

THE USE OF THE WINGS AND FEET BY DIVING BIRDS.¹

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BIRDS that dive and swim under water may be divided into two main classes,—those that habitually use the wings alone for subaqueous propulsion, and those that use the feet alone. The following paper includes my own observations which have been made only on wild birds and have been recorded at the time, and of records given me by other observers, as well as of those collected from literature. These two last named include observations on captive birds in tanks, which I believe are of value, for, as we shall see, the birds that habitually use their wings alone under water when in the wild state, and those that habitually use the feet alone, follow this rule even when confined.

In watching wild birds diving I have concluded that those that spread their wings just as they enter the water, use them under water, while those that keep the wings tightly pressed to the sides, and often execute graceful curves in diving, sometimes leaping clear of the water, depend on the feet alone. The truth of this conclusion I have confirmed in some instances by observing the bird under water; in other instances the conclusion has been borne out by the observation of others, so that the rule is, I think, a good one. Since formulating this rule I have found that Edmund Selous (15) expresses this same idea when he says: "This opening of the wings in the moment of diving is, I believe, a sure sign that they are used as fins or flippers under water." And again (16): "On the other hand cormorants, shags, and mergansers, birds which do not use their wings in this way, dive in a quite different manner. Instead of the sudden, little, splashy duck, as described, they make a smooth gliding leap forwards and upwards, rising a little from the water, with the neck stretched out, and wings pressed close to the sides to enter it again back foremost, like a curved arrow, thus describing the segment of a circle."

In the Loons and Grebes, the wings are small, but the legs are large and powerful. The femur is short and stout, thoroughly

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imbedded in muscular tissue, while the tibia is long and provided with a crest or keel on the anterior surface of the proximal end, to which the powerful muscles that move the tarsus and toes are attached. In the Grebes there is a very large patella. In these respects this group resembles the fossil *Hesperornis*, a toothed bird with wings represented by mere vestiges, but one that was strongly specialized for propulsion through the water by means of the feet alone.

The Loon and the Red-throated Loon in diving keep the wings closely pressed to the sides, and disappear below the surface without a splash, propelled apparently by the leg action alone. I have not been able to see these shy birds under water, but the inference that they do not use their wings there is confirmed by Mr. C. H. Townsend (25) who says in regard to a tame Loon observed in the New York Aquarium: "In exploring the bottom of the pool, or in pursuit of Killifishes it swam under water *with its wings closely folded* — never in use." The italics are his. The pool in which the Loon was confined was of ample size to display the agility of both bird and fish; it was twenty-eight feet long and three feet deep. Evans (3) states positively both of Loons and Grebes that "when submerged they do not use the pinions." C. Lloyd Morgan (27) says: "It must be remembered that Grebes and divers do not use the wings for progression under water." Lea (8) says of the Loon: "It uses its large webbed feet only, when swimming [under water]."

Although progression by the feet alone seems to be the rule in this group, yet it is a fact that at times the wings also are used. Thus Mr. C. Wm. Beebe, whose opportunities at the New York Zoölogical Park are unusually great, writes me under date of Nov. 6, 1908, that "Grebes and Loons do [use their wings] at times of emergency to turn quickly, or get up a burst of speed."

Mr. Wm. Brewster tells me, and the observation has been confirmed by others, that Loons in diving under boats to avoid being hemmed in, or in hurrying from their nests, use their wings as well as their feet, and this I think has given rise to the idea that they always use their wings. I have also been told by those who have observed young Loons, that they use both wings and feet in diving. A note of this sort was given me by Mr. F. H. Allen, who was impressed by the "quadropedal action" of the young bird under water.

I have watched Horned, Holboell's and Least Grebes diving, and as in the case of the Loons the wings are always kept closely pressed to the side. While the Grebes are able to sink mysteriously in the water, or to dive with very little motion of the body, they often leap clear of the water and execute graceful curves or arcs as they descend into the water. At such times the feet are stretched out behind. In the shallow water of a pond at close range I have seen the powerful leg strokes of the Least Grebe as it progressed under water, while the wings were seen to be motionless at the sides. On several occasions at Ipswich I have been treated to an excellent view of Horned Grebes as they dove, borne up in the clear transparent water of an advancing wave before it broke on the beach. In this case the wings were not in use, they were pressed close to the sides, while the Grebes advanced rapidly by leg strokes alone.

Joseph Kittredge, Jr. (7) in describing the actions of a Horned Grebe in a small tidal pool says: "He dove immediately. . . . In this case certainly, he did not use his wings in swimming." Evans, as already quoted, states that Grebes do not use their wings under water, and in another place (4) he says: "in diving the feet alone act as oars." Mr. A. C. Bent in reply to a question on this subject kindly wrote me as follows: "While collecting in the big Grebe rookeries in Saskatchewan I had ample opportunities to observe the Western Grebes swimming under water at short range, often almost at my feet; I am quite sure that they generally swam with the wings closed, and swam very rapidly. I am quite sure that I have seen the Loons do the same thing, though I have no doubt that they both use their wings occasionally."

Very different is the case of the Alcidae, the Auks, Puffins and Guillemots, birds with stout rounded bodies and short necks. In all the members of this family that I have seen, the wings of the diving birds are not pressed to the sides but spread out for action as they go below the surface, and I have actually seen the wings used under water in some instances. The Puffin on the Labrador coast allows of close approach, and one can plainly see the wings used vigorously as the bird descends under water. That the wings alone are used is stated by Selous (17) who says: "I have been able to follow the Puffin downwards in its dive, and at once noticed that the legs, instead of being used, were trailed behind, as in flight,

so that the bird's motion was a genuine flight through water, unassisted by the webbed feet."

The Black Guillemot or Sea Pigeon plainly uses its wings under water, for it goes down with a very obvious flop, spreading both wings as if to push the water away. Selous (22) says: "In swimming under water the Black Guillemot uses its wings only — the rose red legs trail behind it, a fading fire as it goes down." Mr. James L. Peters writes me that he "watched a Black Guillemot off Nahant. We were almost directly above him and, while we could see his wings nicely, his feet were quite hidden. When he dove he spread his wings and used them under water."

The Razor-billed Auk and the Murres spread their wings in diving, but I have not seen these birds under water. Selous (24) says of these birds: "Whilst watching the Guillemots [Common Murres] on the ledges, one of them flew down into the sea, just below, which was like a great, clear basin, and thus gave me the first opportunity I have yet had of seeing a Guillemot under water. It progressed, like the Razorbill and Puffin, by repeated strokes of its wings, which were not, however, outspread as in flight, but held as they are when closed, parallel, that is to say, roughly speaking, with the sides, from which they were moved outwards, and then back, with a flap-like motion, as though attached to them all along. Thus the flight through the water is managed in a very different way from the flight through the air." In another place (20) he says: "Razorbills also dive briskly, opening the wings. . . . One remarks then that the wings are moved both together — flapped or beaten — so that the bird really flies through the water. In flight, however, they are spread straight out without a bend in them, whereas here they are all the while flexed at the joint, wing raised from and brought downwards again towards the sides in the same position in which they repose against them when closed."

Of the Dovekie or Little Auk I have had the opportunity to make some interesting observations. In diving the wings are spread out as in others of the group, and, from a near-by rock, I have plainly seen it using its wings as it swam under water. As to the feet I cannot say, for I have no note nor distinct remembrance as regards these members. One is apt to assume that the feet as well as the wings are used in these birds under water, but the careful

observations of Selous on other members of the group show that the wings only are used.

The Great Auk, with wings reduced to flipper-like proportions, doubtless advanced rapidly through the water by the action of these members only.

The Penguins, although entirely distinct from the Auks, fly through the water with their attenuated flipper-like wings, and, according to Beebe (1) who has watched them in tanks, "make but little use of their feet in swimming, only occasionally aiding the tail in steering." Evans (5) says: "When submerged, the wings act as paddles with alternating rotary action, and the feet as rudders, but on the return to the surface the latter naturally become propellers." Lea (9) says of Penguins: "Their flight may be watched and studied in the large glass tanks at the 'Zoo'. . . . With short, rapid strokes of its paddle-wings it darts through the water leaving a trail of glistening bubbles behind, and shoots forward with the speed of a fish, turning more rapidly than almost any bird of the air by the strokes of the wings alone, the legs floating apparently inert in a line with the gleaming body, or giving an occasional upward kick to force it to greater depths."

Some of the Terns, in plunging for fish, disappear entirely under water, and as their feet are comparatively feeble, and as their wings are partially open in the plunge, it is possible that these latter are used to some extent in aiding their progress, although it is probable that the impulse of the plunge alone is all that is necessary.

Among the Tubinares, some of the Petrels and the Shearwaters plunge under water. Darwin (2) says of a diving Petrel, *Pelecanoides berardi*: "When disturbed it dives to a distance, and on coming to the surface, with the same movement takes flight. After flying by the rapid movements of its short wings for a space in a straight line, it drops, as if struck dead, and dives again. . . . It would undoubtedly be mistaken for an auk, when seen from a distance, either on the wing, or when diving and quietly swimming about the retired channels of Tierra del Fuego." Lea (10) states of the Capped Petrel, *Æstrelata hesitata*, now nearly extinct: "It poises itself in the air for a moment at a height of twenty or twenty-five feet, and then, folding its wings, takes a header into the water. The actual plunge is made with the wings open, and

they are used under water much in the same manner as during flight."

The plunge of the Gannet, with wings partly open, is so swift and often from so great a height, that it seems probable that there is no need of either wings or feet under water, but that the initial impulse of the plunge, which must be greater than that of gravity alone, is sufficient to enable the bird to catch its prey.

Cormorants execute graceful curves in diving with wings close pressed to the sides, often throwing themselves clear of the water with their powerful feet. I have never seen them under water but have conclusive evidence from literature on this point. F. W. Headley (6) says: "The Cormorant uses his feet alone to propel him [in diving] striking with both simultaneously, and holding his wings motionless, though slightly lifted from the body. The position of the wings must have given rise to the idea, common among fishermen, that the Cormorant flies under water. . . . But when you see him in a tank you can have no doubt that the legs are the propellers." Mr. Beebe, in a letter, confirms this observation from his experience with Cormorants in tanks. Selous (23), speaking of Shags, both adults and full grown young, observed in caverns in the Shetland Islands says: "Others, whose young were still with them on the nest, although full-fledged and almost as big as themselves, plunged, attended by these into the water. . . . It was easy to follow these birds as they swam midway between the surface of the water and the white pebbled floor of the cavern, and I was thus able to confirm my previous conviction that the feet alone are used by them in swimming, without any help from the wings, which are kept all the while closed. I have many times observed this before, but never so clearly or for such a length of time." Lea (11) says of Shags: "This species also may be watched at the 'Zoo'. It always begins its dive by jumping up in the water and taking a header, and then strikes hard upwards with both feet. You will see that it does not use its wings at all for swimming, but holds them quite still, lifted just a little away from its body. It strikes out with both feet simultaneously, and in this differs from the Darters (*Plotus*), which adopt an alternate stroke, as you may see for yourself by visiting the Diving-birds' House at feeding-time." In this connection it is interesting to note that Cormorants

in rising into the air in flight kick away the beach or the water with both feet together. This I have proved by examining the imprints of their feet in the sand of a beach.

The Darters or Anhingas, as just referred to by Lea, use the feet alone under water.

Among the Ducks, both classes of divers are found. The American and the Red-breasted Merganser both dive like the Cormorant. They often leap clear of the water, in graceful curves, with their wings cleaving closely to the sides. At other times the leap is much curtailed, or they sink beneath the surface without apparent effort. I should infer, therefore, that the wings were not used under water, and this inference is borne out by the following from Selous (16): "The merganser dives like the shag or cormorant — though the curved leap is a little less vigorous — and swims, like them, without using the wings. His food being fish, . . . he usually swims horizontally, sometimes only just beneath the surface, and, as he comes right into the shallow inlets, when the water almost laps the shore, he can often be watched thus gliding in rapid pursuit."

The other members of this order that do not, I believe, use the wings under water are the Redhead, Greater and Lesser and Ring-necked Scaups, Whistler and Bufflehead, while those that do use the wings are the Old Squaw, Harlequin Duck, the three Eiders the three Scoters and possibly the Ruddy Duck. This list I have made out from my own observations of the way the wings are held in these birds as they dive, and in a few cases the birds have been observed under water. The only member of our eastern sea or diving ducks omitted from the list is the Canvasback, which I have never seen dive. It is probable that it acts as does the nearly related Redhead. It is interesting to notice that the two classes are grouped separately in the A. O. U. Check-List, the first class being placed together at the beginning of the list, the other class at the end of the list.

Some of these Ducks feed largely on the bottom on shellfish and crustaceans, or on vegetable matter, while a few of them feed largely on fish. The latter birds would naturally develop the swiftest form of propulsion. Mergansers, Whistlers and Buffleheads, largely fish-eating Ducks, progress by the feet alone, while

Eiders and Scoters, almost entirely bottom feeders, use the wings. Many of the others, however, cannot be divided in this way.

Redheads in diving keep their wings close to their sides and Mr. Beebe writes that these birds, as observed by him in tanks, do not use the wings under water. The Scaups, both Greater and Lesser, in the same way keep the wings close to the sides in diving, and sometimes leap clear of the water or disappear with scarcely an effort. Mr. G. M. Allen tells me that he watched a captive Ring-neck Scaup in a small pool, and was able to observe not only the clean cut leap and dive with wings close to the side, but the rapid progress under water by the use of the feet alone. The Whistler or American Golden-eye, is also a graceful diver, and, as far as I have observed, always keeps its wings close to its sides in diving. As it disappears from sight it often sends up a little spurt of water by the powerful action of its feet. I should therefore conclude that the Whistler habitually swims under water by the use of its feet alone. Mr. Wm. Brewster, however, tells me that he has seen it make use of its wings in diving, but this was probably at times when the bird was hard pressed, and it acted as does the Loon in similar circumstances. The Bufflehead also keeps its wings close to its sides in diving, and sometimes leaps clear of the water before it disappears from sight.

Old Squaws, on the other hand, open their wings before diving as plainly as do the Guillemots and the Puffins. On one occasion, while I was watching some Old Squaws sporting in the water off Nahant, chasing each other on and just below the surface, I distinctly saw the wing of one of them cut the water from below like the fin of a great fish. A Harlequin Duck, that I saw on the Labrador Coast, opened its wings as it dove. I have watched the Northern Eider, the American Eider and the King Eider dive, and all open their wings for subaqueous flight as they go down. Of the Eider Selous (15) has made some satisfactory observations. He says: "Their dive is a sudden dip down, and in the act of it they open the wings, which they use under water, as can be plainly seen for a little way below the surface."

Our three Scoters, — American, White-winged and Surf Scoters — all open their wings as they dive. I once shot and slightly wounded a Surf Scoter that was standing on the edge of the beach

at Ipswich. He took to the shallow water and dove where I could plainly see him flying along under water using his wings.

My observations of the Ruddy Duck lead me to think that although its wings are often close to the sides at the beginning of the dive, they are opened just as the bird goes under the surface. The short but strong wing in this bird would suggest adaptation for subaqueous flight.

The curious Steamer Duck, *Tachyeres cinereus*, of the Straits of Magellan, that in the adult state at least is unable to fly, but flops along the water by the use of its wings, and dives awkwardly, probably uses its wings under water. Darwin (2) says that he is "nearly sure" that this bird uses the wings alternately.¹

The group of River Ducks obtain their food by dipping their heads and necks below the surface of the water, but occasionally these birds dive. I have observed close at hand semi-domesticated decoy Black Ducks sporting together, and diving awkwardly. In this case both wings and feet were used. As regards the Mallard, the following note kindly communicated to me by Mr. Wm. L. Finley in a letter dated January 4, 1909, is of considerable interest. "While in the lake region of southern Oregon, on two different occasions I saw a young Mallard duck swimming under water. He looked to me exactly like a frog. He was not many days old. He used his little wings as if they were two front feet, and he went through the water like a streak." It is evident from the context that the feet were used as well as the wings. Teal occasionally dive, especially when wounded, but I have no observations to record as to the method used.²

The Rail family show an interesting diversity in the manner of diving. The American Coot, *Fulica*, with its large lobed feet has evidently perfected the feet method, for with its feeble wings close to its sides, it often leaps out of the water and describes an arc, the bill entering the water as the feet leave it. At other times it disappears without any leap, and all degrees between these two extremes are to be found. Mr. Beebe writes me that Coots in

¹ The alternate action of the wings has already been referred to in the case of Penguins. I have for some years been almost convinced that Chimney Swifts use the wings alternately in flight.

² I recently watched a wounded Brant dive and swim under water. In this case the wings were flapped slowly and the feet used rapidly.

tanks use the feet and not the wings under water, and Selous (18) believes that the Coot belongs "to the cormorant-school of diving." This he infers from the manner of its entering the water. He apparently has not seen it under water.

I have no observations of my own to record on Rails proper and Gallinules but Selous (21) says of the English Moorhen, *Gallinula chloropus*, that he "may follow no fixed plan in his diving, for I have certainly seen him using his feet only under water, and I believe I have also seen him using his wings." Lea (12) says of the Moorhen: "After diving, it flies through the water at a great pace."

Among the Shore-birds the young of the Spotted Sandpiper are said to use both wings and feet in diving.

The impetus of the Kingfisher is probably all that is needed by this bird in its plunge, but it is possible that it occasionally scrambles a bit with its wings under water,—its feet can hardly be of use.

Among Passerine birds the water Ousel is the only diver, and it is well known that this bird uses its wings under water, and many observers state that it uses also its feet (13).

From the result of these studies it seems reasonable to conclude that diving birds tend to specialize in two directions,—either towards the use of the feet alone, or of the wings alone. The question naturally arises as to which line is superior, which has produced the swiftest diving bird,—the line that has led to the use of the feet alone or that which has led to the use of the wings alone? It is evident that a method of diving which leaves the wings unimpaired in size or form for the use in the air is a desirable one, and this is possible where the feet alone are used. In most fishes propulsion is from the rear by means of the tail, for the pectoral fins, which correspond to the birds' wings, are used chiefly for balancing. When the fish swims fast these fins are kept close to the sides. Among mammals the cetaceans have developed greatest speed in diving and swimming under water, and here also the tail is the propulsive power, while the anterior extremities are used chiefly for balancing. The modern screw propeller is superior to the old side-wheeler.

In *Hesperornis* the wing is a mere vestige, reduced to a slender humerus only, without even articulating facets on the distal end.

The tibia, however, is of great strength and size, provided with a keel or crest for the attachment of powerful muscles, and the patella is enormously developed. It is evident that *Hesperornis* pursued its prey under water by means of the feet alone, and that through many generations it had gradually lost the use of the wings, which must have been, therefore, a hindrance rather than a help in its subaqueous flight. It had long since given up aerial flight. Loons and Grebes, however, although apparently allied to *Hesperornis*, do at times, as we have seen, use their wings in addition to their feet under water, yet it seems to me probable from the evidence adduced that as a rule they progress by the feet alone. The young appear to use the wings as well as the feet habitually. These facts would seem to indicate that the method of posterior propulsion in Loons and Grebes has not been long developed nor permanently fixed, and that the young show the ancestral or primitive form of locomotion. The close resemblance in the legs of the Loons and Grebes on the one hand, and *Hesperornis* on the other would suggest either a case of parallelism from similar functions, or that they were all descended from the same stock. In the 'Birds of Essex County' (26) I spoke of the Loon as "approaching the wingless conditions." The present studies would, however, lead me to believe that the Loon in perfecting the method of posterior propulsion under water, has no need to reduce the size of its wings for use there. It can, however, with advantage increase their size, provided it does not use them under water, for the wings are now so small that on calm days it is unable to rise into the air.

Cormorants on the other hand have for so long a time perfected the posterior propulsion method that they do not use the wings under water even apparently when young. In consequence they have been able to retain large wings for aerial flight. That they can develop great speed under water and are very expert fish-catchers is well known.

The other line of evolution, the subaqueous flight by anterior propulsion, or by the use of the wings alone, reaches its height in the Penguins, and probably in the extinct Great Auk, two birds widely separated genetically, but converging to the same result in this particular. Both birds in developing speed under water by the use of the wings, reduced them in size to the proportions of seal's

flippers,— most markedly so in the case of the Penguins,— thereby showing that large wings are not only unnecessary, but even a hindrance in subaqueous flight. In attaining this end they were obliged to sacrifice aerial flight. This the Penguins were able to do owing to the absence of land mammals in their antarctic breeding grounds. The same conditions existed for the Great Auk at its chief breeding place in this country on Funk Island, until the arrival of that most destructive land mammal, the white man.

The Diving Petrel of the Straits of Magellan is a bird that appears to be in danger of sacrificing aerial for sub-aqueous flight, and illustrates the inconveniences of this line of evolution. Nichol (14) says of this bird, after describing its short flights in the air and its diving: "In appearance it reminds one forcibly of the little auk. . . . The wings are very small and weak, the bird, doubtless, is losing the power of flight."

In the case of the existing Alcidæ and of the other birds that habitually use the wings alone in diving, it would be interesting to determine whether they are able to progress under water as fast as those birds that use the feet alone, for the Alcidæ are trying to make the same tool work for two purposes, to propel them in the air as well as in the water. One is impressed with the imperfection of their wings for both purposes, when one watches a Puffin endeavoring to get out of the way of a steamer. First the bird dives and flies under water. Then in alarm it rises to the surface and attempts to ascend into the air on its wings, but unless there is a strong wind to act on its small aëroplanes, it soon gives up the attempt and flops down into the water again. Although it would be difficult to prove, it would seem to me reasonable to suppose that the compressed pointed body of the Loon, with the air expelled from beneath the flattened feathers, would make faster progress by feet action alone, than by the wings or by the wings and feet combined, unless the wings were reduced to the proportions of flippers. It is possible that the occasional use of the wings observed in these birds may be explained by fright, which causes them to "lose their heads," and return to the ancestral form of progression, to a reptilian scramble so to speak, without increasing the speed of their progress. It could also be argued that the wings of Loons are now so reduced in size that their use in emergencies

under water is a help and not a hindrance. Experiments on captive birds in tanks might determine these facts.

That Loons are able to progress faster under water than on the surface I have concluded from such observations as the following (26): "Thus on one occasion I was watching a Loon swimming about, dipping his head under water from time to time on the lookout for food. The cry of another Loon was heard at a distance and my friend immediately dove in the direction of the other, and, appearing on the surface for a moment, dove again and again until he reached his companion. At another time on the Maine Coast while watching a flock of young Red-breasted Mergansers swimming off the shore, I noticed a movement as of a large fish on the water outside. The Mergansers at once flapped in alarm along the surface of the water towards the shore where I was hidden, and I soon saw that a Loon was chasing them, following them under water." Theoretically a Loon should be able to go faster under water than on the surface, for on the surface the bird is retarded by the waves in front and the eddies behind, and the faster it goes the more it is retarded by these factors. The subject of the resistance of submerged bodies has been exhaustively studied by naval architects, and it has been shown that a properly shaped body completely submerged under ideal circumstances with the wave eliminated meets with little resistance besides friction. The fact that a Loon when swimming rapidly on the surface is apt to depress its body in the water so that its back is awash seems to favor this contention. It may be argued that the bird does this to avoid observation or to escape being shot, but it certainly swims faster when thus submerged. Under water the diving bird has a great advantage in being able to assume a shape best adapted to cleaving the liquid medium.

Incidentally it may be remarked that the Loon, in perfecting its legs for use under water, has disabled itself for walking on the land, but as it usually builds its nest on or close to the water, it can well afford to sacrifice terrestrial locomotion.

The combined use of wings and feet, a reptilian form of progression, would naturally be found among birds that had not fully specialized in either direction. Among living birds the Cormorant and the Penguin represent the extremes of specialization for the

posterior and anterior extremity respectively. Where either habit is not firmly established we should expect at times a return to the primitive method, and we should expect to find it in young birds. This is well shown in the case of the Loon. We should expect to find it at all times in beginners in the art of diving, *i. e.*, among birds whose ancestry in the diving line is not a long one. The Mallard, the Black Duck, the Gallinule, the Spotted Sandpiper and the Water Ouzel may perhaps illustrate this contention.

In conclusion the following tentative inferences from these preliminary studies may be set down.

1st. That progression by both the wings and feet under water in diving birds is the primitive method, and is therefore to be looked for among beginners and young birds.

2d. That specialization towards the use of the wings alone leads to a diminution in the size of the wings, and finally to a form of bird that is flightless in the air; for wings of flipper proportions, too small for aerial flight, are more efficient than large wings for subaqueous flight, as witness the Great Auk and Penguins.

3d. That specialization towards the use of the feet alone is probably best adapted for the most rapid progression under water, and this method may leave the wings undiminished in size for use in the air. The apparent exception, *Hesperornis*, with powerful feet but with wings degenerated to vestiges through disuse, serves but to confirm the inference of the superiority under water of feet action alone.

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A REPRINT OF THE ORNITHOLOGICAL WRITINGS
OF C. S. RAFINESQUE.

PART II.¹

BY CHARLES W. RICHMOND.

RAFINESQUE, with his brother, left Leghorn in March, 1802, and landed in Philadelphia on the 18th of April. He at once began to botanize, collect specimens, and make drawings. He says ('Life of Travel,' p. 17): "My brother had become a sportsman, and procured me many birds. I wanted to undertake the Ornithology of the United States, finding many of them new or unknown, or badly described. I continued also to study the Snakes and Reptiles, communicating some of them to Daudin for his work on Reptiles." So, it appears, Rafinesque narrowly escaped being the Father of American Ornithology. However, this plan, like many others projected by him, fell through, and on his first visit to the

¹ For Part I see *antea*, pp. 37-55.