Avian development

The avian embryo has a long and distinguished history as a subject of embryological study. The modern Egyptians appear to have been the first to investigate its development in a systematic way. The avian embryo is still one of the organisms of choice for modern developmental biologists because it is easily obtained, large and relatively translucent, allowing delicate microsurgical manipulations to be performed easily, and because its development is relatively well understood.

Birds are actually, like mammals, whose development more closely resembles the mammalian development. The main differences are in the earlier stages; the avian embryo does not have a placenta and is a self-contained developing system.

In the modern developmental biologist, the avian embryo offers a very accessible system in which molecular studies can be combined with classical embryology. Excellent staging systems are also available for the chick embryo. Transplantation, cell labelling, immunocytochemistry, and chemical manipulations can now be combined with in situ hybridization and northern blotting to examine changes in the patterns of gene expression resulting from experimental manipulations with well-defined effects. Moreover, with the advent of techniques for producing transgenic birds, which have recently become available, the developmental effects of targeted mutations can be studied in cellular as well as molecular detail.

The egg

Most of the material in the new laid egg (Fig. A52 [1.2] is nutrients, laid down by the mother to support the embryo. The embryo itself lies initially on the surface of the yolk, just under the vitelline membrane. The egg is designed to conserve water, to allow gaseous exchange and to prevent microorganisms from coming into contact with the embryo as well as provide nutrients and protection to the embryo.

It also provides a complex environment for the embryo to develop. For example, the pH of the yolk is slightly alkaline, while that of the albumen is quite alkaline. During early stages of development, the edges of the single-cell-thick embryo stick to the inner (pale) face of the vitelline membrane, so as it expands, it is thus poised in a pH gradient that may contribute to as much as 3 pH units per stage cell.

Chick and quail embryos hatch 19–21 days after laying if incubated at 38°C. Quail embryos develop slightly faster (19–20 days) than chicks (20–21 days).

Development in utero

After fertilization, which occurs internally in the mother, the new egg spends about 5 hours in the oviduct, and then moves to the uterus, where cleavage begins. This happens about 5.5 hours after laying of the previous egg. The cleaving embryo remains in the uterus some 20 hours before it is laid.

Cleavage (cleavage) of the fertilized egg occurs in a plane 90° with the axis between the vitelline membrane and the yolk. Unlike mammalian embryos, in which blastocyst formation, cleavage in zygote embryo is morulas. This means that the blastomeres acquire new