

CORRESPONDENCE

GLACIAL DRIFTS

SIR,—I regret that circumstances have not permitted my making an earlier reply to Mr. Carruthers' letter (1941) regarding my note (1940) on Glacial Drifts in Midlothian. The erroneous impression may have been given that I have accepted the reinterpretation which he has put forward.

I should perhaps first answer Mr. Carruthers' accusation of "dismissing" his views. As the purpose of my paper, which I do not suggest necessarily invalidates Mr. Carruthers' conclusions regarding his own district, was to describe and interpret certain local sections of a temporary nature, no detailed consideration of Mr. Carruthers' arguments was called for. Further, I saw no reason to add to the very full discussion at the Geological Society of London. For the same reasons I shall confine myself in this reply to dealing with Mr. Carruthers' opinions only in so far as they affect my paper.

Mr. Carruthers' main point is that the fissures in sands near Roslin filled with boulder clay are post-Glacial frost-wedges. Although he does not make it altogether clear I assume his suggestion is that these wedges are initiated on the surface of the boulder clay, worked downwards through the latter, which is up to 6 feet thick, and then penetrated another 6 feet into the subjacent sands. It is perhaps worth noting at the outset that the examples of frost-wedges described by Mr. Paterson, quoted by Mr. Carruthers, are entirely in sands and gravels. I am aware that frost-wedges in silt and mud occur in Alaska, but I know of no instance of their being recorded in boulder clay, if indeed they could form in a substance of this nature. I am, however, open to correction on this point and shall continue the argument on the assumption that their formation in boulder clay is a possibility. In that case, for every fissure which penetrated into the sands several shallower examples should occur in the boulder clay. None were seen. Further, few deposits reveal weathering more quickly than boulder clay and as the material in the fissures, on Mr. Carruthers' assumption, must have come from the surface it should be less fresh and less cohesive than the unweathered boulder clay resting on the sands. Such is not the case. Lastly, if the fissures in the sands

are the continuation of cracks initiated at the surface, the traces of the sides of the fissures should be continued as lines of weakness or of weathering upwards through the boulder clay. No such lines are seen; unweathered boulder clay crosses the fissures in a completely undisturbed manner.

The proof of the later date of the Upper Boulder Clay does not, however, depend entirely upon the evidence discussed above. There is, among other reasons given in my original paper, the fact that boulder clay lines a large erosion hollow in the sands at Roslin. This feature Mr. Carruthers makes no attempt to explain.

With Mr. Carruthers' second paragraph it is more difficult to deal. It is merely a restatement of faith in his own theory and therefore contains no logical argument against my interpretation of the Roslin drifts. Mr. Carruthers is willing to accept conditions in post-Glacial times sufficiently cold to cause frost-wedges to penetrate 12 feet into boulder clay and sands. Yet, during a temporary withdrawal of the ice, he is unwilling to admit of freezing of sands and gravels strong enough to enable them to resist distortion during a readvance just as readily as a sandstone. In this connection might I draw his attention to my observation of the effects of a severe Scottish winter on the Roslin sands?

The views Mr. Carruthers has put forward are based mainly on observations made within a fairly limited area. He is quick to impute a lack of scientific outlook to those whom he regards as his opponents. Yet he has no hesitation in dogmatizing about glacial drifts in other parts of the country, an extension of his theory for which there can be no scientific basis without careful examination of local sections, especially as long as the evidence regarding his own area is not so strong as to meet with general acceptance.

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19 GRANGE TERRACE,
EDINBURGH.
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REFERENCES

- ANDERSON, J. G. C., 1940. Glacial Drifts near Roslin, Midlothian. *Geol. Mag.*, lxxvii, 470-3.
CARRUTHERS, R. G., 1941. Letter to *Geol. Mag.*, lxxviii, 317-18.