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Translator's Notes:

1. Popular species names are difficult to translate because, often, the same species goes under different names in separate geographic regions, or the same popular name applies, in different regions, to two different species.

   The following reference works were used here:

   Das grosse illustrierte Tierbuch by Hans-Wilhelm Smolik of Die grosse Bertelsmann Lexikon-Bibliothek, Bd.8
   C. Bertelsmann Verlag, Gütersloh, 1964

   The Genera of Fishes and a Classification of Fishes by
   David Starr Jordan
   Stanford University Press
   Stanford, Calif., 1963

   Septemlingual Dictionary of the Names of European Animals
   by L. Gozmány
   Akadémiai Kiadó, Budapest, 1979

2. The dentition of Cyclostomes is complex and the parts are not given in technical dictionaries. I have used as best I could the descriptions given in:

   Hubbs, C.L. & I.C. Potter: "Distribution, Phylogeny and Taxonomy" in: The Biology of Lampreys, M.W. Hardisty and I.C. Potter, Editors, Academic Press, Inc. 1971; Volume I, Chapter I, pp. 17-20; 24; 45. (Attached).

3. Lampreys attach themselves to prey or substrate by means of suction. In German, this idea is expressed by the word ansaugen; no corresponding, single word exists in English. In order not to multiply words needlessly, I have translated the German word, which occurs frequently, as, simply, attaching, or adhering, rather than by the correct but cumbersome attaching through suction.

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Notes on the Natural History of *Eudontomyzon danfordi Regan.*

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Table XV and 2 Text Figures

In 1911, Regan described a new Cyclostome, which he named *Eudontomyzon danfordi* (nov. gen., nov. spec.), from the Sebeş, a tributary of the Mureş river in Transylvania. In 1925, VLADIKOV* described *Lampetra bergi* from the upper Theisz,** but later, in his review of the fishes of the Russian Carpathians (1931), synonymized *L. bergi* with *Eudontomyzon danfordi*.

These observations suggested that *E. danfordi* inhabits the upper reaches of all the Theisz tributaries, if not necessarily those of the entire Lower-Danube drainage system.

My studies have so far confirmed this assumption, as I found these animals in the following streams and rivers: the Someş above Cluj; the Jara, a minor tributary of the Arieş, which is, itself, a tributary of the river Mureş;

(*) Transl. Note: VLADYKOV in bibliography & elsewhere.

(**) Transl. note: For "Theisz" The reader may wish to read "Tisza (River)".

the Drăgan, a tributary of the Crişul repede ("Swift-flowing" Crişul). The three rivers, Mureş, Criş and Someş, however, are the major Transylvanian tributaries of the Theisz.

Outwardly, Eudontomyzon danfordi closely resembles the two Central-European lampreys, Lampetra fluviatilis and L. planeri, but differs from them in the structure of the buccal funnel, which is armed with many radially disposed denticles (Table XV)(see also: Translator's Notes #2, p.2). The supraoral plate is broad and has two sharp cusps laterally. On each side of the mouth are three large one-, two- or, rarely, three-cusped teeth (lateral circumorals). The infraoral plate carries 8 to 12 teeth, of which the middle ones are the smallest. The outer, or anterior, lingual lamina usually has 13 sharp teeth, of which the middle one is enlarged. The posterior lamina has smaller, evenly-sized teeth. As in Lampetra, the dorsal fins of young animals are distinctly separated, whereas the fins of sexually mature adults abut one another.

The body length of the sexually mature animals varies with both the sex and the place where they were captured, and ranges from 178 mm to 270 mm.

In the section on *Cyclostomes* in "*Tierreich*" (= "Animal Kingdom"), Holly considers - probably correctly - the genus *Eudontomyzon* as a sub-genus of *Lampetra*. It is possible that an in-depth study of all *Lampetra*-species, including from the biological standpoint, will show that *Eudontomyzon* may not be tenable even as a sub-genus.

The habitat of *E. danfordi* in the Rumanian rivers is approximately coextensive with that of the brown trout (*Salmo trutta fario*). As soon as the rapidly flowing streams reach the plain, where the trout are replaced by *Leuciscus cephalus* , the chub, and the river crayfish, the lampreys also disappear. This shows that *E. danfordi* is a typical member of the stream fauna, much dependent on a high oxygen content of the water.

The animals were particularly abundant in the valley of the Jara, a stream that flows down from the Muntele Mare ("Big Mountains") and in which there are no fish other than trout, greyling (*Thymallus thymallus*) and bull-head (*Cottus gobio*). At first, the stream flows rapidly through a deep, wooded valley, in places more like a gorge; then through meadows. Further downstream, it courses lazily through fields. Our specimens were collected along a 20-kilometre sretch of the mid-upper course, but no doubt occur also above and below this segment of the stream. Wherever, along this stretch, silt containing relatively little sand has accumulated - in eddies, deep pools and at dams - there one can collect the young lampreys, the ammocoetes, in greater or lesser numbers. At first, notably at the start of the investigation, in March 1937, few specimens were caught because the best sites were still covered by high water levels. Later, in May and June, after the snows had melted in the mountains, the more rewarding collection sites became accessible.

The silt was shovelled onto the bank, and the wriggling larvae collected. Their food is probably similar to that of L. planeri and L. fluviatilis larvae, i.e. anything edible they can overpower. No useful information could be derived from the examination of the gut contents as these contained no solid particles except sand grains. In some places, small tubificid worms, Enchytraeids and the larvae of Ephemera occurred in large numbers together with the ammocoetes. While the Ephemera larvae would hardly be a suitable food for the latter, their presence reveals that nutrient matter in sufficient quantities is available.

Lampreys may be particularly numerous in this stream because, along its upper course, there are many sawmills. The sawdust they produce is waste and accumulates on the banks until it is washed away by the floods which frequently follow thunderstorms. If the silt in which the ammocoetes live is carefully excavated, it becomes apparent that it is composed of alternating layers of silt and sawdust. The ammocoetes live by preference at the interface between the topmost silt layer and the immediately subjacent layer of sawdust, where the latter has not yet completely decayed.

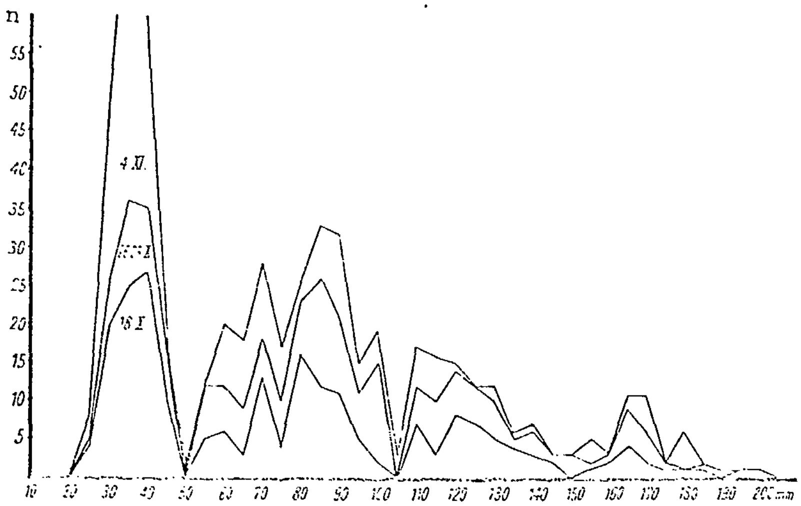

Figure 1. Size-Frequency Distributions of the ammocoetes of Eudontomyzon danfordi Regan on 18 X, 26-29 X and 4 XI. Abscissa: length in mm; Ordinate: number of specimens (n)

Authors disagree widely in respect of the duration of the larval phase of lampreys, i.e. the life span of the ammocoetes. RAUTHER writes: "The larval period of L. planeri in Central Europe in general probably lasts about 3½ years; larvae that emerge in the spring of year n, would therefore metamorphose in the late summer of year n+3 and become sexually mature in the spring of n+4". But IVANOVA-BERG comes to quite different conclusions.

She measured 3445 L. planeri larvae from the Narowa river system and constructed a frequency distribution curve from which she concluded that the larval period lasts, on the average, five years. However, she is not quite certain of this because the frequency curves for each month, and for the entire May-to-November collection yielded figures that varied from 4 to 7 years.

The results that IVANOVA-BERG attained by a statistical analysis of her collections of L. planeri larvae suggest that this method may actually be unsuitable for the determination of larval age-groups in a stream. Nevertheless, I collected larvae monthly in the Jara, measured them, and erected frequency-size distribution curves.

Figure 1 shows these curves for collections on 18, 26 and 29 X and 21(*) XI, in the Jara. The abscissa gives larval length (mm); the ordinate, number of specimens (n). The lowest curve is for the collection on 18 X; the middle one for the same, plus those of 26 and 29 X; the uppermost curve sums the data for all four collecting dates.

(*) Given as 4 XI on the graph in Figure 1.

Our method of presenting the data shows that the four maxima displayed are true maxima, not sampling errors. If the preponderance of a particular size-class on one day had been due to random factors, it is unlikely that on another day, at another - albeit nearby - site, the same size-class would also predominate. Thus, by summing, for each curve, the data for all collections made to that date, random maxima - indeed all chance variations of size - will be largely smoothed out.

In order to simplify graphic presentation and also to compensate for any growth that might have taken place during the one-half-month-long collecting period, the measured lengths were recorded in increments of five millimetres; thus, all measurements between 20 and 24 mm are grouped under 20 mm, while those between 25 and 29 mm are recorded as measuring 25 mm.

The first maximum, which lies between 15 and 45 mm, corresponds to the one year-old class. These are the animals that emerged from their eggs in the early summer of year n. The second and third maxima, respectively between 45 and 100 mm and 100 and 145 mm, represent the second- and third-year crops, i.e. those from years n+1 and n+2. The fourth maximum, between 145 and 200 mm, is the n+3, or fourth-year, class, just ready to metamorphose. A few begin metamorphosis early, in autumn:

e.g. in five specimens on 18 X, in 2 on 26 and 29 X, and in 3 on 21 XI, the mouth had already become rounded and the eyes were visible under the skin.

During the winter months, the ammocoetes do not grow, as can be seen from Figure 2, where the collections of 23 III, 22 IV and 20 V are represented in the same graphic format as in Figure 1. The four maxima occur at about

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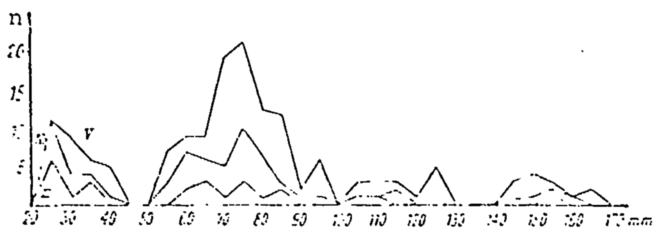

Figure 2. Size-frequency Distributions of the ammocoetes of <u>Eudontomyzon</u> <u>danfordi</u> Regan on 23 III, 22 IV and 20 V. Abscissa: length in mm; Ordinate: number of specimens (n).

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the same intervals as in the previous graph, which shows that, until May, the animals hardly grow in length. Rapid growth does not take place until the summer months. Unfortunately we have no figures to support this contention because of an error in the collecting method: the animals caught in June and July were not collected from a single site, nor even from several closely neighbouring stations, but over a stretch of stream several kilometres long. The size variations which are caused by environmental factors - quantity of food, temperature of water, differences in spawning time, etc... - are clearly noticeable, if only because of the small number of specimens collected. Nevertheless, our graphs show that the statistical methods used are sufficient to determine the duration, in years, of the larval period from spawning to metamorphosis.

Further, Figure 1 also shows that the older the age groups are, the fewer the individuals taken. Two reasons may be adduced here: (1) natural mortality due to disease and accident, which reduces the number of specimens; (2) avoidance of capture by the older, stronger larvae, which flee more quickly when the silt is being disturbed. We noted several times that older larvae, particularly those measuring between 150 and 200 mm in length, are extremely sensitive to tremors of the environment. At the first impact of a spade on a mud bank, flight reactions could be observed as far as 50 to 70 cm away from the digging site.

RAUTHER's determinations concerning the ages of L. planeri larvae, based on the work of several other authors, thus also apply to my observations on E. danfordi. In the drainage system of the Jara, an animal hatched in the spring of year n, attains, on average, a mean length of 30 to 35 mm by November of that year. During winter, growth is arrested and does not begin again until the following summer. By autumn n+1, the larvae have reached a length of 70 to 75 mm, and in autumn of n+2, a mean length of 110 to 120 mm. Late in n+3, some animals, now measuring 160 to 175 mm, begin metamorphosis; others do not do so until spring of n+4. By May-June of that year, however, all the animals spawned in the year n, have entered the second stage of development and begin to live as predators. As shall be shown below, sexual maturity, spawning and death all occur in year n+5.

L. planeri does not go through a predatory stage, and so becomes sexually mature immediately after metamorphosis: it thus lives only four years, and all similarities between L. planeri and E. danfordi end at the completion of metamorphosis.

A comparison with L. fluviatilis, which also becomes a predator between metamorphosis and sexual maturity, is desirable but impossible because we do not know what happens to L. fluviatilis after its descent to the sea. Authors disagree about the length of its oceanic sojourn WEISSENBERG thinks that all river lampreys stay in the sea only during the summer following their metamorphosis and return to their river in the autumn of that same year in order to spawn. ENEQUIST, on the other hand, holds that anadromous migration occurs by chance: he believes that the animals are extremely sensitive to rheotaxic stimuli, so that they migrate back to their rivers to spawn as soon as they sense the currents from the spring floods. This can happen during the first year, or not for several years, depending on where the animals happen to be in the sea.

There can be significant differences in size between E. danfordi larvae of the same age class. In the first year of life the range may amount to 20 mm only, which is not much, per se, but does represent a major fraction of the total length which, after all, averages only 35 mm. Such size differences are not so much attributable to individual differences or to variations in the food supplies of the habitats as to differences in spawning dates. Even if collections were all made at a single site only, it would still not be possible to take only those larvae spawned by a single female; and females may be early or late spawners, just as there are animals that metamorphose at the end of autumn, while others don't until spring.

In the next age class, the variability of body lengths, some 50 mm between the shortest and the longest specimens, is already more pronounced because in addition to the variability caused by the differences in age mentioned above, there are variations due to individual, sexual and nutritional differences. The variability in length noted toward the end of the second year remains about the same in subsequent age groups. Even after metamorphosis , variations in length are not much greater. The smallest of 33 animals caught on 19 IX, a male, measured 178 mm, the largest, a female, 235 mm; the difference between these two is thus 57 mm. Mean length of the animals was 208.3 mm; the greatest deviations from the mean, respectively, +27 mm and -30 mm. If, however, one eliminates two animals from each of the extremes of the range, the 29 remaining had a mean length of 208.5 mm, with a ± deviation of 21 mm from, or approximately 10 percent of, the mean.

The animals in the Jara valley continue to grow slightly in September, then stop feeding during October. The mean length of 209 mm probably represents a maximum for the animals from this stream. Of the eight specimens caught on 23 VIII, none measured more than 200 mm, and their mean length was 181.8 mm.

The animals living in the Someşul rece ("Cold Someşul") behave differently. Both the valley, itself, and the stream are much larger and, furthermore, the collections were made at the downstream limit of the lamprey's range.

Of the 48 specimens caught there during the end of July, the smallest, a male, measured 178 mm and the largest, a female, 254 mm; the mean length of all animals was 223.5 mm. The specimens from this valley were, therefore, much larger. Whether this is related to the lower elevation or to the greater size of the waterway is difficult to determine. Whatever the reason, it can not be attributed to a greater food supply, because in this region, the river had been "treated" with dynamite and poison so that, for all practical purposes, it was devoid of fish, trout or sculpins. Even insect larvae were present only in small numbers.

This waterway is much used for the rafting of logs downstream. For this, dams are opened at least once a day to drive the timber to the valley and the periodic flooding by large masses of water prevents the accumulation of silt. Because of this, there are only a few sites suitable for the collection of ammocoetes, and only one of these could be investigated. But even here the larvae were bigger than those from the Jara valley, where the largest animals collected on 23 VII measured 158 and 156 mm, respectively; but in the Someş, on 20 VII, some larvae were 180 mm long. On 15 IX, the largest specimens taken from the Someș measured 210 and 200 mm, while on 19 IX, those from the Jara were only 190 and 186 mm long. But one month later some Jara animals had begun to metamorphose and measured between 156 and 200 mm in length.

It may be possible to explain the differences in size of the animals in these two streams on the basis of a difference in the spawning dates, which would occur earlier in the Someș. In fact, as early as 28 VII there were larvae measuring 17 to 19 mm in length in the Someș which must have come from eggs laid that year, whereas five days earlier, in the Jara, not one of 68 specimens measured less than 39 mm.

Optimal growth occurs during July and August; at this time the water is warmest and the lampreys greedily attack everything edible they can catch. In one of the Jara's shallows, we observed, in quick succession, two lampreys each attach themselves to a small sculpin, which they tried to subdue. In each case, the lamprey had attached itself at the nape of its prey's neck (just behind the head) and in spite of all of the latter's efforts could not be dislodged. It is well known among local fishermen that when the entrails of a fish are thrown into the water, or even when a creel full of trout is set to cool in the water near shore, lampreys will soon congregate.

The lamprey's olfaction must be extremely sensitive; whereas its sense of vision is of minor importance and is probably capable only of distinguishing light from dark, but not of forming images.

If one baits the water with fish intestines, one soon observes - within 2 to 4 minutes - lampreys moving upstream toward the bait. By making use of the eddies behind the boulders, they overcome the more powerful currents. If they lose the scent, either because they swam too far upstream or because they were deflected out of the scent-carrying stream, the lampreys go downstream until they once again pick up the scent. Near the bait, they advance in groping fashion until they reach it, then they greedily and firmly attach themselves by means of their suction apparatus. Once they are thus in place, it is difficult to make them relinquish their prey. One can lift the entire bait, with its attached lampreys, clear of the water without causing them to let go of their hold. On the other hand, they flee immediately when one attempts to take them by hand - a difficult feat because the slippery body easily slides through the fingers. In air, the lampreys do not long survive; they are, however, less sensitive than trout or greyling, but more so than chub.

The relative unimportance of sight is demonstrated by the observation that when a whitefish is placed as bait on a dark substrate, it is found no more rapidly than on a light surface, not even when the bait is being agitated by the current. Under similar circumstances, river crayfish, which are also guided by their sense of smell, attack much more rapidly. Furthermore, lampreys moving toward a bait are not in the least disturbed when objects near them are moved about, whereas this immediately causes crayfish to flee.

I asked a fisheries supervisor (who had also made a reputation for himself as a poacher), why one stream contained lampreys when another didn't. According to him, those streams which contained crayfish did not have lampreys, whereas the streams with lampreys had no crayfish. He further maintained that when a lamprey had begun to eat a fish, a crayfish would quickly arrive, grab the lamprey with its pincers and hold on to it. In order to test the validity of these assertions, we looked for a site in the Someş, above Cluj, which was still within lamprey territory, but also clearly within that of the crayfish. We found a deep pool with quietly flowing water. There were boulders (placed along the bank to protect an adjacent roadway) which offered sufficient shelter for crayfish, and part of the bottom was silted. Then the bait was laid out close to the bank: five small whitefish on a string. Soon the first crayfish approached with slow deliberation over the boulders, and nearly as soon we could observe a lamprey gliding in on the current that hugged the bank. It quickly reached the bait and attached itself to a fish downstream from the crayfish. But now a second crayfish of considerable size approached. He approached the bait with wide-open pincers prepared for attack and took hold of the lamprey near the middle of its body. Just as the crayfish was going to use its second chela, the lamprey freed itself through vigorous movements.

The frightened lamprey raced away about half a metre but returned and attached itself again to the bait. Several other lampreys as well as more crayfish also arrived. Several times, a crayfish would catch a lamprey, but not once could it hold on. No matter how strong a crayfish may be, it can probably rarely keep hold of a healthy lamprey with its pincers. The bodies of the lampreys are too hard and slippery. Nevertheless, the crayfish's attack leaves a scar, but the resulting compression injury does not seem to be life-threatening.

Thus, the fact that crayfish and lamprey inhabit distinctly different niches does not seem to be caused by any incompatibility of the two species, but is due to their different habits. *E. danfordi* lives in oxygen-rich trout waters; the crayfish, on the other hand, prefers the more slowly-flowing, oxygen-poorer waterways of the plains.

In order better to observe the behavior of the lampreys during the winter, 15 animals caught by bait on 28 IX were transferred to a roomy, 80 L aquarium. In order to create an environment that would be as natural as possible, the bottom was covered with sand and stones. The inlet delivered about 1 L/min of tap-water close to the bottom; the overflow removed water from the surface. Small fish were used to feed the lampreys.

During the first days, the animals swam about in the aquarium, occasionally attaching themselves to a glass wall or stone, but showed little visible signs of excitement. After three days they had become acclimatized and began to attack the small fish. They did this mainly during the evening and at night, only once during the afternoon. First they attach themselves randomly to any part of the prey, then they begin to feed. If the prey-fish is strong enough and if the lamprey attached itself along the side or on the caudal end, the victim may free itself; but if the lamprey attached itself in the region of the head or immediately behind the head, the fish is lost. It tires quickly, and the lamprey devours it live, gradually sliding down the body from behind the head to somewhere between the pectoral fins, where it rasps a hole into the body cavity to reach the intestines.

When the fish is finally dead, other lampreys arrive to take part in the meal. Because they can not see, and orient themselves entirely by smell, they sometimes err, and attach themselves to another lamprey; the attacked lamprey, as soon as it feels the first bites, defends itself vigorously. But the attacker does not release its hold so easily, and a lively fight ensues during which the two animals intertwine like snakes. But the attacker can not long maintain its hold and is soon removed. A dark spot, elongated and narrow, remains as a permanent mark on the olive-brown skin of the victim. One sees these marks often on newly caught animals, which suggests that such incidents also occur in nature, and not only in the aquarium with its crowded living conditions.

During the first week of October, the 15 lampreys ate a total of 16 small fish; some of these belonged to the smaller Leuciscus species, others were Cobitis barbatula measuring up to 8 cm in length.

Three of the captive lampreys, two males and one female, died on 13 X. Autopsies showed that the gonads had considerably increased in size, but without compressing the intestine significantly. The last food-fish was eaten on 12 X. Seven more animals, three females and four males, had died by 18 X without showing any obvious cause of death, from which one might conclude that they could not tolerate the tap-water used to feed the aquarium. In all these specimens, the intestine was still large and functional.

The remaining animals, together with two small whitefish, some ammocoetes and a small, 3 cm long crayfish survived uneventfully. The lampreys usually rested on the bottom, lying most often on the belly, sometimes on the side. At rare intervals, one or another would begin to swim, then attach itself to the aquarium's glass wall; but it did not remain there long before sinking back to the bottom. If the tap was opened so that the stream of water became more intense, they lampreys fled to a quieter place, or attached themselves to some object. When light from a powerful lamp shone on them, they fled out of the cone of light to a darker place, something they had not done previously.

Two females, each about 175 mm in length, died on 10 and 13 X, respectively. After their 2½ month-long fast they had considerably shrunken in length; the liver, too, had shrunken, but was still distinct. The intestine, on the other hand, had become reduced to a delicate, thread-like tube, entirely compressed by the eggs. The ova had increased in size and the ovaries filled the entire body cavity. Two other, external, signs were noted: the dorsal fins now abutted and mating signs had begun to appear near the anus. The horny covering of the teeth had been shed, leaving only soft, blunt remnants. The last animal died at the beginning of February, a few days after a fungal infection had become manifest.

The ammocoetes that had been placed in the aquarium at the same time as the lampreys are still alive, as are two small whitefish. One must assume therefore that the lampreys are particularly sensitive during the fasting period. The surviving ammocoetes remain constantly buried in the sand and do not emerge even at night. If the sand is stirred up, they swim about excitedly for a short time but as soon as they have quietened down, they hide again.

Where the lampreys stay during the fasting period could not be determined. They probably hide in the deeper places under stones or between the roots of the trees which border the stream.

ENEQUIST believes that the period of inanition is also the stimulus for sexual maturation. He states:

that ..."Even in the river lamprey all food intake stops during the spawning migration. The animal swims upstream and rests from time to time by attaching itself to rocks and boulders. After arriving at the spawning grounds (or, more precisely, at the rapids just upstream from these) it remains for a considerable while, holding tightly onto the substrate. The suction needed to remain attached to such an unyielding substrate is not accompanied by swallowing motions (as is normal suction, when the animal is attached to its prey in the sea). It is because of, or at least simultaneously with, this special suction activity that the anterior part of the intestine collapses and atrophies, so that even the anatomical prerequisites for the intake of food disappear. .... If this assumption is right, it would have far-reaching implications. If, indeed, the spawning migration is a primary drive, and not a consequence of - i.e. not secondary to - sexual maturation, then the positive rheotaxis of migrating lampreys must have other causes. I do not find this unlikely and believe that the new factor may be the ability to sense water currents".

It seems legitimate to compare E. danfordi to L. fluviatilis, though the former, the object of my study, is a different species, possibly even a different genus or subgenus. Changes as important as the degeneration of the digestive system at the onset of oogenesis must be functions that are deeply embedded in both the species and the genus. If they occur in both species in the same way, they must be elicited by the same causative factors. But in _E. danfordi_ sexual maturation is not elicited by sensing water currents, nor is the degeneration of the digestive tract caused by entry into flowing waters and the consequent adherence to unyielding surfaces by suction. These animals spend all their lives in flowing waters, and even those animals that have just metamorphosed during the end of May and in June are in the habit of attaching themselves to hard surfaces in order not to be washed away by the current. In spite of this, they lead a predatory life well into October, a proof that suctorial attachement to stones has no effect on the diameter of the anterior intestine.

As mentioned above, some animals were placed in an aquarium toward the end of September, where they fed, just as their feral relatives, on living fish. Yet both the wild and the captive lampreys stopped feeding simultaneously in mid-October. The period of inanition that precedes sexual maturity had begun with all its side effects. It had begun, furthermore, without any alterations of potentially significant environmental conditions such as temperature or water mass, because these, in the aquarium, were always the same. Even food was always plentifully available.

We must therefore assume that in _E_. _danfordi_, and in the other European lampreys as well, the degeneration of the digestive system is caused by the ripening of the ova. This seems more logical and is easier to understand physiologically.

In _L_. _planeri_, where the ova ripen early, immediately after metamorphosis, the digestive system is also already non-functional immediately after metamorphosis, even though the streams carry enough nutrients to feed a lamprey, as _E_. _danfordi_ shows. In _L_. _fluviatilis_ and _E_. _danfordi_ the gonads are not well developed during metamorphosis and these animals have normal digestive organs. The principal factor causing the degeneration and consequent closure of the anterior gut is the onset of sexual maturation and, possibly, related endocrine activity.

It is dangerous to attempt an explanation of such a process solely on the basis of mechanical factors. We have many examples of changes wrought in an animal by puberty, but I know of none in which mechanical effects can cause the rapid regression of an organ.

The idea that the return migration of river lampreys to their home rivers and streams depends only on a "positive rheotaxic response" elicited by the sensing of water currents does not agree with what we know about the other, anadromous, marine fishes. So too, the migratory behavior, from sea to inland waters, is triggered by maturation of the gonadal products. But this also invalidates ENEQUIST's hypothesis, according to which river lampreys remain in the sea for varying lengths of time, depending on whether or not, in spring, they happen to encounter the currents caused by the rivers in flood.

ADDENDUM, X. 1938. - Among the ammocoetes held in the laboratory aquarium, some were in their fourth year of life. They remained healthy throughout the winter and metamorphosed in May. But a few days after they had emerged from the sand, they died. The younger ammocoetes survived, and are now already one year in captivity.

Spawning in the Jara valley began towards the end of May, and was terminated in June. By the middle of this month, dead animals were found on the sandy sections of the banks, where currents had deposited them. No animals were found in July.

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