air. Water-vapor is not nearly so diathermous as dry air. Much of the heat that would pass down to the sand on the desert is held back by the vapor over the ocean, and some is caught again from the heat radiated upwards by the water, so that a considerable thickness of air is warmed. Of still more importance is the vapor's action as a great storehouse of solar force, required in the process of its evaporation, generally known as 'latent heat.' For all these reasons, the accumulation of energy in the preparation for an oceanic cyclone is vastly greater than in the making ready for a desert-whirl.

(To be continued.)

REMARKS UPON THE OSTEOLOGY OF PHALACROCORAX BICRISTATUS.

It is a fortunate thing for science, that time allowed many of our Alaskan explorers to bring back in their collections, and to the museums, skeletons of so many of the rarer forms of the vertebrates, particularly the birds of those unfrequented regions. To Dr. T. H. Bean and Mr. H. W. Elliott, both of the Smithsonian institution, we are under lasting obligations for such material, and for making so good use of their advantages. The writer has enjoyed the unusual privilege of examining and studying long series of skeletons of Lobipes hyperboreus, Haematopus niger, rare forms of Rissa, Larus, and Sterna, many of the auks, puffins, and the like, — nearly all from the source that I have mentioned.

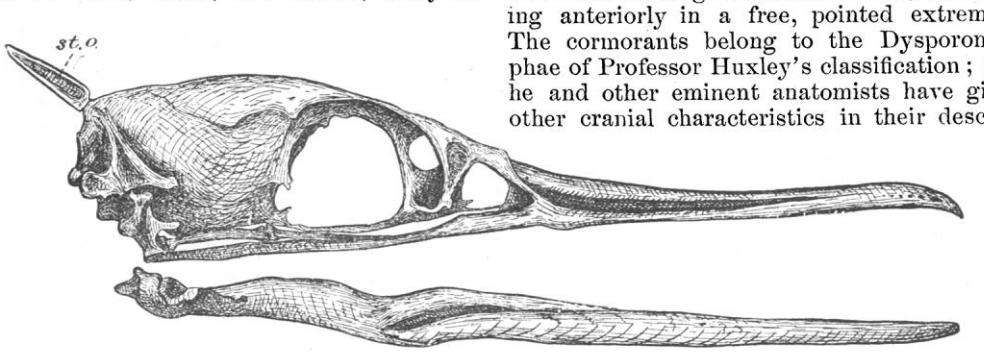

Fig. 1. — Skull of Phalacrocorax bicristatus, life size; right lateral view, showing occipital style, *st. o.*

It was during the course of my examination of these sub-arctic rarities that my attention was called to several points of interest in a set of skeletons, representing three young and an old one, of a species of cormorant, Phalacrocorax bicristatus, forming part of the collection of the last-named naturalist. Professor Owen, in the second volume of his 'Comparative anatomy and physiology of vertebrates,' on p. 64, speaks of a bony style that is attached to the occiput in the cormorant as one of the cranial peculiarities of the class. This author does not mention its use; and as the writer has not a cormorant before him intact, with all the soft parts, it would be hardly safe to give its exact function in this bird's economy: but as I do not believe we have a figure showing the site of this bonelet, an illustration of the skull of Phalacrocorax is here given, showing, life-size, the right lateral view. This prominent style is seen protruding from the summit of the occiput in my drawing, not as a spinous outgrowth from that point, but rather as a free bone, concave below, separated into two concavities on its superior aspect by a sharp median crest that is developed on its entire length, — a transverse elliptical facet anteriorly, that articulates freely with a corresponding one on the occiput.

At the base of the cranium, we find that the pterygoids are completely overshadowed by the sub-compressed but rather large brain-case above. There are no basi-sphenoidal processes thrown out to meet these bones. The posterior halves of the palatines form a close union all along their median and inner margins, which portions are much spread out horizontally. Beyond, they become narrower; and in the space that we find existing between them we observe a long attenuated vomer, terminating anteriorly in a free, pointed extremity. The cormorants belong to the Dysporomorphae of Professor Huxley's classification; and he and other eminent anatomists have given other cranial characteristics in their descriptions of this well-defined group. The rami of the lower mandible are deeply grooved on the inner aspects of the dentary portion; and these elements, originally free, retain their sutures, distinctly marked, through life, where they join the other interested segments at the posterior moiety. Seventeen vertebrae are found in the cervical region, before we arrive at one that bears a free pair of ribs. Of this

series, we find the atlas and axis articulating in the usual manner, the former with its cup-like depression with the occipital condyle, the vertebra being perforated at its base. The parial parapophyses beneath the centra of these vertebrae are more or less prominent throughout; but in the eighth, ninth, and tenth, they are developed to an unusual extent, being long, needle-like processes, reaching nearly the entire length of the vertebra. A small pair of rudimentary free ribs are found beneath the transverse processes of the eighteenth vertebra. The next two ensuing ones have their ribs well developed, and bear large uncinate processes; but their lower ends still fail to be connected with the sternum by the intervention of costal ribs. Three more dorsal vertebrae are found before we come to the anchylosed series of the sacrum. These all have true ribs connected with the sternum by costal ribs, and their uncinate processes are strongly produced. A pair of ribs, as well developed in every particular as the series just mentioned, springs from beneath the ilium on either side, joining costal ones below; but the last pair of all, or the second that is produced from the anchylosed vertebrae of the sacrum, is without the uncinate processes, and in the specimen before us the costal rib on the left side is the only one of this pair that meets the sternum in a true facet. On the opposite side it articulates along the posterior border of the haemapophysis beyond it. The neural spines completely coalesce, in the ultimate sacral vertebrae, into a well-pronounced crest, which is surmounted along its entire length with a spreading cap of bone.

There are six free caudal vertebrae, not including the terminal segment or pygostyle, here quite large, pointed above, and possessing a moderately dilated posterior margin, thrown out to support the rectrices of the tail. The two anterior free caudal vertebrae are quite firmly grasped on either side by characteristic spine-like processes thrown backward, and developed on the part of the ilia. A lateral view of the pelvis, which is very long and much compressed from side to side, shows the ischiadic foramen to be an unusually large aperture, while the slender pubic bone fails to close in the other two foramina below, that are found in many other birds. This last-mentioned element of the pelvis slightly expands behind, where it meets the lower margin of the ischium for about a centimetre of its length. It then contracts again in size a little, to be directed downwards, and curved inwards. The body of the sternum is quadrilateral in outline, with two rather shallow excavations on either side of the median line, occupying the entire xiphoidal margin or border.

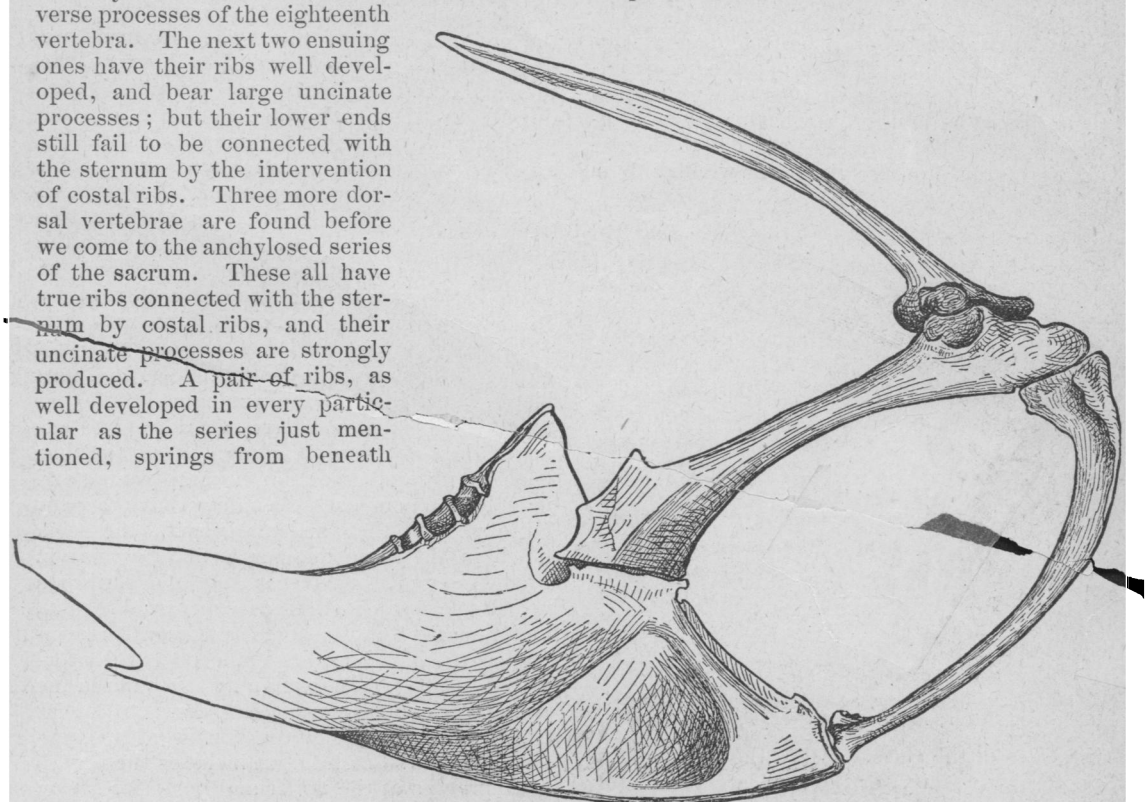

FIG. 2. — Right lateral view of sternum and shoulder-girdle of Phalacrocorax bicristatus, life size.

The keel is very much produced forwards, where, at its lower apex, it has a rough surface of some extent, against which the united clavicles abut. Sufficient material is not at hand for me to say whether anchylosis ever takes place at this point or not: it may do so, because we find in Aluco these bones usually unite at this point; but yet we come across specimens of this owl where the union is no more perfect than it is here. The hypocleidium of the clavicles, and the manubrium of the sternum, are both about equally feebly developed. The upper extremity of each clavicle has a very broad abutment for the head of the corresponding coracoid, to the inside of which expansion these clavicular bones throw backwards a scapular process; but they fail to reach these elements of the shoulder-girdle, as we find them

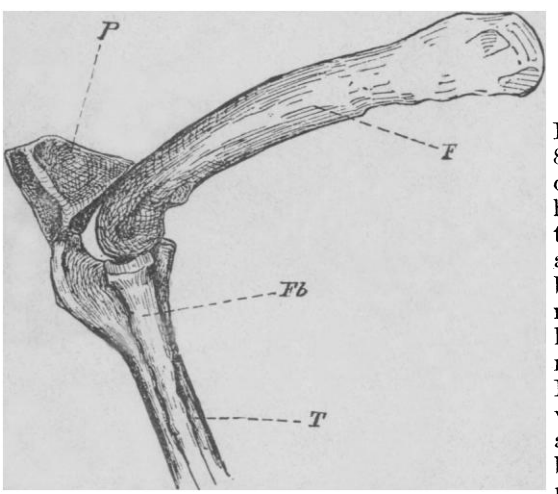

Fig. 3.—Knee-joint of Phalacrocorax bicristatus; right limb, life size. *F*, femur; *Fb*, fibula; *T*, tibia; *P*, patella.

in others of the class. All of the bones of the pectoral extremity, or the arm, are completely non-pneumatic, but otherwise well developed. Faint papillae for the quill-knobs of the secondaries are found along the entire length of the outer aspect of the ulna. The manus is composed of the usual number of bones,—one phalanx for index digit, two for the next, and one for the last.

In the lower extremity we find a femur of $6\frac{1}{2}$ centimetres in length; a tibia of $11\frac{1}{2}$; a metatarsus of 6; and the outer toe with five joints, measuring in all 10.7 centimetres. This limb is likewise non-pneumatic, in so far as its osseous structure is concerned. The fibula is carried unusually far down the side of its companion bone, to within 1.5 centimetres of the lower periphery of the outer tibial condyle.

The greatest interest, so far as the bones of the leg of this cormorant are concerned, centres about the knee-joint. Here we find a condition of affairs which is presented in my drawing. The femur, which is much roughened above for the attachment of muscles, articulates about equally with the leg-bones. In front of this joint is placed a very large and massive patella, of a pyramidal form, articulating with more than half its lower surface with the anterior and lower fifth of the femur, its inferior and anterior margin articulating at the same time with the upper border of the cnemial crest of the tibia. In front, we find that the groove that exists between the pro- and ecto-cnemial ridges of the tibia is produced on the entire anterior face of this patella, and, no doubt, the muscles of the leg are therein inserted, as in many divers. Such examples as this throw some light on such birds as Colymbus and Podiceps, where this bone becomes anchylosed with the tibia in the adult. I have not the skeleton of a loon at hand, to examine the process spoken of by Professor Owen ('Comp. anat. phys. vert.,' ii. 83), and followed by Dr. Coues in his osteology of the same bird ('Mem. Bost. soc. nat. hist.,' i. pt. ii.), as the analogue of the patella. The skeleton I have of Podiceps to examine does not show it; but it is one that has been in my collection for several years, and may have been lost. Penguins have a very large patella, that articulates with the tibia much in the same manner as it does here in Phalacrocorax. Professor Marsh describes a very large, free patella for Hesperornis regalis, and remarks that it bears a general resemblance to that bone in Podiceps ('Odontornithes,' p. 93). In examining this bone in the young of our cormorant, it seems to ossify from one centre. The ossification at the summit of the tarso-metatarsus includes the prominent process at the upper and posterior aspect of that bone.

Many other points of interest are to be found in the skeleton of the adult, as well as of the young of Phalacrocora xbicristatus, which space will not allow me to enter upon here: the leading points, however, I have endeavored to give, and these are always valuable when we wish to have them to compare with kindred forms.

R. W. Shufeldt.

THE ELECTRIC LIGHT ON THE U. S. FISH-COMMISSION STEAMER ALBATROSS.—I.

In pursuit of the hidden treasures of the deep, the work of the Albatross keeps her at sea many days at a time; and the operation