formed by fishes and reptiles—that the *Articulata* alone, of all the *Invertebrata*, possessed the powers of aërial, terrestrial, and aquatic progression, and in as great perfection as the *Vertebrata*.

Mr. Woodward called especial attention to those orders and families of crustacea which are of greatest interest to the palaeontologists, because they are represented, in some instances, far back in time, their remains being found in oldest Palæozoic strata.

He spoke of those world-wide forms—the bivalve *Entomostraca*, to which Messrs. Parker, Jones, and Brady, have devoted so much attention, which have lived on from Silurian times to our own:—of the *Apus*-like Crustacea, *Ceratiocaris*, *Peltocaris*, *Dithyrocaris*, &c., equally persistent: of the gigantic *Eurypterida*, and their modern relatives, the *Limulidæ*, (these latter appearing, by recent discoveries, to go back in time to the Upper Silurian)[1]:—of the extinct Trilobites and their relationship to *Apus* and *Branchipus*. Mr. Woodward noticed that aberrant group the *Cirripedia*, represented by the "Barnacle" and "Acorn-shell," and their relatives, who prefer whales and turtles backs to live on, rather than the sides of ships. He mentioned that one fossil Cirripede had been discovered as low down as the Wenlock limestone, and that the fossil shell, of a species parasitic on the whale, had been found in the Crag of Suffolk, where such vast quantities of the bones of fossil *Cetacea* are also met with in the Coprolite-diggings in the Crag. He then spoke of the higher forms, the Decapod Crustacea, represented by the Crab, Lobster, and Prawn, and showed that the short-tailed Crabs have, at present, only been found as far back in time as the great Oolite, but that the long-tailed type go back to the Coal-measures.

In conclusion he strongly recommended this group to the attention of Town-members, as, from the London Clay, some of our finest Tertiary fossil Crustacea had been obtained; whilst from the Chalk of Kent and Sussex and the Gault of Folkestone, an equally abundant harvest might be procured.

Mr. Woodward's lecture was illustrated with a large series of Diagrams and Specimens of recent Crustacea, serving to show the wonderful diversity of form and modification of the appendages which are displayed in so remarkable degree by this interesting class.

## CORRESPONDENCE.

### DENUDATION, AND ITS AGENTS.

Sir,—I am pleased to find that your contributors have of late returned to the attack upon the difficult subject of denudation. There is plenty of room for other workers to labour in other departments of our illimitable science, without this subject being lost sight of. We must be content to undergo a good deal more hard thinking and close reasoning upon it. Fine writing will not solve our difficulties. Even alliteration may fail to help us.

Denudation has been going on for extended ages, and this pecu-

[1] See the first article in the present number of the Geological Magazine, p. 1.

liarity attaches to it, that the last agency at work necessarily obliterates the marks of others which may have preceded it. When, therefore, we are discussing this subject, it is important to avoid misconception by stating clearly what stage of the whole process we are upon. One may say, we have marine action here; another, we have glacial; another, pluvial. Each may be right if he limits his assertion to the proper stage; each will be in error if he carries it beyond. It is as, in describing the fashioning of a board, we might truly assert it to have been cut either by the axe, or by the saw, or by the plane. But if we were to attribute the formation of the smooth surface to one of the two former instruments, the assertion would be incorrect.

The present phase of the discussion refers, I apprehend, to the final stage of denudation. To use the above illustration again, were I shown a board, and asked by what tool the surface had been brought to its present condition, I should look at two things—first at the *form* of the surface, and, secondly, at the *condition* of it. From the two together, I should be able to arrive at a sure judgment of the mode by which the surface had been produced. Now, I think that these tests have not been carefully enough applied to discover the true cause of the form of the ground. The acknowledged power of rain to carry some portions of the soil into the rivers, and the power of rivers to convey what the rain gives them into the sea, does not prove that the contour of our landscape was produced by those agents. The question to be decided is, whether rains can mould the surface to the particular *form* which it presents, and whether it can remove, not some material, but the particular material of which each locality has been denuded. This is a question concerning the mechanical power of water, in the quantities which rain yields, moving over surfaces having the *minimum* inclination of the denuded country. And when we call in the assistance of the weather to disintegrate the harder rocks so as to fit them for removal by rain, we must recollect that, in cases of unequal solubility, the harder portions would be left, if only temporarily, to accumulate behind, and thus to point out the manner in which the waste of the surface was being effected. Neither must it be forgotten that such pluvial action must have been carried on when all the less elevated parts of the surface were covered with herbage, as they would have been if the climate was not glacial. If it was glacial to the extent of preventing the growth of herbage, then ice action would have taken place.

The second index to the agency which has been in operation is to be found in the *condition* of the surface. It is inexcusable to neglect the study of this, which is to be seen in every shallow pit or ditch that is opened. Such sections always afford an interesting study. We must no longer be content to disguise our slothful ignorance of the true nature of the first few feet of every section under such terms as "heading," "vegetable soil," "rain wash" (unless we can *prove* it such), "rubbish," or what not. There you have a veritable record of the last touch of Nature's hand in fashioning the landscape. Say, what tool did She use? Those contorted layers of gravel, those

pebbles set on end, those larger stones suspended in what was once a plastic mud, that distinct line of demarcation between the moved and unmoved ground usually marked with slikenside if you look for it, those beds bent back and dragged down hill—nay, sometimes bent over on level ground: all these are indications of some universal agency, bringing the surface into the state in which we see it. What power was competent to produce, not one of, but all these effects?

The modern changes in the form of the ground, by the growth of peat, the silting up of valleys, the erosion of the banks of streams, the slipping of hill-sides under the action of springs, will help the close student of the subject to arrive at a satisfactory conclusion upon the older mode of denudation; for they will show him that the present agency of rain, and rivers, and springs, is modifying, not continuing to produce, the original contour of the ground. Until all these indications of form and condition of the surface are patiently and honestly studied, this question will continue to vex the geological mind, and to occupy the valuable pages of your Magazine.

O. Fisher.

Harlton, Cambridge.

P.S.—The above was written before the appearance of the December number of the Magazine, and has no reference to the papers therein contained.

## THE EARTH'S FEATURES.

Sir,—"*The true views of the operations of nature in sculpturing the surface of the earth can never be arrived at unless we take into consideration the effects of all possible agencies, and give them their due place in the great work.*"[1]

Never were truer words spoken than the above,—*Marinists* may rave about what their special agent can do; so may *Subaërialists* proper, *Glacialists*, and every other *ists*, but unprejudiced observers will find that all the different agencies work hand in hand, and that if any of them had been absent, the present features of the earth could not have been formed as we now find them.

Why is it necessary that any new theory should be invented or any *special* theory adopted to account for the present features of the Earth? Why not rather allow the existing forces to do the work nature has assigned each? Let the changes in the earth be considered from "the beginning," and may not a solution for most, if not for all, the apparent difficulties be found? To suit the *special* theories, various forms have been suggested as the first; but is there one of them so simple or better than that given in The Book—"The earth was without form and void, and the spirit of God moved on the face of the water." From this, the oldest record, it would appear that at "the beginning," the earth was surrounded by an envelope of water. Moreover, this statement agrees with present conditions; for a similar phenomenon might again occur if all the land was sunk in the depths of the ocean. This sea, as proved by Mr. Campbell in "Frost and Fire," must have been motionless, there being no light

[1] Hull, "Geol. Mag." Vol. IV. p. 569.