

I N T R O D U C T I O N

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Until recently flight whether in insects, birds or bats has been conceived as a morphological problem and in consequence, extensive studies on the structure of wings, orientation of wing muscles and their action and such other related aspects received considerable attention. Thanks to the allround renewed interest in aviation during the last few decades, animal flight is now being looked upon as a mechanical process and its various aspects are being reexamined.

Flight as a phenomenon, has also its historical background inasmuch as flying animals have evolved from non-flying ones. This facet of flight study has unusual interest with reference to birds as they are believed to have been descended from the reptiles. " Almost all of the characters that distinguish a bird from a reptile are the essential elements of its flying equipment " In these words Newman has summed up the difference between birds and reptiles. Palaeontologically birds are a recent group most of them having suddenly risen in the older Tertiary period and maintained their distinctiveness ever since. Though the age of birds has not exceeded ¹⁵⁰ million years, during this interval of time, they have evolved in many ways and established themselves in a large number of ecological niches. But our present knowledge of extinct birds has not provided

substantial information regarding the evolution within the group and as such the inter-relationship of the various orders of birds remains vaguely delineated. Nor does comparative anatomy offer help in this direction, since striking structural differences do not separate the orders. This lack of fundamental information is clearly evinced in the loose texture of the classification of birds, unlike that of the mammals. Perhaps the field of comparative physiology will be able to offer some explanation regarding the forces then in action and the early evolution within the group. The physiological evolutionist has therefore first to assess the energy equipment in flying birds and also to assess the beginnings of its source in reptiles to connect it up with the past.

Again birds are the only animals which can in a natural way ascend up in the air and remain aloft as does an aviator. Moreover, they are the only animals which can perform long distance and even intercontinental flights as our aviators do. The eastern golden plover living in Northern Siberia and Arctic North America spends its winter in the Pacific Islands. This journey for example from the Aleution islands to Hawaii, a distance of two thousands miles, it covers flying at a stretch for about 35 hours across the ocean without food nor rest. The machinery which they possess to perform this gigantic task has therefore evoked considerable curiosity all over. To the physiologists this sustained flight means a source of

considerable energy locked up somewhere and its efficient and gradual utilization. It means also the running of the machinery of flight without undue strain. A number of questions on the nature of the machinery involved and its working are therefore naturally asked. What is the fuel that provides so much energy? Where is it stored? What are the successive steps in its utilization? Do any of the intermediate products interfere with the smooth running of the machinery? If so, how are the difficulties overcome?

The present studies are by no means an attempt to provide answers to these questions. On the other hand they are only meant to present some possible explanations to elucidate certain aspects of the processes involved in bird flight. Incidentally they may throw some light on the problem of avian evolution.

This study on birds has been first undertaken in collaboration with Dr. J.C. George. The preliminary reports on the results published so far have been referred to in their appropriate contexts and also in the Bibliography.