

assign to the Upware rock is, I think, so worded as to convey a wrong impression. "He correlates it with the lowest portion of the Corallian region, on account of its containing *Cidaris florigemma*, a reason which would make us assign to it nearly the highest." This, coupled with the rest of the paragraph, and their use of the word Corallian, would give rise, I think, to the supposition that I had placed the Upware rock below the Coral Rag. On the contrary, I take some pains to prove it to be Coral Rag, and the only support for this statement is that, as I was contending against Mr. Seeley's attempt to place the bed in the Kimmeridge series, and as *C. florigemma* was then supposed to characterize rather the lower part of the Coral Rag, I point out that the affinities of the Upware rock are downward rather than upward, so that it cannot even be paralleled with the Continental Séquanien. It is true that, according to Messrs. Blake and Hudleston, the position of the zone of *C. florigemma* is less constant than it was supposed to be; but in reasoning on that point, I used the best information to be obtained at the time, and the change does not materially weaken my main position that the Upware limestone is true Coral Rag, as the word was then understood.

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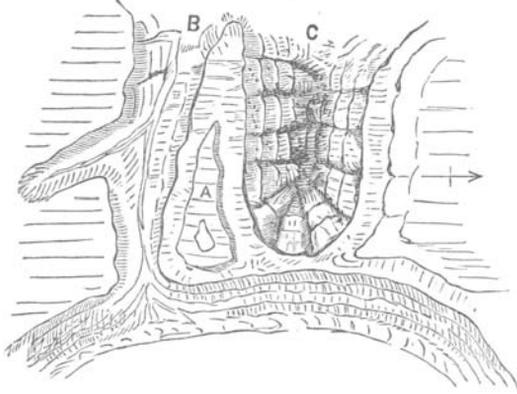
THE ORIGIN OF CIRQUES.

SIR,—In a recent number of the GEOLOGICAL MAGAZINE (p. 273), Mr. Bonney has replied to the arguments adduced by Mr. Helland in favour of the glacial origin of cirques (Quart. Journ. Geol. Soc., vol. xxxiii. p. 142), and has adduced many cogent reasons in support of the explanation he has previously given, viz. "that the cirques are mainly produced by the combined erosive action of streamlets."

May I be allowed to cite what I conceive to be an illustrative case, occurring in a country which I have lately visited, and where it would be difficult to discover any traces of ice action, but where the erosive power of torrential rains is markedly exhibited? I refer to Upper Egypt, and especially to that district lying between the valley of the Nile and the Red Sea.

The eastern bank of the Nile above Cairo is bordered by a desert plain, about three or four miles wide, and stretching up to the high cliffs beyond, which rise into mountains some 600 or 700 feet high, and form the range known as the Arabian chain. These cliffs are furrowed by numerous deep gorges and valleys opening on to the desert plain below, over which is spread out the detritus brought down from the hills; for Egypt is not the rainless country it is sometimes represented to be, and in winter-time rain falls occasionally in quantity sufficient to convert these dry valleys into rushing torrents; thus among the recesses of the bare and barren limestone rocks, into which the valleys lead, signs of water-action are everywhere visible. A cirque in such a land as this could hardly be formed by any other agency than that to which Mr. Bonney attributes them, and yet a very cirque-like hollow came under my notice while exploring one of these ravines. I had ridden some distance along

this, and, wishing to gain a better view of the country, I dismounted, and ascended the steep slope which formed its northern side; I then found myself on a flat-topped ridge looking down into three valleys at once (as shown in diagram at A).



The watercourse I had been following (B) was cut off by a wider and deeper valley, here making a magnificent curve; and on my left was a deep, broad, and short hollow (C), only separated from the same valley by a narrow ridge or knife-edge. Its sides presented a succession of irregular steps, resulting from the weathering of the hard and soft beds of the limestone; but these were interrupted by numerous small channels and gulleys, and the heaps of *débris* which choked up the bottom testified clearly to the mode of its formation. Although evidently a rain-gorge, its cirque-like form struck me at first sight, and the reason of its taking this shape was easily perceived; having been cut backwards till a mere knife-edge remained between it and the valley beyond, elongate extension had become impossible, but the runlets which drained the flat-topped heights on each side had so extended it laterally that its width was already more than half its length.

Now is not this very suggestive of the origin of other cirques? Mr. Helland finds a difficulty in the fact that the part of the crest surrounding the cirque, and sloping to it, is so narrow that it cannot feed even a small stream. Mr. Bonney has shown that he should have said, "can only feed very small streams," and with this correction the sentence would fairly indicate the very conditions which I conceive to be essential to the formation of a cirque, viz. the concentration of small streams falling off a narrow mountain crest.

Mr. Helland himself says (p. 165): "The cirques which occur isolated in the mountains are not essentially different from the valleys which end in a cirque. . . . They both occur in the same way, except that the valleys are longer, their area being as much as 25 times as great as that of the cirques." Surely he would not have us believe that these valleys are likewise the result of glacial action; and if not the valleys, then why the cirques?

In truth, as Mr. Bonney has pointed out, the cirque form is the natural termination of a valley cut back far into the hills; and I think it might almost be said that the farther a valley is carried back amongst hard rocks, the more cirque-like does its termination become; rounded hollows certainly do occur at the head of such valleys, and these might even become broadly subcircular, if the lateral streams happened to be stronger than the terminal.

Finally, are not cirques more rationally accounted for in this way, than by crediting glaciers with the curious "tooth-drawing" propensity which Mr. Helland suggests, and thus investing them with even more wonderful powers than have yet been claimed for them by the most devoted glacialists?

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FOREST-BED AT HAPPISBURGH.

SIR,—I am glad to see that a discussion has arisen in your pages, which may lead to a more strict inquiry into the age and position of the portion of a submerged forest at Happisburgh, or Hasbro. If I recollect rightly, upon my first visit to Norfolk, Mr. Gunn took me to the spot, and told me that the Forest-bed (meaning the pre-glacial one) was usually to be seen open here, but only occasionally so at other places on the coast. I at that time collected some fir-cones from it.

At a subsequent visit I thought that the Boulder-clay passed under it, although I could not perceive what the actual superposition was. For I could trace the Boulder-clay to the edge of the foreshore, very close up to the Forest-bed; and there was no indication of those "laminated beds" of sand and gravel, which intervene between the Cromer Forest-bed and the glacial series. I therefore concluded that the deposit at Happisburgh was not a continuation of the Cromer bed.

Mr. Gunn, in a paper, which he read at Norwich in the spring of 1868, remarked upon this bed, and seemed to think it was not exactly coeval with the Cromer bed, but belonged to an upper portion of it, "which remained dry land on the partial submersion of the subsiding forest." He likewise referred to the absence of the "laminated beds." He also stated that "metatarsal bones of sheep or the goat were discovered here by Mr. William Haughton. The elephants had at that period died off from the increasing cold." Now the goat is not included in the list of mammals belonging to the Cromer bed as given by Prof. Dawkins at p. 417 of the *Quart. Journ. Geol. Soc.*; nor I believe is it usually known to occur in the *earlier* Quaternary formations. If then the determination of that genus be correct, it is rather an argument on palæontological grounds for a later date for the Happisburgh deposit.

It is of some importance that its true age should be settled, because the vegetable remains from it have been much relied upon as indicating the climate of the Cromer forest period, which possibly may after all be different. Cannot the true relations of the "hard" clay in which the trees are rooted be determined by digging a pit of sufficient size, so as to find out on what the Forest-bed really rests?