Early Embryology of the Adélie Penguin

JOHN R. BAKER

Department of Zoology
Iowa State University

The object of this study was to compare the early development of the Adélie penguin (*Pygoscelis adeliae*) incubated under extreme environmental conditions with that of the domestic chicken incubated under ideal conditions. "Early embryology" here means those stages between the featureless unincubated blastoderm and the formation of the first recognizable vertebrate structures (somites, neural tube, and notochord). The following questions were among those considered: In what stage of development (compared with the normal stages of the chicken embryo) is the penguin embryo when the egg is laid? Does the unexpectedly long incubation period of the Adélie penguin (about 35 days) result from retardation in the early part of the incubation period?

This study was made at Hallett Station, near which was a large group of nesting Adélie penguins. The first penguins arrived on October 16, 1967, and the two embryologists (my able assistant was Mr. Nels H. Granholm) came on October 21, 1967. The first eggs were laid November 2. From then until November 9, several colonies close to the biology laboratory were searched for eggs at 8-12 hour intervals, and all of the eggs found were marked with the date and time. Eggs of approximately known age were taken into the laboratory, where the embryos were removed and examined.

Although we did not obtain any eggs as soon as they were laid, we could determine that the Adélie penguin embryo is probably in a stage corresponding to the unincubated chicken blastoderm when the egg is laid. The unincubated penguin blastoderm is about the same size (3 mm in diameter) as the unincubated chicken blastoderm. Adélie penguin embryos incubated by the penguins required 3-4 days to reach a definitive streak stage that the chicken embryo attains in 18 hours. A comparison of the ratios of the time required to reach the definitive-streak stage with the total incubation period for each species indicates that the penguin embryo remains proportionately longer in this early stage of development than does the chicken embryo. Whether this retarded early stage of development is due to a lower incubation temperature or to egg exposure, or whether this would be the rate of development at any constant physiological temperature, remains to be investigated.

In our small sample of embryos, we found that about 33 percent were dead or had been so arrested in development that hatching would have been unlikely, indicating that a large proportion of the natural breeding mortality occurs even before the embryo proper is formed. Most of this mortality is probably caused by poor brooders—birds who do not sit tightly on their eggs.

Comparative Biochemistry of Proteins

ROBERT E. FEENEY

College of Agricultural and Environmental Science
University of California (Davis)

During the past antarctic summer, two graduate students from the University of California (Davis) carried out biochemical research and collected specimens on Ross Island. These students, Richard G. Allison and Stanley K. Komatsu, had participated in the biochemistry program at Davis for several years and had conducted field work at McMurdo Station and elsewhere on Ross Island during a previous summer. The 1967–1968 field work was a continuation of the Davis laboratory's study of the physical and chemical properties of proteins, including enzymes, of antarctic species. This project has concerned two major subjects: (1) the egg and blood proteins of penguins and (2) the blood proteins and muscle enzymes of several of the cold-adapted fish of McMurdo Sound. Both of these subjects involve evolutionary adaptations at the molecular level, and the second one involves particularly the effect of cold adaption on the molecular parameters of the purified proteins and enzymes.

During the fall of 1967, our attention was directed primarily to obtaining biologic material, partially processing it, and freezing it for return to the University of California. This work included collecting eggs and blood samples from approximately 25 Adélie penguins, some of which had been injected with antigens of bovine serum albumin and chicken ovotransferrin. These birds were injected and banded at Cape Crozier in the 1966–1967 season and then recaptured last season. Approximately 100 specimens of the fish *Trematomus borchgrevinki* were obtained, and samples of their blood and muscle were prepared. A preliminary study was conducted on the effect of temperature on the rate of blood clotting in one cold-adapted fish. In addition to the collection of samples for return to the U.S., certain chemical and physical examinations of the material were made at the McMurdo biological laboratory, including gel electrophoretic patterns of blood-serum proteins and initial fractionations of some of the muscle enzymes.

The more definitive phases of the characterization of the proteins is being continued in the laboratories of the University of California (Davis).