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RETROGRESSIVE METAMORPHOSIS IN HERDMINIA

The retrogressive metamorphosis may be defined as – the period of rapid transformation from larva to adult form in which considerable destruction of advanced larval organs ultimately disappear in adult.

Generally the simple system of larva become complex and advanced. But in some cases metamorphosis involves considerable distruction of larval tissue. Some organs completely disappear and some become degenerated while some may become complicated.

The Ascidian larva exhibit retrogressive metamorphosis during its development.

Structure of Ascidian Larva :-

(I) Free swimming Ascidian larva is an elongated cylindrical shaped measuring about 1.5 mm in length and 0.3 mm in width.

(II) The body of Ascidian tadpole may be distinctly differentiated into an oval trunk (about 0.3 mm), a long laterally compressed tail (about 1.2 mm).

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(III) The anterior end of trunk bear 3 suckers or adhesive papillae out of the 3 papillae 2 are dorso-lateral and one ventromedian.

(IV) The entire body is covered over by the test. The test covering the tail expand to form a transparent caudal fin.

(V) Within the tail, in the axis, a notochord is present which is surrounded by gelatinous ~~structure~~ substance. Notochord is derived from endoderm and about 60 vacuolated cells makeup the entire rod.

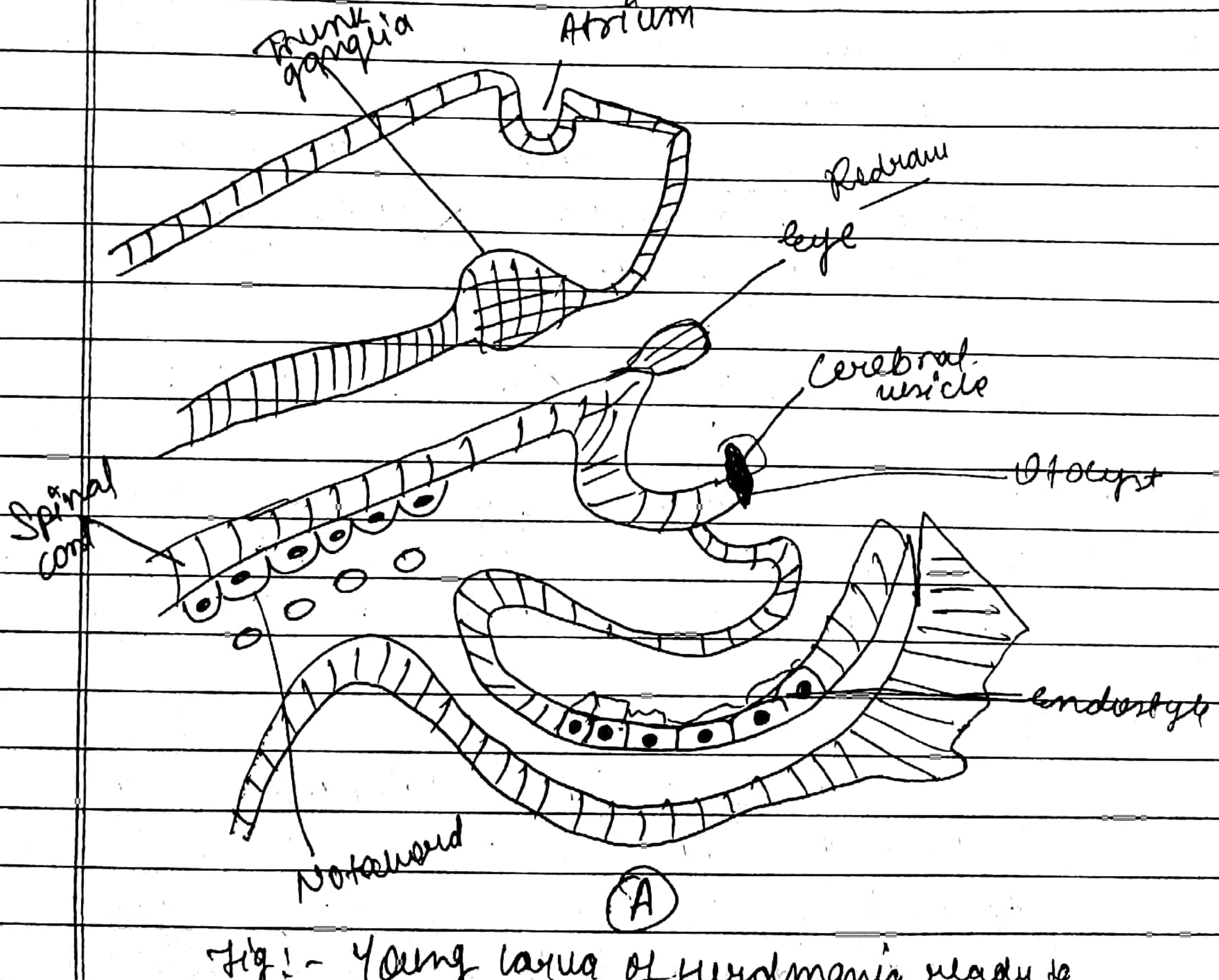

Fig:- Young larva of Herdmania ready to hatch

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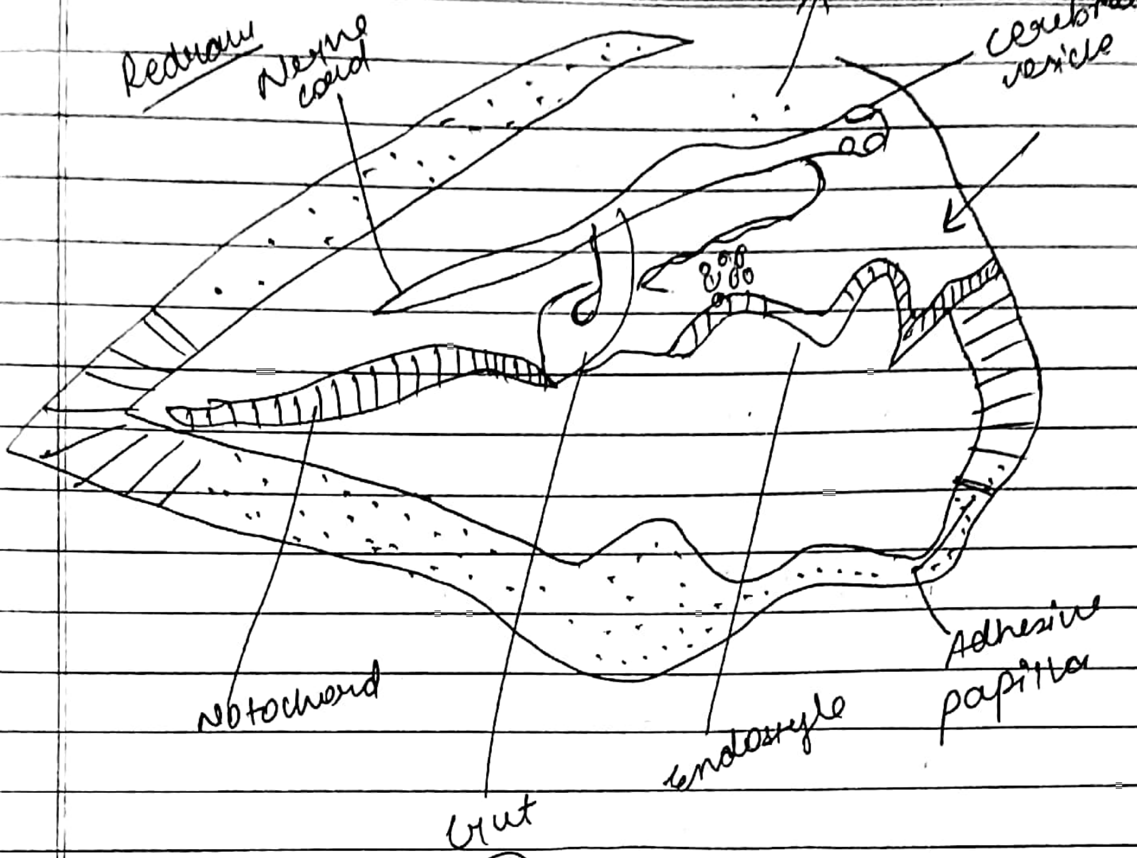

(B)

Fig:- Free swimming ascidian tadpole / larva

(VI) Dorsal to the notochord runs the dorsal nerve cord. Nerve cord is continued into the trunk where it dilates to form the cerebral vesicle. The vesicle consists of a dorsal pigmented eye, a ventral pigmented otocysts and a thickened ganglion representing the brain.

(VII) The alimentary canal is distinguishable into pharynx, oesophagus, stomach & intestine. The mouth is situated anterodorsally and leads into the pharynx, consisting of the endostyle towards the ventral side.

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(VIII) Each of the two side walls of the pharynx is corporated by a number of stigmata or gill slits. Gill slits do not open to outside directly. They open into a pouch called atrium. The atrium open to the exterior by a single dorsal pore called atriopore.

(IX) The heart surrounded by the pericardium lies posterior and ventral to the pharynx.

Transformation :-

The Ascidian larva swims in water for some time, the period of which may vary from a few hours to one day. And then, sinks in bottom and attached itself to some object by means its suckers.

In this fixed condition it starts undergoing retrogressive metamorphosis. It involves two process, namely

A) Disappearance and as well as

B) The growth and appearance of certain organs.

Thus the chief changes involves as follows -

A) Disappearance

(I) Soon after fixation, the tail begins to reduce and eventually disappear completely.
(II) Together with the tail, the notochord and posterior part of dorsal nerve cord disappears.
(III) The nerve cord reduced to a single ganglion.
(IV) The eye and otocyst disappear completely.
(V) Suckers disappear.

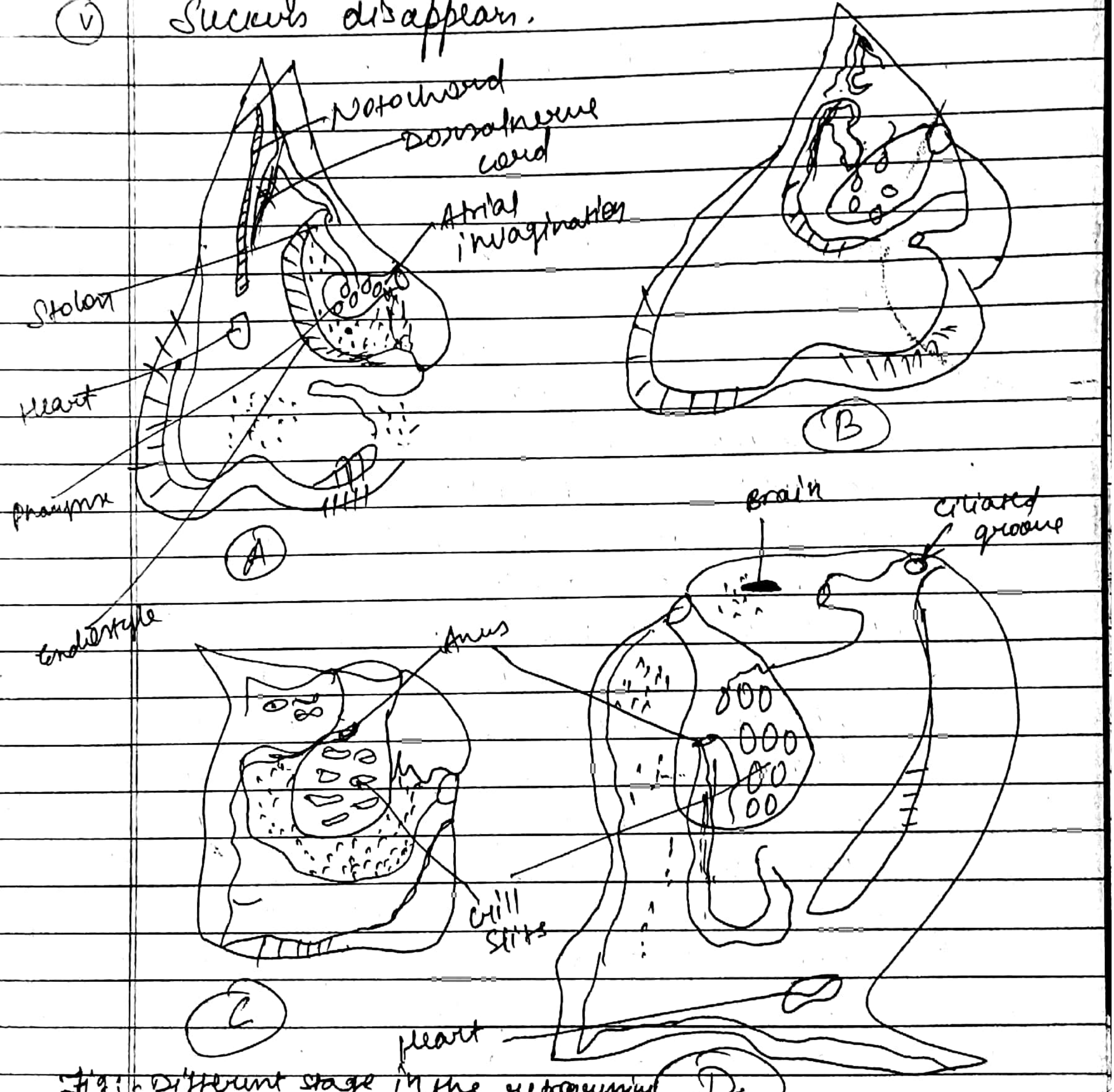

Fig: Different stage in the retrogressive metamorphosis of ascidian tadpole larva

(vi) The sense organ, the ocelli & the otolyth are also completely lost.

(vii) The region b/w the adhesive papilla and mouth grows rapidly, while the opposite region becomes degenerated. As a result, the body is rotated through 180°. The mouth & the atrial aperture is shifted and the intestine becomes looped.

(viii) The adhesive papillae is lost.

(ix) 4 ectodermal ampullae are formed to anchor the animal to the substratum.

(x) The test increases in thickness & form foot.

(xi) A heart and circulatory system are developed.

(xii) The gonads are developed.

(xiii) The adult become sedentary in habit.

Models of Energy Flow

For explaining mode of energy flow in various types of ecosystems, ecologists have suggested the following models:

1. Single-channel energy flow models.

(a) Lindeman's model. This model was first suggested by **Lindeman** (1942) who died at the age of 26 years. As shown in Fig. 6.10, out of total incoming solar radiation (118,872 g cal/cm²/yr), 118,761 g cal/cm²/yr remain unutilised. Thus gross production (net production plus respiration) by autrophs is 111 g cal/cm²/yr with an efficiency of energy capture of 0.10 per cent. It may also be noted that 21 per cent of this energy, or 23 g cal/cm²/yr is consumed in metabolic reactions of autotrophs for their growth, development, maintenance and reproduction. It can be observed further that 15 g cal/cm²/yr are consumed by herbivores that graze or feed on autotrophs — this amounts to 17 per cent of net autotroph production. Decomposition (3 g cal/cm²/yr) accounts for about 3.4 per cent of net production. The remainder of plant material, 70 g cal/cm²/yr or 79.5 per cent of net production is not utilised at all but becomes part of accumulating sediments of the total energy

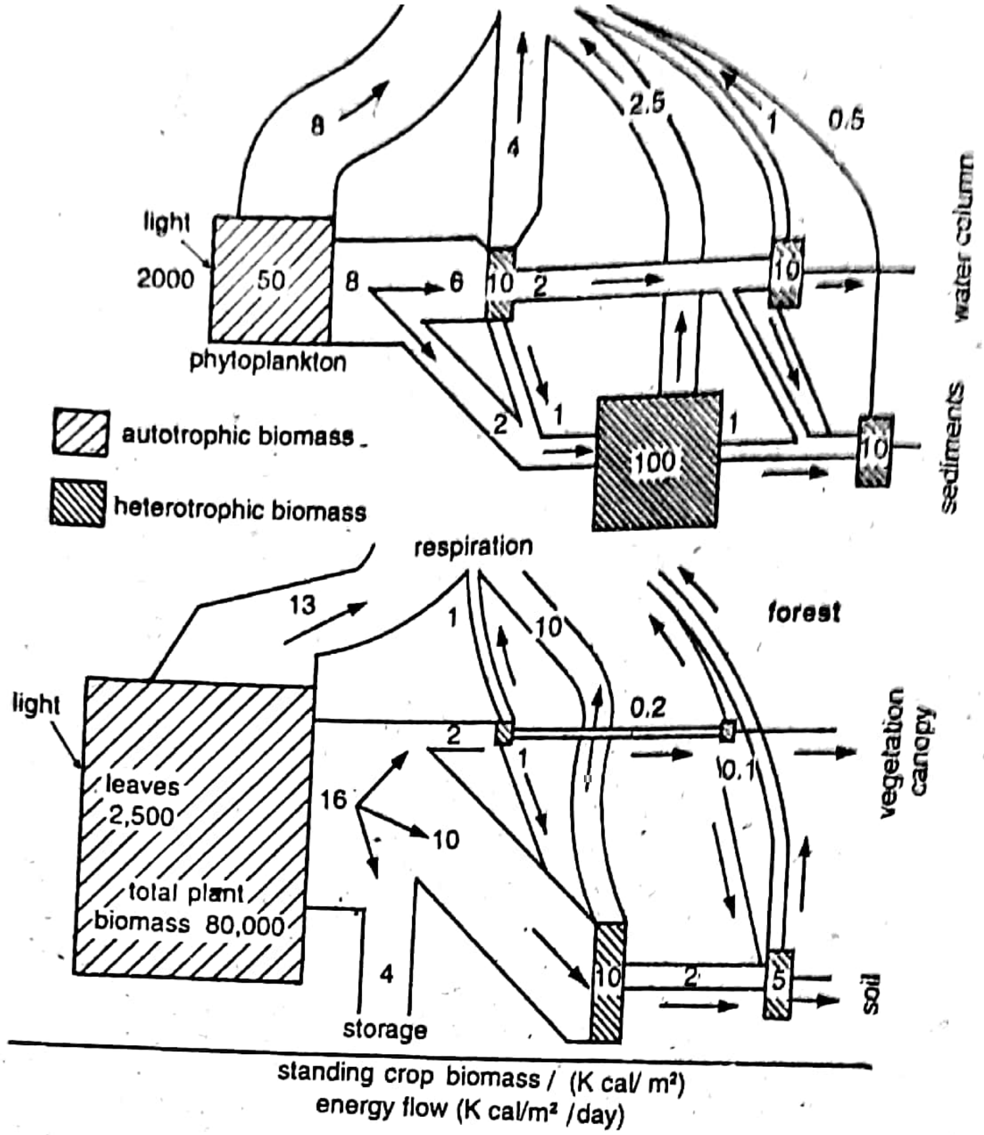

Fig. 6.12. A Y-shaped or two-channel energy flow diagram that separates a grazing food chain (water column or vegetation canopy) from a detritus food chain (sediments and in soil). Estimates for standing crops (shaded boxes) and energy flows compare a hypothetical coastal marine ecosystem (upper diagram) with a hypothetical forest (lower diagram).

E. P. Odum (1983) gave a generalized model of Y-shaped or two-channel energy flow which is applicable to both terrestrial and aquatic ecosystems (Fig. 6.13).

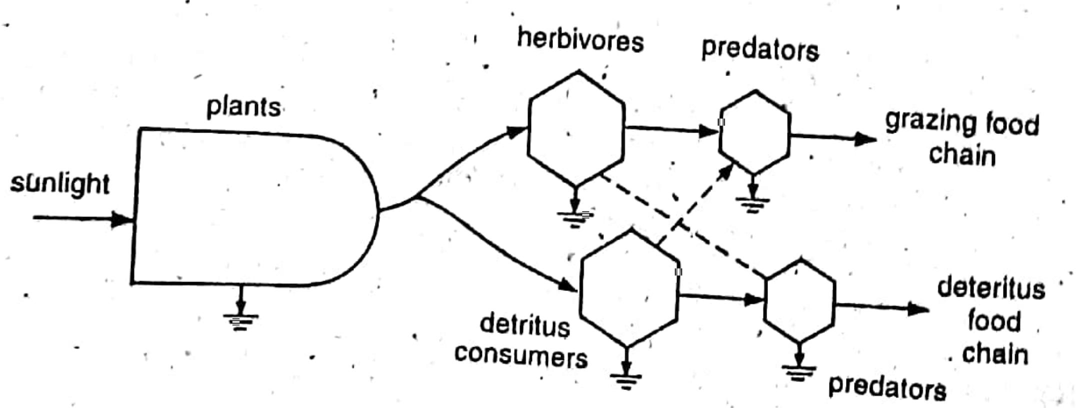

Fig. 6.13. Y-shaped energy flow model of Odum (1983) showing linkage between the grazing and detritus food chains.

The Y-shaped model is more realistic and practical working model than the single-channel model because (*i*) is confirms to the basic stratified structure of ecosystem; (*ii*) it separates the grazing and detritus food chains (*i.e.*, direct consumption of living plants and utilization of dead organic matter respectively) in both time and space, and (*iii*) that the microconsumers (absorptive bacteria, fungi) and macroconsumers (phagotrophic animals) differ greatly in size-metabolism relations. The important point in Y-shaped model is that the two food chains are not isolated from each other.

Odum's Universal Model

In 1968, **E. P. Odum** suggested a Y-shaped energy flow model (Fig. 6.14) which is applicable to any living components, whether a plant, animal, microorganism or individual,

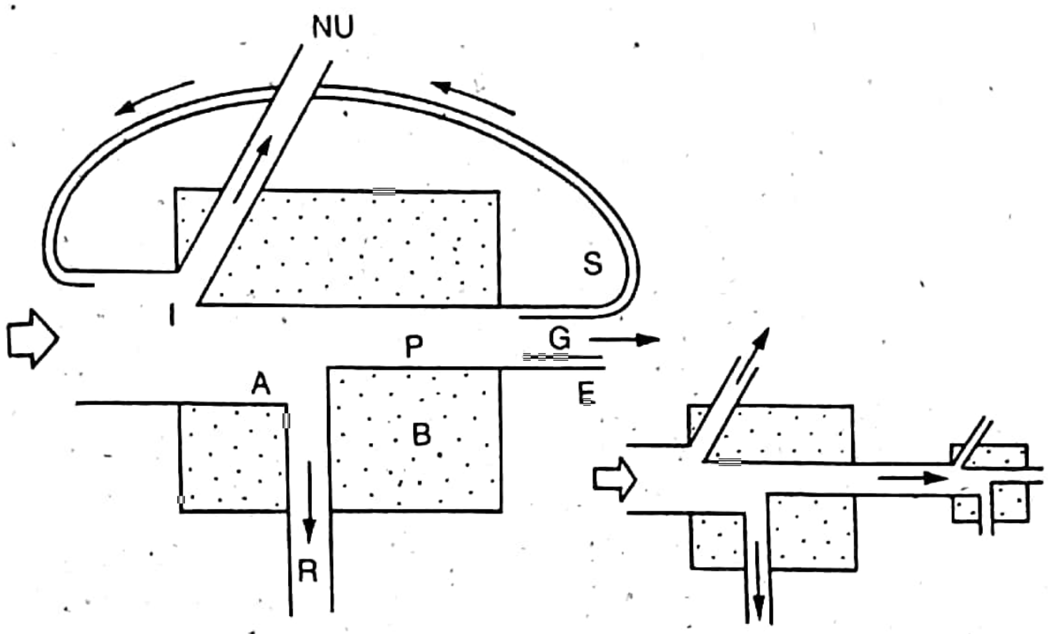

Fig. 6.14. Components of a "universal" model of energy flow. I = input or ingested energy; NU = not used; A = assimilated energy; P = production; R = respiration; B = biomass; G = growth; S = stored energy; E = excreted energy.

population or a trophic group. It is called **universal model of energy flow.** In the figure, the shaded box labelled "B" represents the living structure or biomass of the component. The total energy input is indicated by "I", which is light for autotrophs and organic food for heterotrophs. Such a model may depict food chain as already shown in other Y-shaped energy flow systems, or the bioenergetics of an entire ecosystem. This model can be used in two ways: (*i*) It can represent a species population in which case the appropriate energy inputs and links with other species would be shown as a conventional species oriented food-web diagram, or (*ii*) the model can represent a discrete energy level in which case the biomass and energy channels represent all or parts of many populations supported by same energy source.