THE PATAGIAL FAN IN THE TUBINARES

WITH ONE ILLUSTRATION

By ALLAN BROOKS

While collecting Tubinares in New Zealand in 1931-32 I dissected out the wing muscles of a number of species and was greatly interested in the structure of the patagial fan and especially in the presence of a bone until then unknown to me although I had cleaned the wing bones of a number of species in years gone by. On a subsequent visit to that region, as well as on other trips to both coasts of North America, much attention was given to the presence or absence of this bone, which I had called the "spreader-bone," in different genera.

Dr. Alexander Wetmore and Mr. R. A. Falla (of the War Memorial Museum of Auckland) were both acquainted with this bone when I talked with them of it; the former considered it only a specialized cartilage, however, and of no taxonomic value. When in England in the spring of 1935, I drew the attention of Mr. Gregory Mathews, who was working on this group, to this special feature of its wing structure. He took the matter up and his conclusions may be found in *British Birds* (vol. 29, 1935, p. 201) and in the *Ibis* (ser. 13, vol. 6, 1936, p. 831). That fine anatomist, Forbes, in the Report of the "Voyage of H. M. S. Challenger," 1882, had recognized and illustrated the

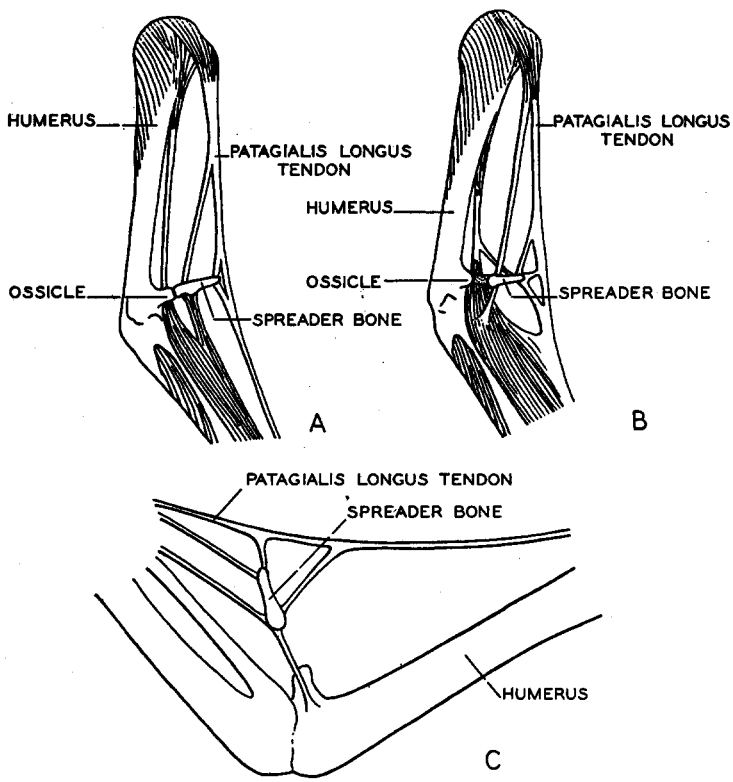

Fig. 22. A, right wing of *Puffinus bulleri;* B, right wing of *Pterodroma inexpectata* (stippled area is cartilage); C, left wing of *Diomedea nigripes.*

peculiarities in structure of the wings of the different genera of Tubinares without attaching much significance to the spreader bone. Meckel and Reinhardt had noticed it before that.

In my own investigations I found four different types of structure: 1, where the bone was pivoted on the ossicle at the distal end of the humerus, its extremity attached to the *patagialis longus* which extends from the shoulder to the wrist, as in all species of *Puffinus*; 2, where the spreader is attached to the *base* of the ossicle by a long tendon as in *Diomedea nigripes*; 3, where there is a wide flat cartilage connecting the spreader with the head of the ossicle as in *Pterodroma*; 4, where there is no trace of a spreader bone, ossicle present or absent. This last condition obtains in all the fulmars, storm-petrels, prions and in *Daption*. It will be seen that the presence or absence of the spreader-bone, called the "moklosteon" by Mathews, divides the Tubinares into two groups, the "gliders" where it is present, and the "flappers" where it is absent. I must say, however, that the fulmar in which it is absent does a great deal of gliding although not as much as the shearwaters. But the difference in flight between the Giant Fulmar (*Macronectes giganteus*) where the bone is absent and any of the albatrosses in all of which it is present is very noticeable.

In Forbes' beautiful diagrams *Pterodroma* is figured without the spreader bone. This is an error as I have found it present in three distinct types of that genus, *P. macroptera, P. cookii* and *P. inexpectata.*

The function of the spreader bone is obviously that of a strut, to support the strain of the long tendon, the *patagialis longus*, extending from the shoulder to the wrist. The effortless gliding flight of the albatrosses where the wings are rarely flapped must be greatly aided by the action of this bone. Many shearwaters are splendid gliders at all times, others like the Fluttering Shearwater (*Puffinus gavia*) beat their wings a great deal in a light breeze or a calm, but as soon as the wind hardens their whole flight alters; with rigid wings they swerve and swoop, now low over the water and at the next moment thirty feet or more above it in wild curves and pitches. The Black-vented and Manx shearwaters belong to this group.

The diagrams on page 82 were made from fresh specimens in the case of *Puffinus* and *Pterodroma*; in that of *Diomedea nigripes* from a partly cleaned wing (fig. 22). In *Diomedea exulans* and in *Thalassarche* the spreader bone is much longer than in *D. nigripes* and with a closer attachment to the ossicle.

Spreader bone present	Spreader bone absent
All albatrosses	*Macronectes*
Procellaria	*Fulmarus*
Puffinus including *Thyellodroma*	*Priocella*
Pterodroma	*Daption*
Bulweria	All storm-petrels (*Hydrobatidae*)
	Pachyptila (prions)
	Pelecanoides (diving-petrels)

Okanagan Landing, B. C., November 12, 1936.