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Explaining the Crude and Simple Mechanics of Parasitic Feeding by Conodonts

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Abstract

The purpose of the study is to provide novel details about how the ubiquitous, jawless, parasitic, conodont-animal: created tiny conduits within their host-victim's epidermis in order to withdraw its body fluids; and then granulized any fragments broken down from the epidermis. It is determined here that the driving-force was solely due to the frantic, fluttering movements of the host-victim while trying to free itself from the parasitic attachment of the condont(s). This induced an oscillating, back and forth movement of the epidermis towards stationary, S-element denticles which resulted in a poking and/or scraping action until shearing of the epidermis was achieved. Analogous to that, would be thorns on a wooden stem because accidental movement by animals into stationary, sharp thorns result in penetration and cutting of an epidermis. That analogy is supported by the simple fact of maximal sharpness shared by thorns and the renowned denticles. Likewise, the above concept is applied to the occlusion of P-element denticles. Occlusion was mechanically powered by the same, jerking-movements of the parasitized, host-victim which resulted in the P-element denticles either rocking or rattling back and forth against each other which accomplished pulverization of food-fragments. This altogether implies that the conodont brain had no control over the occlusion of its own denticles because the denticles' job of shearing and crushing was synchronized to the distressed movements of the parasitized, host-victim.

Keywords: Conodonts; M, S and P elements; Denticles; Thorns; Host-victim's distressed movements

Introduction

Conodonts (Phylum: *Chordata*; Superclass: *Agnatha*; Class: *Conodonta*) [1] utilized a parasitic-feeding habit which is now a competitive hypothesis [2,3] *versus* the popular belief of conodonts as being macrophagous animals [4] and so, the object of this study is to explain the mechanics of the parasitic feeding by the conodonts in detail. Conodonts were globally ubiquitous (except in paleo-periglacial arctic realms), very slender, worm-shaped to eel-shaped, photic-zone, unarmored, jawless, extinct sea fish [5,6,2] that lived from at least the Cambrian Period up to the Hettangian Stage of the early Lower Jurassic Period (Figure 1) [2]. Also, they lacked both a skeleton and jawbone, but the fact that they possessed an apparatus of interpretive, stationary denticles composed of apatite attached to only soft tissue of their exposed oral cavity, raises questions about the mechanism of their food-consumption process, which will try to be answered here by using new insight.

Methodology

The study aims not only to reassert a competitive hypothesis advocating a parasitic-feeding habit versus the traditional belief of macrophagous-feeding by conodonts, but also, to explain in detail, the mechanics of parasitic-feeding. To achieve that goal, the study bases the cumulative evidence of parasitic-feeding upon the established, peer-reviewed literature such as, Iannicelli [2], Janvier [5] and Terrill et al. [6], followed by coordinating new insight, correlations and rationalizations together.

Figure 1: Diagrammatic, lateral view of a representative conodont (*Clydagnathus*, Rhodes, Austin and Druce, 1969) [7]. The oral apparatus encompasses exposed m and s elements while the p-elements are hidden within the pharyngeal area of the animal. The perimeter of its oral cavity at the anterior end of it, is depicted here as having an incline of approx. 45° which is very similar to the orientation of a representative lamprey's oral cavity seen in Figure 2. From Dzik [8].

The emphasis on parasitic-feeding helps to resolve enigmatic aspects about the conodonts such as the ubiquitous, vulnerable-looking, unarmored, jawless conodonts surviving past the Devonian extinctions that obliterated virtually all other jawless fishes (agnathans) especially the armored ones while the conodonts survived from the Cambrian up to the early Lower Jurassic Period [2]. This was accounted for by correlating the slender-shaped conodonts when they were attached to a host-victim which unintentionally mimicked tentacles of jellyfish and cephalopods since nektonic tentacles are known to instinctively alarm nektonic predators in forcing them to keep their distance away from conodont-attached, host-victims [2]. Attributed to their tentacles, the jellyfish and cephalopods have the magnanimous distinction of "endless life" since they perpetually lived from the Cambrian to the Present. That was justifiably correlated to the conodonts' sister-group, the parasitic, slender-shaped, jawless lampreys (Phylum: *Chordata*; Superclass: *Agnatha*; Class: *Petromyzanta* Linnaeus, 1758) [9] (Figure 2) who also demonstrated the mimicry of nektonic tentacles whenever parasitically attached to a host-victim (Figure 3) since they still survive from the Devonian Period to the Present, resulting in "endless life" for the combinatorial lineage of conodonts and lampreys from the Cambrian to the Present [2].

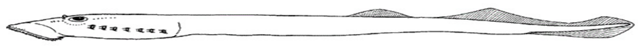

Figure 2: Lateral view of a representative lamprey (*Mordacia lapicida*, Gray 1851, sensu Neira, 1984). The perimeter of its oral cavity (referred to as a "buccal funnel") at the anterior end of the animal is inclined at approx. 45°, similar to the orientation of the conodont's oral cavity in Figure 1. From Neira [10].

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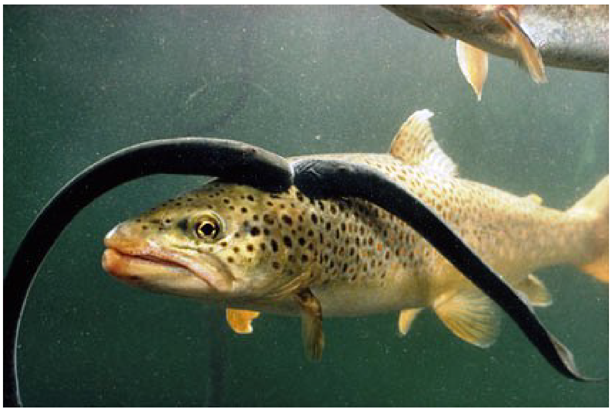

Figure 3: Photograph of extant lampreys parasitically attached to a host-victim (a fish) which simulates nektonic tentacles of either cephalopods and/or jellyfish (Great Lakes, USA and Canada). Although this photo shows only two lampreys, other photos show more than two lampreys parasitically attached to a host-victim [2]. An unwritten rule of this situation expresses that the greater number of attached lampreys there are, then the greater amount of magnification of pseudo-tentacles there are, since cephalopods and jellyfish possess many tentacles themselves. One only has to substitute conodonts in the place of the parasitically-attached lampreys of this situation in order to envision the mimicry-effect of cephalopods/jellyfish, as explained in the text of the study. From Iannicelli [2]. Photograph is accredited to James L. Amos of National Geographic.

Thus, it is necessary to explain the mechanics of parasitic-feeding by conodonts which is unique, unexpected and interesting, just as the "pseudo-tentacles" facet of parasitic-feeding was, and so, the upcoming discussions unravel the conundrum.

The Crudest Time Known as the Early Paleozoic Era

Before examining the detailed mechanics of parasitic feeding by conodonts, it is essential to remind the reader that the genesis of the conodont-animal began during a primitive time known as the Cambrian Period which is considered just barely past the advent of Animalia (the Animal Kingdom). As previously mentioned, they all were jawless while lacking a skeleton, comparable to the other jawless fishes of that time. But that's where the comparison stops since the other jawless fishes utilized a filter-feeding strategy, unlike the conodonts, during the Cambrian – Devonian periods. During the latter part of the Devonian Period, the other marine fishes eventually evolved the sophistication of a jawbone (i.e., gnathostomes) which enabled a biting-motion, thus helping them to successfully survive up to the present time. In contrast, the conodont's overall, slender, very elongated, unarmored, jawless body plan remained in its relict form presumptively ever since the Cambrian Period based on some fossilized Ordovician parts of a soft-bodied, conodont-animal found in Africa [11] while their same relict, body plan was retained by them up to the Carboniferous Period (specifically Mississippian time) based on several, fossilized, soft-bodied, conodont-animals found in Scotland [12]. This infers retainment of that same relict body plan extended from the early Paleozoic up to the middle of the Mesozoic Era [2].

New insight about the Feeding Mechanics of the "Thorny" Conodonts

The simple mechanics of the S-elements

With the above in mind, a primitive facet of all jawless fishes was their exposed oral cavity but the conodont genera was able to advance to the next level, which was the development of denticles within their mouth while the other jawless fishes (filter-feeders) (agnathans) remained "toothless" throughout the time of the Cambrian - Devonian periods. During the first half of the Cambrian Period, the first and only denticles to grow from out of the exposed oral cavity, were a pair of anterior M-elements which automatically classifies this earliest conodont-animal as a "paraconodont" [13]. Descriptively, an early Paleozoic M-element is typically just a simple, singular, conic-shaped, elongated denticle (commonly referred to as a coniform) composed of apatite (Figure 4) [14].

Later on during the Paleozoic, the M-element evolved into a complex form such as a curvy, trident-shaped, denticle [16]. The M-elements were used for grasping or holding onto prey [17,2]. But since the paraconodonts and the other jawless fishes did not possess an outer protective body-cover (such as scales) during the Cambrian, then grasping of the prey by M-elements was followed by the paraconodonts somehow feeding upon their soft-bodied prey. Their method of food ingestion at that time is obscure since they lacked additional denticles to process their preys' soft flesh. A suggestion offered here is, apparently whenever their penetrative M-elements punctured prey, the soft flesh of the prey was eroded during parasitism of their prey because their prey constantly shook throughout the water to rid itself of the attached conodont(s) [2]. Favorably, the strategy of flesh erosion by parasitism happens to become very evident later in the upcoming discussions of the study.

The beginning of the Ordovician then saw a remarkable

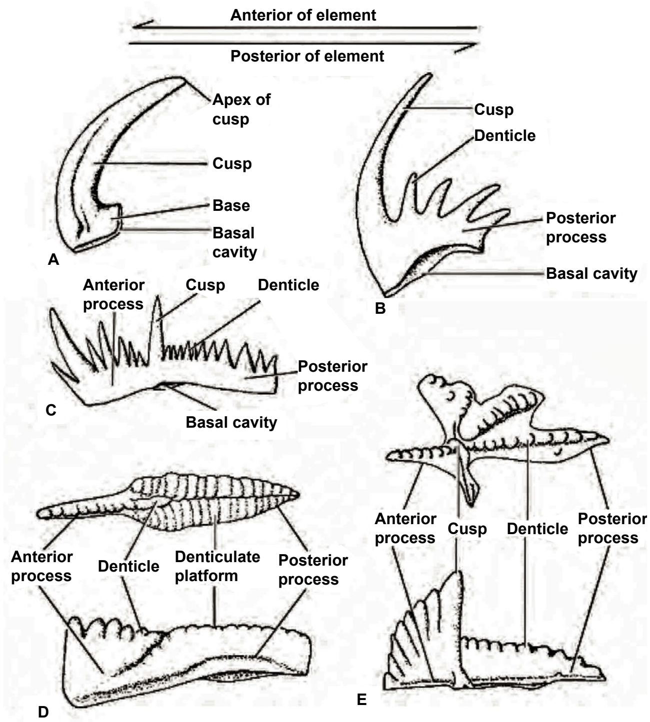

Figure 4: The three element types of a conodont-animal. A. Simple, M-element coniform with only a small base. That evolved later on to a coniform as part of a bar that is monopolized with many smaller denticles (ramiform). B. and C. Common S-elements with each featuring a multi-spiked bar (ramiform). D. and E. Two different types of P-elements, a pectiniform and a platform, respectively. All elements are composed of apatite while a basal cavity is usually found within fossilized elements which was filled with mineralized tissue while it was altogether paleo-attached to the soft-tissue of a conodont [15]. From Prothero [14].

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transformation of the other jawless fishes (agnathans) since they evolved an ossified epidermis while remaining jawless, popularly known as "ostracoderms" (armored agnathans). That particular change had to have been prompted by conodonts [2] who evolved/grew a second and third set of denticles which altogether composed an apparatus within their exposed, epidermal oral cavity, while this type of conodont-animal is classified as an "euconodont". Apparently, the denticles ultimately won the war of competition versus the ostracoderms' body armor, since the ostracoderms became extinct during the Devonian while the euconodonts survived past the Devonian and up to the early Lower Jurassic Period. The second set of denticles are called "S-elements" (Figure 4) and are composed of apatite. They were used for wearing away or abrading the epidermis, so that body-fluids of the of the host-victim could drain into the oral cavity of a conodont [2]. Yet, a third set of denticles are called "P-elements" (which encompasses "pectiniforms" and "platforms") (Figure 4) which are composed of apatite. They are located within the oropharyngeal part of the exposed oral cavity, and did the job of pulverizing any hard fragments that were previously loosened from the epidermis by the S-elements, just so safe swallowing was accomplished [18,2]. Thus, all three sets of elements teamed to complete the process of the euconodonts' parasitic feeding. From here on in the study, the general name "conodont" will suffice in lieu of "paraconodont" and "euconodont".

But how exactly did the parasitic conodonts' primitive oral cavity wear away or abrade the epidermis of their host-victims' that resulted in body-fluids extruding into the insides of conodonts? The question is especially baffling considering the S-elements (just like the M-elements) were interpretatively stationary [2] with no existing jawbone, which precludes a biting or chewing motion. One hint to the answer, is that the interpretive, stationary S-elements are analogous in a way to the factual, stationary teeth in the exposed oral cavity belonging to the previously-mentioned conodonts' sister group called the "lamprey" (agnathan) [2,5,6] (Figure 5) who was also a parasitic-feeder [19]. We already know that the job of shearing or abrading the flesh of the host-victim so that the body fluids could leak into the conodont belonged to the S-element denticles [2] attached to the soft tissue of the conodont's oral cavity (Figure 6) . To resolve the enigmatic job of the S-elements, we first have to remind ourselves that the latter part of the Cambrian Period was still a very primitive time for all marine animals, which also saw the S-elements first appearing, meaning that primitive times logically and initially adopted only crude measures during the early course of evolution. A primitive and simple measure had to occur during parasitic attachment, when the host victim's epidermis shoved or motioned many times towards the stationary denticles of the S-elements according to the frantic, fluttering movements of the frenzied, host-victim when attempting to rid itself of any attached, parasitic conodont(s). It must be emphasized here that the epidermis pulsated directly into the stationary, S-element denticles which resulted in the epidermis being poked or scraped (Figure 7). Thus began penetration of the epidermis which resulted in tiny breaches or conduits upon the epidermis. The same reaction of agitated movements occurs today in host-victims (such as fish) who have an attachment of extant parasitic lamprey(s) [21]. To analogously apply the simple principle of this particular conodont-feeding mechanism to a similar situation, one only has to know about the simple danger from a wooden stem of thorns (i.e., *Rosa laevigata* Tausch sp. [as *Rosa hystrix* Lindley, 1820]) [22]. Of course, thorns are stationary objects which only penetrate humans and animals whenever movement by them makes contact

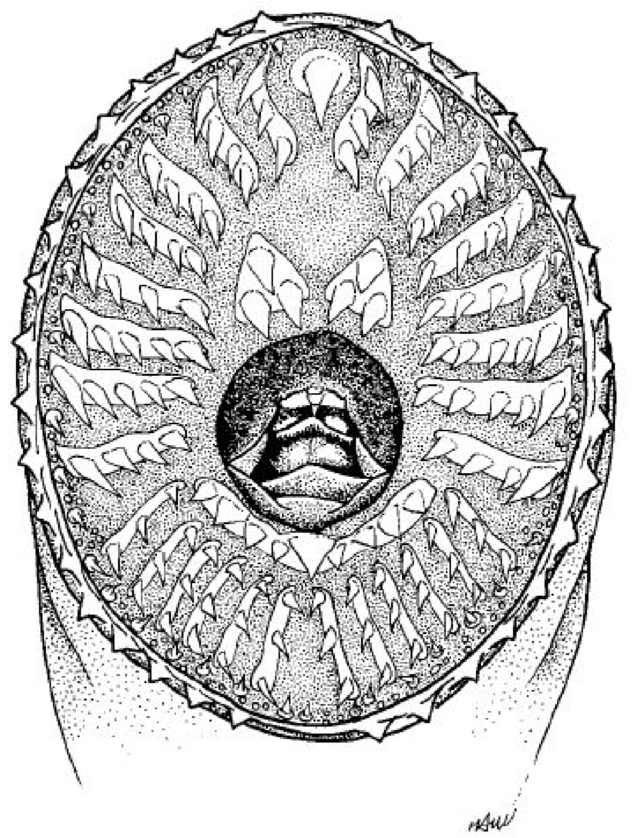

Figure 5: Anterior view of many stationary teeth within an exposed oral cavity of a parasitic lamprey (*Mordacia lapicida* sp.). As with the conodont-animal, the teeth here are attached only to soft-tissue. Deep within the oral cavity, is the lingual laminae (tongue) in its resting-position. It mobilizes when it whips outwardly, which then starts the scraping/poking action upon an epidermis of a host-victim. From Neira [10].

with the stationary thorns. The analogy to thorns on wood is even more convincing when we generally compare the quality of immense sharpness of thorns to the conodonts' denticles which happen to be the "sharpest tools in the box", a phrase applied to the denticles by Jones [23]. That is a fact in itself since stationary denticles with their quality of maximal sharpness, is very conducive to the penetration of epidermises.

The simple mechanics of the P-elements

The above dynamics is further extended to the P-element denticles (Figure 4) of the oropharyngeal area within the oral cavity (Figure 6), which had the job of occlusion by crushing or granulizing any loosened, hard fragments of the host-victim's epidermis that were previously scraped off by the S-elements, allowing for safe swallowing. Here too, the same precept of the stationary, S-element, denticles is applied to the P-element denticles which were subjected to the same exact driving-force that was powered by the host-victim's constant fluttering-movements in the water due to the delirium of trying to free itself from the attachment of parasitic conodont(s) upon its body. The quick, back and forth, constant shaking of the conodont's body had to have either rocked or thumped the P-elements back and forth against each other in an occlusal motion resulting in pulverization of any hard fragments that loosened from the shearing of the epidermis by the S-elements. In the case of the P-elements rocking back and forth

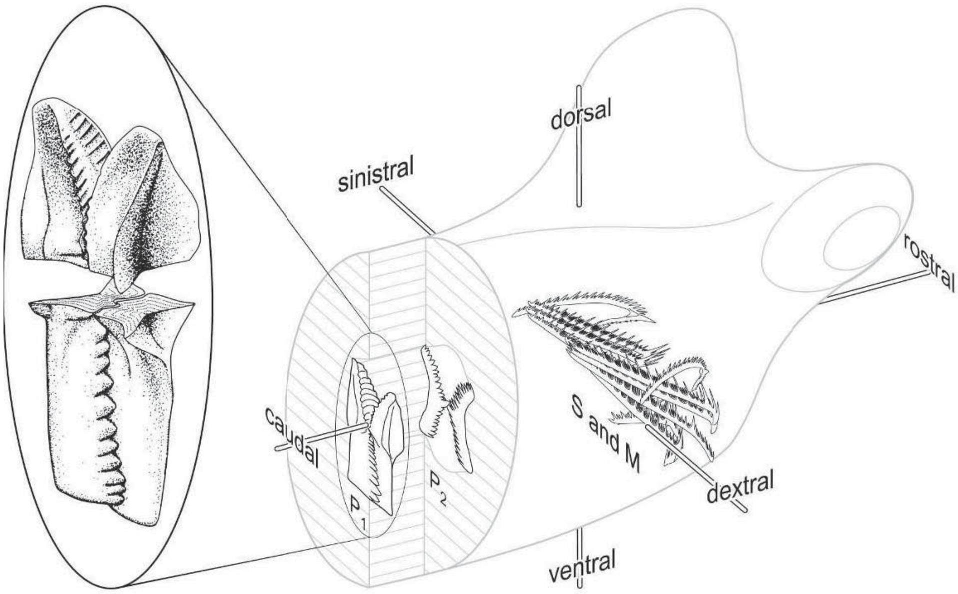

Figure 6: A diagrammatic, reconstructive design of a conodont's M, S and P elements in relationship to one another within the conodont's exposed oral cavity. The several horizontal rows of many denticles are a series of S-elements. Those denticles were constantly poked by a pulsating epidermis according to the jerking-movements of a parasitized host-victim since it was trying to free itself of attached conodont(s). A pair of M-elements each individually feature a long cusp (coniform) as part of an overall curvy bar (ramiform) with many multiple, smaller spikes that altogether either flank or nearly flank the S-elements. The pair of M-element coniforms are located at the outermost point of the anterior (rostral) end of their exposed oral cavity, surpassing the S-elements. M-element coniforms helped a conodont to initially attach itself to a host-victim. Behind them, within the pharyngeal area, are two sets of p-elements (P_1 and P_2). Their close adjacency to one another within each set, enabled grinding of food whenever a set of P-elements rocked or rattled against each other, while that occlusion transpired only whenever a parasitized host-victim was frantically jerking itself around in order to rid itself of attached conodont(s). The authors of this diagram elected not to include an orientation of the exposed oral cavity, which is then left to the imagination of the viewer. See text for discussion of the various orientations of the conodont-amimals' oral cavity. From Purnell and Jones [20].

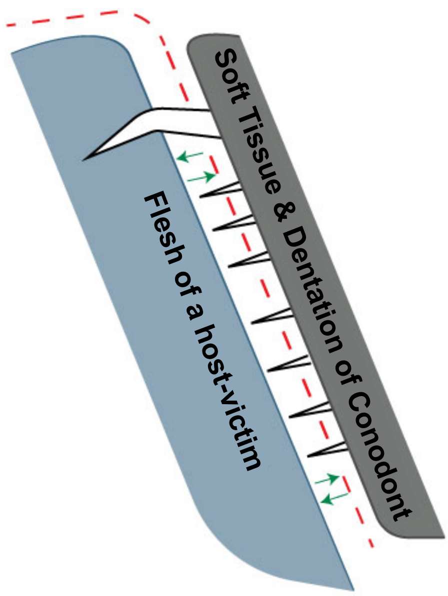

Figure 7: Sketch depicting a close-up view of a host-victim's flesh parasitized by M and S elements of a conodont's exposed oral cavity during the frantic, back and forth, fluttering movements by the host-victim in order to rid itself of the attached conodont. Only one M-element coniform and only one row of S-element denticles are shown here. The M-element coniform initially pierces the host-victim in order to consistently grasp it. This is quickly followed by the parasitized host-victim's flesh thrusting back and forth (represented by the dashed line and up/down arrows) towards the stationary, small denticles of the S element which causes a constant, oscillating, contact that resulted in tiny conduits within the flesh while the host-victim discharges its body fluids through the conduits. The author elected to embed the denticles' bar just inside the surface of the conodont's soft-tissue so that it is not seen in the sketch. Explanation of the symbols: dashed-line represents a constant, oscillating, thrusting, movement of the host-victim's flesh directly into and away from the stationary denticles. The up/down arrows represent an oscillating, actional direction of the host-victim flesh. Length of a sketched arrow is 10 mm while the actual lengths of all fossilized elements range from .2 mm to 2 mm.

against each other, an illustrative analogy would be akin to two semi-circular gears always actively interlocking while alternating between clockwise and counterclockwise motion, due to the parasitized, host-victim's frantic, fluttering motions. Thus, here too, the conodonts' brain did not instruct their own P-element denticles to occlude. Once again, this points to the conodonts strategically achieving a successful feeding process based on the simple, crude or rudimentary, physical composition of their body plan.

An epithet such as "the thorny conodonts" is very fitting because of several reasons: their denticles are shaped and maximally sharp as "rose thorns"; the mechanics of flesh-cutting between stationary denticles and stationary thorns are the same since they depend on an animal's epidermis moving directly into them; and their thorny characteristic of parasitism commonly caused the sickness and slow deaths of their host-victms lasting for many days. This is, of course, versus the predation of marine animals by other predators who typically induce a relatively quick death upon their prey.

Generating a General Maxim Regarding the Early Evolution of Fishes

The above discussion about how denticles and teeth evolved/changed both physically and functionally for fish over the course of time, allow us to infer a maxim about the early evolution of the fishes. Of course, the general reason for the advancement of evolution is to improve the quality of life belonging to an organism. But the fact of the relict, original, overall, body plan and denticles being retained by the combinatorial lineage of the conodonts and lampreys proves their body structure had reached an optimal design very early during their perpetual time range, which precluded any further evolvement of it [2]. Further proof of this, as previously mentioned, is the jawless, unarmored, conodonts and their sister group, the jawless, unarmored lampreys, who both successfully survived beyond the extinction of virtually all other jawless fishes even though many of them were armored. Once comprehended, we may now present a surprising picture about evolution in the case of fishes, as seen in Table 1. The result of these comparisons made in Table 1, tell us, fish successfully evolved according to: obvious trial & error since the armored, jawless fishes went extinct during the Devonian Period, while the combinatorial lineage of the unarmored, jawless, conodonts and lampreys flourished throughout the entire Phanerozoic Eon (Cambrian Period to Present) [2]; and the subtle but important implication of whether or not brain control was directly powering their own feeding mechanism. An adjunct to the above, is when the conodonts ultimately became suddenly extinct during the middle of the Mesozoic Era which was not due to any possible flaw in their perpetually, optimized body structure. Instead, their paleoenvironmental inability to adapt to freshwater and wide ranges in marine salinity, ultimately proved to be their total demise [2].

Brief Criticism Concerning the Traditional School-of-thought regarding Conodonts as Macrophagous Feeders

Goudimand et al. [4] advocated a macrophagous feeding lifestyle for conodonts by illustrating a model that demonstrated "tearing flesh off of prey achieved by a biting- motion from denticles". Their model is explained through complex sets of conglomeritic details which depend and revolve around the idea of a hypothetical "cartilage-pivot". This implies that an instruction from a conodont's brain would enable a biting-motion of its denticles. However, that conflicts with the maxim promoted by the present study which invokes: the primitive times of the early Paleozoic Era only call for a crude way of food-processing such as a rudimentary feeding system of all jawless fishes which were either the parasitic type or the filter-feeding type. Thus, we can conclude that a primitive stage had to materialize first of when there was no brain-control over denticles rooted in its own soft flesh. Only then afterwards, is when the stage is set for brain-control over denticles and teeth, such as denticles or teeth on the tongue of a lamprey which was then followed by teeth on a hinged jawbone that performs the act of occlusion (Table 1) during progressive evolution. In an attempt to parallel the evolvement of no brain-control transitioning to brain-control of an anatomical part of the body, one only has to observe human/animal hair that is typically not controlled by the brain to move on its own. But evolution did eventually provide for brain-control of hair in the case of the porcupine (Kingdom: *Animalia*; Phylum: *Chordata*; Class: *Mammalia*; Order: *Rodentia*) (i.e., *Erethizon dorsatum*) [9] since its brain instructs its own stiff hairs or quills to stand up on their own (for defensive purposes).

Just to further the case for parasitic-feeding by the conodonts, an important observation not reported by Iannicelli [2] is the glaring fact that conodonts lacked a skeleton. This essentially implies that their weight was negligible-enough not to weigh down the host-victim during parasitic-attachment, which permits the open-space, fluttering, panicked/frenzied, movements of the host-victim, described in the current study.

Other Ramifications due to the Conodonts' Elements through Time

A general principle derived from the current study, is the many various, ornate, designs, patternings and emplacements of the S-elements within the conodonts' oral cavity during the course of time/evolution, which only reflect the different types of epidermises locally encountered by local conodonts. Thus, this simply means, as the epidermises of fishes evolved/changed through the ages, so did the S-elements of conodonts in coordination to the different types of epidermis-textures, since those had the important job of constantly scraping/poking at the different textures. Preferences by individual conodonts for only particular epidermis-textures most probably didn't exist because recent testing for it on extant parasitic lampreys resulted in virtually no preferences upon the many geometrically-varied, grooved surfaces of host-victims [24].

Category of Fishes	Time Range	Ability to Cut Flesh	Mode of Scraping/Poking Action Upon an Epidermis by Denticles/ Teeth	Ability to Occlude with Denticles/Teeth	Instruction from The Brain
Jawless fish such as Conodonts	Cambrian to early Lower Jurassic	Yes	Dependent on an epidermis moving into stationary S-elements	Yes, only with oropharyngeal P-elements	None
Jawless fish such as lampreys	Devonian to the Present	Yes	Dependent on a toothed-tongue moving onto an epidermis	None	Yes, to power their toothed-tongue
Jawed fishes	Devonian to the Present	Yes	None since there is occlusion by all teeth	Yes	Yes, to power movement of the lower jaw

Table 1: Comparing the evolutionary function of denticles and teeth dependent / independent of the brain for fishes during the entire Phanerozoic Eon.

Borrowing from the preceding simple fact, we may also easily say that the many, various sizes of the overall fossilized forms of adult P-elements were coordinated to the particular qualities of hardness that characterized the local host-victims' diverse types of epidermises over the course of time and evolvement since they had the important job of crushing various, hard, tiny fragments that were derived from the scraping-action of the epidermis by the S-elements. This must be differentiated from any global, uniform, size-changes to elements and even teeth of all marine animals during the course of history due to episodic, global warming bracketed by the Lilliput Effect [25].

Fossilized elements almost always echo the timespan of wear and tear upon themselves during the lifetime of the conodont-animals. Denticles commonly feature microwear such as abrasion-facets plus macrowear such as fractures and truncations [20]. These erosional and broken features were attributed to conodont-denticles operating as typical teeth with a biting-motion as commended by Purnell & Jones [20]. But it can be equally said here that the wear and tear aspect of fossilized denticles was attained when the parasitized host-victim tried to constantly shake itself free of the parasitically-attached conodont-animal(s). Specifically, let's use the following example, host-victims such as fish who have scales covering their body. Here, during parasitism, the stationary S-element denticles would have been subjected to the constant thrusting of the scales against them, incurring micro-wear such as abrasion facets upon the denticles. An example such as the macrowear aspect in the form of elongated denticles that were fractured in half can be accounted for, by again, the frantic, jerking movements of the host-victim whenever it was trying to free itself of an attached conodont(s). In all probability, robust host-victims were possibly successful in freeing themselves from some of the conodonts' parasitism since the fossilized, fractured denticles now lay as mute testimony to the liberation of the host-victim.

Orientations of the Conodonts' Oral Cavity

The study takes the opportunity here to supplement the study's thesis by filling in a void left by Figure 6 of this study. Its illustration did not image nor indicate any orientation of the conodont's exposed oral cavity. Figure 1's inclined orientation of an oral cavity by a representative conodont is already supported by Figure 2 which displays a representative lamprey's inclined oral cavity (or oral disk). Investigators had illustrated variations of the conodonts' oral cavity's orientation that run the gamut ranging from frontal-oriented [26,16] to incline-oriented [16], and finally to a ventral-oriented oral cavity [27]. A limitation to those orientations in an inventory of the world's extant lampreys by Renaud [19] revealed the lampreys' oral cavity being either only inclined-oriented or ventrally-oriented. However, support for a conodont's frontal-oriented oral cavity is exhibited by a well-fossilized, Cretaceous, freshwater, lamprey found in Inner Mongolia, China [28] that featured nearly a frontal-facing oral cavity (*Mesomyzon mengae*, Chang et al.) [28].

Envisioning a Typical Paleo-Seascape with Interactions During the Ordovician–Devonian Periods

It would be interesting to now envision a sequence of events dramatizing the interaction of the conodonts and their host-victims. A typical Ordovician-Devonian scenario most probably encompassed large-eyed conodonts targeting the planes between the plates of armor belonging to an ostracoderm so that it could deliberately collide its own pair of M-element coniforms into the epidermis which caused penetration into the epidermis. That particular stage of the paleo-scenario can be seen today with extant lampreys just before they make contact with their prey since these extant animals most probably have the ability to recognize attachable and unattachable surfaces according to Adams [24]. The following, immediate paleo-scenario was the commencement of the stationary S-elements shearing the epidermis caused by the parasitized, frenzied, host-victim who constantly fluttered through the water in a vain attempt to detach itself from the foreign attachment of the conodont. This achieved a constant, ramming of the host-victim's epidermis into the stationary S-elements, resulting in a constant poking-action/scraping action that eventually sheared the epidermis. That is sequentially and quickly followed by the tiny, hard fragments loosened from the breach in the host-victim's epidermis being crushed by the P-elements that rattled or rocked back and forth against each other due to the jerking-motions of the frenzied host-victim. Based on observations of parasitic lampreys, parasitism by conodonts upon the host-victim may have lasted days to a week or more, depending on the number of individual conodonts attached to the host-victim who were busy slowly draining the host-victim of its body fluids.

Interestingly, within that same paleo-scenario, a question is raised concerning the shaking-motions of the parasitized, host-victim, which may have conceivably demonstrated a marine animal who is sick or injured. A predator's instinct draws it to even any apparent display of pseudo-weakness by that prey which incites a predator's contemplation of an attack upon it. But that display of weakness by a frenzied prey in hypothetical cases like this, had to still sensibly perturb the predator, which ultimately discouraged a potential attack by it. This is because the simulated tentacles (due to multiple attachments of conodonts upon a host-victim) mimicked actual tentacles of jellyfish and cephalopods which represented the threat of a sting or entrapment to any animal observing it [2], as previously discussed.

Overall, the above also implies a realistic perception of the general, paleo-scenario of the Paleozoic Era through the middle of the Mesozoic Era (which was the time range of the conodonts) indicating a very likely monopolization of the communal paleo-seascape by many numbers of conodonts parasitically attached to many marine animals. This should coax paleo-ecological artists to reflect the preceding and the resulting-mimicry of jellyfish/cephalopods [2] in their artwork.

Conclusion

Interpretation of the enigmatic conodonts' feeding process was always a problematic issue for paleontologists and paleobiologists but a detailed explanation presented here of the parasitic-feeding habit not only reasserts work by other investigators who advocated parasitic-feeding [2,5,6] but also describes a novel, simple concept of eating by conodonts. The resolvement of the matter is calculated by recognizing the simple, crude way of the S-elements at cutting the epidermis of a host-victim, which had to have been accomplished by stationary S-elements while not by S-elements moving on their own accord, nor dependent on brain control issuing an instruction to make either a biting or an occluding motion. Null movement by these elements means that the parasitized, frenzied host-victim pushed its own body into the sharp, stationary S-elements, resulting in a constant poking-action/scraping-action upon the epidermis that eventually created tiny holes or conduits into it. This same crude strategy is analogous to thorns (i.e., belonging to *Rosa laevigata* sp.) on a stem of wood since both thorns and denticles are maximally sharp while stationary thorns and stationary S-elements only require that the epidermis of animals accidently move into the thorns and denticles, resulting in penetration and cutting of the epidermis. Of course, the results of that strategy achieved a slow, nurturing discharge of the host-victim's body fluids into the parasitic oral cavity of the conodonts.

The above also allows us to apply the same driving-force responsible for the function of the P-elements. That source was powered, once again, by the constant, frenzied, fluttering movements of host-victims who frantically struggled to free themselves of the conodont(s) who were parasitically attached to their bodies. That induced the P-elements to rock or thump back and forth against each other, resulting in their occlusal motion, while ultimately crushing any tiny, hard fragments derived from the poking/scraping of the host-victim's epidermis by the S-elements. Here also, no instruction was generated by the brain to operate an occlusal motion of the conodonts' elements for the sake of eating. We must always keep in mind that the preceding bolsters a basic axiom of: primitive times dictated simple, crude or rudimentary ways of processing the achievement of eating.

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