

been dried on to the nylon gauze from a solution of progesterone in acetone, before the gland was stuck to it.

The control culture shows a regression in development compared with the first mammary gland that had been fixed at the beginning of the experiment. This is a regression, not merely a degeneration; a number of cells of the tubuli degenerate and die; the remaining cells remain in good condition and may survive for at least three weeks.

The control culture shows collapsed tubules but without signs of regression; there is possibly an increase in nuclear material. The cultures shown were fixed after five days in culture. These effects were found to be reproducible in four series of each one pair of experiments.

Full details of results obtained with several hormones will be published elsewhere.

An additional advantage of the method is that pictures are obtained comparable with the mammary gland preparations as used in hormone and cancer research in intact mice.

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Lasfargues, E. Y., *Exp. Cell Res.*, **13**, 553 (1957); *Anat. Rec.*, **127**, 117 (1957).
Elias, J. J., *Science*, **126**, 842 (1957).

² Hardy, M. H., *J. Anat.*, **84**, 388 (1950).

Speciation among Lampreys

Not all lampreys migrate to the sea. Some (the 'landlocked') always remain in fresh water; but after metamorphosis they migrate from the brooks, where they are born, to lakes and rivers. After a long feeding period they go back to the brooks, where they spawn and then die. This is known to happen with *Petromyzon marinus*, the landlocked form of which multiplied abundantly and spread widely in the Great Lakes of North America¹. The same phenomenon was recorded for *Lampetra fluviatilis* of Lakes Ladoga and Onega in the U.S.S.R.²

In other cases more differentiated forms of species have originated. These I would call 'paired forms' or 'paired species'. There are, in fact, related forms of lampreys (usually a couple), which are almost identical morphologically, while their biological features are quite different. One form, in the couple, after metamorphosis, feeds parasitically on other fishes, while the other does not take any food. Moreover, the former reaches sexual maturity after the feeding period, whereas the latter begins its maturation during metamorphosis.

So far, cases of paired species of this kind were known only in the genus *Ichthyomyzon* and *Lampetra*. Recently I have found another one in the Danube waters for the genus *Eudontomyzon*. The relationship among the paired species or paired forms are shown in Table 1.

In every case the non-parasitic forms can be found in the same river basin together with the parasitic forms, but they are confined to the upper zone. Sometimes, however, both forms can be caught spawning at the same time and place³.

The parasitic lamprey in the Danube does not migrate at all, unlike the parasitic forms of other paired species. The former always remains in the same streams where it lived as a larva and underwent metamorphosis, just as the non-parasitic forms of the other cases of paired species. This perhaps explains why the existence of these two forms has remained so far unknown.

The presence of paired lampreys in so many different localities raises the problem of their specific difference and of their origin. The most common opinion to-day is that each of the two paired forms is a 'bona species' and that the non-parasitic species originated from the parasitic one.

Some previous authors thought that the parasitic form had become non-parasitic through having come to live in a habitat where they could not find suitable hosts. Recently Young⁴ and Leach⁵ advanced the suggestion that this phenomenon is similar to that of the neoteny or pedomorphosis: gonads maturation has been anticipated, probably by action of anterior hypophysis⁵, thus inhibiting parasitism after metamorphosis. This fact seems to be confirmed by the recent capture of female ammocoetes with mature eggs and well-developed secondary sexual characters⁶.

The lampreys of the Danube suggest the existence of a gradual stage in this process of transformation. At first, they apparently kept within fresh-water boundaries, which allowed internal migrations. Later, they stopped these migrations in fresh-water also, though retaining their nutrition stage. Finally, either on account of nutrition difficulties or because of anticipated gonads maturity, they become non-parasite, breeding without nutrition after metamorphosis.

From the observations which, so far, have been made on the lampreys of the Danube, it may be concluded that from *E. danfordi* may have arisen a non-parasitic, but morphologically similar, form, which I name *E. danfordi vladikovii*. This lives in the upper part of the Danube. Perhaps *E. mariae*, with some morphological differences and living in Russian streams flowing into Black Sea as well as in some tributaries of the lower Danube (Prut and some others), has a similar origin; but this hypothesis needs confirmation.

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June 13.

¹ Applegate, V. C., and Moffett, J. W., *Sci. Amer.*, **192**, 4, 36 (1955)

² Berg, L. S., *Ann. Mus. Zool. Acad. Sci. U.R.S.S.*, **1**, 87 (1931).

³ Zanandrea, G., *Pubb. Stat. Zool. Napoli*, **31**, 127 (1959).

⁴ Young, J. Z., "The Life of Vertebrates" (Oxf. Univ. Press, 1950)

⁵ Leach, W. J., *J. Morph.*, **89**, 2, 217 (1951)

⁶ Zanandrea, G., *Boll. di Zool.*, **23**, 414 (1956); *Atti Instit. Ven. L. Sci., A.*, **116**, 180 (1958); *Nature*, **179**, 928 (1957).

Table 1. RELATIONSHIPS AMONG THE 'PAIRED SPECIES' OF LAMPREYS

Genus	Parasitic species	Non-parasitic forms	Habitat
<i>Ichthyomyzon</i>	<i>I. unicuspis</i> <i>I. castaneus</i> <i>I. bdellium</i>	<i>I. fossor</i> <i>I. gagei</i> <i>I. greeleyi</i> and <i>I. hubbsii</i>	Great Lakes and northern region of the Mississippi basin Western region of the Mississippi basin Eastern region of the Mississippi basin
<i>Lampetra</i>	<i>L. fluviatilis</i>	<i>L. planeri</i>	West and southern Europe (Atlantic and Mediterranean tributaries except Adriatic and Black Sea tributaries)
<i>Eudontomyzon</i>	<i>L. japonica</i> <i>E. danfordi</i>	<i>L. japonica kessleri</i> <i>E. danfordi vladikovii</i>	North Europe and North Asia (Glacial and Pacific Ocean tributaries) Danube