WALCH'S TRILOBITE RESEARCH— A TRANSLATION OF HIS 1771 TRILOBITE CHAPTER

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ABSTRACT—Johann Ernst Immanuel Walch was a German naturalist who engaged in geological research in the 1760s and 1770s. Walch coined the term "trilobite" in a publication that appears to be the most in-depth, thoroughly-researched, and lavishly-illustrated paleontological work of the 18th century. This was his "The Natural History of Petrifactions." We provide a new English translation of Walch's trilobite chapter as it provides a summary of the understanding of trilobites in the late 1700s. Walch essentially closed the door on the ca. 60 year-old debate on the classification of trilobites as arthropods or mollusks.

INTRODUCTION

The paleontological contributions of the 18th century naturalist J. E. I. Walch (Fig. 1) are not often discussed by historians of geology (see comments by Gayrard-Valy, 1994, and Gould, 2002). Modern paleontologists usually only encounter "Walch" as part of the names of some genera of Late Paleozoic conifers, such as the foliage-genus *Walchia* or the cone-genus *Walchiostrobus*, and as author of the "Class Trilobita" (Walch, 1771). The latter report is frequently cited by trilobite workers, but obtaining this publication has traditionally been difficult (see remarks in Fortey, 2000, p. 49), and it is rarely included in reference lists. Modern trilobite workers are typically familiar with literature that postdates the landmark monographs of Wahlenberg (1818) and Brongniart (1822). However, a number of pre-1800 references (64 or so) describes, discusses, or illustrates trilobites. The most significant of these is Walch's (1771) long and well-researched chapter on trilobites. This chapter was

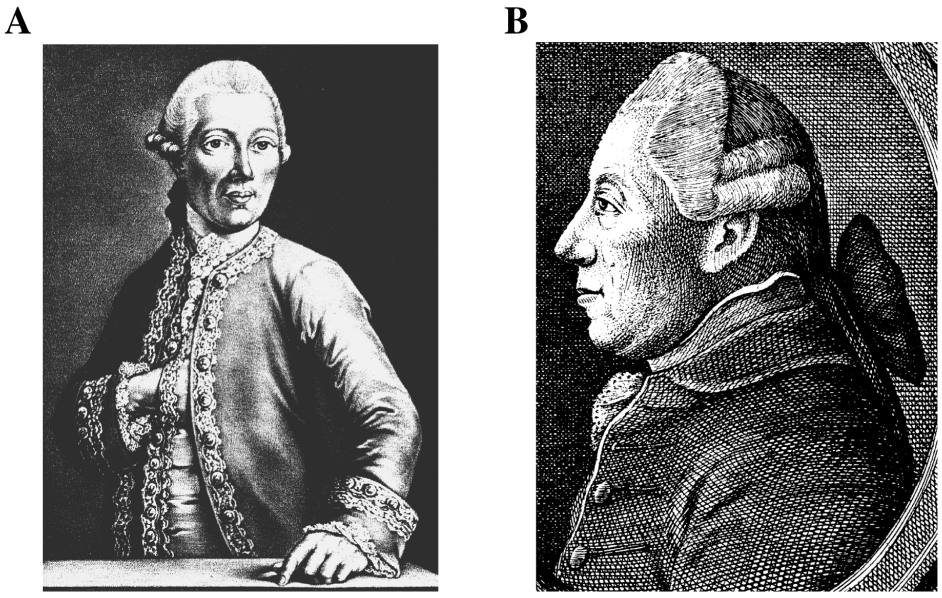

Fig. 1. Portraits of Johann Ernst Immanuel Walch (1725–1778), university professor, theologian, linguist, and naturalist. A, Frontispiece from volume 1 of *Recueil des Monumens des Catastrophes que le Globe de la Terre a Éssuiées* (Walch, 1777). B, Profile by Justus Christian Hennings; appeared as the frontispiece in Schröter (1780).

FABULOUS FOSSILS—300 YEARS OF WORLDWIDE RESEARCH ON TRILOBITES, Edited by Donald G. Mikulic, Illinois State Geological Survey, 615 East Peabody Drive, Champaign, Illinois 61820, Ed Landing, New York State Museum, The State Education Department, Albany, New York 12230, and Joanne Kluessendorf, Weis Earth Science Museum, University of Wisconsin-FoxValley, 1478 Midway Road, Menasha, Wisconsin 54952. New York State Museum Bulletin 507.

Die
Naturgeschichte
der
Versteinerungen
zur Erläuterung
der
Knorrischen
Sammlung von Merkwürdigkeiten der Natur
herausgegeben
von
Johann Ernst Immanuel Walch
Hochfürstl. Sachsen Weimarischen und Eisenachischen Hofrath, wie auch der Beredsamkeit und Dichtkunst ordentlichen öffentlichen Lehrer auf der Universität zu Jena.
Dritter Theil.
Nürnberg,
gedruckt bey Paul Jonathan Felßecker, 1771.

DE NATUURLYKE HISTORIE
DER
VERSTEENINGEN,
OF
UITVOERIGE
AFBEELDING EN BESCHRYVING
VAN DE
VERSTEENDE ZAAKEN,
DIE TOT HEDEN
OP DEN AARDBODEM ZYN ONTDEKT:
AANGEVANGEN DOOR
GEORG WOLFGANG KNORR:
VERVOLGD EN OMSTANDIG BEREDENEERD
DOOR
JOHANN ERNST IMMANUEL WALCH
HOOGVORST. SAXEN WEYMARSCHEN EN EISENACHSCHEN HOFRAAD; HOOGLEERAAR DER WELSPREEKENDHEID EN DIGTKONST OP DE HOOGE SCHOOL TE JENA:
UIT HET HOOG IN 'T NEDERDUITSCH VERTAALD
DOOR
M. HOUTTUYN, MEDICINÆ DOCTOR,
MET VERSCHEIDE AANMERKINGEN.
DERDE DEEL.
Te AMSTERDAM,
By JAN CHRISTIAAN SEPP, Boekverkooper.
MDCCLXXIII.

RECUEIL
DES
MONUMENS
DES
CATASTROPHES
QUE LE GLOBE DE LA TERRE
A ÉSSUIÉES,
CONTENANT
DES
PÉTRIFICATIONS
DESSINÉES, GRAVÉES ET ENLUMINÉES,
D'APRÈS LES ORIGINAUX,
COMMENCÉ
PAR
FEU Mr. GEORGE WOLFGANG KNORR,
ET CONTINUÉ
PAR
SES HERITIERS
AVEC
L'HISTOIRE NATURELLE
DE CES CORPS
PAR
Mr. JEAN ERNEST EMANUEL WALCH,
CONSEILLER DE COUR DE S. A. SERme. MONSGR. LE DUC DE SAXE-WEIMAR, ET EISENAC ET PROFESSEUR D'ELOQUENCE ET DE POESIE A' L'UNIVERSITÉ DE JENE.
TOME TROISIEME.
A'
NUREMBERG
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Fig. 2. Title pages of the German (1771), Dutch (1773), and French (1775) editions of J. E. I. Walch's "Natural History of Petrifactions," part three.

published in the "Natural History of Petrifactions" series (Fig. 2) that was started by Georg Wolfgang Knorr in 1755 and continued by Walch in the late-1760s to late-1770s. Walch's chapter is an early landmark in the understanding of trilobites that has a significance beyond its nomenclatural importance. Indeed, the work is accompanied by plates of moderately high quality, by comparison with many 1700's and 1800's references, and it shows a near-comprehensive familiarity with earlier literature. Most significantly, its discussion of the debate on trilobite affinities provides insights into how 18th century naturalists dealt with problematic fossil organisms.

BACKGROUND ON WALCH

The summary presented below is mostly derived from Baldinger (1770), Schröter (1773, 1779, 1780), Meusel (1815), Doering (1835), Dobschütz (1896), Zittel (1901), and Geikie (1905).

Johann Ernst Immanuel Walch was born August 30, 1725, in Jena, Germany. He was the eldest of three sons of the famed 18th century theologian Johann Georg Walch. His schooling emphasized theology, philology and linguistics, math, and natural history. His first several publications were completed before he was 20 years old. Jena University hired him as a lecturer in 1745, and as a theology professor in 1750. Walch later switched to the logic and metaphysics professorial position at Jena University in 1755, and then to a position in poetry and elocution in 1759. Most of Walch's interests and publications were on topics in the humanities. These included early Christian church history; New Testament exegesis and commentary; Latin and Greek linguistics, literature, and inscriptions; Roman history and antiquities; Celtic religion; and the history of medicine.

Probably by the mid- to late-1750s, Walch turned his focus to natural history, especially geology and paleontology. He started building what would become a sizable and significant natural history collection. Walch's conversion from the humanities to the natural sciences began during a long study trip in 1747–1748 to cities in central, western, and southern Europe. While in Florence, Italy, Walch viewed the Baillou Cabinet, a large collection of rocks, minerals, and fossils that was on public display until its purchase and transfer to Vienna, Austria, in 1748 by the Holy Roman Emperor, Francis I (Wilson, 1994). Although Walch continued to teach and publish in the humanities, he confessed that the natural sciences overtook his interests in theology and languages. His natural history collection expanded in size and reputation to the point that many European naturalists, even royalty, came to view the Walch Cabinet. The collection included plants and animals. Particularly well represented were fossils, rocks, and minerals of the "Stone Kingdom." Walch's collection was combined in 1779 with that of Karl August, Grand Duke of Saxe-Weimar, to form the foundation of the current museum holdings at Jena University (now the Friedrich Schiller University).

Walch (1762, 1764, 1769) summarized the cataloguing system used for his geologic and paleontologic specimens as *Das Steinreich, Systematisch Entworfen* ("The Stone Kingdom, Systematic Outline"). He envisioned publishing a cataloguing scheme for the plant and animal kingdoms that would rival the Linnaean system, but never completed it. The first volume of *Das Steinreich* (Walch, 1762; 2nd edition, 1769) consists of two major sections: one on rocks and minerals, and one on fossils. The rocks and minerals are arranged systematically on the basis of texture (granular, lamellar, filamentous, fissile, etc.) and other physical properties, such as transparency. The much-longer section on fossils subdivides the animal kingdom into terrestrial, aquatic, and amphibious categories, and the plant kingdom into terrestrial and marine groups. Walch's concept of marine plants principally included corals, milleporid hydrozoans, and rudist bivalves. The fossil descriptions are accompanied by 24 plates that depict a wide variety of mostly Mesozoic and Cenozoic marine invertebrates. The second volume of *Das Steinreich* (Walch, 1764) rarely mentions fossils, but has extensive remarks on the inferred mode of formation for many rocks and minerals. Some early mineralogists preferred a chemically-based classification for rocks and minerals, while others used the textural and descriptive classification of *Das Steinreich* and similar works.

Walch's most significant contribution to paleontology began after the publication of *Das Steinreich*. Georg Wolfgang Knorr, a Nuremberg copper-engraver, art dealer, and fossil collector, had published some works with colored illustrations of such natural history objects as shells, fossils, minerals, and various modern plants, vertebrates, and invertebrates. Knorr prepared copper-engraved plates of fossils for a work titled "Lapides Diluvii Universalis Testes" ("Stones that Testify to the Universal Flood"), which was intended to document the effects of the Noachian flood. Only one portion of the project was published before his death in 1761 (see Knorr, 1755). Over 200 plates that depicted fossils were unpublished. Knorr's heirs contacted Walch about writing text for these plates. Walch agreed, and the result was the beautifully illustrated, four-volume "Die Naturgeschichte der Versteinerungen" ("The Natural History of Petrifactions"). This work was released from 1768 to 1773, and also published in French and Dutch editions (Fig. 2). All of Knorr's plates were printed as hand-colored copper engravings that depicted fossils from private and society collections across Europe. The figured fossils include scleractinian and tabulate corals, bivalves, gastropods, nautiloids, ammonoids, decapods, trilobites, crinoids, echinoids, terrestrial and aquatic vertebrates, leaves, wood, and trace fossils. Few of Knorr's plates illustrate non-biogenic objects, such as manganese dendrites from the Solnhofen Limestone, Liesegang banding, and a large figure of the active Solnhofen quarries.

Walch continued scholarly work in the humanities and natural sciences during the 1770s, and also started a new journal, *Der Naturforscher* ("The Naturalist"). By the end of his career, he had completed over 80 publications (books, chapters, and articles) on various topics in the humanities and about 50 publications in natural history. He became ill in Summer 1778 with the onset of hypochondriac (abdominal) seizures. Walch participated in a last dissertation defense for a Jena University student in late 1778, a month and a half before his death on 1 December 1, 1778, from intestinal infections. He left behind a reputation for being an energetic, practical man and a popular lecturer with a pious Christian character and an enthusiastic concern for his students, colleagues, and university.

SUMMARY OF WALCH'S TRILOBITE CHAPTER

The trilobite chapter in the 1771 volume of the "Natural History of Petrifactions" was accompanied by six plates that showed isolated pygidia and cranidia, as well as complete, partially enrolled, enrolled, and outstretched specimens. Walch's chapter appears to be the most in-depth discussion and description of trilobites published before the 19th century. He began with a documentation of the various names given to trilobites by previous workers, concluded that none was suitable, and proposed the descriptive name "Trilobite." This name was generally accepted after Walch's time, with two notable exceptions. Wahlenberg (1818, p. 18) considered "trilobite" to be "a greatly common name, ... of excessively trivial significance, but unassuming." Dalman (1827, p. 120, 121; 1828, p. 7) noted the "highly unconventional origins and barbaric construction ... of the term."

Walch included some especially noteworthy observations in his lengthy descriptions of trilobite cephalic, thoracic, and pygidial morphology. For example, he rejected the interpretation of a Swedish olenid trilobite that Linnaeus (1759, pl. 1, fig. 1, pl. 2, fig. 1) claimed to have antennae. Walch correctly identified the "antennae" as the anterior cephalic border ("lips" in Walch's terminology). This was well over a century before Charles Beecher's (1896) article on the same topic. Walch also anticipated the discovery of preserved legs within enrolled trilobites. This prediction was about 100 years before Charles D. Walcott discovered appendages in enrolled specimens of *Flexicalymene* and *Ceraurus* from Upper Ordovician limestones of New York State (e.g., Walcott, 1879, 1921; Brett *et al*., 1999). Walch had numerous trilobite specimens that represented many species. But, he acknowledged his lack of well-preserved specimens, and held back from proposing names and classifications for these species. This restraint contrasts with the enthusiasm for proposing numerous genera and species based on incomplete and poorly preserved material in some of the 20th century trilobite literature.

The remainder of Walch's chapter is devoted to lengthy discussions about the search for the living analogue of trilobites. A concept of extinction was not widespread in the late 1700s, and typically denied based on the argument that God's creation was perfect and extinction could not take place. However, trilobites presented a particularly frustrating problem for some 18th century naturalists. Trilobites seemed to have a paradoxical combination of characters—the segmented body of "crustaceous" animals with the hard mineralized shell of "testaceous" animals. This body plan had not been recorded from any organism in the modern oceans. Walch gave a thoroughly summarized the historical debate of the "testaceous" vs. "crustaceous" affinities for trilobites (i.e., molluscs versus arthropods). He noted the temptation to view trilobites and chitons as similar organisms, but strongly argued against and rejected the chiton hypothesis. Marine isopods were the favorite candidate of many mid- to late-1700's naturalists as the modern analog of trilobites. Walch favored the notion that marine isopods were the closest living analogs of trilobites, but observed that isopods are not hard-shelled as trilobites. He believed that the true living analog of trilobites was yet to be found in the modern seas. This expectation had a reasonable precedent in the discovery of living crinoids in the 1750s (Guettard, 1761), centuries after fossil crinoids were described and illustrated in the literature (e.g., Gesner, 1565; Bauhin, 1598; Imperato, 1599; Lhwyd, 1699).

WALCH'S TRILOBITE CHAPTER

The English translation provided below is from the French edition (Walch, 1775, volume 3, chapter 3) of the "Natural History of Petrifactions." The French edition is titled "Collection of Monuments of Catastrophes that the Globe of the Earth Has Experienced;" Fig. 2). The French version appears to be a faithful translation of the original German edition (Walch, 1771), with occasional, minor differences. Transcription and other inadvertent errors between the German and French editions have been corrected below to correspond with the German edition. Non-proper nouns that Walch capitalized in the French edition are also capitalized herein. City and other place names have usually been modified to correspond with modern spellings. Names of people have usually been modified to correspond with spellings from their original references. Charles Mortimer's (1752, p. 601) quotation in *Philosophical Transactions* was incorrectly rendered by Walch, and Mortimer's original phrasing is used. Words not easily rendered into English and other unusual terms are defined below in the glossary. Walch's footnotes follow the translation.

CHAPTER III - ON THE TRILOBITES IN THE KINGDOM OF PETRIFACTIONS, OR ON THE WRINKLED THREE-LOBED CONCH (*CONCHA TRILOBA RUGOSA*)

If ever during our times, a Petrifaction has excited the attention of Naturalists, it is surely that which has the common name of the wrinkled conch with three lobes, *Concha triloba rugosa*. In the beginning, only the posterior part, or the tail, was discovered, and as it had a Test as in other shells, most have taken it to be a kind of still unknown shell, and have tried to discover its analog. Later, the anterior part of the Test was also found, but isolated, and nobody conjectured that this particular figure was part of the Petrifaction that was previously discovered. Shortly thereafter, some less mutilated pieces were unearthed, both curved and stretched-out, and it was then that was recognized in the Kingdom of Petrifactions a body, that so far had not been observed in all the Kingdom of Nature, a Creature which had a head greatly resembling that of a spider, its back divided into three lobes, and garnished with testaceous rings much like the tail of a crayfish, and with a large tail extremity equally divided into three lobes. At that time, it was observed that this animal must have, under its Test, free movement, and be able to curl, to extend and to contract itself in all directions. Successive Examples were found in the Kingdom of Fossils, which confirmed this observation in an incontestable manner. Until now, we could barely determine positively and with certitude the true analog of this particular Petrifaction, no matter how much effort had been employed; and for the past few years especially, the most learned Naturalists have been piqued, so to speak, at the wish to make such fortunate discoveries, and to approach this analog, by searching and comparing exactly those Examples which have been found. I now will follow this method, and I will detail the Natural History of this Petrifaction, and I will pro-

pose my conjectures on its analog, so that the connoisseurs of these subterranean curiosities might investigate them. My friends have furnished me with a quantity of instructive Examples, which I have compared with great care not only with each other, but also with pretended analogous marine specimens. For the past three years, as I have entertained a correspondence on this Petrifaction with some learned Naturalists, and particularly with Provost Gentzmar of Stargard, I have learned several things, which still could be totally unknown, or at least not well known. But I am arriving at the proposal itself.

At the beginning, as only fragments of this Petrifaction were found, and as it was not known under what kind of body to classify it, almost each Naturalist who found it thought it his right to give it a proper name; Bromell[1] named it *Lapis insectiferus, Insectum vaginipenne*, as he thought he found the imprint and Petrifaction of certain Insects having wings covered with hard and horny scales. Mr. Woltersdorff[2] placed it with the Petrifactions of bivalved shells and, as it had three protuberances, he gave it the name of *Conchites trilobus*, a denomination that many others adopted with very little change, and this is where we might recall the names of *Concha trilobos*, *concha triloba rugosa, pectunculites trilobus*, as are found in the works of Messrs. Gentzmar,[3] Wilckens,[4] Klein,[5] Bertrand,[6] and several others. It must be said however that, already in a certain sense Mr. Hermann[7] is the inventor of this denomination, as his *Pectunculites trilobus imbricatus* is precisely that shell which we call *Concha triloba*. The celebrated Naturalist Mr. Linné[8] gives to this Petrifaction, because of its peculiar form, the name *Entomolithus paradoxus*; Brander in Davila[9] gives to it the name of *Eruca anthropomorphites*; Brückmann[10] calls it *Petrefactum polypi marini* and *Armata Veneris*; Mr. Baumer,[11] *Trigonella striata*, and Inspector Wilckens,[12] *Entomolithus branchiopodis cancriformis marini*. Several German Naturalists use the names *Cacadumuschel* and *Kaefermuschel*. It is supposed that this first name given to this Petrifaction is because of its resemblance to the erect plumage of the bird which the Ambonese call Cockatoo, and the last name after the name of *Lapis insectifer*, a name given by Bromell. After the report of Mr. Lehmann[13], the narrow kind of tails of this animal also carries the name of Sea-Hare. In England, it is commonly named *Dudley Fossil*, after the locality where it is found, and others call it *Eruca* or *bivalva*, as may be seen in *Philosophical Transactions*, vol. 46, p. 598. Several of these names were given to this Petrifaction before it was well known, and when the extremity of the tail was thought to be one of the two valves of a shell. In examining all these different names, it may be seen that they have been so named either by linking them to the form and to the resemblance of this Petrifaction with other bodies, or else by relating them to a pretended analog which was taken to be the same, although, most often, without base, or even naming them after the locality where these Petrifactions were found. Thus, it is given that designation which is the least studied by naming it a *Trilobite*. The three lobes of the back and of the tail are the characters by which this body is distinguishable from all others, and as these characters are visible, we judge them as appropriate, and accordingly it is not now about giving it a denomination from an analog, particularly as this analog is also subject to many arguments and many doubts.

This particular body, when complete, is composed of three parts, the head, the trunk, and the tail, which, when extended together, form an oblong Oval. The head is covered with a vaulted Test, which is sometimes smooth and sometimes grainy, often the grains being hardly perceptible such as on the armor of a crayfish. Ordinarily, it has certain symmetrical protuberances and depressions dividing it into three parts. The trunk, or the back, as it is usually named, is mostly cylindrical and composed of three lobes. It has a banded armor, that is, the shell which covers it, is composed, the same as a crayfish tail, of rings, each of which is of three arcs, as the back has three lobes. These rings are able to slip by each other, as the animal extends or curls, in a fashion which allows for free movement that doesn't hinder its crustacean armor. The crust, or as it is named, the shell of its tail consists of one piece, as that of the head, and is divided into three elevations. As in the past this tail part was found isolated and as it was believed to be a shell, it was given the name three-lobed conch (*Concha triloba*). The Test (external shell), which is the armor of this animal, is like that of a shell; it separates in laminations and sheets, as I have observed in several Examples, and noted that it was composed of many laminations like the Test of shells. Commonly, this Test is thin, especially in those Examples where several laminations have already become detached; one cannot arrive at a conclusion by the thinness of the test of one Petrifaction as to the thickness of the Test in its analog. There are Examples where the Test has the thickness of a knife blade; the same in the large pieces, there are those the thickness of a quill, and also in larger pieces, the thickness of the Test is a quarter of an inch. Although, it is also observed, at the same time, that the test of the trunk is commonly much thinner than the scale that covers the head and the tail of the animal. The internal surface of the scale, when it detaches from the core, which happens sometimes, is rayed or has very fine lines, often imperceptible, which are slightly undulating and parallel. These lines are even more noticeable on the core which is found immediately below the shell, because of the imprint that they made, and, where these impressions are found, most likely on the tail, it is a sign for sure as to where the test separated. No one has ever been able to discover any vestige of the test on the bottom side; on the cores themselves, the imprint of the internal surface of the superior shell is found all the way to the extremity of the tail, without ever observing anything that holds or unites a shell below with the shell above. Some expert Naturalists thought that they had observed, in the rocks, where one Trilobite was transversely dissected, one shell below[14], which was the same as that above, composed of three arcs, and the two sides holding together. However, this observation proves nothing. As the section had been made across a nearly enrolled Trilobite, its back was dissected twice, and as a consequence, it must be presented on the surface of the stone as two lines with three arcs, facing each other. For the rest, as an animal who is hiding in its shell, and is free to move in all direction, in dying, it is not always in the same attitude. Some are stretched straight[15] and thus have an elongated oval shape. Others are contracted in a manner that the tail is below the head, giving the animal a heart shape[16]. Yet others take a form twisted above and below. Following the difference in attitude, the dorsal rings enter sometimes more, sometimes less underneath others, and thus the rings appear larger or smaller. When the animal is stretched, the rings often enter two thirds into each other, which is distinctly seen in the lateral lobes of some individuals.[17]

Now we must examine more closely the head, the trunk and

the tail of this particular animal. Most are found with their head separated from the trunk, and it may be inferred from this that they are only held together by a few muscles, which putrefy rapidly, and which give the head a freer movement. This head, or to state it more clearly, this shell under which the head of the animal is hidden as under a helmet, has forms so varied in the Kingdom of Fossils, that it becomes troublesome to report and determine all these variations. At the same time, we must accept that many pieces, taken to be the head shields of Trilobites when they surely are not, and which are in effect the shells of other marine bodies found among the Trilobites and which were petrified with them.

The shell of the head represents a crescent[18]; it is commonly strongly convex and consists of a single piece. In a few, it is simply a smooth curved surface, without grooving, protuberances, or depressions,[19] and it is probable then that these would be simple cores, their natural test missing; else, they are damaged and their tubercles lost, unless there is effectively a species, which in its natural state has the head covered with a totally smooth head shield. For the most part, they are garnished with protuberances and furrows. In other words, passing from top to bottom up to the extreme edge of the shell, are two fissures or furrows,[20] where the total shell, which covers the head of the animal, is divided into three parts, being that of the middle, and of two lateral parts. We need, to speak more intelligibly, names to identify the different parts of the head. Therefore, we will borrow the names of the parts from the head of an animal, understanding however, that in our animal the parts will not be precisely as those in a quadrupedal animal. Thus, we will name the two lateral parts the *cheeks*, and we will divide the middle part into three parts, which we will name the *forehead*, the *nose*, and the *lips*. There is above on both sides of the forehead two hemispheres or tubercles, which we call the *eyes*. Besides this, we note in some Examples, where commonly are found the eyes, certain cylindrical protuberances, which resemble long ears or horns, and which are covered with small grains and, as regards to the structure, much resemble the eyes of certain Insects. As I do not have all the necessary experience, I dare not determine if these protuberances, in the species of Trilobites which have them, precisely what are in others the hemispheres that we have named the eyes, although it is sure that I have observed two kinds of such Examples. In some which had the protuberances garnished with small grains, it could be seen near these protuberances and toward the forehead, an additional two small, commonly lengthened tubercles, while in others, the forehead was flat, and it seemed that these horns touched above the hemispheres which we call the eyes. Whether they are horns or something else, we will nevertheless call them horns in order to distinguish them from these hemispheric eyes; this is even though we are inclined to accept these for some other thing, and we might discover there a very artificial structure of eyes. All we need is for time to open our eyes in order to judge those of this animal.

We have said that the middle part of the shell, or the forehead, the nose, and the lips, are separated from the cheeks by two furrows. These furrows are sometimes straight and without curves,[21] which gives to the forehead and the nose an equal width, but most of these furrows arc,[22] and the arcs are sometimes narrow, and sometimes wide, sometimes turning inward and sometimes turning outward so that the shape of the forehead and of the nose are presented in a different manner following the difference of these arcs. Some have two similar arcs, while others have three. Most of these Trilobites, which have such furrows curved between the forehead and the cheeks, have united cheeks, where tubercles are not seen, except those formed by these arcs. I have also noticed that Trilobites which have such arcs, have for the most part noses of a mediocre width, but at the same time these are more elevated.

The *forehead* is the superior part of the middle of the shell, which is held close to the shell of the back by a connection. It is sometimes flat, sometimes strongly convex, ordinarily more narrow than the nose,[23] commonly smooth, and marked with a ridge, which consists of a elevated transverse line. Above the forehead is the *headband*, which passes above, on the cheeks and the temples, and which consists of an edge that, bit by bit, takes the shape of the three arcs, and which unites the lobes of the back; that is to say, it unites the first ring of three arcs of the back shell to the head[24]. If we give to this headband the name of *collum trilobum*, and accept it as the neck of the animal, I will be agreeable with this nomenclature. This part is damaged in most of the isolated head shields found, or else, it is pushed in too far forward in the stone to be easily noticed. The *nose* is like the flat nose of a Negro. When, ordinarily, the furrows below, on the lip, form a strong arc directed outwardly, the nose is in this case always larger than the forehead[25]. It is flat even though, the entire shell of the head being convex, it is more elevated than the cheeks. The eyes are hemispheres, and in proportion to the head, smaller or larger, more or less elevated or flattened[26]. Ordinarily these are located at the two sides of the forehead, at the superior part of the cheeks, although in some they are found lower, at the two sides of the nose. At the side of the eyes are found, in some individuals, three or four small tubercles, which differ from eyes only by their size. They are commonly closer to the forehead than the larger hemispheres, which we have named the eyes.[26a] The cheeks are a little convex, in some species more or less large, depending on whether the furrows, which form the shape of the forehead and the nose, make a greater or lesser arc. Consequently, if the nose is quite large, the cheeks are small. They have, in a way, a triangular shape, and they are placed in such a way that, there, where the lateral lobes begin, they terminate in a point which, in some enrolled Examples, come forward a little; we may conjecture that this point or sting may serve as a last defense to this animal, in case its armor or shell, into which it could envelop itself, should fail. Here we give the name of *lips* to the part which Inspector Wilckens[27] names the pivot (*Hängestok*). It forms a round arc, so that, from the extremity of one of its cheeks, which is closer to one of its lateral lobes, it goes to about the same height at its opposite cheek.

What is the most remarkable on the head of this animal is the horns;[28] this is the name that we have given to those cylindrical protuberances, which are raised on both sides of the forehead. We cannot yet determine the use for these for this animal, or for some other parts; in any case, I am convinced that these parts, as found on this Trilobite, if found on an Insect, I would take them, without hesitation, to be eyes. Meanwhile, we leave them the name of "horns," to distinguish these from the hemispheres, which we have named the "eyes." We do not find these horns in all the animals found, nor in any which British authors have written about in the *Philosophical Transactions*; this difference, as well as several others which we have already noticed on the

head shield of this animal, informs us that the Trilobite is a widespread type of animal consisting of a very large number of species and subordinate species. When the horns are found on a Trilobite, they are located on the superior part of the cheek, on both sides. Some terminate in points; others have, above, instead of the point, a small surface in the shape of a crescent, in the middle of which is a small conical protuberance. These horns are garnished with very fine grains, with such regularity, that it would be hard to imagine something finer and neater. These grains are closely packed, are all perfectly of the same size, and go in straight lines around the horns. They present themselves in three different manners: firstly, they are whole, undamaged, and they are found on the horns like grains of millet, in a manner so that one half are ensconced in the stone, and the others stand out, brilliantly, just like Onyx; or secondly, they are found blunted, and it is then that one does not observe the grains, but simply the circular shapes which enclose each the other half of the small grains; or thirdly, these grains have fallen off, and it is then that may be well seen circular shapes, which instead of being filled, are each a hemispherical cavity. In this last case, which is not observable without the aid of a microscope, one may see very clearly, but small, a kind of beehive cells, also symmetrically arranged as such cells are.

We must not fail to mention here a certain crustacean Insect whose eyes exactly resemble those parts, which we have here named above the Horns of the Trilobites. Here I allow my readers to reflect, if these parts can be utilized to find the analog, and I am content to add here, that this testaceous Insect has its back composed of similar rings as that of Trilobites, except that it is not divided into three lobes. This crustacean Insect is given the name of Iceland Sea Aselle, Cloporte or Scolopendra (*Oscabiörn*) and, after the reports of Thorlenius and of Borrichius, there is, in the *Neue Gesellschaftliche Erzählungen*,[29] the following description for the eyes: The eyes of this marine louse merit being admired; they are infinite in numbers, are solidly encased in a horny membrane, of oblong shape and greenish color, ... being yet in the head shield they present themselves as a network composed of a thousand scales, somewhat greenish; with the aid of a magnifying glass it is seen that they consist of two oblong and convex horns, where are observed in each at least two hundred little eyes with their eye sockets; but it is with difficulty that they may be exactly counted ... with their cells, they seem like a honeycomb. Until the anonymous author of *Neue Gesellschaftliche Erzählungen*, Borrichius gives to this crustacean Insect, whose back resembles the tail of a crayfish, the name of *Argus Islandicus* because of the great number of its eyes, and because it is native to the sea of Iceland.

I was not able to discover other parts to the head of this animal. In the Swedish *Kongliga Vetenskaps Academiens Handlingar*, there is represented a similar Trilobite with antennae. Even though I have examined a great number of Trilobites, and that my colleagues, principally Provost Gentzmar, Dr. Hempel and Pastor Woltersdorff were kind enough to provide me, for this purpose, the best and the most instructive pieces, I have not been able to find, other than these horns, which I described above, the least vestige of any antennae, things that I believe impossible by itself in a Petrifaction. For this reason, I reject as questionable the authenticity of this figure until I may be convinced otherwise. Anyhow, if we would suppose that this animal has, under its shell, antennae like a snail, they could not have petrified any better than another fleshy part subject to putrefaction. Perhaps part of the inferior and slightly raised edge of its lips were mistaken for antennae.

The *back* has the character by which this animal is distinguished from all other crustacean animals. It is divided into three lobes, and is covered similarly by a scale, whose three lobes are composed, like the tail of a crayfish, of rings which pass one into the other when the animal extends itself or bends upward, and which move one under the other, and enlarge when the animal enrolls unto itself in such a manner that the head and the tail approach each other.[30] Ordinarily, these three lobes are of the same width, although there are Examples where the middle lobe is more narrow, and other Examples where it is wider, larger and considerably higher than the two side lobes. The rings are ordinarily of a thinner shell than that which covers the tail and the head of the animal, probably because it is there that the animal can least bear any lesion. The delicacy of this part may well be the reason that these Trilobites are mostly broken and destroyed before they pass into the Kingdom of Fossils. It is rare that is found such a ring, where its three arcs have remained entire. These rings are united at a small furrow which they have near the two extremities, where they cover the lateral lobes.[31] Each ring consists of three inflections or three arcs, so that they always cover part of the entire back, which is composed of three lobes; thus the number of rings is the same for each lobe. These three curves appear in some Examples to not consist of a one piece shell, since the two furrows of the back, which is divided into three lobes, sometimes appears separated and interrupted.[32] Perhaps this is due to a hardened mud, which clings to it; if we could remove it from the scale which is hidden below, we could see that each ring of the back consists of three arcs, which together form an entire ring. The most remarkable thing about these rings is the way that they mesh into each other and yet how they are separate from each other. Each ring is composed, so to say, of two raised, rounded striations, in such a manner that one striation is more elevated than another. This last striation, less elevated, is hidden below the ring which immediately follows it, when the animal is extended, but when the animal is curled, this less elevated striation only shows between the rings of the center lobe, although when the animal turns, the rings separate one from the other such as with the tail of a curled-up crayfish. Inspector Wilckens has noted this same particular circumstance in Trilobites, in his fine Treatise: *Nachricht von Seltenen Versteinerungen*, page 7. I will report his description: "there is," he says, "between each articulation, in the middle a spherical prominence, which meshes perfectly into the cavity of a ring, and meets it, without adhering to it. Instead, it is rather attached to the greatest elevation of the ring which is below it as if it were part of it, and all being jointed together, it fills the cavity of the articulation, which was previously curved, and it advances even a little, as it seems, below this articulation. However, each of these prominences is separated by a little furrow from the ring on which it is."

The number of rings is not the same for all individuals. Eight, ten, twelve, and more rings have been counted; some Naturalists have counted twenty four. It is possible however that they have taken the furrows of the tail for rings, and counted these. Probably these rings hold to each other by certain nerves, in such a manner that the animal living underneath is able to turn as it will, and thus, following their movement, the

rings can easily mesh one into the other, or separate each from the other. After the death of the animal, these nerves putrefy, as it seems, must happen soon, so it must be that these rings detach one from the other, and separate from the head shield and the tail. There must be, as we may conjecture from some Examples, under these rings, as well as below the shell of the tail, a membranous skin, which retains it after death. This could explain a certain phenomenon. The rings being crustacean, and by that being disposed to curve or to furrow, are symmetrically placed, whether the animal is extended or enrolled on itself, and represent scales that are united, and the furrows are never irregular or contorted. However, Examples have been found, which on the three lobes up to the extremity of the tail, do not present as many of the rings united, and even that they pull away from each other, so that the folds are not too regular. It appears that these Examples have been stricken bare from their natural shell, or else they remained in their matrices when it was separated, in such a way that only the core was found, thus presenting the ridges of its contracted skin. In this case, this skin still exists, or else, only its imprint is seen on the core. These wrinkles then go to the extremity of the tail, which for this reason is much more curved in those Examples which are contracted, than in those which still have their natural shell. It seems to me that it is this type under which we must place Linck's well known Example.

The tail, or rather the extremity of the tail, is not less different than the head shield, or the shell which covers the head. If, however, each type of head shield suggests its own type of tail, which particular one belongs to which type of head shield or another, is something that one could not yet determine, it being that we only find the shells of the head and of the tail mostly separated and isolated from each other. The shell of the tail consists only of one piece, like the head shield, and has two longitudinal furrows, thus dividing it into three lobes, so that, near the extremity of the shell, the middle lobe terminates in a blunted point.[33] The shell, in itself, has the shape of a semi-oval or a semi-circle,[34] or else it is sometimes conical.[35] There is not in all others the same proportion between their width and their length. There are some that are longer and more narrow than others.[36] All three lobes are convex,[37] and end below in the middle of the edge as a more or less blunted point. The middle lobe is ordinarily narrower and shorter,[38] but also more convex than the two lateral lobes. However, there are some that have the middle lobe quite wide, and where the inferior extremity doesn't have a blunted point, but are perfectly round in shape.[39] When the two lateral lobes still have their natural shell, they meet below under the middle lobe,[40] or else, the extremity of the tail is either pushed too far into the shell, or the shell was destroyed. Around the lateral lobes may be seen in several a smooth edge[41] which is continuous with the rest of the shell, and it is this circumstance that makes us believe that this edge is not the skin of the animal,[42] although otherwise this skin could not be contiguous with the shell itself. We observe on top, there where the tail is attached to the back, a narrow edge which is somewhat raised. This edge, which when separated, presents a slanted surface, thus justifies the conjecture that the tail is attached to the back only by a strong ligament which is in the middle.

The three lobes of the tail differ in several manners in regard to the surface of the shell. I only know one single species, which has the shell totally smooth and without folds,[43] all others have folds, but at the same time, they also differ much between each other, so we must refrain, where the shell is missing, from taking for the shell itself, the contracted and folded skin which is below. In some of these it is merely the middle lobe which is transversely folded, and it is there that the lateral lobes are smooth, and thus neither too convex nor too curved,[44] and the transverse folds of the middle lobe are more or less flat or pushed in. We must place here a very small species of tail shells, which is found in a black Stinkstone in the environs of Berlin, and which, unless I am in error, is also found in the countryside of Mecklenburg. Its three lobes are smooth, but the middle one has certain prominences, which on both sides project obliquely toward the top, unite in the center of the middle lobe, and appear to form, so to say, an obtuse angle. The shells of the tail, which are found in the alum shales of Andrarum, and which are known of in the *Mineralogia et Lithographica Svecana* of Bromell, are this same species, but finer and sharper, and with this difference, that toward the inferior extremity they show a compressed arc, and there it is observed both at the extremity of the edge, and also where the middle lobe ends, an elevated transverse striation. I thought at the beginning to see in this shape a particular type of head shield of the Trilobite, but I was disenchanted when examining with more attention this shale of Andrarum. It is, as all the circumstances prove, the tail of a particular species of Trilobite. In others all three lobes are folded,[45] and these folds, as they go toward the extremity, become narrower and finer, but they differ from each other in that, in some, they are quite large and few in number,[46] and in others narrow and numerous,[47] or there are also cases where, the sides, which are elevated between the folds, are sometimes finer or thicker. In some the sides always unite, two by two, to the extremities, where they bifurcate.[48] In some species the number of folds on the lateral lobes is equal to that of the folds of the middle lobe,[49] while in others, the middle lobes have more folds than the two lateral lobes.[50] The folds themselves are either smooth or garnished with grains; in this case the grains are found either simply on the middle lobe,[51] or in one row, or in two rows, or these grains are found also on the lateral lobes. The number of these small protuberances or grains, especially on the middle lobe, is sometimes larger, sometimes smaller, but all these grains become successively smaller and more closely spaced toward the extremity. The disposition of the furrows, on the side where they begin, is also not the same in all the individuals. On the middle lobe, these furrows are always transverse. On the lateral lobes, it is not always the same, but they descend in an oblique direction, and form an angle where they join the furrows of the middle lobe.

Here is another circumstance of the tail of the Trilobites which should not be neglected. The difference in size of the shells of the head and of the back is not as perceptible as in the shells of the tail. The reason must be due to the large quantity of the latter. Had we found as many shells of the head and of the back, as of the tail, we would find among these the same differences in size. There are shells of the tail that are barely the size of a pin head, but there are also some the size of a hand and larger, and even pieces half a foot long.[52] It can be judged that this important difference is not simply due to growth, but also due to generic size, and it must be that in the sea there are creatures of this kind, where their length must be greater than one-half ell, it being that the shell of the tail is one-third or one-quarter of the

total length of the animal. Independently of this, we cannot yet determine exactly, by the shape of the tail, the actual genus with respect to its natural size. It was discovered, even among the little ones, with the help of a magnifying glass, these same species differences, as we have indicated above, and I have noticed this same difference in the Trilobites which are the size of a hand.

In the countries which are preferably the home of the Trilobites, are found, mixed with the Trilobites, certain Petrifactions where we are not positive if they should be classified as the genus of Trilobites; else, these are other bodies, which by hazard have mixed with the Trilobites, and whose analogues are also unknown. These bodies are not all of the same type. We could easily divide these into four Classes. For those that belong in the first Class, it is most probable that they are the tails of certain particular species of Trilobites; there we can, for example, place the Petrifactions of Westgötland, which Mr. Bromell has communicated in his *Mineralogia et Lithographica Svecana*.[53] Apparently, we should also mention here all the squarish Trilobites that this Naturalist[54] and Mr. Linné[55] have observed in the alum shales of Andrarum. These are commonly found mixed with the tail of Trilobites, and they could be isolated pieces of the back shells with three arcs, and even of that species, where the middle lobe is more convex than the lateral lobes.[55*] For the bodies of the second Class, it is still very doubtful that they belong to a genus of Trilobite. It is there that we are to classify this Petrifaction of which Inspector Wilckens[56] gave us a detailed description, and which we generally take to be the fry of Trilobites. We can only attest on those stones where Trilobite bodies are found in such great quantities that it is as if they had been sown; here there are only isolated pieces which have great resemblance to Trilobite tails. However, for the most part, they do not resemble them at all, and, up to now, I have not found any at all where I could discover the least vestige of any furrows or striations as are seen on tails, even with examination using the best Microscopes. However, it is for sure that these small bodies consist of a shell where its inferior surface has a concave shape and where in the upper convexities we note something which resembles lobes. If these small shells are also found with larger pieces, and this I can not tell, but I am certain, that on all the pieces which up to now fell into my hands, that I have never found any vestige of a true Trilobite tail. We will place in the third Class all those bodies which truly resemble Trilobites, but where it is noted that they belong to bivalves, where one valve has in the middle a round fold which is much raised, and where the other has this same fold, but where instead of being convex, is pushed in. Of these there are many species in the Kingdom of Petrifactions. Some are classified with ammonites, other as pectunculites, and particularly those that are striated, and also those among the false arches; here principally are those where the extremities of the hinge are far from each other. It is among these true bivalved conchs with three lobes that we also need to report that species, for which Inspector Wilckens[57] has provided a drawing. In the fourth Class, we place certain bodies which are found among and with the Trilobites, but which evidently must be taken as unknown, and which we do not have the time or the space to handle here as a treatise. Perhaps, these are the shells of certain crayfish of the North Sea that are still unknown, and of other crustacean Insects.[58]

Up to now, I have thus described with all possible exactitude all the parts of this creature which has been given the name of Trilobite. Before I talk about its analog, the question comes: should it not be possible to make a certain classification of the different species and subordinate species which we have noted? I think that up to now, it is too soon to think about it. Up to now, we have found too few perfect and instructive Examples, notwithstanding the quantity of isolated pieces and tail shells produced in the Kingdom of Fossils. We are thus not yet capable to advise exactly as to the shape of each species of Trilobite, and neither to determine which species of head shield belongs to what tail. For sure, at least when we have found more, the division will be founded principally on the form of the head; by this same reasoning, I suggest to make a small attempt and propose as a prelude a sketch of the Classification of Trilobites. The principal division should be founded on the difference in the furrows of the head shield. Some species have no furrows at all, and actually the shell is convex without any depression;[59] others have furrows which are not curved, and where the two furrows which divide the head in three equal size lobes, descend in a straight line from the forehead to the lip;[60] and others yet have curved furrows. It is this kind of Trilobite which is the most common, and thus the direction of the curve determines the different subordinate species. So as the arcs of these furrows are larger or smaller, or more or less numerous, these animals have the forehead and the nose sometimes narrow, sometimes wide, and the cheeks sometimes large, sometimes small. In this manner, some have, for example, the forehead narrow, the nose large and the cheeks narrow,[61] others have the forehead narrow, and most often enlarge as a vase toward the extremities by curved grooves, and have a narrow nose and large cheeks,[62] others which have the forehead wide, the nose wider and the cheeks almost imperceptible,[63] and to finish this list, there are others which have the forehead wide, the nose narrow (which does not widen until near the lip, at the bottom) and the cheeks round and quite large.[64] I am doubtful here, if I should place for now into a particular class the Trilobites which have horns, as mentioned above, for who knows if most of the heads of Trilobites which have been found don't have similar horns on their tubercles, and these have been lost. Perhaps this will be clarified in the future.

What, then, is the present analog of this particular creature, which the Kingdom of Fossils allowed us to find? Has it already been found, or where should we search for it? Is there already a kind of animal, under which we could classify the analog in case it is found? Should we look among the Insects, or among shells, or somewhere else? These are the most difficult questions where we need a positive response, questions which our best Naturalists have tried to resolve. As to this analog, I will firstly report the different opinions, examine them, and then add my own opinion.

The opinions of the Naturalists with regard to the analog of the Trilobites may easily be sorted into three classes. This is because some believed it is to be found among the Insects, others among the shells, and yet others among other kinds of marine bodies. The Partisans of the first opinion are Lyttleton,[65] Mortimer,[66] Bromell,[67] Sir Linné,[68] Wilckens,[69] Davila,[70] Guettard,[71] Emanuel Mendez da Costa[72] and several others, and these differ still between each other on several points. Several, and in particular, Mr. Bromell, have taken the Trilobites to be Petrifactions of Coleopteran Insects, Scarabs, and other Insects of this kind, and have thought they had seen in these stones the

vestiges of these small animals (*Scarabæorum vel aliorum vaginipennium animalculorum vestigia*.). Others, on the contrary, have classified these with the wingless Apteran Insects, but they have not agreed as to whether they should search for the analogue in the crayfish or among the Monocules. Mr. Guettard and Mr. Davila place them among the Astacoliths, and believe that these are crustacean animals, which have an articulated back, since all crayfish have an articulated tail. They classify the Trilobites among the sea lice (*Pediculus marinus*), and if these Naturalists such as Mr. Emanuel Mendez da Costa, of whom I will talk later, understand this animal under the name of *Pediculus marinus*, the Insect of the Sea, which is named *Oscabiörn* in Iceland, and whose back resembles a crayfish tail, they have, following my opinion, come nearest to the true analog of the Trilobite, as I will prove later. In examining the Insect which carries the name *Oscabiörn*, I myself fell into the conjecture that the analog of the Trilobites must belong to this genus, before I became aware of the thoughts of three knowledgeable Naturalists. Messrs. Linné, Mortimer, and Wilckens supposed that their analog belonged to the genus of animals that are called Monocules (*Monoculus*). The first is in some doubt yet, as to whether it should not be classified as a middle genus among the crayfish, the monocules and the Aselles (*Oniscus*), being that the distinction between them is that they have an oval shape with twenty intersections; as to the feet, he adds, which in this genus separate easily with the animal destroyed, they have not yet been seen distinctly. In *Museum Tessinianum*, p. 98, he declares this Petrifaction to be a *Monoculus*, and he also gives it feet, although here some error must have slipped in. For if the Example which is represented on Plate 3 effectively has feet, its back cannot be divided into three lobes, and thus it is not a Trilobite. However, if he has taken the two lateral lobes, which are ensconced too far into the matrix, for the feet, and that these supposed feet are really lobes, there is no longer any reason to give feet to this Example. He has confirmed this same opinion in a letter addressed to Provost Gentzmar dated 9 November 1767, "*It cannot be a Testacean or a Chiton. I am convinced that it may be a species of Monocule, although the animal has not yet been discovered*." Mr. Mortimer supposes that the analog to the Trilobite is in affinity with the *Scolopendra aquatica scutata*, the same one that Mr. Klein has described with that name in the *Philosophical Transactions*, vol. 40, number 447, p. 150, but this is precisely the Monocule of which Mr. Schaeffer[73] gave a detailed description. Inspector Wilckens thought he had found the analog among the Monocules, and even among these same Monocules a form of crayfish, although he could not precisely say that the Monocule, which Monsignor Schaeffer gives a description, is in fact the analog of our Trilobites, but he supposes that it belongs, as another unknown species of the genus *Monoculus*, and that it is probably a species that is more likely found in swampy lakes, and maybe even the sea, rather than in fresh waters. Mr. da Costa[74] gives as its analog the Sea Louse name (*Pediculus marinus*), which belongs, as I see it, as well as to the Chitons, as to a marine Insect of the North, which has feet, and of which I will talk in more detail later. However, he believes that the true analog has not yet been discovered, and rather he gives to our Trilobite the name of *Pediculus marinus maior trilobus*. Mr. Lehmann has inserted in volume 10 of *Novi Commentarii Academiae Scientiarvm Imperialis Petropolitanae*, p. 410 and following, a treatise on *Entrochis* and *Asteriis columnaribus*, where he yet has some doubt as to why he has to have the name of Three-Lobed Conch. Later, and after this Volume was already printed, he added in the Summary an Annotation, where he declares that the *Oniscus*, which he believes properly, and as assured by Professor Beckmann of Göttingen, the *Oniscus entomon* of Mr. Linné is, according to his opinion, the analog of the Trilobite.

Following the second principal opinion about the analog of Trilobites, it is not an Insect, but a testaceous animal, which should be searched for among the shells. Scheuchzer,[75] Pastor Torrubia,[76] Provost Gentzmar,[77] Professor Franz Zeno[78] and several ingenious and expert Naturalists have taken this opinion. Or, as the shells are divided between conchs and snails, each has found their partisans. There was no other Naturalist, except the English scholar Leigh[79] who classified them with the snails. He believed that this Petrifaction was a piece of a Nautilus, an opinion which likely would not be adopted by anyone. All the other Naturalists thus decided on the genera of conchs as the place to find something resembling a Trilobite. Since Shells are univalved, or bivalved or multivalved, none of these classes failed to pick up some Partisan. Scheuchzer classified our Trilobite among the univalved Shells, by supposing it could well be a species of Patellite, an opinion that later the expert Professor Zeno[80] of Prague adopted. Most of the Naturalists went for bivalved Shells. Several of them took the tail of the Trilobite, before understanding it, not for a part of the entire animal, but for the entire animal, that is for an entire shell, and even for the entire valve of a bivalved conch; this is because such a tail, especially when it is described, as it often happens, as a semi-circle, and its circumferences has some resemblance to a conch. Hermann[81] was already of this opinion, and by this reasoning gave this tail the name of *Pectunculites trilobatus*. Mr. Woltsersdorff[82] also places it among the bivalved conchs, which is also done by an Anonymous author in the *Berlinisches Magazin*[83]. Some Naturalists who are of this opinion, and who know the entire shell of the Trilobite, maintain that the place of the Trilobite in the Kingdom of Shells cannot be disputed, as this animal may, as all other conchs, hide its entire fleshy body in its shell, as it may open it and close it, and that, which in other conchs is its hinge, is here its articulated back. In modern times, some Naturalists have begun the search for its analog among the multivalved conchs.

There is among these a certain genus which, as the Chiton, has a shell composed of rings, and which, like the Patellites, does not have any valve below, which attaches itself to rocks, and which, when pulled from the rocks, contracts itself like the Trilobites. It has different names; Sir Linné names it *Chiton*, others *Oscabrion*, Sea Louse, Whale Louse, *Pediculus marinus*, etc. Thus this multivalved animal must, following the opinion of some, be the genus to which the analog of our Trilobite could well belong to as a species. Two expert Naturalists are of this disposition, one being Father Torrubia,[84] and the other is my friend, Mr. Gentzmar of Stargard, with whom I have maintained correspondence, most instructive for me, for three years, on the subject of Trilobites. Father Torrubia said, that from the beginning, he took the Trilobites for a species of sea crayfish, but that later, after having seen the Ambonese Rarity Cabinet of Rumphius, and seeing what was a *Limax marina*, he had changed his mind; now he is convinced that this same *Limax* is the analog of our Trilobite.

And finally, we must make mention of the third principal

opinion on the subject of the Trilobite analog, and it is the one that will classify it neither with the Insects nor with the shells. This is the way that Brückmann[85] says that the Trilobite is the Petrifaction of a Sea Polyp, without further explanation, and that others maintain, following the report of Inspector Wilckens,[86] classifying it within the genus *Tethys*. Whatever animal species is properly understood by that, this I cannot tell. I do not expect that they will search for the analog among the Molluscs where, as is known well enough, the Tethys belongs.

Several of these opinions do not have the least probability, and a verbose refutation would be easy but superfluous. Other opinions are more plausible, and merit examination with more attention. All these opinions agree on the principal point, that is the analog must belong to the Animal Kingdom, and even to the marine animals. The Partisans of this opinion agree furthermore that the true analog has not yet been located, it being that up to now, of all the marine bodies, none have yet been found which have the back divided into three lobes, and additionally it being articulated. Consequently, when they talk about the analog to the Trilobite, and when they propose their conjectures about it, they only propose to indicate the category, to which the analog, yet to be discovered, must belong, a species to date unknown in its natural state; or else, they determine a species, to which this unknown body could be considered as a subordinate species. It is there that they all agree, but then divide into two principal camps, so that one side places the supposed analog, yet to be discovered, among the shells, and the other side among the Insects. To be sure, this will easily be decided when the analog is found, and meanwhile, numerous things can be said as a preamble of this topic, it being that it can be judged by the character of Classes and of genera, which were adopted and established in the Animal Kingdom.

When it is a question in general, if it is more proper to place the analog among the shells or among the Insects, I must admit ingenuously that here and there, some of these opinions have good arguments, however several difficulties will assail them. The Test, and principally that of the tail, perfectly resembles, in all its substance, and its laminated tissues, that of seashells, and as we already know there are shells whose back resembles a crayfish tail, as for example the Chitons; beyond that, there are shells, which have only a shell on one side, and whose other side clings firmly to rocks, as for example the Patelles; and also, following Rumphius' report, those snails, when they are ripped from their place, contract upon themselves the same as our Trilobites, and give their oblong bodies a round shape; it almost seems that the *Limax* of Rumphius, which we will learn at closer hand later, is the analog of our Petrifaction. Independently from those who take the analog to be an Insect, they are not yet willing to concede, and they still have good reasons for it. In their opinion, the total form of a Trilobite is repugnant to the constant and essential characters of a shell, and even the specific difference that there is between a shell (*animal testaceum*) and a crustacean Insect (*Insectum crustaceum*) removes doubts to the opinion about the Trilobites' analog so that it cannot be a shell, but must be a crustacean Insect. The Test of a testaceous animal never has, as we know, articulations in a manner where can be distinguished in the shell, the head, the back and the tail, and that even in these principal parts, may be distinguished yet other parts, as for example, the tubercles and the Horns of the head of a Chiton. Rather, the shell of a testaceous animal is continuous, without it having separate members and parts of the body, whether the shell is jar shaped or in the shape of a pipe or some other shape. In contrast, we observe in the Insects, for example in the crayfish, the Aselles, the Monocules, etc., that their distinctive Character consists in these visible characters, which constitute the difference in the head, the back and the tail, and as they purport, not without good reason, manifest against all the Zoological Principles, leading to the conclusion that an animal such as the Trilobite is a testaceous animal. Truly, there is not much to be said about that. But no matter, the opposite party fights in the same way the idea that Insects are the pretended analogs of the Trilobite, and would we not think that they would find repugnant even the idea of representing an Insect without feet? The Trilobite has no feet, since they have never been discovered in the petrified Examples that have been found, and as a consequence it could not be a crustaceous animal, and, as there is not a third type, we must place it among the testaceans. This objection has much likelihood, although I think that there are many things to be retold here with further thought. We should suppose meanwhile, that we have not yet discovered feet in Trilobites, and we could infer by that positively, especially when we have paid attention to several particulars, which are found in this Petrifaction, and that is those feet are also missing in the analog? When only the tail of the Trilobite was known, and that it was thought to be a shell, and that this pretended shell was given a back which resembled the tail of a crayfish, when actually this had yet to be observed? Nevertheless, later this back was found, and at present, we see this rare Petrifaction from a viewpoint much different from before. How long have we not known the Trochites, the Entrochites and the Asteries before knowing the crown which they wear? If then someone had conjectured the existence of such a head or crown, they would surely have encountered many contradictions, and this would principally be based on that which has not yet been discovered about the Entrochites which up to then had been found.

There can be reasons, why the Trilobites are mostly stripped of their feet after death. The reason, why for most Trilobites the rings of the back separate from each other, and that within some hundreds of tails one can find only a single one where the rings of the back still hold firm, is the same which causes the loss of feet in Trilobites. No one will discover that the living animal, which is the analog to the Trilobite, will not have nerves by which, not only will the testaceous articulations hold to each other, but that they will also extend and contract them, and thus have free movement of their body. The ligaments, which attach the rings of the back to each other, must, as no one will also discover, be much stronger and compact than those, by which they allow movement to the soft feet.

As, for the most part, the rings of the back are separated from each other by the reason that the ligament was destroyed by the putrefaction which occurred before the dead Trilobite passed into the Kingdom of Fossils, how much more can it not be that by this same reason it was stripped of its feet? It is the same with Encrinites; why do we find such immense quantities of Trochites, why much fewer Entrochites and why yet more rarely Encrinites? Because the nervous system of this Zoophyte was destroyed before it found, in the Kingdom of Fossils, a tranquil place, and because by this destruction it must be that all these pieces separate. Thus we will not find any Echinite that will still have its spines, since the skin and the nerves, which

give free movement to the spines on the test, have been destroyed by putrefaction. They must fall before the Sea Urchin passes into the Kingdom of Fossils. By consequence if the analogs of the Echinites were still unknown, no one could easily convince himself that the animal in its natural state had spines, which it used as feet.

We must still add a circumstance which merits attention. The Trilobites found in the Kingdom of Petrifactions are either stretched-out or contracted. It is probable that this animal, in dying, contracts, and if in this state it passes rapidly into the Kingdom of Fossils, it maintains its rounded form. But when its nervous system putrefies, it cannot maintain its contracted form, the dead body, being half putrefied, decomposes, and it is probable then that the feet, due to the thinness of the nerves, are first to separate, the shell of the back stays still attached a little at the head and at the tail, and by a fortunate chance, a few Trilobites find themselves in a tranquil place before being totally destroyed, but for most, the shells of the head and of the tail, being in the shape of a vase, are soon transported by water and sunk whereas the more fragile rings of the back are not. For this reason, it is not possible to find feet on stretched-out Trilobites. Beyond this, the number of stretched-out Trilobites is much too small to allow anything to be inferred in general; principally, because of the rarity of perfect Examples, no one will easily be convinced to take apart a well preserved piece to search under its shell for feet, which could well yet be hidden in its core. As for closed Trilobites, it is quite possible that, should we wish to try and cut them through the middle, that we might still find the vestiges of feet. But as the beautiful and perfect Examples are still a rarity in the Cabinets of those most knowledgeable, no one is willing to sacrifice these so as to resolve this Problem, although it would certainly be worth the effort. And after all, even if such an attempt was not successful, we still could not infer by this that Trilobites, in their natural state, had no feet. We should remember here for example the Echinites; were not many different bones contained in their shells, when they were still alive? One would think that we would find these bones in the Echinites turned to pieces, seeing that they are all around enclosed in a shell; and yet, we almost did not find at all the bones of Echinites enveloped in the cores.

All that I have just stated about the feet of the analog of the Trilobite, is well confirmed by an observation of Dr. Charles Mortimer, inserted in the *Philosophical Transactions*, vol. 46, p. 600. As I have just received this volume, in scanning it I find that among the Examples of Trilobites, which had been sent to the Royal Society of Sciences, I noticed one stretched-out Trilobite, which is referenced there as fig. 10, and below which is something that advances to one side, and which perfectly resembles feet, which up to now has not been willingly attributed to this animal. Mortimer himself is of this opinion. In explaining f. f. on fig. 10, he says there "appear some traces of feet, which seem to lie under the belly: but, as the belly, or under side, was not distinct, not being cleared from its stony and earthy matter, I could not discern any other legs." I have read Mortimer's observation with great satisfaction. As my conjecture was effectively based on such, and I do not regret at present the difficulties which I went through to make probable the existence of feet in Trilobites, before I had heard from England that they had found vestiges on one Example. And even presently I find that in France, the same discovery was made on one Example which is located in the Cabinet of Mr. Davila, as may be seen in Mr. Guettard's Treatise in the *Histoire de l'Académie Royale des Sciences* for the year 1757, p. 82. The opinion of finding the Trilobite's analog among the shells thus falls by itself.

Up to now, we have only considered in general the question of whether the Trilobites should be classified with the shells or with the crustacean Insects. We are now arriving at the opinions of the Naturalists, in particular to the subject of the analog of the Trilobites. I am here only reporting on those which merit our examination and our attention.

The opinion that the Trilobite is half of a bivalved conch, falls by itself, as this idea only took place with regard to the tail, and as long as we had not yet the entire body of the Trilobite, and that we were persuaded that this tail was its entire body. If some Naturalist maintains that, notwithstanding this, we can take the entire body as a bivalved conch, and that instead of a hinge, has an articulated and flexible back, this is repugnant in general for the bivalved conch organisms, and in this case, I would much prefer to classify its analog among the Patellites or among the multivalved conchs.

The opinion that the Trilobite belongs to the Chitons, seems to have more probability, and I confess that in the beginning, I had myself adopted this idea, upon which Provost Gentzmar suggested first in Germany. Later, I obtained some species of these Chitons, in their natural state, which furnished me with the occasion to examine them more exactly, and to compare them with our Trilobites. Different names were given to the Chitons; they are called Lice of the Sea, *Pediculus marinus*, Whale Lice, Elephant Lice and Oscabrion, but manifestly it is by this last denomination that has been mistaken the Icelandic Oscabiörn, which is a crustacean Insect having fourteen feet, and which we will understand better later on. For Chitons belong to the shells, and not to the articulates; in contrast, the Oscabiörns belong to the Insects and much resemble the Cloportes (*Oniscus*) and for this reason most Naturalists classify them thus. The shells of the Chitons perfectly resemble an egg cut longitudinally in two pieces, it is hollow below, and hemispherical above, and because of this, it is comparable to a large nacelle. The entire shell is composed, as the Trilobite, of rings, that following the movement that the animal makes to stretch or contract, enter or slip one under the other. We count at least six and at the most eight of these rings. As this is a mollusc which lives in this shell, there is no visible articulation, as in the crustacean Insects, and for this reason, it is not possible to distinguish the shell of the head or of the tail, but its entire hemispherical testaceous armor is composed of rings, with this difference, that it has an oval contour, and the rings are shorter and more blunt toward the extremities than in the middle. There are on the same rings elevated sheets, wide at the base, and pointed higher toward the back, which Rumphius[87] calls spines. Below, at the edge of its shell there is all around a large, tough roll, to which the rings are attached. This roll is garnished with very fine scales, making it appear as grainy leather. The Chitons grab hold of rocks at the bottom of the sea, like the Patelles, so that they are only removed with great difficulty, and then they contort and enroll upon themselves. There are several species of these Chitons,[88] but they all are similar with regards to this generic character to which I am referring. They are represented in the Works of Mr. d'Argenville,[89] Seba,[90] Rumphius[91] and Knorr,[92] without even mentioning others. In the meanwhile we

have not said with reference to this multivalved marine body more than was necessary for this. There is still the question which is, could this Chiton be the analog to our Trilobites? Here are the arguments which have made me doubt it. The Chiton has neither a helmet, nor a shell for a tail, and cannot have it as long as it is classified with the shells; in opposition, in the Trilobite may be seen distinctly testaceous articulations, a helmet and a test on the back and on the tail. The rings or the scales of the Chiton are garnished with a kind of elevated sheets and pointed or flattened spines, characters which are entirely missing in the Trilobites. All around the shell of the Chiton is a rolled edge, elevated and scaly, but this scaly roll is not found in the Trilobites. Mr. Davila has in his Cabinet a considerable quantity of Chitons and even several species of Trilobites. He makes an effort with Mr. Guettard, who knows Chitons only too well, to show their analog, and yet among all these Chitons, he has not found a single species that has any resemblance to the Trilobite. For this reason he classifies the Chitons among the multivalved conchs, and on the other hand he classes the Trilobites among the crustacean Insects and even with the Astacoliths.

To give my ingenuous opinion, I find much less resemblance between a Monocule and a Trilobite than between a Trilobite and a Chiton. It is thus a must that in all the Examples the convex and horny skin of the back has been lost, and yet in all the members and the parts of its body it is the most disposed to become petrified. The articulated or ringed body hidden below this shell is of a substance much too soft to resist putrefaction, to not contract, and, which is the most remarkable, to change it to a layered and hard scale. As to the shell of the tail, which already in its natural state must be either crustaceous or testaceous, there is not the least vestige. If it was supposed that the body of a Monocule was petrified and stripped of its shell, it would be that only the soft flexible skin was petrified, or else that the soft fleshy substance followed the same change. In the first case, we would not understand how this soft skin could, without putrefying, and without contracting, separate from the flesh, and without suffering any compression, be enveloped in stone with such regularity. In the last case, there must at least be found under the shell of the back of the Trilobite a spathic substance born of the petrified soft parts of the animal; anyhow, as well as I know, this was never found, and this makes us conjecture that it is nothing but a simple shell that was either crustaceous or testaceous, which passed into the Kingdom of Fossils, and which is now presented as the body which we call a Trilobite.

To state my opinion on the subject of the analog of this Petrifaction, up to now I believe that it has not yet been discovered, since among all the animals, testaceous as well as crustaceous, we have not found a single one, which has all and at the same time, an armor of the back divided in three lobes, a shell of the head or a helmet and a shell of the tail. I could not be less convinced that we must search for the analog in the sea, as it is generally found in marbles and calcareous stones, which get their origins from the sea, and that are found in the company of marine bodies and not with terrestrial bodies. I also believe that if we discover the true analog, it could well constitute a separate genus, as it cannot be conveniently placed under known genera, unless that we wanted to establish characteristics too expansive and not determined enough, and in determining the genus, neglect those characteristics which are essential to these bodies. I am also of the sentiment that up to now it is too early to determine the genus of the Trilobites, even to establish with certitude a species of a genus already known, be it either shells or be it Insects. As much as the affair does not have to be decided but only by appraising those, for the most part, imperfect Petrifactions which we have, we can always make negative conclusions rather than positive ones, being that it would be easier to say what the animal is not rather than what it is. Besides, in the Kingdom of Petrifactions, hidden from our eyes are several parts of these bodies which are for the most part destroyed, and which are after all necessary to determine the genus, and in opposition are presented several parts, which we must consider from a different perspective, that we are quite pleased to be able to compare with the body itself an analog which is unknown up to now, and which will then be known. The Belemnite and the Trilobite will justify some day well enough the conjecture that I have proposed here. But when some day the analog of the Trilobite will be discovered, the Zoologist will have no problem in assigning its place among the animals, and to classify it either in a genus already established or, as I suppose it, to establish it as a separate genus. At present, the best position is that of searching among the marine testaceous bodies which have already been found, without paying attention to their Classes, families and genera, or to the Classification methods, which anyway are quite variable, for this body within the confines of which our Trilobite would most likely be placed, if it could be found. All depends to the more or less great resemblance that there is between our Trilobite and marine bodies which have already been discovered. Either I find the greatest resemblance, or in the marine body I find essential qualities with regard to the external and visible organic structure, or the entire shape of the Test, or the ringed back, (because it is there that are the essential and visible characters, that Nature presents us so as to discern bodies from each other); or I find, I say, these marks and these characteristic traits, which agree the most, and in the most natural way and without the help of our imagination, with the Trilobite; in the meanwhile, it is within the confines of the Animal Kingdom that I must place the Trilobite, until we are proposed a more founded and a more probable opinion, and then I will be the first to recognize and retract my error. In the seas of the North, and thus by consequence in the countries, where principally, solid earth is the home of the Trilobites, there is a certain marine testaceous Insect, which the habitants of Iceland call Oscabiörn. It is also named Aselle of the Sea, since it is found in the sea, and much resembles the Aselle or Cloporte. I have myself, in my cabinet, such an Insect, and I have compared it exactly with the descriptions and the drawings that have been given me as well as with my Trilobites. Each lobe of the Trilobite has much resemblance with the testaceous back of this Insect, and it is only missing the two grooves to have it become three lobed like that of the Trilobites. Hannes Thorlev, born in Iceland, gave us a description of this Insect which may be found in Bartholin's *Acta Physico-Medica*.[93] After this author, another anonymous author has inserted a very exact description of this Insect in the *Neue Gesellschaftliche Erzählungen*.[94] The body of this Insect is oval. The head, the back and the tail are covered by a smooth shell, which is similar in several ways to that of a crayfish, but which appears to be of a more compact substance than that of a river crayfish, so that I am almost tempted to believe that this shell, especially when it is strong and thick, must have divided into sheets. The shell of the head or the hel-

met, as in the Trilobites, only consists of a single piece. In some, as may be seen in *Museum Wormianum*,[95] this shell is large and perfectly proportioned to the size of the head of the Trilobite and to the rest of its body. In others, as in my Example, this shell is considerably smaller, although it has, as do the Trilobites, two fine curved furrows, which start above near the first articulation of the back, and which disappear slowly, below, near the lip. This back is similarly composed, as I just stated, in all the Trilobites, of rings, which enter or slip one under the other, and it is only missing the double furrows to give it the shape of a three-lobed back. The number of these rings of the back is unequal; in my Example, I count twelve, and in Worm's Example, the shell of the tail is very small, unless it had been mutilated, because in my Example, I have noted that the smallest violence is enough to separate the articulations of the back. On the other hand, in the Example which I have in my Cabinet, and that which Monsignor Gesner has communicated in *Insectis Marinis*, p. 268, the shell of the tail is much larger than in that of Worm's, which ends as a blunted end, and its shape totally resembles the shell of the tail of a Trilobite, except that it is not divided into three lobes, and that the transverse folds are missing, as it is completely smooth. As to the rest, the shell is pretty well at the proportion of the body; and as my Example is about an inch long, it must be that in the larger Examples that have a length of four or five inches, the shell must be of a considerable thickness. We see at the inferior part fourteen very soft feet, with their extremity furnished with a recurved hook such as the claw of a bird. With these nails, these Insects attach themselves to fish, such that they cannot remove themselves readily. They hold firmly in place where they attached themselves, and kill the fish by sucking its blood. In some of these small animals, the shell of the head is furnished with two prominences; it is with reason that I say in some, because in my Example there are none. These protuberances are the eyes of this Insect. Following Thorlev and Borrichius' description[96] they resemble exactly the granulated horns of some Trilobites. Below the shell of the back we have not yet discovered, besides the feet, any viscera, however a viscous and gelatinous substance, which hardens in time, was found. This substance is scissile, half transparent, and generally reddish yellow. The inhabitants of Iceland call it Stone of St. Peter (*Peters-Stein*). As we have not found in this animal other soft and fluid parts, and that it is for the most part hollow, it is perhaps here the reason that it can hide its feet under the shell of the back and to contract them in such a manner that they are totally hidden as in a bowl, and that from the outside, we cannot perceive any trace of feet. Thus this animal, laying on its stomach, cannot even be suspected of having a hint of feet; they even almost touch the internal surface of the shell. The individual that Worm describes with a side view of the back and the stomach shows no feet. It must already have been stripped of them because, according to Sir Linné, the feet of this testaceous Insect fall readily. Perhaps these animals hook on so tenaciously to fish with the help of their highly curved claws, that in death they remain attached. Whether the fish escapes or not, it is easy to conceive, that in putrefaction, the feet thus hooked remain attached to the fish, and that the shells that cover the head, the back and the tail, fall either together, or, which happens more often, fall in pieces.

Any impartial Naturalist agrees, that of all the marine bodies known, there is not one known which resembles more to our Trilobite than this marine Insect; at least, we can remove more easily the difficulties that are encountered with the other opinions. It suffices for me to offer a testaceous Insect, whose species include the analog of the Trilobite. I leave it to the Zoologist to find the Family and the Genus under which it may be classified. Perhaps among the Aselles (*Onisci*), shall we say. As for myself I find great difficulty with this opinion. I cannot myself classify our cloportes and other apteran molluscan Insects with the same genus as the animals which have a testaceous armor, a head shield and a shell on the tail. I admit that a cloporte has fourteen feet and as many folds on the back: must we understand, by this, that all which has fourteen feet and has folds on the back, must be an aselle? The difference that there is between a soft skin and a testaceous armor, is too essential to be neglected in the classification of the apteran Insects. It suffices then to separate all the cloportes which are covered with an armor such as the crayfish from those that have a soft skin, and to make these a particular genus, which I would place between the crayfish and the soft-skinned cloportes. This middle genus could be given the name Armadille, which anyway is given to a certain species of cloportes, and the description would be the following: *Body ovate-oblong, crustaceous, VII-XII articulated dorsal segments, shell of head & tail integrated, XIV feet*. Maybe we could classify under this new genus, which we would establish between the crayfish and the cloportes, several marine animals, which have been classified, in my opinion wrongly, among the crayfish or among the cloportes. For when we establish for the characteristic of the crayfish an articulated tail, we cannot well classify under a particular genus the marine animals that have the back articulated and armored, and to place them before the cloportes, which do not have a crustaceous armor. We would classify then, in this middle genus, most of the Insects which Mr. Linné has placed under the name of *Macroura manibus adactylis*, *Systema Naturæ, 12th Ed., Tom. I, Pars II*, p. 1054. And certainly, if we consider the *Scyllarus* in Rumphius, *D'Amboinsche Rariteitkamer*, pl. 3, fig. F, the *Pulex marinus* in Frisch, *Beschreibung von Allerley Insecten in Teutschland*, part 7, pl. 18, whose back is practically divided into three lobes, and if we pay attention to other similar aquatic Insects, we will note a very natural analogy between them and our Trilobites. I would also classify, without difficulty, in this same class the testaceous insect, whose petrifaction was communicated in the *Histoire de l'Académie Royale des Sciences* of Paris for the year 1757, p. 82, pl. 7, fig. 2. For upon close examination, we easily find a very great resemblance between the *Scyllarus* or the *Squilla arenaria marina* in Rumphius, pl. 3, fig. F, and a stretched out Trilobite, so that all these species of bodies could well constitute a middle genus under the name Armadille.

I must still deal with the condition in which this body is found in the Kingdom of Fossils, the matrix in which it is mounted, and the localities where it is found. The Trilobites which are found, are for the most part imperfect and in pieces. The shell of the tail and of the head is ordinarily isolated and separated from the lobes of the back, while their rings are found much more rarely in the stone, isolated or only partially coherent. We can allege here a most probable reason. As the shell of this animal is composed of mobile parts, tied to each other by some soft ligaments, it must be that after the death of the animal, when the soft parts and fluids putrefy, the shell falls in pieces, just as in the same situation the spines of the sea urchins fall off ordinarily. But the principal reason why so few isolated rings of

the back have been found, must well be that they are for the most part too thin and too fragile that they may, as the shell of the head and of the tail, pass into the Kingdom of Fossils without being destroyed. Perhaps we have not until now examined them with enough attention for these were not known, and that probably these were taken to be fragments of papyraceous shells, as these are actually found.[97] I possess myself a slab found in the country of Mecklenburg, covered with similar isolated rings, which are spread on the stone, with several tail shells. Often the test is no longer there, or else, when the piece is fractured, there remains in this half the imprint of the animal. However, when there are some remains, they are typically white in color, or a yellow gray, sometimes dark yellow brown, which also often depends on the color and the quality of the stone in which the Petrifaction is found. The test is either petrified or calcinated,[98] or metallized; in this last case, it is ordinarily pyritized.[99] Trilobites are commonly found in the company of other marine bodies. They are found in particular with Belemnites around Prague, with Pectinites and with Pectunculites near Frankfurt-on-Oder, with Orthoceratites in the region of Mecklenburg,[100] and with Coralliolithes, as may be distinctly seen on one of my examples, which offers on one side a Trilobite of average size, and on other side a *Tubularia fungiformis*.

The matrix is, particularly in the North of Germany, of a gray or reddish marble, and often it is but a piece of limestone. In other regions they are found in a smelly black stone, such as at Neuruppin, and in Sweden, as attested by Mr. Bromell, and especially in the areas around Prague. The region of Stargard also provides an arenaceous black shale, which encloses Trilobites. I have received some from Gnoyen in the area of Mecklenburg that are enveloped in a very fine greyish sandstone that is poorly compacted. In the region of Mecklenburg, they are also found in half-decomposed flint.

As for localities, they are found much more frequently in the septentrional regions than in other places. In the North of Germany, Uckermarkt and Mecklenburg offer them in abundance, and, notwithstanding that, even in those regions, nothing is rarer than a perfect Example. Very expressive specimens have been found besides in the environs of Berlin and of Frankfurt-on-Oder; the Cabinet of Mr. Woltersdorff contains some beautiful ones. The same thing can be said of several provinces of Sweden. Particularly in the regions of East-Götland and West-Götland, in Öland and in Scania, the shells of the tail of Trilobites are found in such great quantities that, referring to the report of Mr. Linné[101], they appear to form rocks. We find in particular beautiful Trilobites in England, where they are named *Dudley-Fossils*, after a place in the County of Worcester with the name of Dudley, where they are extricated from limestone quarries, sometimes loose, and sometimes fixed in their matrices, and often in large and beautiful slabs. Near Colebrookdale in Shropshire are even found very nice Trilobites, as are seen in vol. 25 of *The Gentleman's Magazine*, p. 24. Already, Lhwyd knew them under the name of *trinucleus*, and found some in Merionethshire (*Comitatus Mariduniæ*), as he tells in his first letter inserted in his *Lithophylacii Britannici Ichnographia*, p. 96.

They are also found, but much more rarely, in other regions in, as well as out of, Germany. Brückmann[102] obtained some from Stemme, in the Bishopric of Paderborn. In the *Berlinisches Magazin*[103] there was mention of those that are found near Aachen, and near Burgwenden in Thuringia. Similarly, they are found near Prague, and, apparently, they are found there as far as the chain of calcareous mountains that stretch from there toward the South-East, and where is drawn this pungent black stone. Following the remark of the late Mr. Klein[104], Mount Cyngal near Danzig also supplies these Petrifactions; however, it seems that there they are not found too frequently. They are also found in Switzerland,[105] although the simple tails that are found there are quite rare. They are also found in France, although, it appears, very rarely, in the slates of Angers.[106] In Spain, Father Torrubia, as may be read in his Natural History of Spain, has also found some at the edge of Pardos, two leagues from Molina of Aragon, in the environs of Anchuela.

To date, we can only say very little about the history of this petrifaction. During the past century, it was totally unknown; at least, I do not know any author who mentioned it. At the end of the past century and during the beginning of the present one, the English made known the first ones, without knowing what they were. Lhwyd[108] names it *trinucleus*, and admits that he does not know where to classify this petrifaction. Soon after him Leigh[109] attempts to do so, but not too successfully, considering that he decided it to be a fragment of a Nautilite. It is only ten years later that Hermann[110] located the first Trilobite in Germany, in Silesia; but he did not know, any more than the others, what to do with it; nevertheless, he conjectured that the shell of the head, which he found, could be an Echinite, and the shell of the tail, a Pectunculite. Sixteen years later, Scheuchzer[111] also found some in Switzerland. He did not guess either that it was a Trilobite, and took it to be a type of Patellite, or even an Ostracite. These knowledgeable Naturalists ignored the discoveries of each other.

Since this time, we neither heard nor saw anything until the year 1730, in which Bromell, in his *Lithographiæ Svecanæ*, made known the shells of the tail of our Trilobites under the name of petrified vaginipennous Insects. The German translation of this Work also made them known to German Naturalists, and while they did not take them to be petrified scarabs, as did Bromell, neither did they know what they were, until Mr. Woltersdorff, in 1748, assigned them, in his System of Mineralogy, to a place among the bivalved shells. Since this epoch, the German Naturalists placed them among the petrified shells, in their lithologic Systems and Works, and there things generally remained until the year 1750.

Since that year the Trilobite has been the subject of research for several Naturalists, who have published several scholarly Works, as follows:

1. Mr. Gentzmar, Provost of Stargard in Mecklenburg. This learned Naturalist was the first to describe the Trilobite in a particular memoir under the title: "Description of a petrified shell with three lobes (*conchæ rugosæ trilobæ*)." It is found in vol. 2 of *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, 1751, in octavo, p. 285. The continuation of this scholarly memoir is found in vol. 3, p. 183. There, he compares and writes very exactly about the Trilobites which have been found in the country of Mecklenburg, particularly of those that he has himself in his elegant cabinet. At first, he took the Trilobite to be a species of shell; however, in the continuation here mentioned, he proposed, reasonably, that its analog is an unknown marine animal, whose test is composed only of crescent-shaped rings. He is disposed, at the same time, to look at the Chiton, described here above, to be the analog of

this unknown marine animal. We owe, to this same scholar, that information on the Trilobites, which is found in article 11 of the *Neues Hamburgisches Magazin*, p. 440. Also in 1771, he inserted a small memoir on the three-lobed conch as article 2 of vol. 3 of *Berlinische Sammlungen*, where he proposes the possibility that a Chiton is the analog of the Trilobite.

2. Emanuel Mendez da Costa. We obtain from him: "A description of a curious fossile animal," which is written in *The Gentleman's Magazine*, vol. 25, p. 24. This curious animal, which he describes, is precisely our Trilobite; he gives it the name *pediculus marinus maior trilobus*.
3. Guettard. We obtain from him the "Mémoire sur les ardoisiéres d'Angers", which are written in the *Histoire de l'Académie Royale des Sciences* for the year 1757, p. 82 and following. Here he also deals with certain *Chevrettes*, which he finds on these slates, and he includes, under this name, our Trilobites and some other species of astacoliths that he found on these slates.
4. "Peculiar Petrifactions of an insect, *Entomolithus paradoxus*," described by Mr. Linné from the Cabinet of Count Tessin. This is the title of a little, but scholarly memoir inserted in the German edition of the Swedish *Kongliga Vetenskaps Academiens Handlingar*, vol. 20, p. 20. He supposes, as we have said above, that the Trilobites hold an intermediate place among crayfish, monocules and aselles.
5. Charles Lyttelton. He has published: "A letter concerning a non descript petrified Insect." This letter is found in the *Philosophical Transactions*, vol. 46, number 496, p. 598. Here may be seen very exact illustrations of extended and curled Trilobites, which were found in the Dudley quarries in Worcestershire. Dr. Charles Mortimer has added here several items that serve as an explanation to Lyttelton's description.
6. Johann Gottlob Lehmann. In vol. 10 of *Novi Commentarii Academiae Scientiarvm Imperialis Petropolitanae*, there is on p. 401 and following, a Treatise from this learned Naturalist: "De entrochis et asteriis covmnaribvs trochleatis," to which he has added a "Problema de petrefacto incognito noviter invento" name, under which he includes precisely our Trilobite. When he wrote about this problem, he did not declare why he specified this petrifaction. However, he added to the summary of this volume a supplement, where he recognizes an oniscus indigenous to these waters (*Entomon* of Sir Linné) to be the analog of the Trilobite. Professor Beckmann of Göttingen, who then was in Petersburg, and Mr. Staehlin, Secretary of the Academy of Sciences of Petersburg, sent a live oniscus of this species to Mr. Lehmann, and those two scholars thus assured the latter that the analog should be searched for among the onisci. Mr. Bergmann in his *Physikalischen Beschreibung der Erdfugel*, p. 161, reports that Mr. Staehlin, while at his country home, found in nets, among small fish, a certain aquatic Insect (probably in fresh water) barely as thick as a fishing line, with skin as white as snow, but on which he could find neither feet nor any opening. It had no scales, but had unfolded wrinkles (*rugæ explicatæ*), where, upon touching, they contracted, so that the animal, which had a large and flat shape, when it contracted, took on a round shape. Mr. Staehlin showed this Insect to Mr. Lehmann, who recognized it to be an oniscus, and initially took it to be the analog of our Trilobite.
7. "Nachricht von einigen seltenen Anomiten, oder Bohrmuschelsteinen." This is the title of a scholarly memoir found in the *Berlinisches Magazin*, vol. 4, p. 36. The author also talks about our Trilobite on p. 54, and places it among the bivalved shells with unequal valves.
8. *Nachricht von Seltenen Versteinerungen, Vornemlich des Thier-Reiches, welche bisher noch nicht genau genug beschrieben und erkläret worden, in drey Sendschreiben an seine Gönner und Freunde abgefasset von Christian Friedrich Wilckens, Inspectore der Cothusischen Diöces und Pastore Primario*. Berlin & Strasbourg, 1769, in octavo with 8 Plates. The author of this scholarly work gave a well detailed description of Trilobites. He proposed, as was mentioned above, that the analog of this petrifaction should be searched for in the genus of aquatic cloportes (*Branchiopus*).

TRANSLATION OF WALCH'S TRILOBITE PLATE CAPTIONS

Following the order of the Plates which compose this Supplement, I arrive at the Trilobites, and at the same time at some echinites which for the most part are quite rare. I will add some explanations with reference to both.

Supplemental Plate 9 (see Fig. 3)

Number 1. The shell of the tail of a trilobite of considerable size; from Öland. It is of the group whose edges form a semi-circle. The three lobes have raised striations, but that of the middle has more of them than the two side lobes. The analog, when complete, must have been of considerable size, and at least of eight to ten inches. This piece is still covered with its natural test, and it may be seen distinctly, that in these animals the shell of the tail consists of a single entire piece, and that it is not furrowed like the back.

Number 2. A semi-rounded shell of a tail of medium size, from Mecklenburg, covered with its yellow-grayish thin natural test, detached at one of its extremities. The middle lobe is narrow, and shows the same number of raised striations as the two side lobes. There, where the back was, the shell slants into the stone, and it may be inferred from this that the shell of the tail must have been united to the shell of the back only by some large muscles.

Number 3. A little shell of the tail, from Gnoyen, in Mecklenburg. It is still covered with its test, brown in color, set in a grayish calcareous stone. The middle lobe is very narrow, and advances nearly to the edge. The two lobes are very smooth, and have no striations.

Number 4. A shell of the tail of mediocre size, from Mecklenburg, set in a gray calcareous stone. The petrifaction is of the same color, the test is whole, of the thickness of a knife blade. The middle lobe has the same number of striations as the lateral lobes. These striations disappear little by little toward the edge, as if the painter had missed, and the middle lobe does not advance all the way to the edge.

Number 5. A very large shell of the tail, set in a reddish marble, from Stargard. The test, still there, is thicker than the blade of a knife. The width of this piece allows for the conjecture that in its natural state, it would have been longer.

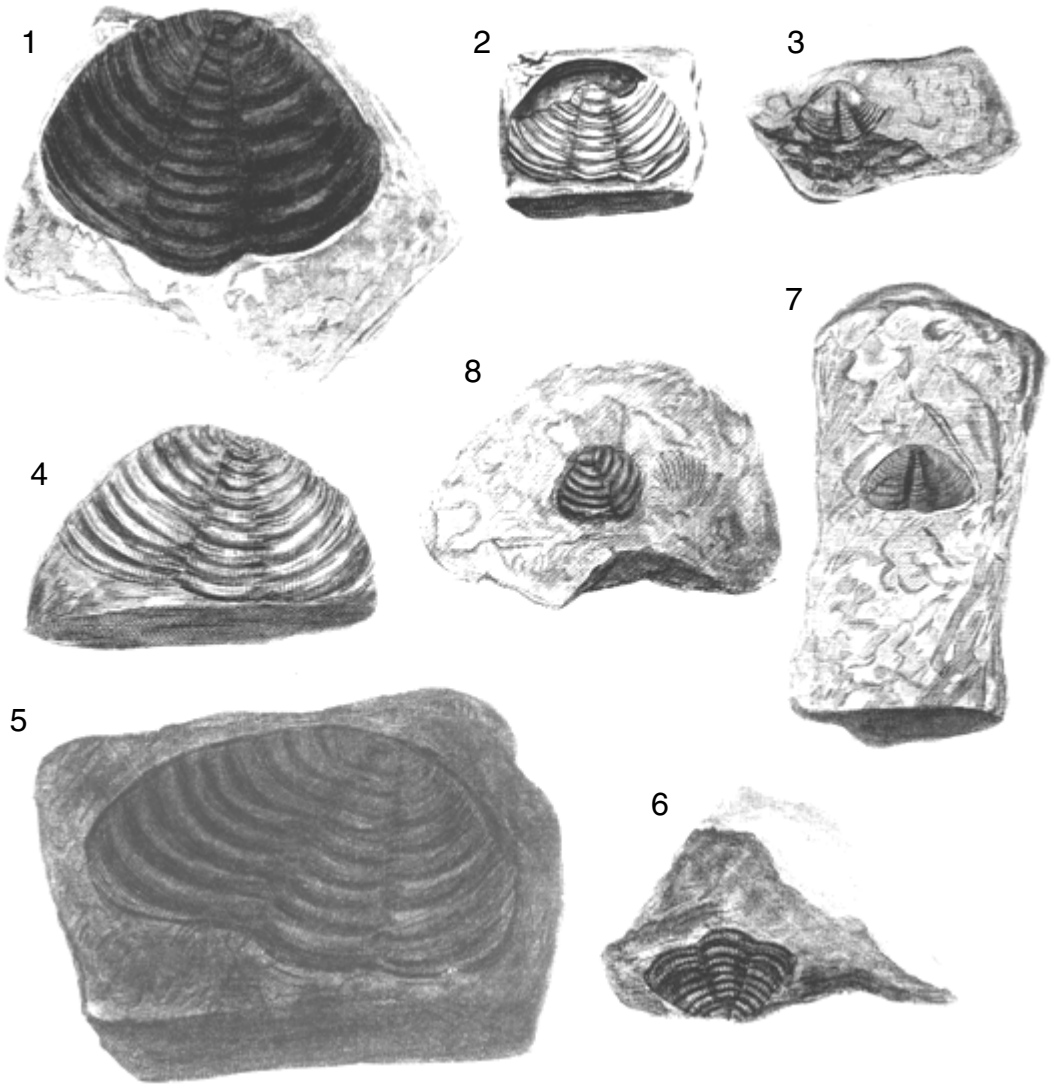

Fig. 3. Trilobite pygidia from Supplemental Plate 9 of Walch (1771). Numbers correspond to the original figure designations. Number 1 is from the Gdansk Physical Society collection. Numbers 2–8 are from Walch's collection.

Number 6. This piece is from Gnoyen, and is cloaked in its natural test. It is set in a yellowish brown calcareous stone.

Number 7. A piece that has been found around Stargard. The test is very thin, and it remains attached to the imprint of its body in the other half of the stone, as often happens when rocks are broken open. Therefore, seen here is the internal surface of the test, and noticeable also are elevated striations, in a manner so that, what is ensconced on the external side is in relief here, and that which is relief is ensconced here, somewhat the same as the embossed relief work of a jeweler. In these stones, the trilobites are sometimes found in the company of orthoceratites.

Number 8. A whitish yellow calcareous stone, from Frankfurt-on-Oder. One of its lobes is sunken in the stone, and thus there are only two that are visible. The elevated striations are, in proportion to the size of the piece, quite wide. The test, which is still there, is spathic. In the same stone there are pectunculites and turbinites which have very fine striations. Other strange bodies are mixed in without any regularity.

Supplemental Plate 9a (Fig. 4)

Numbers 1, 2. This trilobite is found in the famous Cabinet of Mr. Linck of Leipzig. It is enclosed in the manner that this testaceous insect, in death, bends and contracts. Number 1 represents the shell of the tail along with the lower portion of the back, and number 2 the helmet or the shell of the head with the upper portion of the back. This piece was found near Leipzig by a servant, and as, since that time, no one else has discovered, in all the environs, the least vestige of this petrifaction, it is not probable that this area contains such a piece, and most likely it was found by accident, and perhaps someone had lost it there. This petrifaction could have been transported into the Cabinet of Mr. Linck, and as at that time it was still completely unknown, Mr. Linck corresponded with other learned Naturalists on this subject, principally with Messrs. Klein, Breyn and Brückmann, and with the intention of molding the piece in wax, so as to communicate copies for them and to learn of their impressions. The correspondence continued on with the first

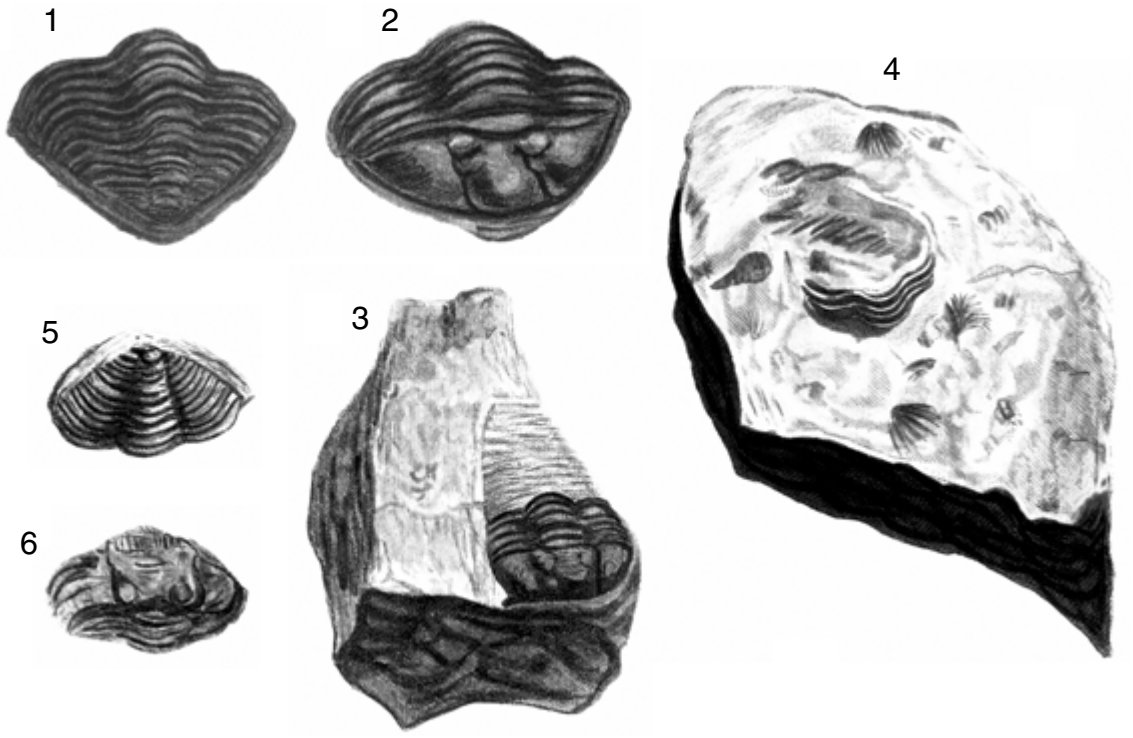

Fig. 4. Trilobites from Supplemental Plate 9a of Walch (1771). Numbers correspond to the original figure designations. Numbers 1, 2 are from the Linck collection. Numbers 3–6 are from the G. A. H. Heydenreich collection.

two, may still be found in Danzig at the famous Academy of Curiosities; but the petrifaction itself is still in Leipzig in the Cabinet of Mr. Linck. There is a slight misunderstanding because Mr. Wilckens, in his *Treatise on Petrifactions*, page 3, says in a note, that only Mr. Linck had the good fortune of possessing copies of this petrifaction in a copperplate engraving and in wax. Actually the continued correspondence on the subject of this body caused it to be known soon and to be copied many times. Mr. Brückmann was the first to do so in his *Centvria Epistolarvm Itinerariarvm*, Epistola itineraria 23, pl. 2, number 6. Later this same piece was described, probably after another example, in the *Berlinisches Magazin*, vol. 4, and a not very exact copy was made on a plate that was added. This body appeared a third time in the *Specimen Oryctographiae Gedanensis* of the late Mr. Klein, pl. 15, numbers 3 and 4, similarly copied on a form of wax, and this representation is most nearly the same as the one I offer here. It is only because of the conviction that this piece was the complete animal, that it earned the honor of being engraved on a copper plate. It may be observed here, it is true, that the principal parts of the body, therefore the head, the back and the curved tail, are in a certain sense complete and undamaged. But the best part and the principal part is missing, that is the natural test, which, following all conjecture, remained in the matrix when the body was removed from the stone, which often happens to this petrifaction. I had my doubts already, while examining a wax copy with attention, before I had obtained any trustworthy information. This is difficult to see, as the raised rings of the back are not segmented, and that they form a continuum with the shell of the tail, which is never observed in the examples which still have their natural test. I described my suspicion already when I composed my Chapter on the trilobites, and I find it now well founded following the advice which Baron von Zorn had the kindness of communicating to me on this subject. This learned Naturalist assures me that the late Mr. Linck, in his letters, which are still preserved in Danzig, expressly states that this petrifaction is only a simple core. The hood or the shell of the head is what holds the most interest in this piece, since it is rarely found complete. We see that the interior of the shell expresses perfectly, by its recesses, the protuberances of the external surface, and that this trilobite belongs to that type which has curved furrows, the forehead and the nose fairly wide and with triangular cheeks. The small protuberance on the right side of the lower part of the nose is probably only a defect made during fusion, as in this area, no other trilobite has any tubercle, and especially as there is none to be seen on the other side. Nothing is observed of the headband on this core. I add a few more words of remarks. It is observed on the cores of trilobites, that they never present the protuberances and the arcs as regularly as those that are still covered with their test. Why is that? It is because it is not so much the test that leaves its imprint, but rather the wrinkled skin which is under the test; and this is also the reason why in these cores the back always makes a continuum with the tail, which after all is only held by certain muscles.

Numbers 3, 4, 5 & 6. All these pieces are found in the Cabinet of Mr. Heydenreich; they are all from England and probably from Dudley, the Storehouse of trilobites. Number 3 presents the trilobite extended, although the posterior part is missing, and only a vestige of its place remains. Here is seen distinctly the headband of the forehead, and the trilobite belongs to the type

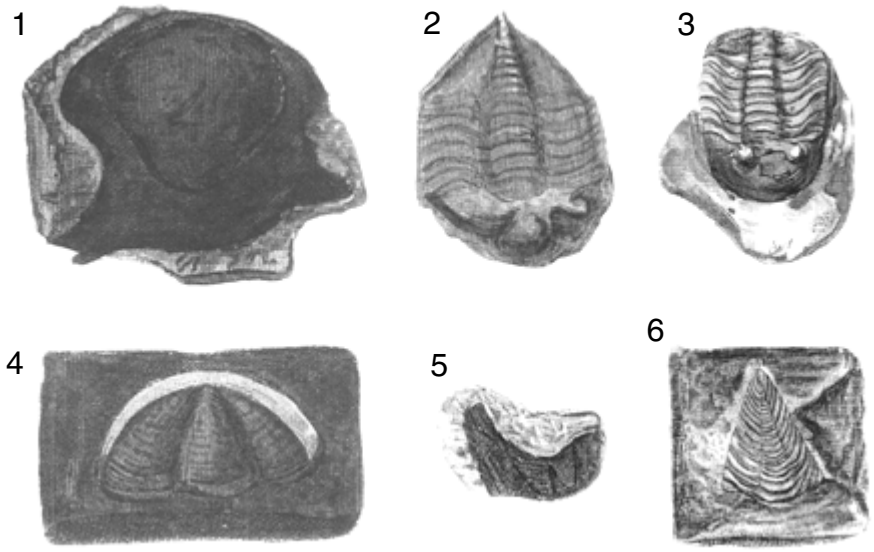

Fig. 5. Trilobites from Supplemental Plate 9b of Walch (1771). Numbers correspond to the original figure designations. Specimens are from the J.B. Gentzmar collection.

whose head shield has straight furrows and whose forehead, nose and cheeks are of regular proportion. The piece number 4 is shown only because of its situation. With individuals that lay horizontally in their matrix, never is found the least vestige of a lower test, which would be expected if there was one it its analog. This circumstance then confirms the conjecture that I proposed above, that the animal is not like bivalved conchs, with two valves, but that they have, under the shell of the back, testaceous feet hidden like a crayfish. Numbers 5 and 6 represent both sides of a very well preserved curved trilobite. Above is distinctly seen the slanted edge where the nearest rings of the back are joined. The other half of this trilobite, number 6, is presented here at a bias. There, where the tubercles are located, is the forehead of the trilobite. It has a flattened head shield without apparent furrows. How many different species of this testaceous insect, which is still so poorly known, must there be in the sea?

Supplemental Plate 9b (Fig. 5)

All the petrifactions presented on this Plate are from the beautiful Cabinet of the late Provost Gentzmar in Stargard. He thinks that number 1 is the shell of a trilobite of a peculiar configuration. He means probably the front of the shell or the head shield. However, this conjecture is subject to doubt. I have already stated above that usually, where trilobites are found, are fragments of unknown shells, and that because of this they are thought to be fragments of trilobites. But they could be just as well be fragments of other testaceous insects, which possibly are still unknown. Anyhow, this piece has little resemblance to the head shield of currently known trilobites. Mr. Gentzmar did not indicate where it was found, but, as well as we can conjecture from the type of reddish marble, it is a Petrifaction from Mecklenburg. More recognizable and more beautiful is the yellowish-brown extended trilobite of number 2, cloaked in its natural test. The lateral lobes of the tail are smooth, and this one, instead of having a rounded contour below, terminates in a blunted point. The back consists of eight rings composed of three arcs, but the head shield is a little damaged. Still, with difficulty, it may be seen that it has a curved furrow, a narrow forehead, and large cheeks. The entire body is, proportional to its length, larger than usual, which could be due to some violent compression it may have suffered in the Kingdom of Fossils. This piece is from Woggersin, near Neubrandenburg. Number 3 is an extended trilobite from Suckow in the Uckermarkt, which has eight well preserved rings on its back. The back is slightly retracted inward, which proves that the animal, independent of its testaceous armor, has free movement in all directions. The head shield consists of a smooth test without furrows, but it has two well raised tubercles, which we have above named the eyes. Number 4 is a shell of the tail, which has a smooth border around the circumference, which is not observed in all. In the example of Linck it is also very apparent. If number 5 must also be counted among the fragments of trilobites, that is a decision which I leave to others. Number 6 is the shell of a conical tail, from Stargard. Normally conical shells look much more beautiful than the rounded ones. They have for the most part more fine elevated striations, and the two lateral lobes have only sixteen. The piece was found near Stargard.

Supplemental Plate 9c (Fig. 6)

Number 1 is very beautiful and large, extended trilobite; it is the most beautiful of those that are presented in this work. Neustrelitz is its native country. It was found in a gray calcareous stone. It has eight rings on the back, of which the little one is quite large. The shell of the tail is missing part of both sides, which makes visible, on the imprint, very fine parallel striations; this is as if the fine lamellae are laying one upon the other, and one advances slightly under the other. All three lobes have the same number of elevated striations. The head shield is no less

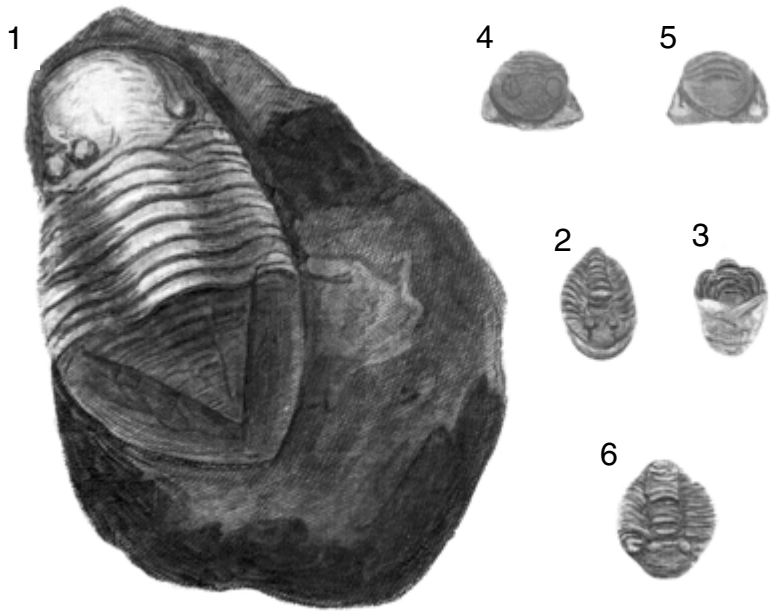

Fig. 6. Trilobites from Supplemental Plate 9c of Walch (1771). Numbers correspond to the original figure designations. Specimens are from the Hempel collection.

remarkable. It has the forehead and the nose so large that it results in the cheeks being only slightly apparent. Tubercles are distinctly visible. It seems that on one side there are two of them together, and in this case this phenomenon is quite rare. The small trilobites, numbers 4–6, are from Neubrandenburg, very well preserved, and distinctly presenting all their parts. Number 3 shows the posterior face of number 2 or the shell of the curved tail, and numbers 4 and 5 show a piece presented from both sides. Number 2 has very large tubercles, and number 4, although of the same size, has them quite small. On number 5 the three lobes of the shell of the tail are not very distinct, unless this is a particular species of trilobites where the shell of the tail does not curve; this reminds me of a piece that I have in my Cabinet.

Supplemental Plate 9e (Fig. 7)

Number 1. The middle part of a trilobite of considerable size, from Havelberg. It is, as may be seen, only a core. What is the most peculiar is that little is visible of the three lobes of the back. Effectively, if were found together in the Kingdom of Fossils bodies whose back resembles the tail of a crayfish, and which is not divided into three lobes, our trilobites would not constitute a particular species of these bodies, and in this case, could not we dispense with taking this individual for the body of the *oniscus crustaceus* described above, or to be the *Oscabiörn* of the Icelanders? This body, shown here, belongs to the so-called tails of petrified crayfish, which are mentioned by Gesner and other Naturalists of that time.

Number 2. Here is the description given by the late Mr. Gentzmar for this trilobite: *the shell is certainly a single trilobed smooth valve, of which the median lobe is short & ends in a depressed furrow leading down to the margin*. In other words, he takes the entire piece to be the shell of the tail, with the middle lobe terminating halfway and this changes, so to say, into a furrow which goes to the extreme edge. As for myself, the inferior part appears to me to be a piece of the shell of the back, upon which lays the shell of the tail. This is because we observe very fine rings which are pushed under each other, a characteristic which only fits the shell of the back, and not that of the tail. Very little of the lobes are seen here. This piece is from Stargard in Mecklenburg.

Number 3. The head shield of a trilobite from Stargard. It is of the type whose curved furrows form a narrow forehead and nose. At both sides are protuberances where the eyes are.

Number 4. Another head shield, where the furrows form a very narrow forehead, and the nose and the lips are all the larger. The hardened earth deposited between the forehead and the cheeks makes it so that the head shield is not seen distinctly in its entirety. This piece is from Ripkerfield, near Stargard.

Numbers 5 and 6. The fields of Stargard have a type of argillaceous stone, which once was hard and compact, but exposure to air has caused it to lose its ancient hardness. It is normally thought of as decomposed cornstone. However, it is completely opaque, even to the edge of a fracture seen in the light. Trilobites are found in this rock, in addition to several other petrifactions, and I communicate here a beautiful and complete example. There are two peculiarities. One is the way it is bent, which proves clearly that the animal had, under its armor, totally free movement, and the other is the two large horns, which it has at the side of the forehead.

Number 7. A trilobite, of which only the shell of the back is preserved. This example distinctly shows the way that the rings disappear one under the other. This piece is from Neuruppin, and is enclosed in calcareous stone. The cores of the head shield and the shell, especially those of the latter, are damaged, and do not now distinctly show their true shape.

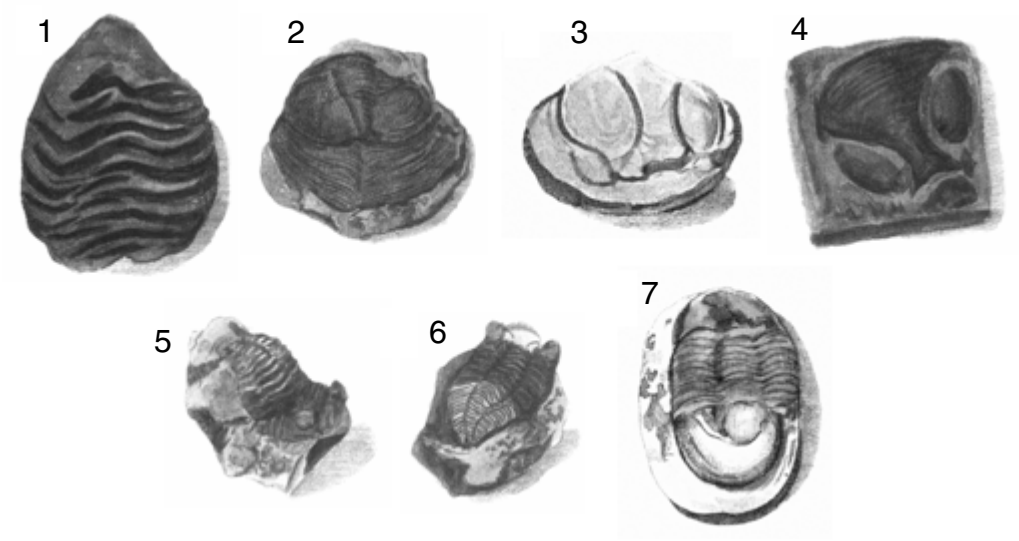

Fig. 7. Trilobites from Supplemental Plate 9e of Walch (1771). Numbers correspond to the original figure designations. Specimens are from the J. B. Gentzmar collection.

Supplemental Plate 9f (Fig. 8)

Numbers 1, 2, 3, 4, 5. Up to this point, we have given preference, above all other trilobites, to those from Dudley, in England, because of their beautiful preservation and of their expressive character. This Plate shows a few beautiful pieces, from the magnificent Cabinet of Mr. André, a learned and celebrated apothecary from Hannover. I find it unnecessary to stop here, being that the parts of this insect, described above in Chapter 3, that is the forehead, the eyes, the horns, the nose, the lips, the forehead band, etc., are seen so distinctly that it would be superfluous to restate here what I said above. I only need to add here that, at the right, number 1, and at the left, numbers 3 and 5, the double prominences are very well distinguished, which I named the eyes, and the others the horns, and that the rings of the back, numbers 1, 2 and 3, do not appear to be similar, but the cause is that hardened earth is deposited between the furrows of the back. If this earth could be detached from the shell of the back, not only would the rings appear differently, but also it would be seen that each shell of the back which by itself consists of three arcs, constitutes one total ensemble. Mr. André had intended to publish a Memoir on this petrifaction, which to date was the favorite subject of the many Curious, and to add copies of the most beautiful pieces from his Cabinet. He supposes that its analog is to be found among the monocules, and even among the sea monocules, and not among the freshwater monocules. He tells me in a letter that a friend from London assured him that the analog of these trilobites was in a Cabinet in London, but upon inquiring more exactly, was given a response that the Cabinet had been sold and dispersed, thus there was no hope of finding the true analog there.

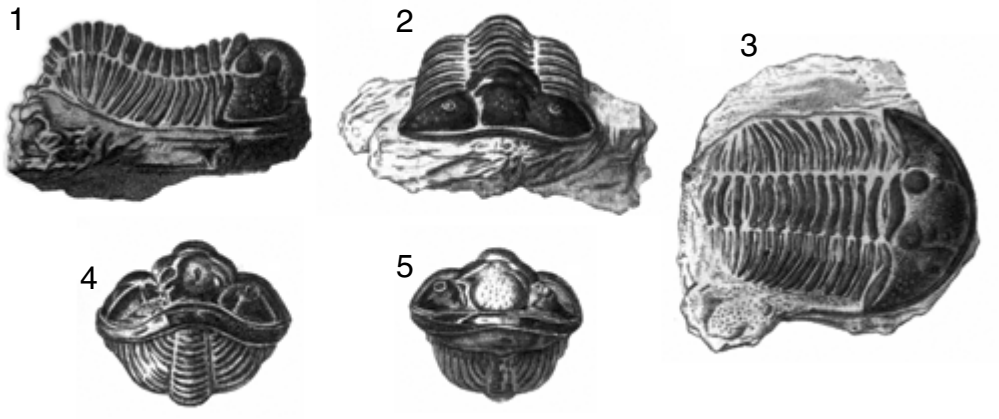

Fig. 8. Silurian (Wenlockian) calymenid trilobites from Dudley, England, from Supplemental Plate 9f of Walch (1771). Numbers correspond to the original figure designations. Specimens are from the André collection.

WALCH'S FOOTNOTES

Bibliographic information in Walch's footnotes is sometimes translated, paraphrased, incomplete, ambiguous, or erroneous when compared with the originals. These problematical citations have been corrected below, and additional information is provided in brackets to assist in locating the original references. For additional information about of the references given below, see St. John (1998, 1999, 2000). The "supplemental plates" noted below are the plates that accompany Walch's 1771 trilobite chapter (reprinted in the 1773 Dutch and 1775 French editions) (see Figs. 3–8).

1. *Lithographiæ Svecanæ*, p. 76, 79. [= *Mineralogia et Lithographica Svecana*, 1740]
2. *Mineral-System*, p. 42. [= *Systema Minerale*, 1748]
3. In the Description of a shell whose back has three lobes. See *Researches of a Society in the Upper-Lausitz*, vol. 2 & 3, 1751, 1752, in octavo. [= Beschreibung einer versteinten Muschel, mit dreyfachen Rücken (conchae rugosae trilobae). *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, v. 2, p. 285–298, 1 pl., v. 3, p. 183–201, 1 pl.]
4. *News of Rare Petrifactions, Primarily from the Animal Kingdom*, at Berlin, 1769, in octavo, p. 28. [= *Nachricht von Seltenen Versteinerungen, Vornemlich des Thier-Reiches*]
5. *Specimen Oryctographiae Gedanensis*, pl. 15.
6. *Dictionnaire Universel des Fossiles Propres, et des Fossiles Accidentels*, part 2, p. 213.
7. *Maslographia*, pl. 9, fig. 50, p. 214, no. 50.
8. *Systema Naturæ* [12th edition], volume 3, p. 160 and Transactions of the Swedish Academy of Sciences, vol. 20, p. 20. [= *Kongliga Vetenskaps Academiens Handlingar*, 1759]
9. *Catalogue Systématique et Raisonné des Curiosités de la Nature et de l'Art*, volume 3, p. 204; compare with volume 46 of *Philosophical Transactions*, p. 600.
10. Epistola itineraria 64, pl. 3, fig. 5 [= 1737] in *Centvria Epistolarvm Itinerariarvm*. [= 1742 compilation of all published epistolae]
11. Natural History of the Mineral Kingdom, p. 328. [= *Naturgeschichte des Mineralreichs*, 1763]
12. In his Work mentioned above, p. 43. [see footnote 4]
13. Treatise on Layered-Mountains, p. 72. [= *Versuch einer Geschichte von Flötz-Gebürgen*, 1756]
14. See the treatise of Provost Gentzmar, which is inserted in the *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, p. 184. Compare with Plate number 7.
15. See Supplemental Plate 9b, number 3 and Suppl. Pl. 9b, number 1 in this Work.
16. Supplemental Plate 9a, numbers 1 and 2.
17. Supplemental Plate 9e, numbers 5 and 6.
18. Supplemental Plate 9a, number 2, 9f, number 3; Mr. Gentzmar in *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, pl., number 3; Wilckens, pl. 1, fig. A.
19. *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, pl., number 1. Supplemental Plates 8d, number 17, 9b, number 3 of this Work.
20. See Supplemental Plate 9, number 3 and Wilckens pl. 1, fig. A and Mr. Gentzmar, in the Work mentioned above, vol. 3, pl., number 11. In some Examples, the furrows only go to the center, and anyway as they have little resemblance to Trilobite head shields, it remains to decide if these are not the shells of other marine bodies. A similar shell, which I mention principally here, was communicated by Provost Gentzmar in the *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, on the Plate that is mentioned, number 6.
21. See Supplemental Plates 9a, number 3, 9c, number 2, 9f, number 3 and *Philosophical Transactions* number 496, pl. 1, p. 604, fig. 9.
22. Mr. Wilckens, pl. 1, figs. A, B, C. Mr. Gentzmar, *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 2, pl., numbers 13, 17, vol. 3, number 4. *Philosophical Transactions* in the passage mentioned above, figs. 3 & 7.
23. Mr. Gentzmar, in the same place, vol. 3, number 11.
24. See *Philosophical Transactions* in the place mentioned here above, fig. 6.
25. In Supplemental Plates 9a, number 2, 9e, number 4. Mr. Gentzmar in the same place, vol. 3, number 11.
26. In Supplemental Plates 8d, number 17, 9a, number 3, 9b, number 3, 9f, number 3.

26a. See *Philosophical Transactions*, at the place mentioned here above, figs. 8, 9, 11 & 12.

27. In the Treatise mentioned above, p. 11. [see footnote 4]
28. See Supplemental Plate 9e, number 6.
29. Part 4, p. 39. [= 1762]
30. Provost Gentzmar in the *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, p. 194.
31. This furrow is expressed as an obliquely drawn line, in the Memoirs of the Royal Academy of Sciences of Sweden, part 20, pl. 1, fig. 1. [= *Kongliga Vetenskaps Academiens Handlingar*, v. 20, 1759]
32. See the Supplemental Plates in this Work, pl. 9f, number 3.
33. Supplemental Plate 9b, numbers 2 & 6.
34. Supplemental Plates 9 & 9e, number 2.
35. Supplemental Plate 9b, number 4. Mr. Wilckens, pl. 2, fig. 2.
36. See Mr. Gentzmar, *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 2, pl., numbers 5 & 6.
37. Mr. Wilckens, pl. 2, fig. 3. Supplemental Plate 9.
38. Supplemental Plate 9, numbers 1, 7. Mr. Wilckens, pl. 2, fig. 5, pl. 3, figs. 7 & 10.
39. Bromell, *Lithographiæ Svecanæ*, p. 77. [= *Mineralogia et Lithographica Svecana*, 1740]
40. Mr. Gentzmar in the same Work, number 4. [see footnote 3] Mr. Wilckens, pl. 3, figs. 6, 7. Supplemental Plate 9, number 1.
41. Mr. Wilckens, pl. 4, fig. 17, pl. 5, fig. 19.
42. This is the opinion of Inspector Wilckens in his Treatise: *News of Rare Petrifactions*, p. 33, 34. [= *Nachricht von Seltenen Versteinerungen*, 1769]
43. I myself am in possession of this species, embedded within a black Stinkstone from Mecklenburg, on which cannot be found the least vestige of any furrow. Besides this, Mr. Woltersdorff communicated to me an Example of a large fragment of tail, where the middle lobe, which still has its natural shell, does not present the least vestige of any transverse furrows.
44. Mr. Gentzmar in the place mentioned above, vol. 2, pl., number 2. [see footnote 36] Supplemental Plates 9b, number 2, 9e, number 2.
45. Supplemental Plate 9b, number 6.
46. Supplemental Plate 9, number 8
47. Supplemental Plates 9, numbers 2, 6, 9b, number 6.
48. Provost Gentzmar, *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, pl., number 7.
49. See the treatise of Professor Franz Zeno on the Petrifactions that are found in the environs of Prague, in vol. 1 of Prague's Physical Entertainments, pl. 1, fig. 1. [= *Neue Physicalische Belustigungen*, 1770]
50. See Supplemental Plate 9, number 1. Inspector Wilckens in the treatise mentioned above, pl. 2, fig. a. [see footnote 4] Mr. Gentzmar, *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 2, number 7.

51. Mr. Gentzmar, vol. 2, pl., number 6. Mr. Wilckens, pl. 4, fig. 17.
52. See the New Hamburg Magazine, article 11, p. 440. [= *Neues Hamburgisches Magazin*, v. 2, part 11 ("*Silftes Stück*"), 1767]
53. p. 80.
54. p. 77.
55. In the Memoirs of the Royal Academy of Sciences of Sweden, vol. 20, pl. 1. [= *Kongliga Vetenskaps Academiens Handlingar*, 1759]

55*. I have been confirmed in this supposition on the Alum Shale of Andrarum, which Pastor Woltersdorff was kind enough to send to me later, and upon which we can observe, quite distinctly, that the square shapes were isolated pieces of the three-arcs armor of the Trilobite.

56. *News of Rare Petrifactions*, p. 75. [= *Nachricht von Seltenen Versteinerungen*, 1769]
57. Plate 6, figs. 26, 27.
58. Here we must perhaps report on the shell, which is found in the Treatise of Mr. Wilckens, pl. 6, numbers 33 and 34, and that which I have mentioned above, after the Memoir of Mr. Gentzmar in the *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, on the Plate, number 6.
59. See Supplemental Plate 8d, number 17, 9b, number 3 & *Philosophical Transactions*, vol. 46, number 496, pl. 1, p. 604, fig. 10.
60. Supplemental Plate 9a, number 3, 9c, number 2, 9f, number 3, and *Philosophical Transactions* in the same place [see footnote 59], fig. 9.
61. Supplemental Plate 9e, number 4. Mr. Wilckens, pl. 6, fig. 24.
62. See *Philosophical Transactions*, at the place mentioned above, fig. 3, fig. 7 & fig. 12. [see footnote 59] Mr. Gentzmar, *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, pl., number 11. Sometimes the shell of the forehead, cut out in the shape of an arc, is found alone. See in the same Work, vol. 2, pl., numbers 11 & 13. Mr. Wilckens, pl. 5, figs. 21, 22, compare with pl. 1, figs. A, B, E, F.
63. Supplemental Plate 9b, number 1. Mr. Wilckens, pl. 9, fig. 15. In some of this species the forehead and the nose have a rounded convexity, the same as found in the Treatise of Professor Franz Zeno on the Petrifactions of marine bodies in the environs of Prague, pl. 1, fig. 2. [see footnote 49]
64. Supplemental Plate 9c, number 3.
65. "A letter, concerning a non-descript petrified insect," with remarks by Mr. Mortimer in *Philosophical Transactions*, vol. 46, number 496, p. 598.
66. In the same place.
67. *Lithographiæ Svecanæ*, p. 76 and following. [= *Mineralogia et Lithographica Svecana*, 1740]
68. A peculiar Petrifaction of an Insect, in the Memoirs of the Royal Academy of Sciences of Sweden, vol. 20, p. 20 and following. [= Petrificatet *Entomolithus paradoxus*. *Kongliga Vetenskaps Academiens Handlingar*, 1759]
69. *News of Rare Petrifactions, Primarily from the Animal Kingdom*, p. 37 and following. [= *Nachricht von Seltenen Versteinerungen, Vornemlich des Thier-Reiches*, 1769]
70. *Catalogue Systématique et Raisonné des Curiosités de la Nature et de l'Art*, vol. 3, p. 204.
71. In the Memoirs of the Royal Academy of Sciences of Paris for the year 1757, p. 82. [= *Histoire de l'Académie Royale des Sciences of Paris*, vol. 1757 (published 1762)]
72. *The Gentleman's Magazine*, vol. 25, p. 24, 25.
73. This Treatise on the Monocule in the form of a crayfish was published at Regensburg in 1756, in quarto. [= *Der Krebsartige Kieferfub mit der Kurzen und Langen Schwanzklappe*]
74. Description of a curious fossil animal, in *The Gentleman's Magazine*, vol. 25, p. 24.
75. *Museum Diluvianum*, number 759. *Meteorologica et Oryctographia Helvetica*, p. 316, fig. 131.
76. In the Natural History of Spain, pl. 3, fig. 4 [= *Aparato para la Historia Natural Espanola*, 1754], following the German Translation of Mr. Murr. [= *Vorbereitung zur Naturgeschichte von Spanien*, 1773]
77. *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 2, p. 288 on.
78. Treatise on the Sea-Petrifactions and Fossils of Prague, 1769, octavo. [= *Abhandlung von Versteinerungen, Welche bey Prag Gefundenen Werden*, the separate edition of the 1770 journal article; see footnote 49]
79. *The Natural History of Lancashire*, pl. 7, fig 1.
80. In the Treatise on the Petrifactions & the fossils in the environs of Prague, p. 5. [see footnotes 49 and 78] In the *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, p. 184. Provost Gentzmar has from the beginning also proposed this conjecture.
81. *Maslographia*, p. 214, compare with pl. 9, fig. 50.
82. *Mineral-System*, p. 42. [= *Systema Minerale*, 1748]
83. Vol. 4, p. 54. The beautiful Treatise, which is found here, is titled "Beschreibung einiger Anomiten," among which our Trilobites are also placed. The author, whom I do not have the honor of knowing, supposes there, p. 53, that I take the cores of the White Strawberry of Rumphius to be Trilobites, in my Kingdom of Fossils, vol. 1, p. 112 [= *Das Steinreich Systematisch Entworfen*]. Never has this entered my mind. Perhaps I did not explain myself clearly enough, as what I said there about the *Nucleus quandrandis fragi albi*, does not relate to Trilobites, but to Trigonelles, upon which also are the words which immediately follow.
84. In his Natural History of Spain, pl. 3, fig. 4. [= *Aparato para la Historia Natural Espanola*]
85. Epistola itineraria 23 [= 1730] *in Centvria Epistolarvm Itinerariarvm*. [= 1742 compilation of all published epistolae]
86. *News of Rare Petrifactions*, p. 36. [= *Nachricht von Seltenen Versteinerungen*]
87. Cabinet of Ambonese Rarities, p. 38. [= *D'Amboinsche Rariteitkamer*, 1705]
88. See the *Systema Naturæ* of Mr. Linné, p. 1106, 12th edition; Davila, *Catalogue Systématique et Raisonné*, vol. 1, p. 392; and the remarks of Professor Müller on the Description of Shells of the late Mr. Knorr, part 4, p. 29. [= *Vernügen der Augen und des Gemüths, in Vorstellung einer Allgemeinen Sammlung von Schnecken und Muscheln, Welche im Meer Gefunden Werden*, 1769]
89. Conchyliologie, pl. 25, figs. L, M. [= *L'Histoire Naturelle Éclaircie dans Deux de ses Parties Principales la Lithologie et la Conchyliologie*, 1742]
90. *Locupletissimi Rerum Naturalium Thesauri*, vol. 2, pl. 61, number 3 on. [= 1735]
91. Cabinet of Ambonese Rarities, pl. 10, fig. 4. [= *D'Amboinsche Rariteitkamer*, 1705]
92. *Vernügen der Augen und des Gemüths, in Vorstellung einer Allgemeinen Sammlung von Schnecken und Muscheln, Welche im Meer Gefunden Werden*, part 4, pl. 17, figs. 3, 4. [= 1769]
93. Vol. 5, number 90, p. 219. [= 1740]
94. Vol. 4, p. 37. [= 1762]
95. p. 241.
96. New Society Reports, p. 36. [= *Neue Gesellschaftliche Erzählungen für die Liebhaber der Naturlehre*, vol. 4 (1762)]
97. See Mr. Gentzmar, *Arbeiten einer vereinigten Gesellschaft in der Oberlausitz*, vol. 3, p. 192. Mr. Wilckens, *News of Rare Petrifactions*, pl. 6, figs. 8, 9. [= *Nachricht von Seltenen Versteinerungen*] We should mention here the beautiful Plate of Trilobites in *Philosophical Transactions*, vol. 46, p. 598, on which may be seen, here and there, isolated fragments of the shell of the back of the Trilobite which protrude from the stone.

98. Gentzmar, same citation, vol. 3, p. 191. [see footnote 97]
99. Davila, *Catalogue Systématique et Raisonné des Curiosités de la Nature et de l'Art*, vol. 3, p. 205, number 261, p. 206, number 266. Bromell, *Mineralogia et Lithographica Svecana*, p. 77.
100. *Neues Hamburgisches Magazin, Silftes Stück*, p. 440. [= vol. 2, part 11, 1767]
101. See his voyages to Öland and Götland, p. 162, German edition [= *Reisen durch Oeland und Gothland*, 1764], & Transactions of the Royal Swedish Academy, vol. 20, p. 20. [= *Kongliga Vetenskaps Academiens Handlingar*, 1759]
102. Epistola itineraria 23 [= 1730] in *Centvria Epistolarvm Itinerariarvm*. [= 1742 compilation of all published epistolae]
103. Vol. 4, p. 56.
104. *Specimen Oryctographiae Gedanensis*, pl. 15.
105. *Berlinisches Magazin*, vol. 4, p. 56. Scheuchzer, *Museum Diluvianum*, number 759. Compare with his *Meteorologica et Oryctographia Helvetica*, p. 316, fig. 131
106. Davila, *Catalogue Systématique et Raisonné des Curiosités de la Nature et de l'Art*, vol. 3, p. 206.
107. In the German translation, which Mr. Murr has published [= *Vorbereitung zur Naturgeschichte von Spanien*], these Trilobites are found on pl. 3, number 4.
108. *Lithophylacii Britannici Ichnographia*, epistola 1, p. 96, compared with the plate that appears on p. 120.
109. *Natural History of Lancashire*, pl. 7, fig. J.
110. *Maslographia*, pl. 9, fig. 50, pl. 11, fig. 44, pl. 12, fig. 31.
111. *Museum Diluvianum*, number 759, compared with his *Meteorologica et Oryctographia Helvetica*, fig. 132.

GLOSSARY OF SOME OF WALCH'S TERMS

articulates - early term for arthropods and many worms.
aselles - terrestrial and aquatic isopod crustaceans; terrestrial forms are often given the common names "pill bugs" or "sow bugs." Walch often used this term (e.g., sea-aselles) when referring to local names for marine isopods (see also Beekman, 1999, p. 412).
astacoliths - fossil crayfish, lobsters, and crabs, or fossils that resembling these groups.
asteries - individual, star-shaped, crinoid stem columnals (rounded columnals are "trochites").
back - thorax.
bones - calcified elements that make up the jaw apparatus ("Aristotle's lantern") in sea urchins.
cacadumuschel - "cockatoo-mussel" or "cockatoo-shell", an early term for trilobite.
cheeks - genal areas.
chevrettes - "shrimp".
cloportes - terrestrial isopods ("wood-lice"), often given the common names "pill bugs" or "sow bugs." Walch often used this term when referring to local names for marine isopods or branchiopods.
core - rock matrix underneath the exoskeleton of a fossil; an internal mold.
cornstone - early term used in Britain for "earthy concretionary limestone, mottled red and green," "a rock of a pseudo-brecciated appearance," or "red limestone" in part of the Old Red Sandstone succession (Conybeare and Phillips, 1822; Roberts, 1839; the *Oxford English Dictionary*; and the discussion on cornstone in Bertrand, 1763, p. 181–183).
coralliolithes - coral or coral-like fossils.
echinites - fossil sea urchins (regular echinoids).
ell - an obsolete unit of measure used in western Europe; its length was not universally agreed upon, and varied from region to region. "Elle" is used in the 1771 German edition (p. 129), while "aune" is used in the 1775 French edition (p. 113). Colburn (1831) equated the aune and the ell, and gave their lengths as 42 English inches. Beekman (1999) reports the ell as about 27–28 inches; the *Oxford English Dictionary* and Colburn (1831) define the English ell as 45 inches, the Scotch ell as 37.2 inches, and the Flemish ell as 27 inches.
encrinites - complete or nearly complete fossil crinoids (crowns attached to stems).
entrochites - segments of rounded to subrounded fossil crinoid stems that consist of many articulated columnals.
forehead - appears to correspond with the posterior lobe (L1) of the glabella.
fossil - the classic definition of a fossil, referring to any object dug from the ground, including rocks, minerals, fossils, archaeological artifacts, etc.
headband - appears to correspond with the occipital ring and posterior cephalic border.
horns - prominent palpebral lobes, or combination of prominent eyes and palpebral lobes.
insects - early term for arthropods; "arthropod" was introduced by Siebold (1845).
Kaefermuschel - "beetle-mussel" or "beetle-shell", an early term for trilobite, inspired by Bromell's (1729) description of Swedish olenid and agnostoid trilobites as vaginipennous insects (= beetles).
lips - anterior border of cephalon.
monocules - early term that principally encompassed various arthropods (for example, limulids (king-crabs) and several small branchiopod crustaceans), from the eponymous genus *Monoculus* (e.g., Bradley, 1721, p. 157; Linnaeus, 1735, 1758, p. 634, 635).
nose - appears to correspond with all parts of the glabella anterior to the L1 lobe.
oniscus - early general term for marine isopods, from the eponymous genus *Oniscus* (e.g., Linnaeus, 1758, p. 636, 637).
orthoceratites - straight-shelled, fossil nautiloids.
ostracites - fossil oyster shells.
patelles - limpets (patellid gastropods).
patellites - fossil limpet or limpet-like shells.
pectinites - fossil pectinacean or pectinacean-like bivalves, and some strongly-ribbed brachiopods.
pectunculites - includes fossil brachiopods and some strongly-ribbed fossil bivalves.
petrifaction – identical the modern concept of a fossil (also spelled "petrification").
scolopendra - early general term for centipedes (chilopod myriapods), from the nominal genus *Scolopendra* (e.g., Linnaeus, 1758, p. 637–639). Walch mentioned "Iceland scolopendra" as a local name for a variety of marine isopod, and also used Klein's (1741) name, "*Scolopendra aquatica scutata*," for tadpole shrimp (notostracan branchiopod crustaceans).
sea-hare - a group of sea slugs (anaspidean opisthobranch gastropods) with a pair of prominent, slender extensions on the head and a lightly mineralized, internal, asymmetrical, cap-

shaped shell.

sea louse/sea lice - early common name applied to chitons (polyplacophoran molluscs) and various marine isopod crustaceans.

Scyllarus of Rumphius - the Holocene stomatopod crustacean *Odontodactylus scyllarus* (Linnaeus, 1758), illustrated in Rumphius (1705, pl. 3, fig. F, G) (see Beekman, 1999, p. 22, 23, 396).

stinkstone - strong-smelling, petroliferous or bituminous carbonate; "Stinckstein" is used in the 1771 German edition (p. 128), while "Pierre-porc" (pig-stone) is used in the 1775 French edition (p. 112), in reference to the use of this rock as an early remedy for a pig disease (see Regnéll, 1949, p. 19).

test - traditionally refers to the hard shell of molluscs ("testaceans" or "testaceous animals"), but was extended to include the mineralized exoskeleton of trilobites.

trigonelles - distinctly trigonal bivalve shells.

trochites - individual fossil crinoid stem columnals (rounded to subrounded; individual star-shaped columnals are "asteries").

turbinites - high-spired fossil snail shells that resemble turbinid archaeogastropods.

vaginipennous insects - beetles (coleopteran insects).

white strawberry - the Holocene cardiacean bivalve *Fragum fragum* (Linnaeus, 1758), illustrated in Rumphius (1705, pl. 44, fig. G) (see Beekman, 1999, p. 197–199, 459).

wrinkles - refers to furrows on exoskeletal surfaces or internal molds.

zoophyte - "plant-like animal", from Order Zoophyta of Linnaeus (1758). Walch used this term when referring to crinoids.

ACKNOWLEDGMENTS

Some English translations were provided by the following people: A. Glass and A. H. Ganz, of Dobschütz (1896); A. Glass, of passages in Dalman (1828); T. Steckel, of German passages in the French edition of Walch's trilobite chapter (Walch, 1775); and J. Tebben, of the 1767 Latin quotation by Linnaeus. S. R. Jacobson assisted with the glossary. R. Feldmann and A. Thomas provided constructive reviews of the manuscript.

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