

## SECTION VII

### PHYSIOLOGY AND GENETICS

#### RECENT PROGRESS IN PHYSIOLOGY OF JUVENILE DEVELOPMENT AND SEXUAL MATURATION IN NON-PASSERINE BIRDS

M. ABS

*Ruhr Universität, Bochum, Federal Republic of Germany*

The duration of postnatal development from hatching to maturity varies from several months in smaller species to several years in larger. Because growth plays the most important role during this period some organs complete their development early and others such as those of the genital tract develop mainly at the end of this period. Many studies concern factors influencing the role of the hypothalamo-hypophyseal-gonadal system in the physiology of sexual maturation. The temporal pattern of development of this system is triggered by several external factors, mainly by photoperiodism and food. Finally, whether sexual maturity is achieved by a steadily rising development or by a wavy pattern with several peaks of higher activity will be discussed. One of these peaks may be indicated by the breaking of the voice, which occurs in some non-passerine species.

#### THE THERMAL SIGNIFICANCE OF THE NEST OF THE SOCIABLE WEAVER PHILETAIRUS SOCIUS

G. A. BARTHOLOMEW, F. N. WHITE and T. R. HOWELL

*Department of Biology and Department of Physiology, University of California,  
Los Angeles, California, USA*

The Sociable Weaver of southern Africa builds the largest nest of all birds. Nests contain many chambers and may be occupied by a colony of a hundred or more pairs. During winter in the Kalahari Desert, sustained chilling winds are common and temperatures at night often fall to freezing. However, the air temperature in occupied chambers, warmed by the heat of the birds, was as much as 18–23 °C above external air temperature and during most of the night approximated the predicted zone of thermal neutrality.

Except when breeding, Sociable Weavers do not necessarily roost in the same chambers on consecutive nights; on a cold winter night as many as five birds may crowd into a single chamber. Because temperatures in chambers depend on the insulation supplied by the nest and heat released by the birds, the larger the number of birds and the bigger the nest, the greater the independence of the system from outside temperatures. The relatively high temperatures in the chambers during the night diminishes the metabolic cost of thermoregulation, allowing an expenditure of energy 40 per cent less than would be necessary if the birds roosted in the open. The reduced metabolic cost of thermoregulation that is associated with communal roosting in large nests has contributed to selective pressures favouring the construction of giant nests that remain in use for decades and are maintained throughout the year.

## CRANIAL PNEUMATIZATION AND ITS CORRELATION WITH AGE

H. J. DE S. DISNEY

*Australian Museum, Sydney, NSW, Australia*

The cranial area of the skull rapidly becomes fully ossified, but pneumatization (the forming of a double layer of bone separated by small columns of bone and air spaces giving a speckled appearance to the surface of the cranium) may not be completed for several years. Most investigations so far have been made on passerines to determine the time taken for the cranium to be completely pneumatized. For most small passerines this is about six months. It has been used as a method of recognizing young birds and has shown that several Australian honeyeaters (Meliphagidae) may breed when no more than six months old. The male Satin Bower Bird *Ptilonorhynchus violaceus* still has large areas unpneumatized and is in green immature plumage at four years old, yet when it has attained its adult shiny purplish-black plumage in its seventh year it is fully pneumatized.

From an examination of the skulls of all Orders of birds received in the Museum over the last ten years and also of African birds previously collected in East Africa in general the degree of pneumatization probably depends on the calcium available in the food and it may be a storage mechanism for excess calcium, similar to that in the long bones of the bird, particularly for the female before laying. This may explain why females often pneumatize more quickly than males.

## APPLICATION OF A SIMPLE CHROMOSOME TECHNIQUE IN FIELD STUDIES

R. A. C. JENSEN

*Nature Conservation and Tourism Division, SWA Administration,  
Windhoek, South West Africa*

A technique for preparing chromosomes has been developed over several years for use with birds. It is similar to several used by other workers and is based essentially on the methods of S. Ohno and R. N. Shoffner. It was developed specifically for use under 'field laboratory' conditions, with a minimum of steps and apparatus, as well as the option of using biopsy material without recourse to cell-culture procedures. The technique has been successfully modified for use with reptiles and fishes. An early version was successfully tested in the field in the Amazon basin in 1965.

The procedure involves Colcemid or colchicine administration *in vivo*, *in vitro* or both. Embryonic or chick material, including feather pulp, is preferred. After hypotonic treatment, material is fixed in acetic acid solution and squashed on a clean slide. The coverslip is removed after freeze-fixation in a methanol-dry-ice bath (dry ice being made *in situ* from a CO<sub>2</sub> cylinder) and the preparation stained with Giemsa after acid hydrolysis. Permanent mounting follows. This method is compatible with banding techniques, which may be applied at a later stage.

The method may be successfully used to determine sex and to test cytogenetic and systematic hypotheses, of which some examples will be given.

## IMPORTANCE OF WEIGHT IN THERMOREGULATION OF PENGUINS

Y. LE MAHO

*Laboratoire Thermorégulation CNRS, Université Claude Bernard, Lyon, France*

B. DESPIN and J. L. MOUGIN

*Équipe de Recherche de Biologie Animale Antarctique Laboratoire Oiseaux et Mammifères, Museum National d'Histoire Naturelle, Paris, France*

This project was undertaken in 1972 at Pointe Géologie Archipelago, Adélie Land (66° 40' S, 140° 01' E), and concerned both the Emperor *Aptenodytes forsteri* and the Adélie *Pygoscelis adeliae* Penguins. In addition, on Possession Island, Crozet Archipelago (46° 25' S, 51° 45' E), the King *Aptenodytes patagonica* and Gentoo *Pygoscelis papua* Penguins were studied.

Male Emperor Penguins undergo about 110 days of physiological fasting in winter. It is remarkable that the corresponding loss of weight (about 17 kg) is similar to that observed during the forty-day fast accompanying summer moulting. The duration of fasting by male Adélie Penguins falls between that of the Emperor and those of subantarctic penguins.

The aim of this study was to analyse relations between loss of weight and metabolism and we therefore studied:

correlations between loss of weight, internal temperature and oxygen consumption; variations in respiratory quotient during fasting; existence of a critical weight; pathological disorders accompanying forced fasting; evolution of the surface to volume ratio during fasting, and evaluation of the expenditure of total energy, using loss of weight as an index.

## EFFECTS OF HIGH CONCENTRATIONS OF SULPHUR DIOXIDE GAS ON STARLINGS STURNUS VULGARIS AND JAPANESE QUAIL COTURNIX JAPONICA

E. W. MARTIN

*Department of Biology, Bowling Green State University, Bowling Green, Ohio, USA*

The purposes of the studies were to delineate the lower toxic concentrations of sulphur dioxide under which birds may be expected to live for a few weeks and to define physiological, behavioural and histological changes that were manifested in treated but not in control birds.

Four concentrations of SO<sub>2</sub> (51 to 330 ppm) were supplied to different groups of Starlings. Two concentrations (150 and 300 ppm) were supplied to different sets of Quail. Control birds were supplied laboratory air. Starlings exposed to 330 ppm SO<sub>2</sub> died after approximately forty-five hours. Those exposed to 51 ppm survived for eight to ten days. Japanese Quail exposed to 300 ppm survived for five to nine days but those exposed to 150 ppm lived for at least nine days and as long as forty-one days. Half the Quail exposed to 150 ppm were dead after sixteen days.

Starlings lost a greater proportion of initial weight as time of exposure to SO<sub>2</sub> increased even though the level of gas decreased. Losses of weight in Quail were similar under the two different levels of exposure. Treated birds exhibited behavioural stress that indicated gross irritation to the eyes and respiratory tract. Preliminary ultra-microscopic examination of lung tissue showed cell inclusions in the treated Quail that were not found in control birds.

## DISTRIBUTION OF ORGANOCHLORINE PESTICIDES IN THE TWO HEMISPHERES

D. B. PEAKALL

*Cornell University, Ithaca, New York, USA*

G. J. MAEDA

*Tropical Pesticide Research Institute, Arusha, Tanzania*

The data on residual levels of organochlorine pesticides in the southern hemisphere will be presented with particular reference to birds. The more detailed information available from the northern hemisphere will be briefly summarized. Data obtained from lake ecosystems in eastern and western Africa show that residues are low compared with patterns of use in these areas. The possibility that this may be caused by rapid vapourization of the pesticides in this hot arid region will be discussed and its implications considered. The situation in New Zealand and South Africa is more similar to the northern temperate zone. Levels found in shearwaters in the Indian Ocean and seabirds from Antarctica will be considered in the light of likely fall-out of organochlorines.

## TEMPERATURE OF THE BRAIN AS A MEASURE OF DEGREE OF AROUSAL IN THE CHICKEN

U. VON SAINT PAUL

*Max-Planck-Institut für Verhaltensphysiologie, Seewiesen, Federal Republic of Germany*

Temperatures were recorded continuously at different depths in the brain of unanaesthetized free-moving chickens and variations of temperature were related to spontaneous and reactive changes in behaviour. Temperatures increased after behavioural reactions caused by optical or acoustical stimulation as well as after spontaneous arousal; calming and falling asleep were accompanied by a decrease of temperature. Electrical stimulation of the brain, if it was above threshold and resulted in behavioural reactions, was followed by an increase in temperature. The amount of increase was positively correlated with strength of stimulus and of behavioural reaction.

Temperatures measured simultaneously at different sites in the brain changed in the same direction, concurrently with spontaneous as well as reactive changes in behaviour. For electrical stimulation, no difference could be found in the general course of temperature between measurements at the different electrodes and measurements at other sites of the brain. The deeper within the brain the temperature was measured, the more it rose when the bird was aroused and the more it fell with the beginning of sleep.

## RELATIONS OF SIZE OF BODY AMONG PROCELLARIIFORMES

J. WARHAM

*Knaresborough, Yorks, UK*

The range of size of body among procellariiform birds is exceptional, if not unique, among birds in a single order. Weights of the bodies of petrels range from about 17 g for *Oceanites gracilis* to 8,700 g for *Diomedea epomophora*. This great diversity combined with the rather pronounced morphological and behavioural homogeneity of petrels simplifies study of variations in parameters related to size. The present paper

directs attention to interspecific variations in a few parameters that vary, often allometrically, with changing size of body. These include factors as diverse as size of egg, wing-loading and rates of development. Data spanning the whole range of size among petrels are presented and the merits of examining intra-ordinal patterns in this way for emphasizing exceptions to general trends are pointed out.

The distribution of size of body within the order is not continuous but bimodal. The possible significance of this and the view that the radiation in the order has been basically one of phyletic increase of size are briefly discussed.

## FUNCTIONAL MORPHOLOGY OF THE EYE OF THE BLACK SKIMMER

R. G. WOLK

*Nassau County Museum, Tackapausha Preserve, Seaford, New York, USA*

The Black Skimmer *Rynchops niger* feeds in flight upon small fish by the unique method of ploughing the water with its greatly compressed mandible. The shorter and thicker maxilla is kept above the surface. It is crepuscular and has a largely scotopic retina that allows some photopic vision also. The photoreceptor cells are adapted to both diurnal and nocturnal vision and provide only limited visual acuity.

The pupil is slit vertically, unique among birds, and this sacrifices acuity, but protects the scotopic retina during intense illumination. With an extremely narrow iris, the pupillary area can be reduced about thirty times. By squinting, the pupillary area can be reduced well over 1,000 times.

The retinas of closely related, diurnal species (*Larus* and *Sterna*), as well as those of unrelated species whose activities are also largely crepuscular, are compared to that of *Rynchops*. Results were much as expected, except in *Chordeiles*, which has a layer previously undescribed in birds located behind the retina. This layer has not been found in *Rynchops* or in the Laridae examined and probably functions as a light-reflecting device (similar to the mammalian tapetum) allowing the fairly photopic retina of *Chordeiles* to use light at low intensities. The Skimmer's adaptation on the other hand utilizes a scotopic retina protected by a slit pupil.