very indistinct, the first of them has a connection with the suprasylvian sulcus.

The suprasylvian sulcus is relatively long, in its anterior part bent towards the longitudinal fissure. It is connected with the coronal sulcus, which runs parallel and close to this last fissure. The presylvian sulcus is quite short, the splenial sulcus visible on the upper surface of the cerebral hemispheres and the lateral, endolateral and ectolateral sulci are weakly marked.

The precentral region of the cerebral hemispheres of *Cervus warthae* is very narrow and elongate and the frontal cortex, situated rostrally and medially to the presylvian sulcus, is small. The parietal region, between the suprasylvian sulcus and the rostral ectosylvian sulcus is small in area. The insular area is large and so is the optic area between the splenial sulcus and the suprasylvian.

The pyriform lobe of the brain of *Cervus warthae* is large and appreciably convex. The endocranial cast shows the outer and inner parts of the pyriform lobe. The rhinencephalon is relatively large and conspicuous and the olfactory tubercles are large. The mark of the optic foramen is small, the distance between n. II and the anterior edge of the cerebral hemispheres is fairly long. The sphenoorbital and oval foramina have left a joined mark on the cast.

In addition to small blood-vessels, the endocranial cast of *Cervus warthae* exhibits a thick sagittal sinus and, behind the olfactory tubercles, a large medial cerebral artery, which higher, on the lateral surface of the cerebral hemispheres, ramifies repeatedly.

Comparison (Table IV)

The size of the skull of *Cervus warthae* agrees with that of the skulls of sambars and small *Cervus elaphus* (Czyżewska, 1959, 1968). The endocranial casts are smaller than those of *Cervus elaphus*. The front of the skull of *Cervus warthae* was high, steep and somewhat convex, the profile line of the front being like that of young *Cervus elaphus* or adult *Axis axis* Erxleben, which gives the skull of the species under study a primitive appearance. Correspondingly, the frontal region of its brain is steep, the cerebral hemispheres are low and flattened rostrally and considerably higher caudally. The frontal bone of *Cervus warthae* is short, narrow between the supraorbital foramina and very

broad behind the orbits. The low width index of the frontal bone between the supraorbital foramina is a characteristic feature of *Cervus warthae*, in which it differs from *Rusa* and *Cervus elaphus*. With the shape of the frontal bone and skull of *Cervus warthae* correspond the endocranial casts, which show a comparatively great narrowing towards the front (Table IV, 1 and 2) in relation to the greatest cast width. Its brain-box is relatively high and so is the endocranium. The brain, as a whole, is high but the hemispheres themselves are low (Table IV, 3).

Judging from the endocranial cast, the aperture of the olfactory fossa on the inside of the skull of *Cervus warthae* was narrower and less widened dorsally. The convexities of the olfactory tubercles are distinctly marked on the endocranial cast of *Cervus warthae* but they leave no marks in this cast of *Cervus elaphus*. The optic chiasma lies relatively far from the anterior edge of the cerebral hemispheres in the former species and considerably nearer in the latter. In accordance with the position of n. II in *Cervus elaphus* the lamina cribrosa is near the posterior edge of the orbit and in *Cervus warthae* it must have lain near the middle of the orbit or still farther to the front, as it does in the roe-deer or *Muntiacus*. This character could not be found on the whole skulls of *Cervus warthae* (Czyżewska, 1968). The optic chiasma, its position and size also rather resemble the conditions in the skulls of roe-deer or even *Muntiacus*. On the cast *Cervus warthae* the marks of the sphenoorbital foramen (nerves III, IV, 1/V, 2/V and VI) and oval foramen (3/V) are joined and situated close to each other on either side. These two foramina must have been connected by a relatively narrow and rather deep groove. In the endocranial casts of *Cervus elaphus* the sphenoorbital and oval foramina leave separate marks, which are considerably larger, and there is no distinct groove between these foramina in its skull.

The arrangement the sulci and gyri of the cerebral hemispheres on the endocranial casts of *Cervus warthae* does not, as a rule, differ from that in *Cervus elaphus*. The likeness of the brains of these two species lies, above all, in the similar degree of operculization of the insular region, the course of the coronal sulcus parallel to the longitudinal cerebral fissure, and the connection of the rostral ectosylvian sulcus with the suprasylvian.

Notes

Procapreolus wenzensis and *Cervus warthae* occurred in large numbers at Węże I near Działoszyn. Their remains belonging to specimens varying in age from several-month-old calves to several-year-old adults and even old animals were excavated in this cave (Czyżewska, 1968). Vagenknecht (1962) is of opinion that there are usually few young specimens in primary populations of the *Cervidae*, their juvenile mortality being high. The causes of their deaths are various. At Węże most bony remains were those of young specimens: *Procapreolus wenzensis* of age group II, i.e. 4—5 months old, and *Cervus warthae*

in age groups I, up to 5 months, and IV, 25—30 months old (CZYŻEWSKA, 1968). All the endocranial casts of both species belonged to young animals. As regards *Procapreolus wenzensis*, there are no endocranial casts of specimens of age group I, i.e. up to 4 months of age, only one in age group II, and most of them represent age group III and then 12—16-month-old animals, which occurred late in the summer and in the autumn. On the other hand, the bones of *Procapreolus wenzensis* belonging to age group IV are not numberous at Węże I, they form scarcely c. 6% of the total. The remains of this species, e.g. skulls, which accumulated in the cave at Węże I in the autumn, may have met with favourable conditions of formation of endocranial casts later (dampness, water). Nearly all endocranial casts of *Cervus warthae* belonged to very young specimens of age group I. This age group occurred at the beginning of autumn. No endocranial cast of *Cervus warthae* of age group IV has been found, even though the bony remains representing this group were relatively numerous, c. 30% of the total.

Procapreolus wenzensis, *Cervus warthae* and *Muntianus muntjac* show the following developments of cerebral hemisphere regions:

a) The narrow and elongate precentral region is developed, above all, in the frontal zone. It is the area of special movements of the trunk, bead and extremities following rather strong irritations. RADINSKY (1976) maintains that the expansion of the frontal region in the *Artiodactyla* was retarded compared with other parts of the brain and that it provides examples of parallel evolution taking place independently in several tribes.

b) The postcentral region is relatively larger and, in *Cervus warthae*, particularly bulging.

c) The temporal region is quite small in *Procapreolus wenzensis*.

The frontal cortex, medial to the presylvian sulcus, is larger in *Procapreolus wenzensis, Cervus warthae, Capreolus capreolus* and *Cervus elaphus* than it is in *Muntiacus muntjac*. Small differences in the size of the frontal cortex in the *Cervidae* may be connected with behaviour in herds or groups. *Muntiacus muntjac* does not form groups in any seasons of the year.

The following regions of the cerebral hemispheres of *Procapreolus wenzensis, Cervus warthae, Muntiacus muntjac, Capreolus capreolus* and *Cervus elaphus* are similarly developed:

a) The parietal region, which is the sensory area of the snout, is small. The large parietal region is met with in burrowing animals, e. g. in many suids (KRUSKA, 1970).

b) The occipital region — the striate, occipital and preoccipital areas — is elongated and broad; this is the area of vision, movements of the eye-balls and optic orientation. The large size of this region indicates the great efficiency of the sense of sight. In *Procapreolus wenzensis* and *Capreolus capreolus* the outer portions of this region are distinctly larger than in *Muntiacus muntjac*. This difference may be connected with the diurnal ways of living of the former species in well-lighted and often exposed areas, e.g. wood clearings, ri-

verside carrs and thin woods, where optic orientation is very helpful and plays an important role, whereas *Muntianus muntjac* lives in the shade of thick forest understory (WALKER, 1964) and is active by night.

As regards the weight of brain, *Capreolus capreolus*, with its small body weight, seems to be placed high in the order of tribes belonging to the families of the *Artiodactyla* (RONNEFELD, 1970). On account of the different shape of its brain (elongate, rather narrow, with low cerebral hemispheres) *Procapreolus wenzensis*, in all probability, did not reach so high a position as does *Capreolus capreolus*.

The neocordicalization of a mammalian brain can be expressed by the surface area of the neocortex. This surface includes both a) the neocortex of the cerebral hemispheres and, in the case of the folding of the hemispheres, b) the neocortex sunk in the sulci. Judging from the furrowing of the cerebral hemispheres, the degree of neocorticalization in *Procapreolus wenzensis* was nearer that in *Muntiacus muntjac* than in *Capreolus capreolus*, in which the folding of the hemispheres is more conspicuous and rather variable (RONNEFELD, 1970; BRAUER & SCHOBER, 1970). The cerebral hemispheres of *Cervus warthae* were folded to a degree similar to that in *Cervus elaphus*. The *Artiodactyla* representing a high level of phylogenetic development are generally characterized by their strongly folded brains (OBOUSSIER, 1966, 1967; TYSZKA, 1966; RONNEFELD, 1970). The different degrees of folding of the cerebral hemispheres in *Procapreolus wenzensis* and *Cervus warthae* might suggest the difference in the level of their phylogenetic development.

The build of the endocranial casts and that of the brains known from these casts throw more light on the generic relationships of *Procapreolus wenzensis* and *Cervus warthae* and their relation to the genera *Muntiacus, Cervus* and *Capreolus*. GROVES (1974) thinks that the inclusion of the genus *Muntiacus* in the *Cervinae* is well-founded, as, in his opinion, it is even more closely related to the central group of the *Cervinae* that *Capreolus* is. The genus *Procapreolus* liver in the Pliocene (CZYŻEWSKA, 1968; KOROTKIEWICZ, 1963, 1965, 1966) and *Capreolus capreolus*, related to it, has liver since the end of the Pliocene. The build of the endocranial casts shows that *Procapreolus* is undoubtedly akin to the ancestors of *Muntiacus* living in the Miocene and Pliocene and this close relationship is expressed better in the retention of certain primitive characters of the brain than in the structure of the skull, dentition or antlers (CZYŻEWSKA 1960, 1968). The genus *Cervus* has persisted since the end of the Pliocene and *Cervus warthae*, in whose build of the brain-box and brain many primitive characters were extant, e.g. the position of the optic nerves and their decussation and the low frontal region of the cerebral hemispheres, was one of the oldest members of this genus.

Translated into English
by Jerzy Zawadzki

University of Wrocław
Zoological Institute Department of Paleozoology
Wrocław, Sienkiewicza 21

REFERENCES

Brauer K., Schober W., 1970. Katalog der Säugetiergehirne. VEB Fischer Verlag, Jena, 20 pp., 150 Pls.

Czyżewska T., 1959. *Cervus* (*Rusa*) sp. z plioceńskiej brekcji kostnej z Węży. (*Cervus* (*Rusa*) sp. de la brèche osseuse pliocène de Węże près de Działoszyn). Acta Paleont. Pol. Warszawa, **4** (4): 389—429.

Czyżewska T., 1960. Nowy gatunek jelenia rodzaju *Cervocerus* Khomenko z plioceńskiej brekcji kostnej z Węży. (Nouvelle espèce de Cervidé du genre *Cervocerus* Khomenko de la brèche osseuse pliocène de Węże près Działoszyn). Ibidem, **5** (3): 283—318.

Czyżewska T., 1968. Deers from Węże and their relationship with the Pliocene and Recent Eurazjatic *Cervidae*. Ibidem, **13** (4): 537—603.

Czyżewska T., 1978. A Natural Cast of the Endocranium of *Arctomeles pliocaenicus* Stach from Węże near Działoszyn (Poland). Acta zool. cracoviensia, Kraków, **23** (7): 93—100.

Czyżewska T. 1981a. Natural Endocranial Casts of the endocranium of the family *Canidae* from Węże I near Działoszyn (Poland). Acta zool. cracov., Kraków, 25/9/: 251—260+pl. X.

Czyżewska T. 1981b. Natural Endocranial Casts of the endocranium of the subfamily *Mustelinae* from Węże I near Działoszyn (Poland). Acta zool. cracov., Kraków, 25/10/: 261—270+pl. XI.

Głazek J., Sulimski A., Wysoczański-Minkowicz T., 1976. On the stratigraphic position of Węże I Locality (Middle Poland). Proc. 6th Int. Congress of Speleology, Olomouc, 435—442.

Groves C. P., 1974. A note on the systematic position of the *Muntjac* (*Artiodactyla, Cervidae*). Zeitsch. f. Säugetierkunde Hamburg u. Berlin. **39**: 369—372.

Korotkevitsh E. L., 1963. Novy dani pro sistematiku i filogeniju vikopnich kosul roda *Procapreolus*. Dopov. Akad. Nauk Ukr. SSR Kiev. **10**: 1390—1393.

Korotkevitsh E. L., 1965. Novyj wid kosuli iz meotisa Ukrainy. Paleont. Żurnal AN SSSR Moskwa, **4**: 60—67.

Korotkevitsh E. L., 1966. Iskopaemye oleni i ich znacenie dlja vossozdanija landšaftov neogena. Paleogeograficni umovi teritorii Ukraini v plioceni ta antropogeni. Kiev, 55—70.

Kruska D., 1970. Über die Evolution des Gehirns in der Ordnung *Artiodactyla* Owen, 1848, insbesonders der Teilordnung *Suina* Gray, 1868. Zeitsch. f. Säugetierkunde. Hamburg u. Berlin, **35** (4): 214—238.

Oboussier H., 1966. Das Grosshirnfurchenbild als Merkmal der Evolution. Untersuchungen an Boviden II. Mitt. Hamburg. Zool. Mus. Inst., **63**: 159—182.

Oboussier H. 1967. Das Grosshirnfurchenbild als Hinweis auf die Verwandschftbeziehungen der heutigen afrikanischen Boviden. Acta Anatomica, **68**: 577—596.

Radinsky L., 1976. New evidence on Ungulate brain evolution (abstract). Amer. Zool., **16**: 207.

Ronnefeld U., 1970. Morphologische und quantitative Neocortexuntersuchungen bei Boviden; Ein Beitrag zur Phylogenie dieser Familie. Jahrb. f. Morphologie, Erste Abt., **115** (2): 163—230.

Samsonowicz J. 1934. Zjawiska krasowe i trzeciorzędowa brekcja kostna w Wężach pod Działoszynem. Zabytki Przyrody Nieożywionej Ziemi Rzeczypospolitej Polskiej, **3**: 147—158.

Stelmasiak M., 1958. Mianownictwo anatomiczne, PZWL, Warszawa, 430 pp.

Stephan H., 1951. Vergleichende Untersuchungen über Feinbau des Hirnes von Wild und Haustieren. Zool. Jb. Anat., **71**: 487—586.

Sulimski A., 1959. Pliocene *Insectivora* from Węże. Acta Palaeont. Polonica, **4** (2): 119—173, Warszawa.

Sych B., Rzebik-Kowalska B., 1972. Fosil Endocranial Cast of *Desmana kormosi* Schreuder (*Insectivora, Mammalia*) from the Pliocene of Poland. Acta zool. cracoviensia Kraków, **17** (2): 37—44.

Tyszka H. v., 1966. Das Grosshirnfurchenbild als Merkmal der Evolution. I. Boviden (*Bovinae, Hippotraginae*). Mitt. Hamb. Zool. Mus. Inst., **63**: 121—158.
Vagenknecht E., 1962. Biologiczne zapobieganie szkodom wyrządzanym przez zwierzynę płową. Łowiec Polski. Warszawa. 15 4—6 (16): 2—4.
Walker E. P., 1964. Mammals of the World. Hopkins Press, Baltimore 1500 pp.

STRESZCZENIE

Odlewy endocranium *Procapreolus wenzensis* (Czyż.) i *Cervus warthae* Czyż. pochodzą z Węży I koło Działoszyna, województwo Sieradz, gdzie znaleziono także liczne szczątki szkieletu tych gatunków. Sądząc z odlewów endocranium półkule mózgu obu tych jeleni były niskie, szczególnie w okolicy czołowej.

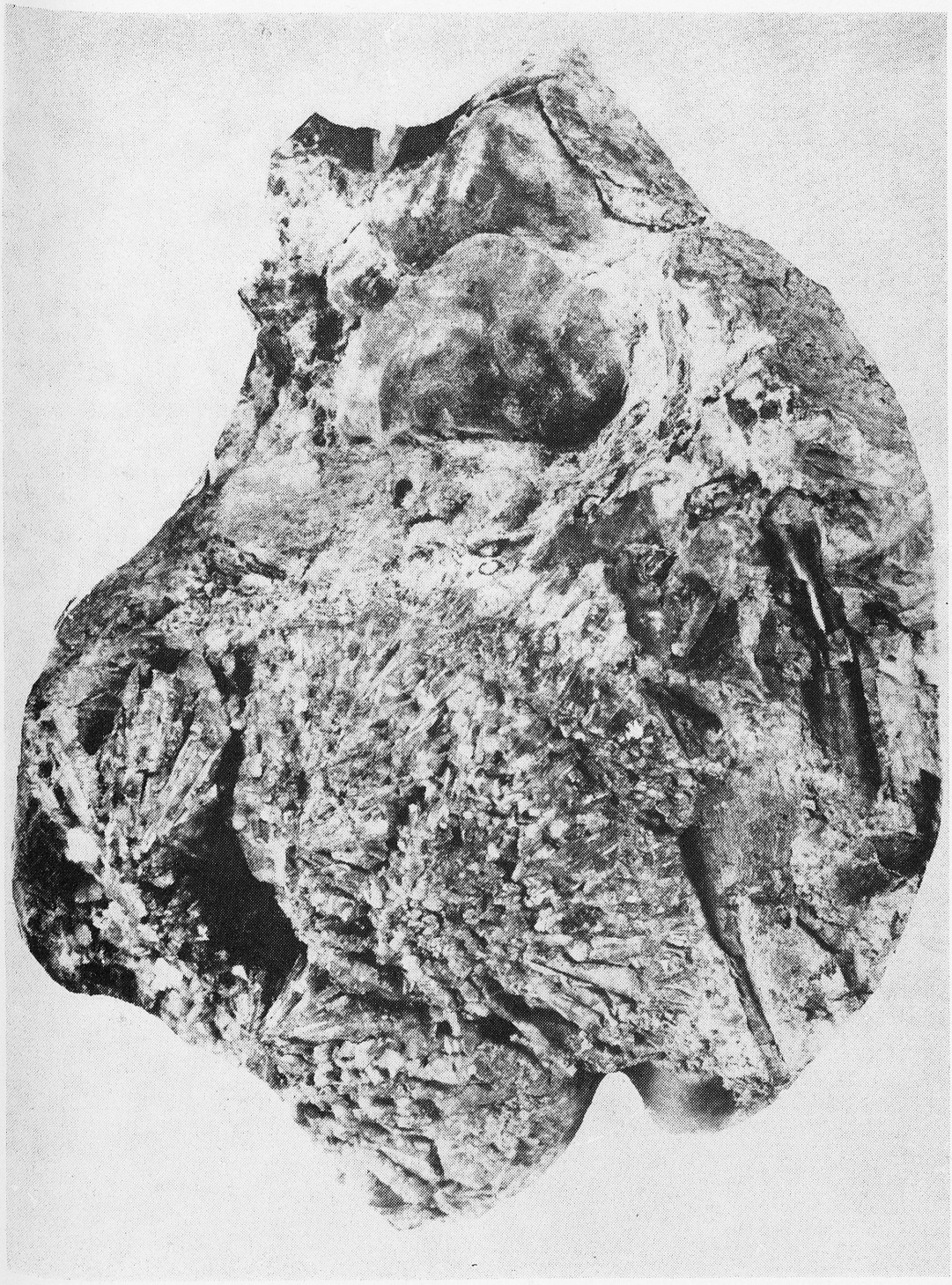
Mózg *Procapreolus wenzensis* był wąski i stosunkowo wydłużony, w układzie bruzd półkul mózgu brak połączenia widocznego na odlewie między sulcus ectosylvius rostralis a sulcus suprasylvius, jest widoczny na powierzchni zewnętrznej sulcus splenialis. Mózg *Procapreolus wenzensis* wykazywał pewne podobieństwo do mózgu *Muntiacus muntjac*. Stopień neokortykalizacji mózgu *Procapreolus wenzensis*, sądząc po intensywności bruzdowania półkul mózgu, był bliższy temu *Muntiacus muntjac* niż *Capreolus capreolus*.

Mózg *Cervus warthae* charakteryzuje zwężenie w okolicy czołowej. Na odlewach bruzdy półkul mózgu zaznaczają się niewyraźnie, szczególnie w okolicy potylicznej. Sulcus ectosylvius rostralis i sulcus suprasylvius są połączone. Sulcus splenialis jest widoczny na powierzchni zewnętrznej półkul mózgu. Półkule mózgu *Cervus warthae* były pofałdowane w podobnym stopniu jak u *Cervus elaphus* L.

Redaktor pracy: dr B. Sychowa

Plate II

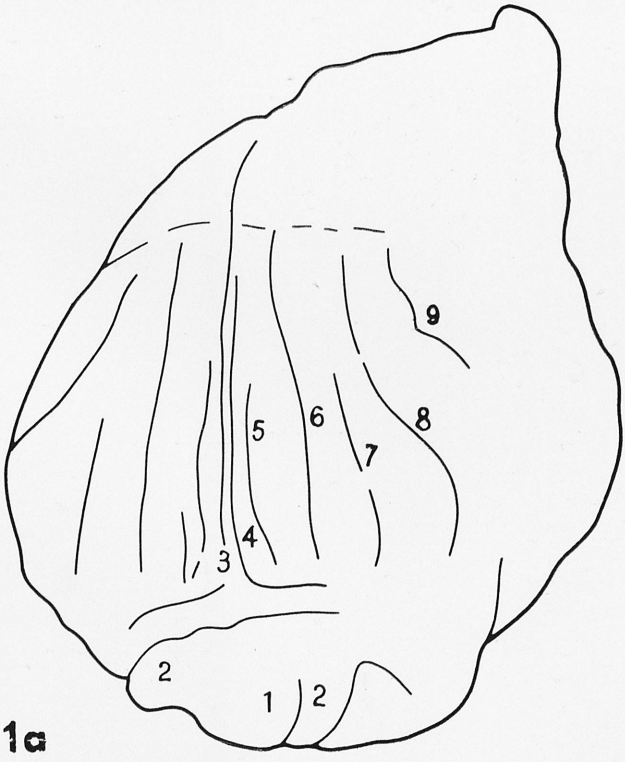
A fragment of the breccia at the Pliocene locality Węże I, containing mammalian bones (*Hypolagus* and others) and, on the right-hand side, a fragmentary endocranial cast of *Procapreolus wenzensis* (Czyż.), X c. 1



T. Czyżewska

Plate III

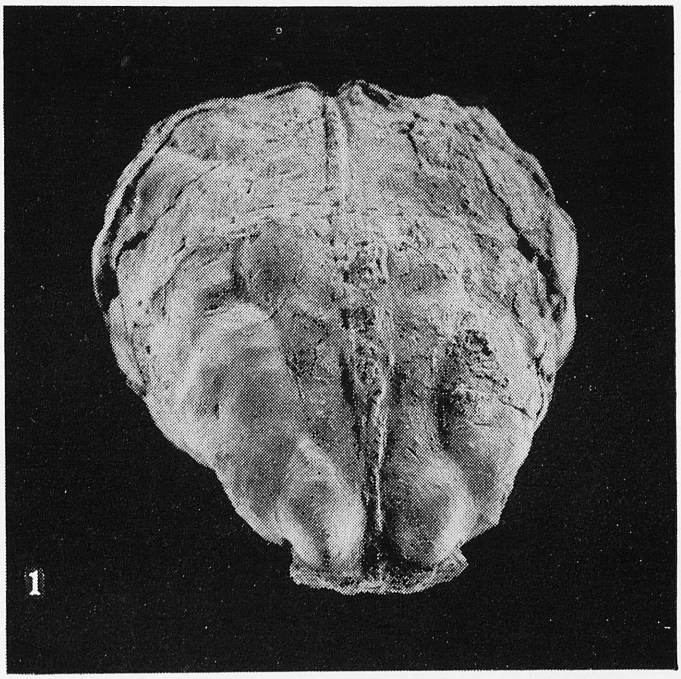
Endocranial cast of *Cervus warthae* Czyż. (MZVIII—Vn—362/4), X c.1.
1. dorsal side, 1a. diagrammatic drawing of the same.
1. cerebellar vermis, 2. cerebellar hemispheres, 3. sagittal venous sinus, 4. splenial sulcus, 5. endolateral sulcus, 6. lateral sulcus, 7. ectolateral sulcus, 8. suprasylvian sulcus, 9. caudal ectosylvian sulcus



1a

Plate IV

Endocranial cast of *Cervus warthae* Czyż., X c.l.
1. MZVIII—Vn—362/1, seen from in front.
2. MZVIII—Vn—362/4, frontal region seen from above


1

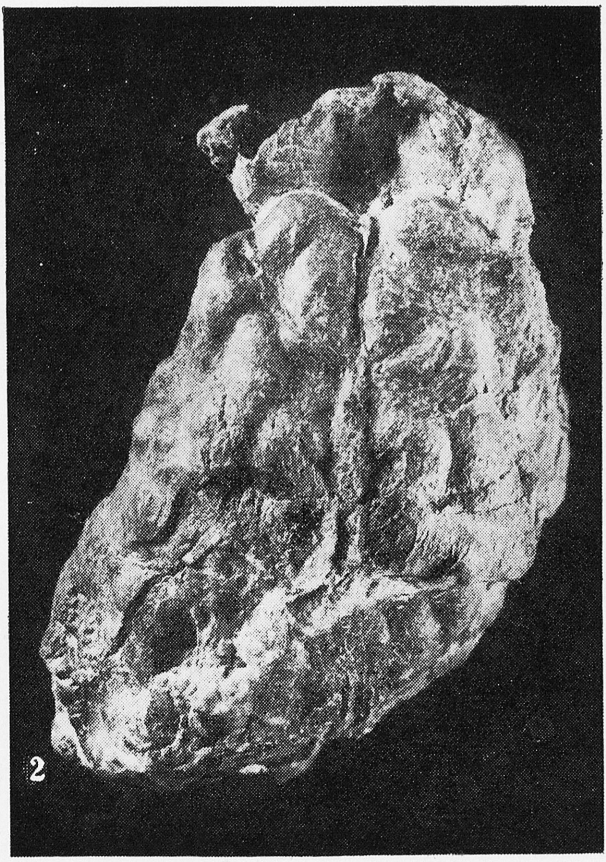
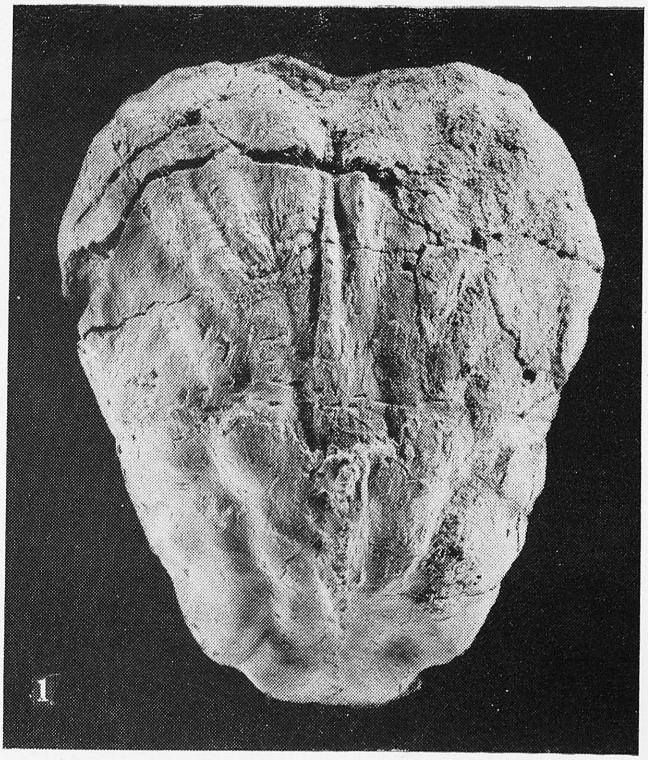
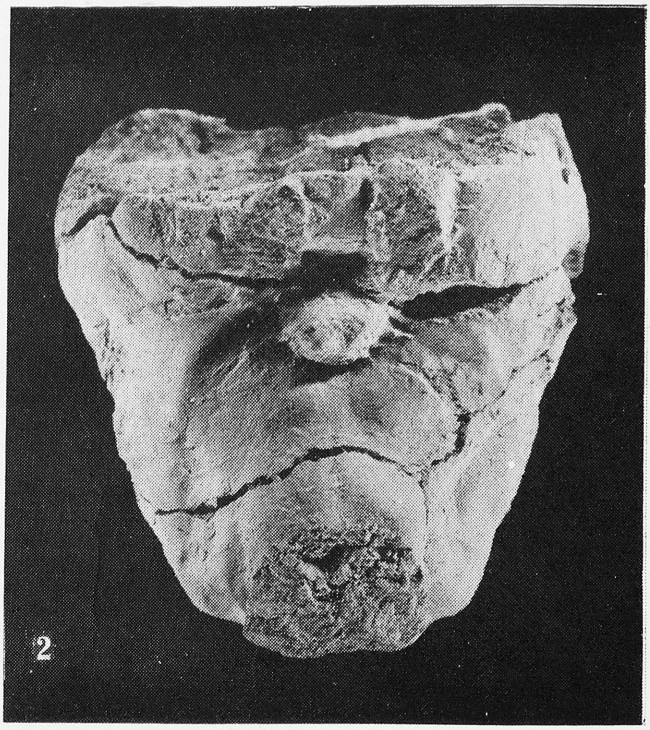

2

Plate V

Endocranial cast of *Cervus warthae* (MZVIII—Vn—362/1), X c. 1.
1. dorsal side, 2. ventral side


1


2