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Note from the Editor

The present issue of the Acta Zoologica Cracoviensia is dedicated to Professor Dr. Marian MŁYNARSKI on the occasion of his retirement. The seventeen articles gathered in this volume are devoted to different fields of herpetology. A greater part of them, however, deals with the fossil history of reptiles and amphibians, the subject especially familiar to Professor MŁYNARSKI. The contributors to this volume, each outstanding experts in their field, are mostly friends or former collaborators of Professor MŁYNARSKI. The articles are arranged in order of reception.

It is a pleasure for the Editor to express cordial thanks to all the authors for their contribution. At the same time, I apologize to those who volunteered papers to this volume, but who could not deliver them in appropriate time. Finally, I am indebted to Professor Kazimierz KOWALSKI, the long-time director of the Institude of Systematic and Experimental Zoology, for this excellent essay about the career of Professor MŁYNARSKI.

Cracow, March 1987 Zbigniew Szyndlar

Prof. Dr. Marian Młynarski enjoying his retirement

Phot. M. Zemanek

Professor Dr. Marian Młynarski

Marian MŁYNARSKI was born on the 29th of January, 1926, in Warsaw. His scientific interests were part of his familial tradition: his father, Feliks MŁYNARSKI was an outstanding economist. Before the war he had been the president of the Financial Committee of the League of Nations in Geneva, later the professor of economy and a member of the Polish Academy of Sciences and Letters. Feliks MŁYNARSKI, by his education, was a philosopher, in his youth and during the second world war again he was active in the political movement for an independent Poland. The mother of Marian MŁYNARSKI, Maria (her maiden name EYSSYMONT) was a singer, she had been living for over a dozen years in New York with her first husband Antoni ZAJĄCZKOWSKI. It was after his death that she came back to Poland and in 1917 was married to Feliks MŁYNARSKI.

At the outbreak of the second world war in 1939 Marian MŁYNARSKI had only finished the primary school and has just started his studies in the secondary school. His scientific interests, at that time, were manifested by breeding reptiles in his terrarium. This did not necessarily presage his future herpetological career.

During the German's occupation of Poland all secondary and high schools were closed, but a system of clandestine education was widely developed. Pre-war teachers, in spite of strict injunctions and the danger of punishment were continuing their teaching in private flats for small groups of young people of every, even academic level. Marian MŁYNARSKI took part in such courses, at first in Warsaw, and later in Cracow where his family has moved. In the last year of the war he joined the clandestine Scouts movement, which was part of the underground Home Army. After the war he received some awards for his participation in it.

He appeared to be more unabating in his interests in nature than many boys of the same age who had also been interested in the breeding of animals. During the occupation Marian MŁYNARSKI had already made contact with the institution where he later spent his entire professional career. It was the Physiographic Museum of the Polish Academy of Sciences and Letters in Cracow. Though the activity of the museum, as with the whole Academy, was broken,

the scientific collections remained and the German authorities employed part of the pre-war staff to preserve them. Some scientists from the Jagiellonian University were employed there, among them professor Roman J. WOJTUSIAK. Marian MŁYNARSKI had come to the professor to volunteer his help and received the task of preserving the famous specimen of the Pleistocene rhinoceros from Starunia. This specimen had been found before the war in the Carpathians. It was preserved with the shin and other soft tissues and was the most precious specimen in the museum. The possibility of work, even only as an unpaid assistant, but nevertheless in a scientific institution, must have made a great impression on Marian MŁYNARSKI. Just before the end of the war, when the front line was approaching Cracow, he was removing the museum collections to the cellars. Fortunately Cracow, and with it the building of the Polish Academy of Sciences and Letters containing the museum were not destroyed.

The end of the war and the German's occupation made it possible for Marian MŁYNARSKI to finish his secondary school receiving his certificate in 1946. Immediately after that he entered the biology department of the Jagiellonian University. At the same time he continued his work at the museum (called now the Museum of Natural History) helping with the preparation of the first post-war exhibition. Up to 1949 he also continued his activity in the Scouts movement. During his studies he was also active in the Institute of Animal Psychology of the Jagiellonian University which was headed by professor Roman J. WOJTUSIAK. His first two works were the result of the contact of his herpetological interests with the current questions being raised at the Institute. One of these works was his Master's thesis, and both were concerned with the problem of visual discrimination in pond tortoises

Marian MŁYNARSKI had finished his Master's studies in 1951 and he started to work as a permanent employee in the Museum of Natural History of the Polish Academy of Sciences. As it was mentioned previously he worked there up to the time of his retirement in 1986. During his career the institution saw several changes of name and association: when the Polish Academy of Sciences was formed in Warsaw it was a section of the Warsaw Institute of Zoology of the Polish Academy of Sciences, then it separated as the Institute of Systematic Zoology, and finally it became the Institute of Systematic and Experimental Zoology of the Polish Academy of Sciences. Parallel to his rise within the Institute Marian MŁYNARSKI also steadily rose up in his scientific degrees. In 1956 he obtained from the Jagiellonian University his doctoral degree in zoology, in 1961 he qualified as an assistant professor at the Copernicus University in Toruń, in 1969 he was made an associate professor and in 1976 — full professor.

In 1951 Marian MŁYNARSKI got married to Maria (her maiden name CHROBAK), a physician, who worked later for many years in the field of human physiology. They had two children. Their daughter Barbara is working now as a physician. Their son Jan Kajetan is continuing in the footsteps of his father and works

as an entomologist in the Institute of Systematic and Experimental Zoology in Cracow.

Marian Młynarski took part in all the works and in the realization of all the projects of this Institute. In the years 1960—1986 he was the head of the Vertebrates Laboratory and from 1965 to 1972 the assistant manager of the Institute for scientific affairs. In behalf of the Institute he was also leading the research concerned with the history of Polish fauna, within the framework of a larger project to study the animal world of Poland. He was and is still a member of the Institute Scientific Council and of the editorial board of the journal Acta Zoologica Cracoviensia. He was, as the editorial secretary, one of the main powers in editing the whole of "The Keys for the Identification of Vertebrates of Poland" in the years 1960—1971. Apart from his official duties he was involved in all the activities of the Institute whether they were the paleontological excavations, the protection of the collections and the organization of scientific meetings. He served there not only by his knowledge, but he also shaped the style of the work, and presented a model of attitude of which was followed by his younger fellow-workers.

Obviously the essential part of the many years of work at the scientific institution was the research done. The nearest to his heart were turtles. He was interested in everything that was connected with them. Primarily though in paleontology, systematics, zoogeography and evolution. As the chief of the Vertebrates Laboratory he presided with a great volubility and humour at the meetings, where the scientists were reporting their works. Everybody knew that irrespective of the theme of the report, at the end of the discussion Marian Młynarski would rise to speak and with reference to the matter under discussion he would include something about turtles. The main work of Marian Młynarski was the description of fossil remains of the turtles from Poland. Soon, his qualifications within this field were recognized and specimens coming from different countries were sent to him. Therefore his scientific descriptions included the samples from Czechoslovakia, Hungary, Romania, Austria, Greece, the German Democratic Republic, Federal Republic of Germany, the Soviet Union, Tunisia, China and Mongolia. In some cases the descriptions dealt with large collections, as it was in 1966 when he described the whole of fossil remains of turtles from Hungarian localities. The sum of his knowledge about fossil turtles was recorded, first of all, in three publications: in 1969 in his book about fossil turtles, which was included in the series called "Die Neue Brehm-Bücherei", in 1976 in the volume concerning *Testudines* which appeared in the international edition "Handbuch der Paläoherpetologie" and lastly — narrowing his scope with reference to the time period and geography dealt with — the key to determining the remains of Pleistocene turtles from Middle and Eastern Europe in "Folia Quaternaria" (1980).

Marian Młynarski was interested not only in the turtle paleontology. Besides his early works about visual perception of turtles, which we discussed

above, he also wrote about the European pond terrapin's distribution in Poland and he was active in the preservation of this vanishing species. In some of his works he discussed also the morphology of the shell of fossil and recent turtles. He also described the finds of turtle shells from archeological excavations and was especially interested in the connections between these animals and man. Many original remarks upon the biology of turtles are contained in his description of the herpetofauna of different regions and in his books for general readers. The summary of knowledge about recent turtles is the chapter, written in co-operation with H. WERMUTH, in "Grzimek's Tierleben" published in 1971.

Marian MŁYNARSKI was always interested in all the problems concerned with amphibians and reptiles of Poland, both extant and extinct. For many years he was the only herpetologist interested in fossil remains from this country. As the consecutive discoveries and the exploration of fossil localities from the Neogene and Pleistocene were done, he described scientifically all of the amphibian and reptilian remains which were unearthed. In later works he was joint in different fields of herpetology by other specialists, in particular Z. SZYNDLAR from Poland, B. SANCHÍZ from Spain, R. ESTES from the U. S. A. and C. VERGNAUD-GRAZZINI from France. These studies have shown the presence of many amphibian and reptilian species which up till then were unknown from this part of Europe. They made it possible to describe many new species, have thrown the light on the ecological conditions of the past and on the process of formation of present European fauna. From time to time Marian MŁYNARSKI recapitulated the actual state of knowledge about the fossil herpetofauna of Poland.

Obviously, also in this field of research he did not restrict himself to Poland. In company with H. ULLRICH he described the reptilian bones from the Burgtonna travertines in East Germany, with F. BACHMAYER the fauna from Kohfidisch in Austria. He also covered the field of herpetology in the collective description of the fossil fauna from the Bacho Kiro cave in Bulgaria.

Besides paleontology Marian MŁYNARSKI was interested in the modern amphibian and reptilian fauna of Poland. He has done, in this field, original studies as well as syntheses. To this first group belong, except for the previously mentioned works about the European pond terrapin, the papers about the melanistic specimens of grass snakes from the Bieszczady Mountains and the descriptions of amphibians and reptiles from the national parks of the Tatra Mountains (1962), the Pieniny Mountains (1966), and of Ojców (1977). But the most important, in this scope, was the volume about reptiles in the "Keys for the Identification of Vertebrates of Poland" (1960). He was also the co-author of the volume about amphibians and reptiles in the series "The Catalogue of Fauna of Poland" (1969).

Much original data are contained in his works about amphibians and reptiles of Poland addressed to wide circles of readers. Marian MŁYNARSKI was

a good popularizer. His first book "Among jararacas and rattlesnakes" (1962) contains his impressions and observations from his trip to Brazil and his stay in the Butantan Institute. The book sold out quickly and for many readers was an encouragement to take an interest in natural history. To the general readers was also addressed an atlas of amphibians and reptiles of Poland, which was printed for the first time in 1967, and which has after had four editions, moreover, the books about reptiles (first edition in 1958, second edition in 1971) and about amphibians of Poland (1976). Marian MŁYNARSKI has also written the entries about herpetology for the Polish Great Universal Encyclopaedia edited in the years 1962—1970. He was the author of many popular articles and he gave lectures on various problems of herpetology in front of very different audiences. He co-operated in the realization of educational films and was preparing radio programmes. He recognized the importance of zoological gardens, was active in the Scientific Council of the Cracow Zoo, and was cooperating with all other Polish zoological gardens possessing collections of reptiles.

Marian MŁYNARSKI, who has been for many years leader of Polish herpetology, has obviously been the protector and mentor of many scholars who are now active in this field. Sometimes he cared for Master's theses, some other time it was the formal participation in doctoral and "habilitation" procedures, but most often — the advice in conversations and letters, a comprehensive help in all the problems connected with the work. To this sphere of activity we may include his work in the Herpetological Section of the Polish Zoological Society bringing together professional research workers as well as amateurs in this field of zoology. Marian MŁYNARSKI was the moving spirit in the creation of this section in 1968, he was its president as well as organizer and president of its Cracow branch.

Marian MŁYNARSKI was well-known internationally. In 1957 he was in Brazil for one year, where in the Butantan Institute in São Paulo under the leadership of Dr. A. R. HOGE he studied ofiology. In 1959 he was working for two months in Paris under the leadership of Prof. R. HOFFSTETTER. Since 1964 he has been in close co-operation with the herpetologists from Czechoslovakia and since 1976 he has been working with Prof. F. BACHMAYER from the Naturhistorisches Museum in Vienna. Many times he went to different European countries. He is a member of several foreign scientific societies. He entertained in Cracow many herpetologists coming for long or short visits for co-operative works or for scientific discussions.

In 1983, in Paris, there was held the first international symposium devoted to fossil turtles. It was agreed at the symposium to create the World Paleochelonіological Association and Marian MŁYNARSKI, one of the initiators of the symposium, was elected its first president.

Marian MŁYNARSKI retired at the age sixty, mainly because of recurrent eye disease. But he has not finished his scientific work and is still working

on the biology and preservation of the European pond terrapin in Poland, and on fossil reptiles. Since 1986 he has been a member of the Committee for the Preservation of Animals in the National Council for the Protection of Nature in Poland, where he is engaged in the preservation of reptiles.

All his fellow-workers and students hope that he will be active in his research for a long time to come.

Kazimierz Kowalski

Chronological bibliography of the publications of Marian Młynarski

This bibliography lists exclusively scientific papers and books. Numerous popular articles, book reviews, biographies, obituaries, symposium abstracts and similar items are largely omitted from this list.

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Robert L. CARROLL

An articulated gymnarthrid microsaur (*Amphibia*) from the Upper Carboniferous of Czechoslovakia

[With plate XII and 2 text-figs]

Szkielet *Gymnarthridae* (*Amphibia, Microsauria*) z górnego karbonu Czechosłowacji

Abstract. A newly discovered skeleton of the Upper Carboniferous gymnarthrid microsaur *Sparodus* demonstrates that the presacral vertebral column is much shorther than that of the Lower Permian genus *Cardiocephalus* and that the skull is both relatively and absolutely larger. The proportions of *Sparodus* are somewhat closer to the pattern of early labyrinthodonts, but the anatomy of the skull and vertebral column are already typical of the pattern in later microsaurs. Trunk intercentra may be derived within the *Gymnarthridae*, rather than being a primitive feature of that group.

I. INTRODUCTION

Amphibians may be divided into three informal groups: (1), the lissamphibians, including the living orders *Anura*, *Urodela*, and *Gymnophiona*, (2), the labyrinthodonts, including primitive Paleozoic genera with multipartite vertebral centra and (3), the lepospondyls, a heterogeneous assemblage of more derived Paleozoic groups, characterized by small body size and holospondylous vertebral centra. The nature of the interrelationships of these groups remains unresolved.

Microsaurs are the most diverse of the "lepospondyl" amphibians, and some families have long geological ranges and show considerable anatomical variation (CARROLL and GASKILL, 1978). The longevity of individual lineages may provide a basis for establishing the polarity of traits within the group and so help in determining their relationships with other early tetrapods.

Gymnarthrid microsaurs are fairly common in the Lower Permian of Texas and Oklahoma. Most specimens are known from isolated skulls and scattered postcranial remains, but *Cardiocephalus peabodyi* is known from a nearly complete, articulated specimen. It has 38 presacral vertebrae and relatively small

limbs. Poorly preserved material from the Upper Carboniferous of Joggins, Nova Scotia and Nýřany, Czechoslovakia have been attributed to this family, but provide little information regarding the body form of early members of this group. In the spring of 1982, an undescribed specimen was located in the collection of the Natural History Museum in Vienna, including a nearly complete skeleton in which the skull and much of the trunk region are in close association although somewhat disarticulated (specimen no. 1899-III-6). The massive palatal and coronoid dentition suggest close affinities with the Permian gymnarthrids, but the trunk is clearly much shorter than in *Cardiocephalus peabodyi*, with approximately 25 presacral vertebrae. Several other primitive features of the postcranial skeleton suggest that *Sparodus* may provide a good model for the pattern of primitive gymnarthrids, and give some hint of the morphotype from which other microsaur groups evolved.

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II. DESCRIPTION

The skeleton is preserved in a single slab (pl. XII). There may originally have been a counterpart, but it could not be located. In contrast with much of the material at Nýřany, the bone is fairly well preserved so that it can be studied directly. Many specimens from Nýřany lack the original bone and must be studied from casts. The back of the skull and some other elements of this specimen are preserved as natural molds and these areas have been cast in latex so as to reconstruct the original surface.

The skull is approximately 33 mm in length. It is exposed primarily in ventral view, showing the front of the palate and an impression of the back of the skull roof. The left jaw is exposed in ventral view. Much of the bone surface is broken and most of the back of the palate is missing.

The back of the skull roof, studied from a latex cast (Fig. 1), closely resembles that of other gymnarthrids in the pattern and proportions of the bones. The surface is almost smooth, with only faint radiating lines to show a vestige of sculpturing. The pineal opening is small, but definitely retained. There is no trace of lateral line canal grooves.

The jaw articulation is far anterior to the posterior margin of the skull table. There is too little of the palate preserved to provide a measure of the normal width of the skull which is flattened into a single plane and clearly much wider than in the living animal.

As in another Carboniferous gymnarthrid, *Leiocephalikon* (CARROLL, 1966),

the palatine bones are covered with large teeth, the most massive of which lie close to the marginal dentition. Two posterior teeth are the largest, matching those in the coronoid bone of the lower jaw. Most are sharply pointed, but some are blunted with wear. Such very massive teeth are not present in Permian gymnarthrids, but they are accentuated in the genus *Pantylus*, which belongs to a distinct, but possibly related family (CARROLL, 1968; ROMER, 1969). A long narrow anterior process is the only portion of the pterygoid that is preserved. It bears large denticles along its medial margin. The expansion of the skull behind the jaw articulation provides much more space for the adductor musculature than in primitive tetrapods.

Most of the marginal teeth were broken off at the time the block was split, and others are preserved only as impressions. Where the tips are preserved, they are sharply conical and strongly fluted. The very extremity of some teeth is laterally compressed, but this feature is much less well developed than in the Lower Permian genera. There are 4 slender teeth in the premaxilla and approximately 11 in the maxilla. That in position 4 is the largest.

The left lower jaw is in place, but much of the lateral surface is lost, obscuring the position of most sutures. The splenial is exposed laterally as a narrow splint of bone extending back from the symphysis. A striking feature is the presence of two huge coronoid teeth. These may be derived from the coronoid fangs common in rhipidistians, but substantial teeth are lost from the inside surface of the lower jaw in most labyrinthodonts. There is room for approximately 13 teeth in the dentary, most of which are in place. The dentary lacks the distinct coronoid process that is present in Lower Permian gymnarthrids, but the low level of the jaw articulation provides a sloping line of insertion for the adductor musculature that has the same effect as the coronoid process in enhancing its mechanical advantage in jaw closure. No submeckelian or other medial foramina is visible in the lower jaw.

Twenty-three vertebrae may be accounted for, extending in a partially articulated string behind the skull. The last is immediately anterior to a clearly identifiable sacral rib. One other vertebra, either trunk or sacral, lies approximately 3 cm behind the sacral rib. The close association of the vertebrae, ribs and limb elements suggests that the column is substantially complete, although the very distinctive first cervical, diagnostic of microsaurs, cannot be identified. One or two more vertebrae may originally have been present, but it is very unlikely that they were nearly forty as in *Cardiocephalus peabodyi*. Twenty-five are shown in the restoration. The trunk is only about 2.5 times as long as the skull.

The individual vertebrae have one piece cylindrical centra, fused to the neural arch. A faint thickening marks the line of attachment. There are no vestiges of intercentra, nor any space between the centra for their articulation. The centra are thin walled and would show a clearly hourglass appearance in cross section. They exhibit not a trace of their presumed derivation from the multipartite vertebrae of labyrinthodonts and many rhipidistians. The surface

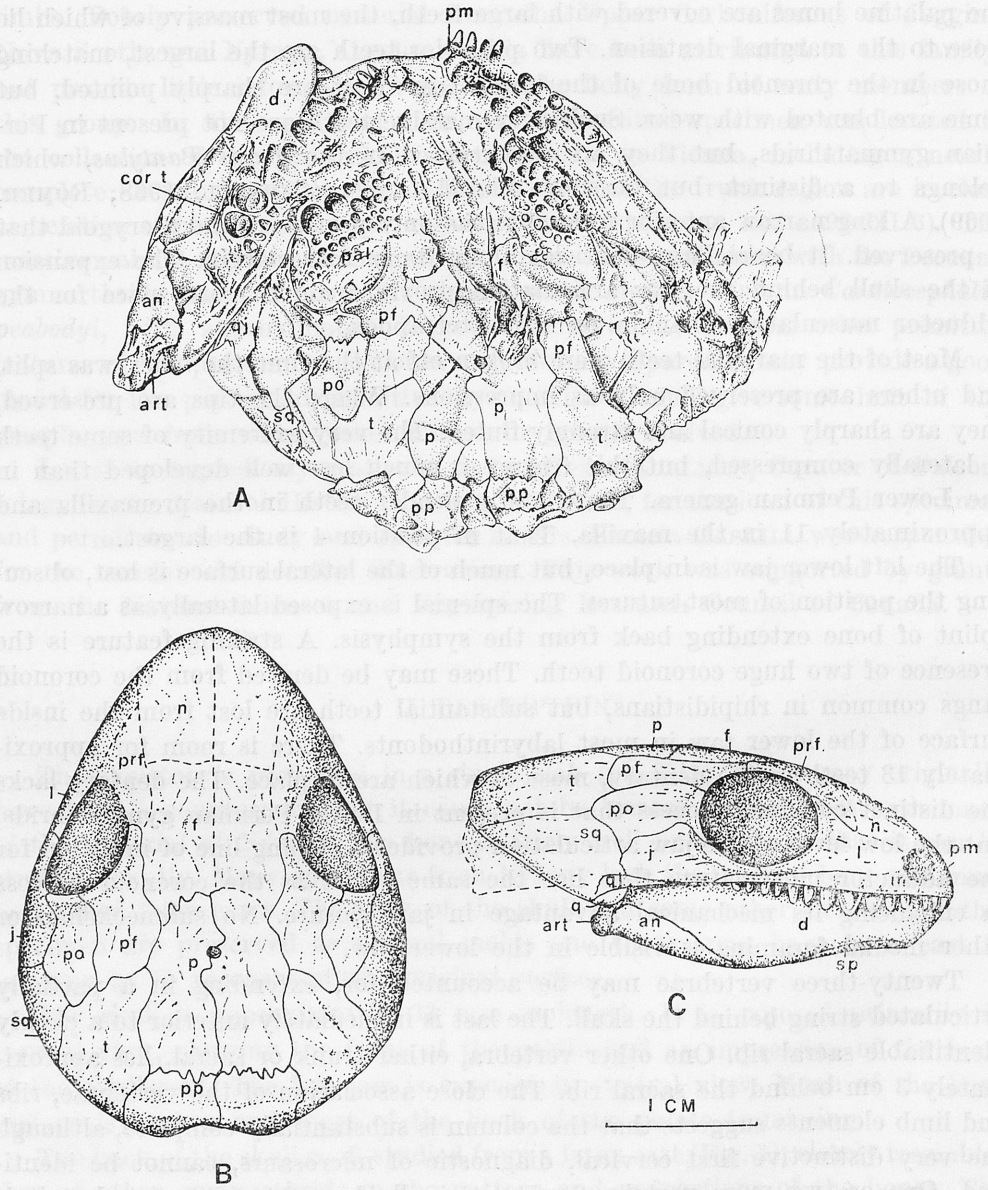

Fig. 1. Skull of *Sparodus validus*. A — Drawing based on latex cast of the skull, showing the anterior portion of the palate as an impression. B — Reconstruction of the skull in dorsal view. C — Reconstruction of the skull in lateral view. Abbreviations: an — angular, art — articular, cor t — coronoid teeth, d — dentary, f — frontal, j — jugal, l — lacrimal, m — maxilla, n — nasal, p — parietal, pal — palatine, pf — postfrontal, pm — premaxilla, po — postorbital, pp — postparietal, prf — prefrontal, q — quadrate, qj — quadratojugal, sq — squamosal, sp — splenial, t — tabular

of the arches is broken and crushed, obscuring the short transverse processes and the presumably separate area for articulation with the capitulum. The size and configuration of the vertebrae appear to be similar throughout the trunk.

A large and distinctive sacral rib is in place behind the last articulated presacral vertebra, but the sacral vertebra(e) is (are) not in place. A small centrum anterior to the skull might bé a caudal, but there is little evidence that it belongs with this animal (pl. XII: C).

Approximately 40 ribs are present in the block, although some are far removed from the vertebral column and may not belong with this specimen. Most of the cervical ribs are more or less in their natural position on the right side. Four ribs are seen that increase progressively in size posteriorly. On the left side are two shorter elements that may be tentatively identified as the first pair of cervical ribs. All these ribs have very widely separated heads, and shafts that expand gradually toward their distal extremity. The sixth rib approaches the condition of the typical trunk ribs, without the distal expansion of the cervical elements. The length of the anterior ribs increases progressively to reach a maximum near the center of the trunk, and then decreases posteriorly. The last 4 trunk ribs are very short and sharply pointed. All the trunk ribs are clearly double headed. The distribution of rib size in *Sparodus* differs markedly from the pattern in *Cardiocephalus peabodyi*, in which the ribs are of approximately the same length throughout most of the trunk. The sacral rib of *Sparodus* is unlike that of Lower Permian microsaurs in being relatively long, without a flared distal extremity. Most Lower Permian microsaurs, including the gymnarthrids, had two pairs of sacral ribs. In other early tetrapods with long narrow sacral ribs like those of *Sparodus*, there is only a single pair.

All the elements of the shoulder girdle can be identified. The scapulocoracoid persists as a single area of ossification, but is badly crushed and shows no details. The long, blade-shaped cleithra and narrow L-shaped clavicles resemble those of *Saxonerpeton*. The interclavicle has a long narrow stem and a broad blade that is fimbriated at the anterior margin. It is exposed in dorsal view so the recesses for the reception of the clavicular blades are not visible. This precludes accurate reconstruction of the width of the shoulder girdle, although it appears to have been narrower than the back of the skull.

To the extent that their incomplete preservation allows comparison, the humeri resemble those of Lower Permian gymnarthrids, with a slender shaft lacking an entepicondylar foramen, and well ossified extremities with a large capitellum. The ulna is short, slender and has a well developed olecranon with a deep sigmoid notch. The radius is short and expanded at both ends. The extent of the distal expansion is exaggerated by crushing. Approximately 6 carpals are present, but their individual morphology is obscured by crushing. None can be specifically identified. Neither metacarpals nor digits are evident.

The pelvis and rear limbs are some distance from the remainder of the skeleton, but their size supports association with this specimen. The three elements of the pelvis are firmly co-ossified, with no trace of sutures, in strong contrast with those of *Cardiocephalus peabodyi*. The ilium has a long slender blade that is bifurcated at the tip, as in *Leiocephalikon*, *Asaphestra* and *Ricnodon* from Joggins (Carroll, 1966). The obturator foramen pierces the anterior margin of the

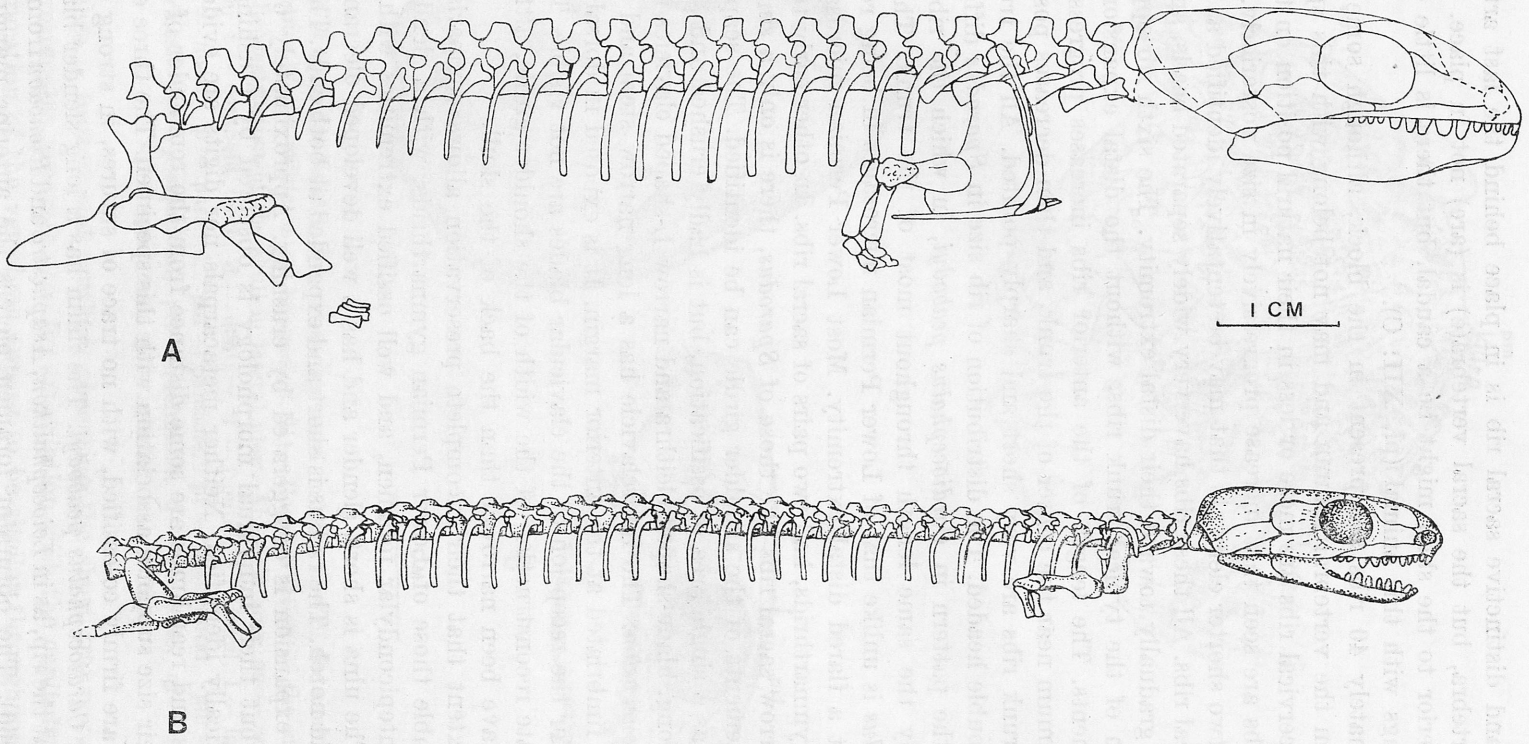

Fig. 2. A — Reconstruction of the skeleton of *Sparodus validus*, based primarily on specimen 1899-III-6. B — Reconstruction of *Cardiocephalus peabodyi*

pubis. The supra-acetabular buttress is sharply defined. The femur is flattened, but shows a large proximal articulating surface, a low adductor crest, and a very wide area for the articulation of the tibia and fibula. These bones appear primitive in the wide expansion of both proximal and distal articulating surfaces. No trace remains of the tarsals, although they were presumably ossified, in common with the carpals. Elements of the foot, either metatarsals or phalanges, lie near the sacral rib.

The entire slab is covered with large scales of a typically microsaur pattern — thin ovals with conspicuous ribbing. GREGORY, PEABODY and PRICE's (1956) reconstruction of *Cardiocephalus* provides a good image of scalation in *Sparodus*.

III. DISCUSSION

The pattern of the skull roof and the distinctive dentition demonstrate the similarity of this specimen to the type of *Sparodus validus* FRITSCH, 1883. It is also clearly allied to the earlier Carboniferous genus *Leiocephalikon*, and the Lower Permian genus *Cardiocephalus*. The most striking difference from *Cardiocephalus* can be seen in the body proportions. Fig. 2 shows both genera drawn to the same scale.

The snout-vent length is approximately equal in these specimens, but the head to trunk ratio and the number of presacral vertebrae differ markedly. In *Sparodus*, the presacral vertebral column is approximately 2.5 times the length of the skull. In *Cardiocephalus*, the ratio is close to 4.5 : 1. There are 38 presacral vertebrae in *Cardiocephalus*, and approximately 25 in *Sparodus*. The skull is equal to the length of about 10 presacral centra in *Sparodus*. In *Cardiocephalus*, the number varies from 8 to 9, with the more posterior vertebrae reaching a greater length. The vertebral proportions also differ, with the relative length of the centra increasing as the vertebral number increases.

Unfortunately, little limb material is found in articulation with *Cardiocephalus*, so it is not possible to establish the manner in which the limb to trunk ratio may differ. Clearly, the major change is toward a more slender, elongate body, with a relatively and absolutely smaller skull. There is, of course, no strong evidence that these particular genera are ends of the same evolutionary lineage, but the greater number of vertebrae in *Cardiocephalus* is certainly a derived feature relative to primitive tetrapods in general, and *Sparodus* does illustrate a number of other features that are primitive for Paleozoic amphibians relative to the condition in *Cardiocephalus*.

Primitive characters of *Sparodus*:

large head to trunk ratio;
approximately 25 presacral vertebrae;
configuration of ribs;

elongate sacral rib, without distal expansion;
co-ossification of elements of the scapulocoracoid and pelvis;
bifurcate iliac blade.

In the relatively short trunk, *Sparodus* resembles *Pantylus*, *Tuditanus*, and *Saxonerpeton*; this may be proposed as a primitive feature of the tuditanomorph microsaurs. The absence of trunk intercentra in *Sparodus* is difficult to explain unless their presence in the long bodied genus *Cardiocephalus* is a derived, rather than a primitive feature. Intercentra are hypothesized as having re-evolved among gekkos after their loss (or incorporation into the pleurocentra) in more primitive members of this family in common with all other groups of advanced lizards (ESTES, 1983, p. 21). Presumably the addition of intercentra would provide additional flexibility to the already elongate column of the Permian genus, as does the proliferation of additional primary centra.

What is known of the postcranial skeleton of *Sparodus* resembles more closely the pattern of primitive labyrinthodonts than does that of *Cardiocephalus*, but the resemblance is general, rather than pointing to either major group, the anthracosaurs or the temnospondyls. The skull and vertebrae, in contrast, are typically microsaurian, and show no significant feature in common with those of labyrinthodonts, other than those common to all early tetrapods.

At present, the most informative basis for comparison of early tetrapods is provided by *Proterogyrinus* (HOLMES, 1984) which is the earliest known amphibian for which a complete description of the skeleton is available. *Ichthyostega* (JARVIK, 1980) is older, but no description has been published that demonstrates the basis for determination of vertebral number or limb proportions.

Whatever major reorganization was involved in the emergence of microsaurs from primitive tetrapods presumably occurred significantly earlier than their appearance in the Carboniferous fauna of Joggins and Nýřany.

The high degree of ossification of the girdles, limb joints and carpals in such a small animal may be explicable in terms of selection for rapid ossification as a means of terminating growth at small body size (HANKEN, 1985). The configuration of the skull, with the jaw articulation well anterior to the back of the skull table, would not be expected to result from retention of a juvenile character in the adult, and must be explained by factors unrelated to body size. Small size may, however, account for the loss of labyrinthine infolding of the teeth and elimination of the squamosal emargination that are characteristic of labyrinthodonts.

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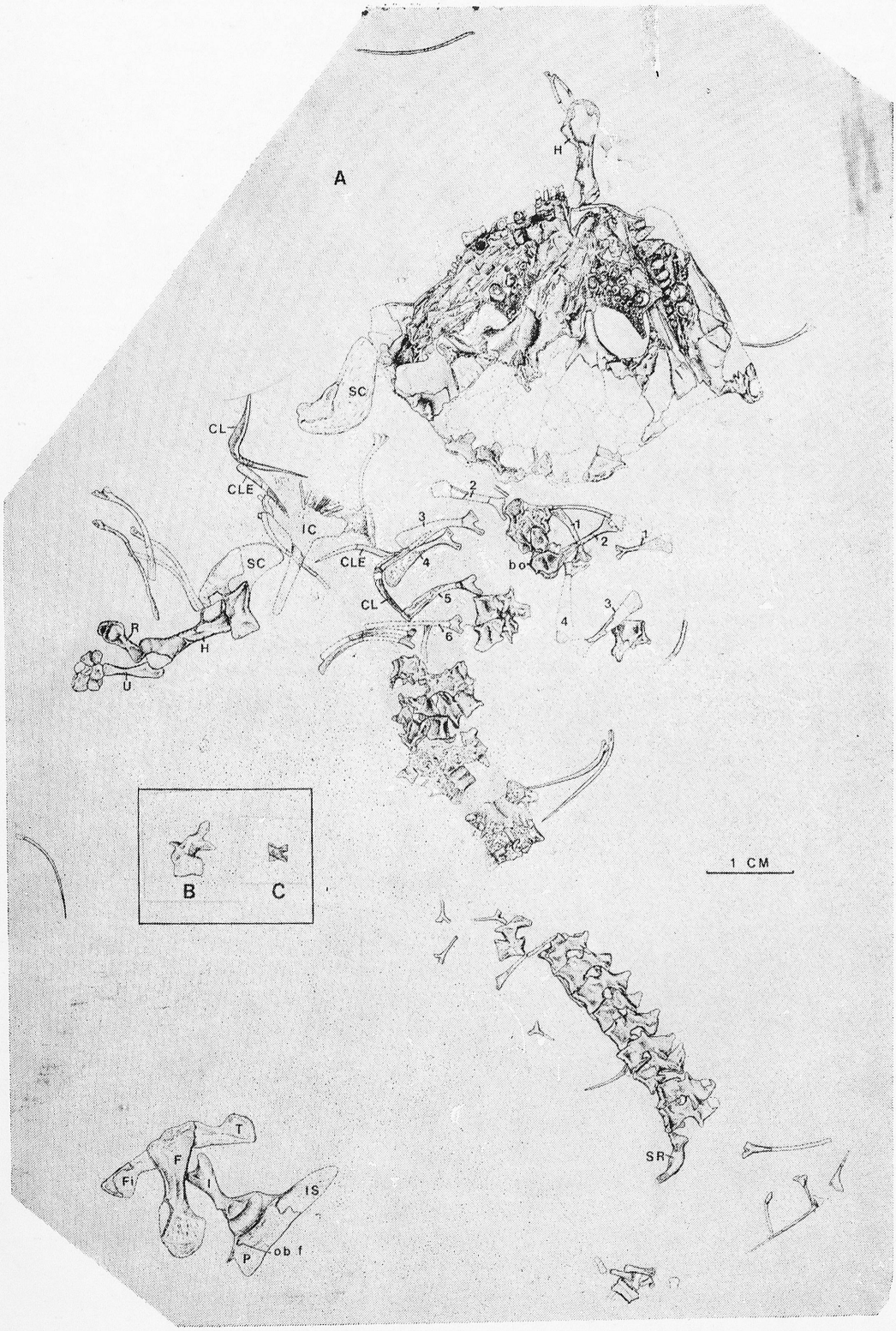
STRESZCZENIE

Nowo odkryty szkielet płaza *Sparodus* (*Microsauria*, *Gymnarthridae*) z górnego karbonu Czechosłowacji pozwala stwierdzić, że przedkrzyżowy odcinek kręgosłupa jest u tego rodzaju znacznie krótszy niż u dolnopermskiego *Cardiocephalus*, rozmiary zaś jego czaszki, zarówno bezwzględne jak i proporcjonalne, są większe. Swoimi proporcjami *Sparodus* przypomina bardziej wczesne labiryntodonty, jednakże budowa jego czaszki i kręgosłupa jest już typowa dla późniejszych *Microsauria*. Obecność intercentrów w kręgosłupie u pokrewnych *Gymnarthridae* (u *Sparodus* intercentrów brak) może być traktowana jako cecha raczej wyspecjalizowana aniżeli prymitywna.

Edited by Dr. Z. Szyndlar

Plate XII

A — Skeleton of the gymnarthrid microsaur *Sparodus validus*; Natural History Museum in Vienna, no. 1899-III-6. B and C — Trunk and caudal vertebrae which are located beyond the limits of the main drawing. Abbreviations: bo — basioccipital, CL — clavicle, CLE — cleithrum, F — femur, Fi — fibula, H — humerus, I — ilium, IC — interclavicle, IS — ischium, ob f — obturator foramen, P — pubis, R — radius, SC — scapulocoracoid, SR — sacral rib, U — ulna, 1—6 — sequence of cervical ribs



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