Genetic & Environment Components of Behaviour

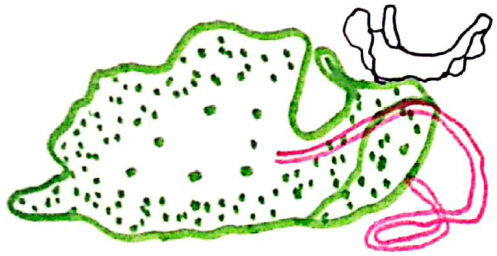
Behaviour pattern result from the complex interactions of external stimuli & internal conditions. However, any behaviour pattern is constrained by the way in which information is processed by the animal. The internal - information processing systems are established during the course of development from the fertilised egg to the embryo to the adult animal, a process called ontogeny. Through ontogeny we can discover the ways in which genetic and envtal. interaction information interact to give rise to behaviour of the animal.

Ontogeny :

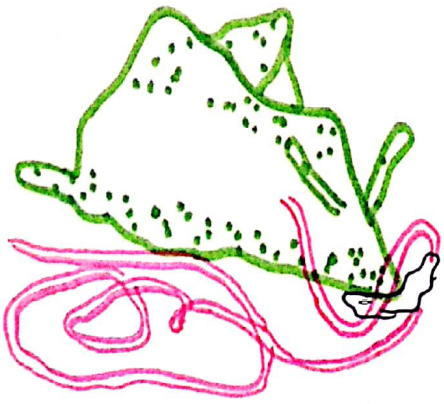
Almost all animals are composed of same basic materials. It is known that genes control behaviour development by producing proteins that regulate

the complex organization of embryological processes. A regulatory molecule acts by causing a specific reaction in cells, whose surfaces contain receptors for the regulatory molecule. The regulator is only functional under a certain range of envtal. conditions.

e.g. Aplysia is a shell-less marine snail, that ~~can~~ Fertilization is internal. Following fertilization, Aplysia lays over a million eggs, connected in a long strip. The egg strand is expelled from the reproductive duct initially through contraction of duct muscles. By using head, egg mass is firmly pressed onto a solid substrate.



Animal grasps the egg string in the mouth



Animal fixes it to the substrate

Richard Scheller and Axel found the behaviour sequence to be the result of gene action at a no. of levels, both during development and from minute to minute. The cells that give rise to Aplysia entire nervous system are descendants of a few cells in the embryo's body wall. Early in development a subset of these pre-nerve cells produces a specific protein called ELH (Egg laying harmone)

ELH-producing cells divide further & migrate to their final locations in the developing organism.

ELH-producing cells to go into full prodn. ELH then causes neighbouring nerves to fire. It also circulates in the blood, causing specific muscle fibres to contract, a response that results in the coordinated behaviour pattern observed as egg extraction and deposition.

Here, the action of genes is of direct importance in guiding the prodn. of a stereotyped behaviour pattern. There are also varying degrees of envtal.

influence that can modify the behavioural results of development. The same genes may have diff. phenotypic effects when the animal is subjected to diff. envtal. influences during development.

Envtal. effect :

The crustacean Gammarus normally has a red eye colour. Ford & Huxley discovered a single mutation that affects the rate at which eye pigment is deposited during a certain stage of ontogeny. If the mutant's temp. is raised to a certain level, the eyes brom red, at higher temp. they become a chocolate brown, and at intermediate temp. there will be intermediate colours.

Genetic & Envtal. influences are inextri-cably bound together in ontogeny.

As suggested by Brown, epigenesis can be summarized as follows:
Starting with the fertilized egg or zygote (P_1) its phenotype at the next stage of development (P_2) will be

determined jointly by the genes that are active in guiding its growth & differen-tiation. during the intervening interval (G_1) and by the envt. in which the development takes place (E_1) i.e. zygote + genes + envt. ⟶ next stage phenotype

$$P_1 + G_1 + E_1 \longrightarrow P_2$$

The phenotype at following stage of dev-elopment (P_3) will be determined by the way in which P_2 has been changed by G_2 & E_2

$$P_2 + G_2 + E_2 \longrightarrow P_3$$

During early stages of development ($P_1 + G_1 + E_1 \longrightarrow P_2$) the envtal. comp. E_1 consist mainly of biochemical factors that surround the early embryo. At later stage, ($P_2 + G_2 + E_2$ may consist of post-hatching $E_2 \longrightarrow P_3$) envt.

Envtal. Influences upon Behaviour.

Some forms of behaviour do not appear until a particular stage of development is reached. Some of these develop without any obvious practice.

for e.g. Pigeons start to flap their wings and fly erratically at a particular age & their flying ability appears to improve with practice.

- Similar e.g. is vocalization of pigeons and domestic fowl, which are highly stereotyped and appear at certain stages of development. They are not dependent on auditory experience but upon certain hormonal conditions that are a normal part of overall maturation

As an e.g., we can consider Kuo's work on the development of behaviour in chick embryos.

Gilbert shows that duck embryos can respond to maternal calls five days before hatching and that such experience may influence the ducklings' subsequent behaviour.

Young of different species develop in very different ways. While ducklings and goat kids are mobile as soon as they are hatched or born, blackbird nestlings and kittens are helpless at this stage.

Sensitive periods during development

Some animals appear to be preprogrammed to learn about certain aspects of the envt. during particular periods of development, for e.g. language learning in humans.

The young of many precocial species show a fairly indiscriminate attachment to moving objects. Thus, newly hatched mallard ducklings, separated from their mother, will follow a crude model duck, a person, or even a simple box moved box moved slowly away from them. Some stimuli are more effective than others in eliciting this following response. In the natural envt.

the most effective stimuli normally are provided by the mother, and approaches to the mother often are rewarded by body contact and warmth or by food that that the mother uncovers.

Role of Behaviour Genetics In Animal Behaviour —

Behaviour genetics can play an important role in the future development of the science of animal behaviour. There are at least three ways in which this can occur. The first is through the impact of behaviour genetic research itself. The second is in providing valuable exptal. preparations. The behavioural geneticist can provide tools — such as genetic mosaics, strains with diff. brain weights and techniques for analyzing development effects.