

alone; but it certainly seems probable, and I have no wish to raise such an objection.

If we admit, then, that combination does occur when sulphuric acid is dissolved in water, as there is much evidence to show, need we abandon the dissociation theory? I think not; in fact, Mr. Pickering admits that my alternative explanation meets the case under discussion.

Mr. Pickering has made no attempt to explain the electrical phenomena I described in your issue of April 29, by any means other than the assumption of dissociation of the ions from each other. I know the idea of such dissociation is abhorrent to people who are fortunate enough to possess an orthodox chemical conscience; but, till some one has accounted for the electrical relations in another way, its acceptance seems to me to be a necessary consequence of the facts.

I cannot quite see the force of Mr. Pickering's objection to the idea that the ions are linked with one or more solvent molecules. There is no need to assume the existence of definite compounds, which could be crystallised out and handled. If we admit the presence of charged ions free from each other, electrical forces will certainly exist between them and the solvent. We know too little, as yet, about the mutual relations of atoms and their charges, to picture exactly what occurs; but these forces must produce some sort of connection between the ions and the molecules of solvent. This connection, of course, only remains unmodified as long as the dissolved body keeps in solution.

Such a view of the dissociation theory seems to me to offer many advantages. It may be contrary to some *opinions*, but I do not think any *facts* have yet been pointed out which refute it. Till they are, it may possibly be of some use as a working hypothesis in the investigation of that complicated structure which we call a solution. W. C. DAMPIER WHETHAM.

Trinity College, Cambridge, May 5.

On the Feathers of "Hesperornis."

A NUMBER of years ago I published in NATURE (December 25, 1890, p. 176) my opinion "On the Affinities of *Hesperornis*," agreeing, at the time, with Prof. D'Arcy Thompson and others, that those toothed birds of the Kansas Cretaceous beds saw their nearest allies in existing birds in the Loons and Grebes, or in the typical Colymbidine assemblage. In other words, the now-living pygopodous birds, such as *Urinator*, *Colymbus*, and so forth, are, by descent, the modern representatives of the ancient *Hesperornithidae*, whether that descent or origin be direct or indirect. There are osteological characters, which the limitations of space will forbid dwelling upon here, that tend to convince me of the probability of the Grebes (*Podicipoidea*) being an earlier offshoot of the pygopodine stem than the *Urinatoroidea*, and so more nearly related to *Hesperornis* than the latter birds.

Re-stimulated by a brief article, by Prof. S. W. Williston, in *The Kansas University Quarterly* (vol. v., July 1896, pp. 53, 54, plate ii.), entitled "One of the Dermal Coverings of *Hesperornis*," Prof. O. C. Marsh takes occasion, in a recent issue of NATURE (No. 1432, vol. iv., April 8, 1897, p. 534), to once more advance the theory—and one which originated with him, and, fortunately, has received but meagre support—of *Hesperornis* having been nothing more nor less than some peculiar kind of "a swimming ostrich." This view of its taxonomic position has never been accepted by the present writer; and it would seem that many other comparative anatomists experience quite as much difficulty in believing that those ancient divers were any more "swimming ostriches" than the modern types of the *Struthionidae* are a sort of group of gigantic terrestrial cursorial divers.

Prof. Marsh is not the only writer that has been led astray in some parts of avian classification by employing what have been called "struthious characters" in avian osteology, and now he thinks his views are supported by the recent discovery of Williston, referred to above. Having carefully examined the published plate of the latter author, I must say that I am quite sceptical as to what he believes to be long tarsal feathers in *Hesperornis*. Surely, in the figure, the resemblance to feathers is very remote; and, quite as surely, long, drooping plumaceous feathers hanging down to the feet in a big, powerful diver, would in no way whatever assist it in either swimming or diving. In fact, just so soon as these soft, plumaceous feathers became thoroughly wet, they would naturally form a serious impediment to the proper use of the pelvic limbs in their forward and back-

ward strokes; and one has but to study the action of these limbs in swimming, in our modern Loons, to appreciate this point. That *Hesperornis* possessed some kind of a plumaceous plumage, however, I long ago believed, and see no reason to change that opinion now.¹

Plumaceous plumage was very likely far more prevalent among the earliest birds in time, than it is now among the modern types; and this applies absolutely to not a few characters in the skeleton. The latter, along whatever line we may trace them, are evidences of an approach reptile-wards, and by no means always point to struthionine affinity. Certain peculiarities in the pelvis, and at the base of the cranium, when associated with certain others, have, as I say, been unfortunately termed "struthious characters," and, with this mistaken idea operative, our more superficial avian anatomists can see but little beyond "ostrich" in either *Finamon* or *Apteryx*. Not so, however, is this the case with the more profound researchers, of which Prof. Max Fürbringer is so able a representative. There is no more ostrich in *Hesperornis* than there is diver in *Struthio*—how much of the latter there may be, I willingly leave Prof. Marsh to consider. R. W. SHUFELDT.

April 28.

On Augury from Combat of Shell-fish.

IN his "Jōzankidan Shūi" (published about 1767, tome i. fol. 3, a) Yuasa Shimbei, a Japanese literatus (1708-81), writes on this subject thus:—"Noma Samanoshin narrated that the destiny of a belligerent could well be foretold by means of the 'Tanishi.'² If two groups consisting each of three of this shell-fish be placed in opposite corners of a tray, the three animals representing the future conquerors would advance, while the others, which are doomed to defeat, would withdraw. This method was approved by repeated experiments during the siege of Osaka [1615].³ Every time the experiment was carried on, it never failed for the three 'Tanishi,' respectively designated Hideyori, the lord of the castle, and his two generals, Ōno and Kimura, to be driven in corners by other three which were representing the leaders of the besieging army, Prince Iyeyasu, Ii, and Tōdō. Thence it is confirmed that there is no better method of foretelling the decision of a war [here Noma's narrative ends]. The same method is given in detail in 'Wu-pei-chi' [by Mau Yuen-i, completed 1621], which is to be consulted for its particulars."⁴ Unfortunately all four copies in the British Museum of the Chinese work, here referred to, are wanting vol. clxxxvi., wherein further details of the method are said to be found.

Besides, two older Chinese works, both of which I have never seen, viz. Fung Ching's "Pan-yu-ki"⁵ (written circa 990-94) and Luh Wei's "Kwei-che-chi"⁶ (twelfth century) are said to describe this method of augury to have been of old used in the region of Ling-Nan (which comprised the present provinces of Kwang-Tung and Kwang-Si).

In connection with Yuasa's statement above quoted, the following notice, by Etienne Aymonier, of a Cambodian mode of divination is equally interesting:—"Si une armée étrangère fait invasion dans le royaume, beaucoup d'habitants prennent deux *Khchau*,⁷ placent au fond d'un bassin, d'un récipient, un peu de sable pour faire une petite arène et assez d'eau pour recouvrir les deux coquilles. Ils allument des bougies et des baguettes odoriférantes, invoquent les divinités protectrices du royaume, les prient d'indiquer l'issue de la guerre au moyen de cette petite naumachie. Les *Khchau* représentant les belligérants luttent jusqu'à ce que l'un des deux soit culbuté"⁷ ("Notes sur les Cou-

¹ See my article, "Feathered Forms of Other Days," *The Century Magazine*, January 1886, p. 357.

² "Tannigi" are the common black Land Snails gather'd for Food in muddy Rice Fields. . . . (Kaempfer, "History of Japan," 1727, vol. i. p. 141). It belongs to the genus *Viviparus*, and is *V. japonica*, if I remember correctly.

³ For this event see, e.g., Caron's "Account of Japan" in Pinkerton, "Voyages and Travels," 1811, vol. vii. p. 616; "Diary of Richard Cocks," 1883, *passim*.

⁴ Referred to in I-i-Ye, "King-chai-ku-kin-tau" (written c. 1234, Brit. Mus. copy, 15,316, d, tome iv. fol. 27, a).

⁵ Quoted in the Grand Imperial Cyclopaedia, "Ku-kin-tu-shu-tseih-ching," sec. xix. tome clxiii. sub. "Lo-pu-ki-shi," fol. 3, a.

⁶ J. Moura, in his "Vocabulaire Français-Cambodgien, &c.," Paris, 1878, simply explains the word "khchau" as "coquille." From parallel instances it is highly probable that this is, too, a species of the *Paludina*id.

⁷ This notice reminds me of an old Japanese tradition, which is this.

⁸ When the battle of Dannoura was about to be fought (1185) [for which battle see Adams, "History of Japan," 1874, vol. i. p. 36], Kumano-no-Bettō Tansō, a warlike priest, who was wavering in question which of the