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Developmental and reproductive biology

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John Graham Kerr's (JGK) primary research interest was in the development of the "lower" vertebrates, and his main research material the extensive collections of preserved lungfish (*Lepidosiren paradoxa*) embryos made on his second trip to South America (1896), supplemented by specimens of *Protopterus annectens* and *Polypterus senegalus* collected by J.S. Budgett from west Africa. Although JGK published on the behaviour of lungfish, most of his work, begun in Cambridge and continued in Glasgow, was on the developmental stages of organ systems as revealed in histological sections of the preserved material. A clear objective of this work, following Darwin's *Origin of Species* chapter on embryos, and later work by Ernst Haeckel and others, was to discover what the development of "lower" vertebrates could reveal about the origins of the organ systems of "higher" vertebrates. This research in Glasgow was highly dependent on the skills of his histology technician P. Jamieson. Some of JGK's Glasow colleagues contributed to this research programme, notably E.S. Bles and W.E. Agar, but embryology gradually petered out as a Glasgow zoology interest.

This situation changed with the appointment of David Newth as Regius Professor in 1965. His previous post was Professor of Biology as Applied to Medicine at Middlesex Hospital Medical School, and he was closely associated with a group of cell and developmental biologists at University College London such as Ruth Bellairs, Michael Abercrombie and Adam Curtis (who also later moved to Glasgow to head a new department of Cell Biology). He was also the second editor of the *Journal of Embryology and Experimental Morphology* (*JEEM*, later *Development*), succeeding Abercrombie. In Glasgow, Newth quickly established an aquarium room in the basement for the breeding of the African clawed frog (*Xenopus laevis*), the amphibian species of choice for developmental biologists because it could easily be induced to breed (Bles had published a paper on hatching in *X. laevis* embryos when in Glasgow), and Axolotls (*Ambystoma mexicanum*: Newth was interested in the origins of colour variants in this species). Newth also set up an experimental laboratory next door to his office, and his research team, initially Jean Clark and later also Ken Crockett worked there. Newth's strengths were in teaching and administration rather than research, and the published output of the laboratory was meagre. However, he was soon to raise substantial external funding that allowed the recruitment of Donald Ede (Fig. 1) from Edinburgh, and the establishment of a Developmental Biology Unit in a Victorian villa at Horselethill. This was fitted out with extensive animal house facilities, staff offices and experimental laboratories. Academic staffing in developmental biology had already been strengthened by the appointment of Suzanne Ullmann (insect embryologist; later working on marsupial mammal reproduction) and Roger Downie (avian embryologist; later working on amphibian reproductive adaptations and marine turtle conservation): both moved to the new unit along with histologist Cathie Morrison. Ede's interests were in what mutations of limb development could reveal about the processes of normal development: his work focused on two avian mutants - *talpid*^{3} and *ametapodia*, and a mouse mutant - *pupoid foetus*. Maintaining breeding stocks of these mutants was a complex, time-consuming and expensive process, but the research output was substantial. Ullmann's interests in marsupials stemmed from a sabbatical visit to Australia, and for a time the Horselethill building housed the biggest breeding collection of some marsupial species north of the Equator! One researcher we sadly could not keep was Peter Thorogood, in Glasgow for a year in the 1970s. He went on to a stellar career in the field of skeletal defect development, before his untimely death in a fall from the Jungfrau, Switzerland at age 51.

Newth's other main initiative was the establishment of an undergraduate degree in developmental biology, as part of a strategy to attract medical students to zoology-related courses. Medical students (including those studying Dentistry and Veterinary Medicine) were able to pause their main studies for two years in order to complete a BSc degree in a medical-related subject, such as Anatomy. For the Zoology Department, the possible medical-related subjects were developmental biology and parasitology (for veterinary students, zoology itself is appropriate, especially for those interested in medicine related to exotic species). With teaching demands growing, colleagues needed some persuading that designing and teaching two new degree courses for possibly small numbers of medical students was a sensible strategy. Newth got his plan through by arranging that the new courses would be collaborative, bringing in staff from other departments, and ensuring that the course would be offered to science faculty students as well as to medicals.

The degree in Animal Developmental Biology (ADB) accepted its first students in 1974, and was initially a collaboration between the Departments of Zoology and Anatomy, with significant input from molecular biologists of the Beatson Institute for Cancer Research. Later, Cell Biology and Plant Science staff also contributed, with the name changing to Developmental Biology. It is not clear why plants were at first excluded.

Fig. 1. Donald Ede photographed at work in his laboratory in Edinburgh, a few years before his move to Glasgow: rather formally dressed! (Photograph provided by his family)

Newth was a strong advocate of the integration of the biological sciences, and in his review (Newth, 1986) of a history of developmental biology, he was critical of the lack of coverage of plants, as well as, in typically witty fashion, of the over-abundance of misprints! It was perhaps considered that inclusion of plant development would discourage medical students from taking the course. Over its 24 years, the course produced 96 honours graduates (four per year on average), and so numbers were not large. Ironically, the course closed (as a result of the non-replacement of retired staff) just when numbers peaked at 12 in 1998.

Science students entering the degree programme at level-3 would have encountered aspects of developmental and reproductive biology in Biology-1 and in some level-2 courses. Medical students would have learned aspects of development in anatomy courses. Level-3 then provided them with a comprehensive overview of the scope of the subject: see Downie (2024) for titles of the modules delivered in the mid-1990s. An important aspect of the course was the tutorial programme, which had a clear set of aims and content covering graduate skills, and the societal and ethical aspects of the subject and the nature and limitations of science (Table 1). The tutorial programme included a two-night residential discussion weekend at Rowardennan, substituting for the field courses provided for the other zoology-related programmes. The relatively small numbers studying developmental biology allowed the discussion weekend to have both level-3 and level-4 students together in an informal teaching atmosphere along with academic staff.

Over the first two terms of level-4, students took four five-week advanced modules (30 hours each) from a selection offered across the biological sciences: the ADB degree offered two such courses- Cellular Morphogenesis and Problems in Mammalian Reproduction. Term 3 offered a short lecture course on contemporary Issues. In addition, each student undertook a supervised research project over terms 1 and 2, taken in one of the contributing departments.

Aims
• To develop skills in researching information using original sources, and in presenting it in written and in oral form. • To develop skills in writing about science in different forms. • To develop a critical and individual outlook in reading scientific reports. • To develop listening and responding skills, and an ability to see other people's viewpoints, by taking part in discussions on controversial issues. • To investigate topics in reproductive and developmental biology that have relevance to people's lives e.g. fertility control and problems of infertility, both from a scientific and bioethical viewpoint. • To develop an understanding of the nature of science and how scientists work.
Topics covered (15 meetings, seven assignments)
• Human fertility control. • Is there a world population problem? • The reproduction revolution. • How science works/Limits to science. • Critical analysis of scientific papers. • Biotechnology: problems with patents and other dilemmas. • The exploitation of animals. • Human congenital malformations. • Ageing.

Table 1. Aims and content of the developmental biology tutorial programme.

Although the degree course closed in 1998, aspects of the teaching continued as components of the degrees in Zoology and Anatomy. The strong emphasis of the degree on mammalian reproduction meant that a significant number of graduates progressed to careers in the infertility services, including *in vitro* fertilisation.

Developmental and Reproductive Biology in Zoology has now come full circle with the establishment of Kevin Parsons' research group, which works on the relationship between evolution and development, like JGK, and Kathryn Elmer's which studies the evolution of viviparity in lizards.

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