THE CONCEPT OF SPECIES
AND ITS ROLE IN PALAEONTOLOGY

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Abstract. This article discusses the concept of palaeontological species or morphospecies. This concept is fundamental in the theory and practice of palaeontology, as well as in the life and Earth sciences. The concept is approached from a geological and biological point of view, demonstrating its significance in understanding biological and geological processes.

Key words: evolution, palaeontological species, morphospecies, biological species.

Résumé. L'article met en discussion un ancien problème taxonomique : le concept d'espèce biologique (bio-espèce) dans la taxonomie paléontologique (paléo-espèce). À cause du fait que les fossiles représentent seulement le squelette ou les fragments d'un squelette qui conserve seulement des impressions de la partie vive c'est-à-dire il ne peut pas répondre à toutes les exigences demandées pour la validité d'une bio-espèce, le concept de paléo-espèce n'a pas une valeur taxonomique. Les études paléontologiques ont démontré que les fragments d'un squelette ou d'une coquille minérale conserve des caractères essentiaux, utiles pour taxonomie. C'est-à-dire, la paléo-espèce n'est qu'une bio-espèce fossile, indispensable pour suivre l'évolution de la vie le long du temps géologique. En micropaléontologie cette doute presque disparaît parce que le squelette (la coquille) représente une copie de l'animal vif.

Mots-clés: evolution, espèces paléontologiques, morphoespèces, espèces biologiques.

BIOLOGICAL SPECIES

The concept of species is used in Biology in three ways:
1. taxonomical, as a small or large systematic unit;
2. conceptual, as an abstract notion, referring to all types of taxa;
3. hierarchical, referring to the self-organizing level of matter.

Beginning with the 17th century (1680), John Rey introduced for the first time the species concept in his book *Historia plantarum*. He defined it as "a group of similar and interbreeding organisms producing similar descendants, with similar morphological and physiological characters".

Opposing this concept, Carl Linnaeus considered at the same time that species were created by a Creator from the beginning, introducing the creationist theory. This theory will dominate biology for more than a century. In the same time, Earth sciences developed intensively as part of natural sciences and many fossils were found often. In the light of the creationist theory, such fossils were considered *ludus naturae*, defined as unsuccessful prototypes during creation. The mystery of such fossils or *ludus naturae* was definitively solved by Charles Darwin (1859), in his work *Origin of species*. Such a book described and demonstrated the species evolution in a logical sense, during geological time and environmental change. During this evolutionary process, new species evolve or disappear, as adaptation takes place. In this theory, the fossils gained their place in today's understanding of the world.

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The clearest and most eloquent definition of the biological species concept belongs to Zawadski (1969), cited by Botnariuc (1979): "the species is a fundamental form of existence of life, a populational level of organizing of the living matter, as a system controlled historically and subject to natural selection. The species has self-reproduction, evolution and long existence capacities, and it represents the fundamental unit of the evolutionary process. The species is contradictory by itself, as a result of evolutionary processes, it has a temporary stable condition, different of other groups (discrete). As a nodal subject of evolution, the species is less defined, it has a composed character, it is unstable, polymorph and it has imprecise limits".

This biological concept is entitled biological species, a concept applied to all living organisms which show development and which have defined cellular characters. In this way, the necessary characters for defining a fossil species are missing, especially the nucleus and chromosomes, which are fundamental elements in transmitting characters through sexual reproduction.

PALAEONTOLOGICAL SPECIES

The palaeontological species is defined by the skeleton which supported or protected the living matter, and this is why some biologists think that the palaeontological species has no living support for justification, as it refers only to the skeleton. This opinion generates a false idea that the morphospecies (or palaeontological species) is only a concept corresponding to a partial perception of the biological species. This is an erroneous concept. The morphospecies is the undeniable result of the initial activity (nucleus, chromosomes) which defined the initial characters of the skeleton, and therefore preserving essential characters of the living organism. The logical conclusion of this observation is that the morphospecies (or palaeontological species) is an accurate copy of the living organism which has generated it. The existence and preservation of the morphospecies generates the material studied in palaeontology and inclusively in palaeontology. In this way, palaeontology becomes palaeobiology, serving the better understanding of the living species. The fossil is the fundamental document for the basis of origin and evolution of life.

Charles Darwin (1859) formulated clearly and convincingly that the origin and evolution of species is demonstrated by fossils, without appealing to an initial "Creator". The morphospecies has an essential value in understanding the evolution of species during millions of years. Since the second half of the 19th century and during the 20th century, genetics confirmed characters that the morphospecies already demonstrated based on well preserved skeletons. These fossils are the connection to the past and proofs of evolution of today's living organisms.

Characters of different species proved to be accurate biological and geological clocks, permitting palaeontologists to understand the evolution of life on Earth and to understand moments of biological crises. Besides, palaeontological studies also permitted a better understanding of the main phases of crustal evolution. The morphospecies allowed to calibrate the stratigraphical scale for the benefit of stratigraphy and historical geology.

The palaeontological studies supported the identification of marker species which are essential for identifying the age of rock formations. Species associations, defined as biozones, also permitted precise dating of the rock formations, with special applications in drilling and not only. Studying the micropalaeontological content, especially of foraminifers, of oceanic drill cores meant the changing of geological thought related to the Tertiary evolution of the terrestrial crust. Based on these marker species, the continental drift was demonstrated. This theory was introduced by Wegener during the first half of the 20th century as the plate tectonics. In biology, the floral and faunal vicariance cannot be understood without palaeospecies.

The morphospecies also demonstrated its special value for understanding species distribution and the palaeonenvironmental conditions of terrestrial and marine realms. Another role, equally important, is in demonstrating the process of radiative and adaptative evolution, as Kovalesvki showed in the 19th century.

The palaeontological species demonstrated its usefulness in the frame of life sciences. The morphospecies also has a remarkable value for understanding marine and terrestrial palaeoenvironments, also using mineralogical proxies, and for proving radiative (adaptative or inadaptative) evolution from species to higher taxa levels. This process is easier to follow in the case of marine or terrestrial vertebrates, and it was demonstrated by the Russian palaeontologist Kovalevski.

Although harder to follow, this process can be traced also in the case of marine invertebrates, with supplementary efforts. This is the case of Turonian foraminifers of the southern eastern Carpathians belonging to the *Clavulinoides* group. This group starts in the Vraconian (the Biozone with *Rotalipora apenninica*), with *Clavulinoides gaultinus* Morozova 1948. From this moment up to the Upper Senonian, this elusive evolutionary process could be clearly traced for independent genera and species, illustrated in Plate I.

The most important economic application of palaeontological species, especially for the marker species, was discovered and developed in oil prospecting and exploration, for designing drills. In conclusion, the palaeontological species is a real research tool with identical significance with the biological species, although the first has only a small part of the initial organism which generated the skeleton. It can be used as a scientific instrument in palaeontology, in the same way the biological species is used, without doubt. The palaeontological species is an indispensable tool for understanding and perfecting the taxonomy and nomenclature, in the same way the biological species is used for modern plant and animal species.

Microbiostratigraphy is based on the study of microfossils, such as protozoans and microscopic metazoans. It is a rather new branch of Earth sciences, especially generated for prospecting, exploring and extraction of oil. It is also applied for detailed geological mapping, for continental drift, for precision dating of lithological units and in field geology, where correct dating of formations is essential, especially for oil industry. In this field, the marker species is fundamental.

For these practical reasons, first of all, and for scientific reasons, a new branch of palaeontology was born, named micropalaeontology, which also generated microbiostratigraphy. The morphospecies or palaeontological species is an extremely useful tool, real and indispensable for Earth and life sciences. It is not representing *ludus naturae*, but a valuable tool for biology and geology as a whole. The nomenclature and taxonomy of living plants and animals is based on the species concept, and the process of evolution cannot be understood without palaeontological species.

In conclusion, the species concept is fundamental for the study of sedimentary formations and at the same time it is extremely useful for following the evolution and origin of the modern species (biospecies).

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EXPLANATION OF THE PLATES

Radiate evolution to the foraminifera *Clavulinoides gaultinus* (MOROZOWA) 1948

Fig. 0 "*Clavulina gaultina* MOROZOWA 1948, holotype-Albian Soci area (copy after Morozowa 1948, pl. 1, fig. 4).
Characters of the test (holotype pl. 1, fig. 4)
– early stage; triserial pyramidal;
– last stage: uniserial, moniliform,
– chambers: globulous with moderate depressionary sutures;
– terminal: central circular, aperture on a short neck.

Figs. 1–7–15 *Clavulinoides gaultinus gaultinus* (MOROZOWA) typical radiation;

Figs. 18–19 Variation (from the Middle-Upper Turonian) with the strong development of the biserial stage (5–6 chambers), followed by the adult uniserial stage. Variation in parallel with the typical specimens (new taxa?, new species or genus?)

Figs. 19–23 (a second radiation of evolution) from the Cenomanian. The specimens present the holotype characters but with an robust aspect).

Fig. 17 (from the Lower Turonian) shows a tendency of the triserial keels to extend on the uniserial chambers which become still with a rounded outline).

Figs. 18–29 The unserial chambers become more triangular in outline.

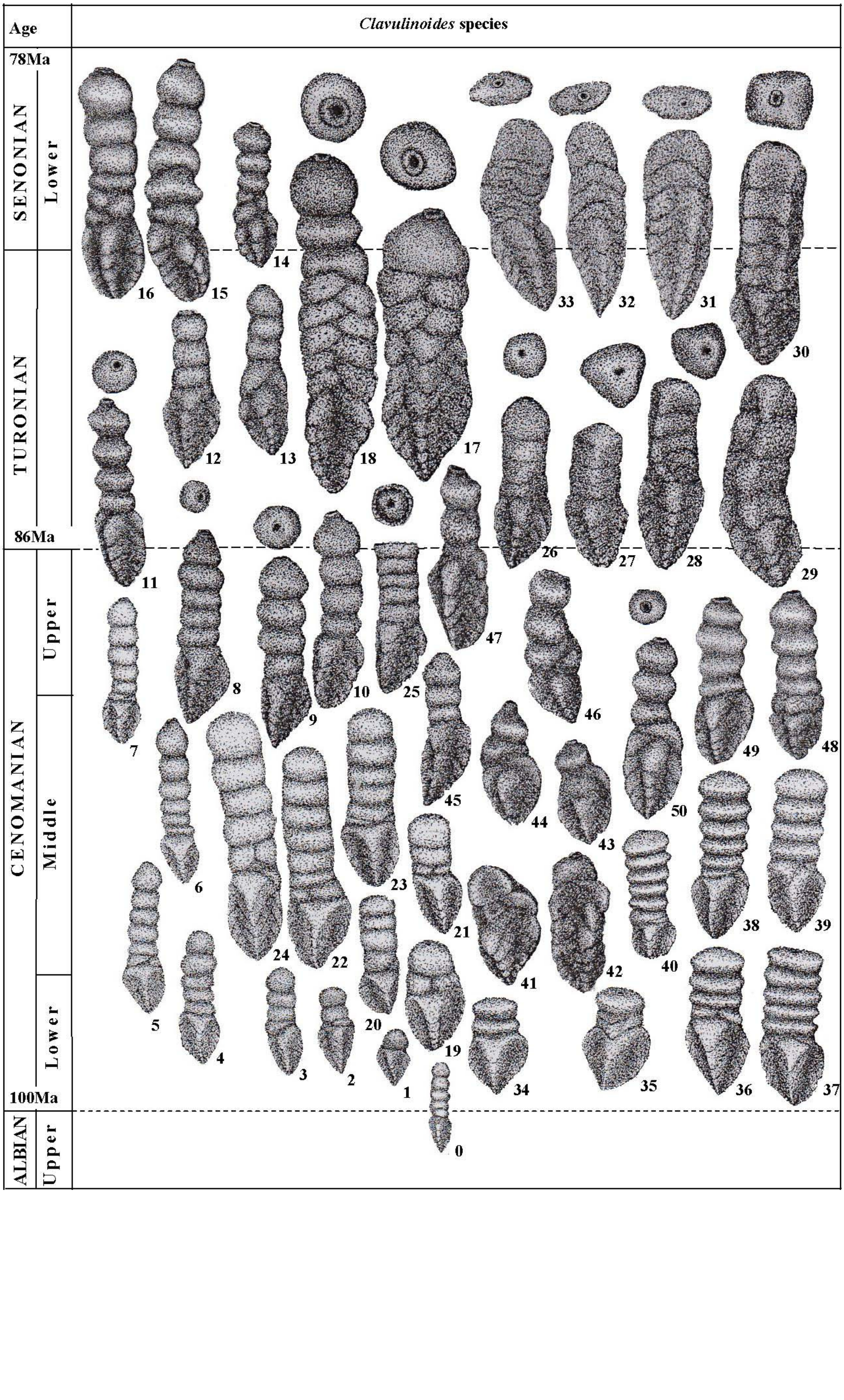
Figs. 28–29 The unserial chamber become more triangular in section.

Fig. 30 The uniserial chambers got a rectangular outline with a rounded central aperture (*Clavulinoides* cf. *asper-whittei* CUSHMAN & JARVIS 1932, only fig. 6).

Figs. 31–33 The uniserial chambers become flats, with arcuated suture and an elliptical outline (*Spiroplecta jackeli* FRANKE 1925)

Figs. 34–40 A third inadaptive radiation only with a robust test but with low chambers and deep sutures, only in the Cenomanian (lower to middle).

Figs. 4l–50 An inadaptive group of *Clavulinoides gaultinus gaultinus.*


Age
Clavulinoides species
78Ma
SENONIAN
Lower
TURONIAN
86Ma
CENOMANIAN
Upper
Middle
Lower
100Ma
ALBIAN
Upper
0
1
2
3
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