

Chapter 3

The Starunia collections in Lviv and Kraków natural history museums and history of palaeontological studies

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Abstract

This paper deals with the history of excavation, examination and storage of the finds of large Pleistocene mammals in Starunia (Ukraine). At the beginning of the 20th century, in 1907 and 1929 the remains of a mammoth *Mammuthus primigenius* (Blum.) and four woolly rhinoceroses *Coelodonta antiquitatis* (Blum.) were found in shafts of an ozokerite mine. The most famous among the finds is the so-called “second” rhinoceros from Starunia. It was found at the end of 1929 as a result of an expedition of the Polish Academy of Arts and Sciences. This is the only, nearly completely preserved specimen of this extinct species in the world. The body was found in an almost perfect external condition. Furthermore, it was overlain by parts of skeletons of two other woolly rhinoceroses (the “third” and the “fourth”) and abundant remains of contemporary flora and fauna, especially insects. The flora and fauna accompanying the rhinoceroses from Starunia document the past habitat and climate of this region. The fossils are indicators of the typical arctic tundra and the so-called “Pleistocene mammoth steppe”. The unique preservation of the finds from Starunia, particularly the “second” rhinoceros, is a result of the reactions of earth-wax (ozokerite), brine and petroleum with the mammal remains. The finds from Starunia are stored in two natural history museums: the mammoth and the “first” rhinoceros in Lviv (Ukraine), the “second” and the remains of the “third” and “fourth” rhinoceroses in Kraków (Poland). Copies of the plaster cast are exhibited in several leading museums in the world. In the 1930s general geological, paleozoological, anatomical and floristic studies were carried out. Further studies were continued after World War II, precisely on the structure of hair, the histology of soft tissues and ¹⁴C dating. The paper contains general remarks on the comparison of recent and fossil rhinoceroses, as well as the distribution and distinction of the woolly rhinoceros.

Keywords: mammoth, woolly rhinoceros, Starunia ozokerite mine, Natural History Museums: Kraków (Poland), Lviv (Ukraine).

1. Introduction

Nearly one hundred years after the first discoveries in Starunia (1907) scientists are still interested in studies on the unique, natural preservation of Pleistocene mammals from this specific locality (Kubiak, 1994; Alexandrowicz, 2005 this volume; Kotarba, 2005, this volume). The animals were found in Miocene salt-bearing strata which host ozokerite veins. These veins were exploited at the end of the 19th and in the first half of the 20th centuries (Photo 1) (Alexandrowicz, 2004, 2005, this volume). The excavated remains of an adult mammoth, *Mammuthus primigenius* (Blumenbach, 1803)

and the front part of a woolly rhinoceros *Coelodonta antiquitatis* (Blumenbach, 1799) found in 1907 were investigated, and the results of the research work were published as a monograph in 1914 (Bayger *et al.*, 1914). Important data were also provided by Niezabitowski-Lubicz (1911a, b) and Hoyer (1914, 1915).

In 1929, the so-called “second woolly rhinoceros from Starunia” was found about 3.5 meters distant from the first shaft. It was the only well-preserved specimen of this extinct species in the world. However, this carcass has not yet been investigated in detail. Preliminary publication on this finding appeared in Kraków in 1930 (Nowak *et al.*, 1930).



Photo 1. View of the Starunia ozokerite mine at the beginning of the 20th century (archival photo)

Both the flora and fauna accompanying the rhinoceros, and some details of the carcass were sent to specialists from various countries. Some of them published their results in special scientific "Starunia" periodical dedicated to the studies on specific materials from the Starunia area: "diluvial mosses" by Gams (1934) in Innsbruck, Austria, and by Szafran (1934) in Kraków, Poland; small vertebrates by Kormos (1934) in Budapest, Hungary; two-winged insects *Diptera* by Lengersdorf (1934) in Bonn, Germany and *Orthoptera* by Zeuner (1934) in Freiburg, Germany. However, most of the samples were lost during World War II.

After World War II studies on the "Starunia material" were continued, among others, by Kubiak (1969, 1971, 2001, 2003); Angus (1973); Kubiak, Dziurdzik (1973); Bigaj *et al.* (1976); Granoszewski (2002) and Pawłowski (2003).

The recent studies by Alexandrowicz (2004; 2005, this volume), dealing with the history of Starunia and its vicinity as well as with the excavations are very important documents which extend our knowledge about this site.

The aim of this paper is a description of the extinct mammals as well as other flora and fauna specimens from Starunia, which are now exhibited in two natural history museums (in Lviv and Kraków).

2. The Starunia discoveries

2.1. The 1907 discovery

In 1907 a shaft was dug in the ozokerite field in Starunia in order to explore the Miocene salt-bearing strata for ozokerite veins. At the depth of 12.5 meters remains of a mammoth were accidentally found. At the depth of 17.6 meters the front part of a woolly rhinoceros body appeared, with preserved skin and flesh. This partially preserved rhinoceros was later called "the first woolly rhinoceros from Starunia".

The remains of the mammoth (Photo 2) included: nearly the whole vertebral column; fragments of ribs; the skull represented by a part of the maxillae with both of the molars and both tusks. The right scapula was preserved while the humerus was missing but the ulna and radius were present; several carpals, metacarpals and phalanges, and a fragment of the pelvis were also found. Moreover, there were fragments of the right femur, tibia and fibula and some tarsals and metatarsals. A large part of the skin (3.20 x 1.34 meters, 1 to 15 millimeters thick), the ear and the eye region were preserved, as well. Ligaments and muscles were connected with the skeletal fragments. The hair in the skin were missing, however, a lot of hair could

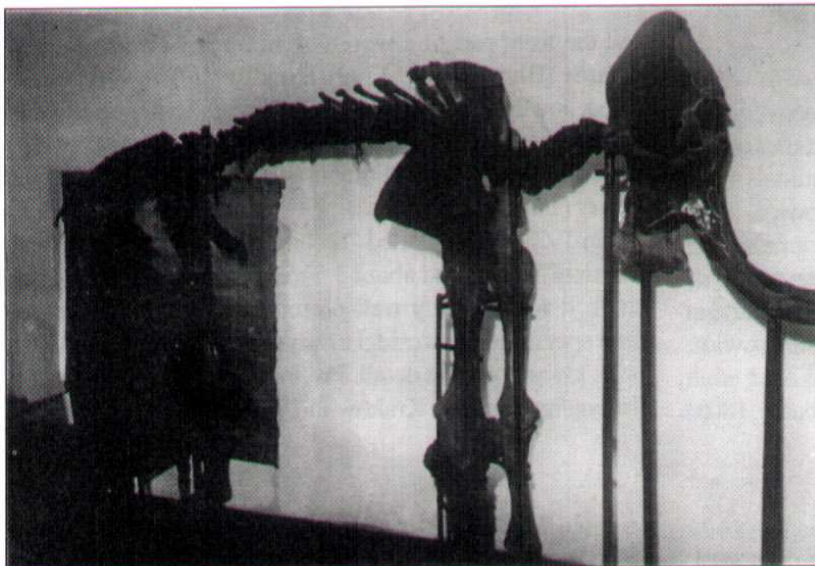


Photo 2. Mammoth skeleton with soft tissues found in Starunia in 1907

Photo 3. Remains of the “first” woolly rhinoceros from Starunia (1907)

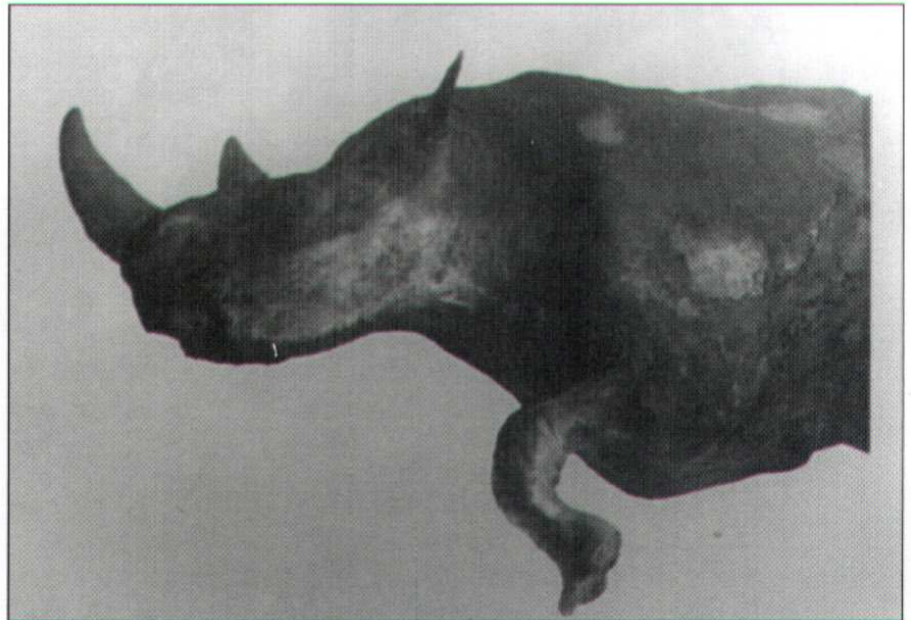
be found in the vicinity of the body remains.

The “first rhino from Starunia” is represented by the whole head, the left fore limb and a fragment of skin (about 2 m long). Both the head and the leg are well preserved (Photo 3). It ought to be pointed out that „most probably the remains of the mammoth and the rhinoceros which had been dug out in the process of former excavations were also thrown back into the pit that was being filled — as proof of this theory we may regard the fact that the horn of the rhinoceros in 1907 was found at a different depth from the rhinoceros itself” (Nowak *et al.*, 1930).

The remains of the mammoth and the “first woolly rhinoceros from Starunia” are stored in the Natural History Museum of the Ukrainian Academy of Sciences (former Dzieduszycki’s Family Museum) in Lviv, Ukraine.

2.2. The 1929 discovery

According to the plan proposed by the Starunia Committee of the Polish Academy of Arts and Sciences, a decision was made to sink a new shaft near that from 1907. The field work started in mid-July, 1929. The end of October brought a success. On 23rd October, 1929 the carcass of the “second woolly rhinoceros from Starunia” was found in



upside-down position at a distance of 3.30 m from the 1907 shaft, at a depth of 12.5 meters (Photos 4 and 5). About 1.5 meter above the well preserved rhinoceros carcass skeletal remains of two other rhinoceroses were excavated. These were named the “third...” and the “fourth woolly rhinoceros from Starunia”. The finds were the results of a special expedition to Starunia organized by the Starunia Research Committee of the Polish Academy of Arts and Sciences and were sponsored by the National Culture Fund.

The remains of the “second” rhinoceros and fragments of the “third” and the “fourth” rhinoceroses are stored at the Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences in Kraków, Poland. Since 1930 the “second” rhinoceros has been exhibited at the Natural History Museum of the above mentioned Institute (Photos 6 and 8).



Photo 4. View of recovery shaft just before transport of the “second” woolly rhinoceros in 1929. Courtesy of J. Nowak



Photo 5. Carcass of the “second” rhinoceros brought to the surface in Starunia (December 17, 1929). Courtesy of J. Nowak

Photo 6. Stuffed skin of the “second” woolly rhinoceros after post-card edited by the Polish Academy of Arts and Sciences (1930)



The skeletal remains of the “third” rhinoceros, consist of the front part of the skull (maxilla and mandible with cheek teeth) and a huge part of the vertebral column, fragments of ribs, the lower parts of the right and left limb bones.

The “fourth” rhinoceros was a young specimen. It is represented only by the left scapula.

3. The storage of the finds from Starunia

As mentioned above, the remains of the mammoth and the rhinoceroses from Starunia are stored at the two famous museums.

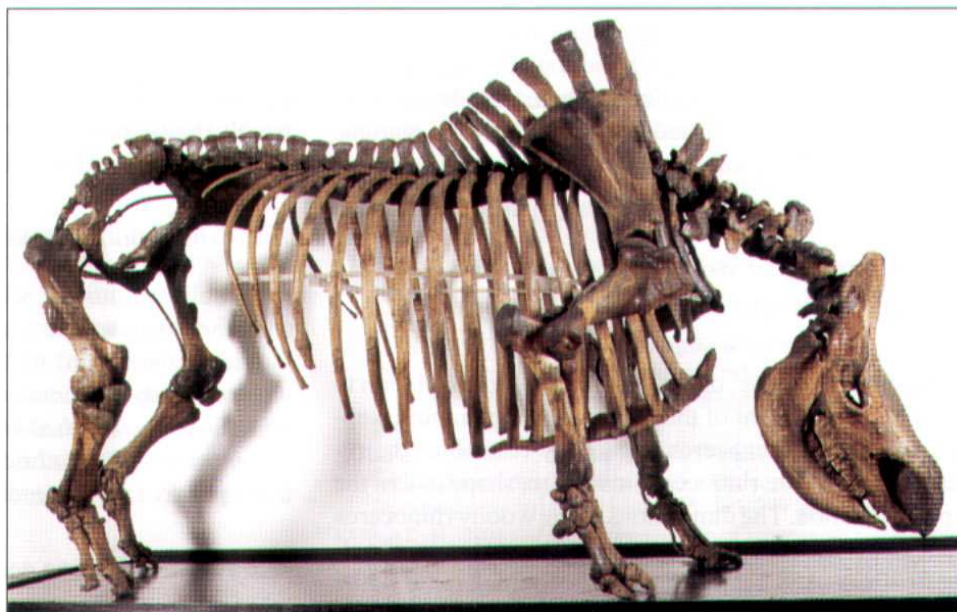
The finds from 1907, i.e. the mammoth and the “first woolly rhinoceros” are displayed at the Natural History Museum of the Academy of Sciences of Ukraine in Lviv, Ukraine. This museum was established in 1870 by the

Dzieduszycki’s Family, although collections were initiated by Count Włodzimierz Dzieduszycki (1825–1899) almost 16 years earlier (Brzęk, 1994). The mammoth and the “first rhinoceros” (1907) have been donated to the Dzieduszycki’s Museum by Mr. Julius Campe — the owner of the ozokerite mine at Starunia. The finds excavated in Starunia in 1907 still remain at the same place.

The Natural History Museum of the Polish Academy of Sciences in Kraków was founded in 1865 and owns the remains of the “second”, “third” and “fourth” woolly rhinoceroses from Starunia, discovered in 1929.

The carcass of the “second” woolly rhinoceros from Starunia was transported by train to Kraków on 22nd December, 1929. On 4th January, 1930, a plaster cast of its body was prepared showing the position in which the specimen was found. In April, 1930 the mounted hide was ready to be transported to a special room of the museum on the 3rd floor of the Academy building. In 1948, the skeleton of the

Photo 7. Mounted skeleton of the “second” woolly rhinoceros.
Photo of P. Witoslawski



“second” rhinoceros from Starunia (Photo 7) was added to the exhibition. In 1992, the Museum was moved from its location in 17 Sławkowska Street to another building in 9 St. Sebastian Street in Kraków. On 30th November, 1995 the original plaster cast (Photo 8), the mounted skeleton and stuffed skin of the rhinoceros were transported to the new building where they are still displayed.

Copies of the plaster cast of the “second” Starunia rhinoceros in its natural position in the sediment are displayed in several museums in the world, i.e. the British Museum of Natural History in London (Great Britain), the State Museum of Sciences in Tokyo (Japan), the Museum of Natural History in Mainz (Germany), the Museum of Natural Sciences in Brussels (Belgium), the Museum in Pordenone (Italy), the Museum in Cardiff (Wales), the National Museum of Prehistory in Eyzies-de-Tayac (France), and in two other Polish museums: the Natural History Museum of the University of Wrocław and the Museum of Natural History of the Bieszczady National Park in Ustrzyki Dolne.

Moreover, a copy of the mounted hide of the “second” woolly rhinoceros from Starunia is in the collection of the

Museum of Natural History (Haus der Natur) in Salzburg (Austria). In 1980, the hide was covered with sheep furs to give the visitors an idea of the appearance of a real “woolly rhinoceros”.

4. Position of the finds at the Starunia site and unique preservation of the mammoth and rhinoceros carcasses

The remains of five large mammals belonging to the two extinct species (the mammoth and the woolly rhinoceros) were discovered in a rather small area (about 8 x 3 meters) but at different depths (12.5 and 17.6 meters).

The ages of the bodies, as revealed by ¹⁴C dating, also differ significantly (47,000 and 14,000 years BC) (Kubiak, 2003; Kuc *et al.*, 2005, this volume). That means that five large mammals neither died nor were emplaced in the sediment at the same time.

The unique preservation of mammoth and rhinoceros carcasses from Starunia is a result of their embedment in



Photo 8. Gypsum cast of the “second” rhinoceros showing its original position in the sediment.
Photo of B. Czopek

a thick layer of silt, containing accumulations of ozokerite (earth-wax) and saturated with brine and oil. In comparison with Rancho la Brea (California) where only bones were preserved, one mammoth and four rhinoceroses of Starunia were found with the soft tissue preserved.

5. Comparison of woolly rhinoceros with extant species

In spite of its long, dense, dark hair — an adaptation to the cold environment of the “Pleistocene mammoth steppe”, the woolly rhinoceros apparently resembles the recent African white rhinoceros in its size, shape and in the type of nutrition. The dimensions of the woolly rhinoceros from Starunia are: total length — 340 centimeters, shoulder height — 158 centimeters (162 centimeters for white rhino), length of the head — 91 centimeters (86 centimeters for the white rhino). The square upper lip is typical of grazers, and is present in both the species. Despite the fact that the two rhino species represent substantially different environments under different climatic conditions and that the time span is about 30,000 years, very little has changed in their morphology.

6. Results of studies on hair and soft tissues of the woolly rhinoceros

Histological character of hair of the “second woolly rhinoceros from Starunia” and of the extant rhinoceroses was studied by Kubiak and Dziurdzik (1973). From the point of view of the hair structure no differences were found, despite extremely different life, climatic and environmental conditions. The five extant rhinoceros species inhabit mainly the tropical climatic zone, whereas the Pleistocene woolly rhinoceros was adapted to arctic conditions. Due to environmental and climatic conditions, the Pleistocene species had a dense hair coat, while its recent counterparts are almost hairless.

Bigaj *et al.* (1976) investigated fossil material taken from the tongue of the “second woolly rhinoceros from Starunia”. The SEM observations showed that the muscle fibers were discernible and apparently preserved. It was possible to observe traces of some vesicular structures on the cross-sections of some fibers. Collagen was best-preserved and occurred in large concentrations, particularly in the vicinity of the muscles.

7. Distribution and habitat of mammoth and woolly rhinoceroses

7.1. Remains of mammoth and woolly rhinoceroses

Remains of mammoths and woolly rhinoceroses are known from many localities in Poland and in the western part of Ukraine including over 100 finds of woolly rhinoceros

and about 300 finds of mammoth in the recent territory of Poland (Kowalski, 1959). Additionally, over 1,000 localities of mammoth remains and more than 40 localities of woolly rhinoceroses were found in the Ukrainian part of the Carpathians (Kowalski, 1959; Tatarinov, 1966).

7.2. Frozen fauna of the mammoth steppe

Woolly mammoths, woolly rhinoceroses, steppe bisons and other species were commonly found in the permafrost — the frozen soil of the far north (Guthrie, 1990). “*Yet much about these animals — the environment in which they lived, and how they died and were preserved — is unknown or controversial*” (Guthrie, 1990). It seems that this is also true in case of the large, extinct mammals from Starunia.

7.3. Flora and fauna accompanying the rhinoceros

Independent studies of Szafer (1930) and Granoszewski (2002) showed that the dwarf birch and the dwarf willows found among other discovered plants at Starunia were indications of the typical arctic tundra.

The fauna accompanying the rhinoceroses and mammoth at Starunia (Stach, 1930; Kormos, 1934; Angus, 1973) consists of many water insects, e.g. beetles and a few vertebrates (arctic owl, hares, rodents and carnivores, such as fox and polar fox). The collected fauna originates from undoubted Pleistocene deposits. Especially interesting are the insects which accompanied the rhinoceros as they are good indicators of arctic climate. Comparative studies on water beetles from Starunia and from other sites were carried out by Angus (1973). A summarized opinion about former investigations on the insect fauna from Starunia has been recently published by Pawłowski (2003).

7.4. Distribution and distinction of the woolly rhinoceros

“*Coelodonta antiquitatis is a characteristic member of the cold stage faunas in Europe. It is undoubtedly recorded from the Saalian Cold Stage but it has occurred even earlier, in the Elsterian one*” (Stuart, 1991). According to Stuart (1991) “...*During the Last Cold Stage it was distributed widely in northern Eurasia, from Britain (not Ireland) and northern Spain across most of central and southern Europe to Siberia and China. However, unlike mammoth it was absent from Fennoscandia (except Denmark) and from much of northern and northeastern Siberia. This relatively restricted range strongly suggests that it was less tolerant to extreme cold than the mammoth*”. *Coelodonta antiquitatis* survived until at least 12,500 BC in western Europe, and apparently disappeared about 12,000 BC.

8. Conclusions

New data provide the possibility to commence new excavations in Starunia and give rise to reconstruction of the accumulation history of these large mammals at a single

site. Further detailed data on the skeleton of the rhinoceroses from Starunia are necessary (paper in preparation by H. Kubiak). The DNA-studies of bone samples of the Starunia rhinoceroses should be made in order to find out whether the rhinoceroses represent the same species.

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Zbiory staruńskie w muzeach przyrodniczych Lwowa i Krakowa oraz badania paleontologiczne

Streszczenie

Niniejsza praca dotyczy historii prac wykopaliskowych, badań oraz miejsc przechowywania znalezisk wielkich ssaków plejstocenijskich ze Staruni (Ukraina Zachodnia). Na początku XX wieku, w latach 1907 i 1929 znaleziono szczątki mamuta *Mammuthus primigenius* (Blum.) i czterech nosorożców włochatych *Coelodonta antiquitatis* (Blum.) w szybach kopalni wosku ziemnego. Najbardziej znanym okazem spośród tych znalezisk jest tzw. „drugi nosorożec ze Staruni”. Został on znaleziony pod koniec 1929 roku w wyniku prac poszukiwawczych ekspedycji Polskiej Akademii Umiejętności. Nosorożec ten jest jedynym — niemal w całości zachowanym — okazem tego wymarłego gatunku na świecie. Ciało jego zostało znalezione w bardzo dobrym stanie. Ponadto znaleziono w tym samym miejscu, nieco wyżej, szczątki dwóch innych nosorożców włochatych (tzw. „trzeciego” i „czwartego”) oraz sporo szczątków ówczesnej flory i fauny, w szczególności owadów. Flora i fauna towarzyszące nosorożcom ze Staruni pozwalają nam poznać dawne środowisko życiowe i klimat tego regionu. Są one typowe dla tundry arktycznej zwanej plejstocenijskim stepem mamutowym. Wyjątkowa konserwacja znalezisk staruńskich — w szczególności „drugiego” nosorożca — jest skutkiem przesylenia szczątków tych ssaków woskiem ziemnym (ozokeritem), solanką i ropą naftową. Znaleziska ze Staruni są przechowywane w dwóch muzeach: mamut i „pierwszy” nosorożec w Państwowym Muzeum Przyrodniczym Narodowej Akademii Nauk Ukrainy we Lwowie, a „drugi” nosorożec oraz „trzeci” i „czwarty” w Muzeum Przyrodniczym Instytutu Systematyki i Ewolucji Zwierząt Polskiej Akademii Nauk w Krakowie. Kopie odlewu gipsowego ciała „drugiego” nosorożca znajdują się w znanych muzeach wielu krajów. W latach 30. XX wieku wykonano wstępne badania geologiczne, paleozoologiczne, anatomiczne i florystyczne. Po drugiej wojnie światowej kontynuowano badania „drugiego” nosorożca. Poznano m.in. strukturę włosów, histologię miękkich tkanek oraz wiek określony metodą ^{14}C . Na zakończenie niniejszego opracowania przedstawiono uwagi ogólne dotyczące porównań nosorożców dzisiaj żyjących z gatunkami wymarłymi.

Стару́нські колекції у природничих музеях Львова і Кракова та палеонтологічні дослідження

Резюме

Дана публікація стосується історії розкопок, досліджень та місць захоронення великих плейстоценових ссавців у Старуні (Західна Україна). На початку XX століття, в 1907 і 1929 роках, знайдено рештки мамонта *Mammuthus primigenius* (Blum.) і чотирьох волохатих носорогів *Coelodonta antiquitatis* (Blum.) у виробках озокеритової шахти. Найвідомішим екземпляром серед цих знахідок є так званий „другий носоріг із Старуні”. Він був знайдений в кінці 1929 року в результаті пошукових робіт експедиції Польської Академії Вміння і є єдиним у світі майже повністю збереженим екземпляром цього вимерлого виду. Тіло його було знайдене в дуже доброму стані. У тому ж місці трохи вище було знайдено також рештки двох інших волохатих носорогів (так званих „третього” і „четвертого”) та багато решток тогочасної флори і фауни, зокрема комах. Знайдена разом із носорогами у Старуні фауна та флора дозволяє пізнати давнє довкілля і клімат цього регіону, які були типовими для арктичної тундри, названої плейстоценовим мамонтовим степом. Виняткова консервація стару́нських знахідок, зокрема, „другого” носорога, є наслідком насичення решток цих ссавців земним воском (озокеритом), розсолами та паром нафти. Знахідки із Старуні зберігаються у двох музеях: мамонт і „перший” носоріг — у Державному природознавчому музеї Національної Академії наук України у Львові, а „другий”, „третій” та „четвертий” носороги — у Природничому музеї Інституту систематики і еволюції тварин Польської Академії наук в Кракові. Копії гіпсового зліпку „другого” носорога зберігаються у відомих музеях багатьох країн. В 30-х роках XX століття були проведені загальні геологічні, палеозоологічні, анатомічні і флористичні дослідження. Після другої світової війни продовжено дослідження „другого” носорога. Вивчено, зокрема, структуру шерсті, гістологію м'яких тканин, а також вік за ^{14}C . Завершується публікація загальними зауваженнями щодо порівняння сучасних носорогів із вимерлими видами, а також періоду існування і часу вимирання волохатого носорога.