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XXVI.—*Zoo-Geological Considerations on the Freshwater Mollusca.* By EDWARD FORBES, Esq., M.W.S., For. Sec. B.S., &c.

THE Mollusca inhabiting fresh water are all testaceous; such as are univalve are either pulmoniferous or pectinibranchous Gasteropoda; such as are bivalve are Acephala Lamelli-branchia. The consideration of the effect of climatal influence on their generic and specific variations of form, and of the comparative geographical distribution of the existing species, leads to some conclusions which appear to bear importantly on certain points in geology.

The genera of Freshwater Pulmonifera exhibit few subgeneric groupings of species, and those few are not climatally centralized. Thus, the forms of *Limneus* are common to the whole world, and the distribution of species is proportionably extensive. The species of *Limneus* present near resemblances whether gathered in England, in India, in Australia or in America—they are often even specifically identical. *Planorbis* presents the same phænomena, and the variations of form in *Physa* can scarcely be regarded as exceptional. So also *Ancylus*. Nor are the two characters most subject to the climatal influence, those of size and colour, much affected by it, either as regards the species of the genera or the individuals of the species. Some of the largest forms of *Limneus* and *Planorbis* are northern, and in them colour never varies climatally. The negative influences which appear to affect the number of species as we go northwards are rather structural than climatal.

Not so however with the pectinibranchous Gasteropoda inhabiting fresh water. Among them we find the number of genera and of species increasing as we go south, and peculiar forms characterizing warm countries. A *Paludina* or *Melania* from the warmer regions of our earth has an eye-character

which enables us at once to name its fatherland. American forms and Asiatic forms differ; we find the minor groups centralized, and we might colour our maps variously, according to the centralization of those groups. Their colouring varies with the climate, and specimens of the same species from different localities may be distinguished by variation of size.

In the lacustrine and fluviatile genera of *Acephala* we see a similar influence of climate at work. The groups of *Naiades* and of *Cyclades* are concentrated in certain geographical localities, and the southern species are often more splendid in form and colouring than the northern. The old and new continents have few or no species in common, and the freshwater *Acephala* of the east and west are in most cases very different.

These facts may be stated *generally* in the form of two *probable* laws:—

1st. The variations of form, specific and generic, are not so dependent on climate in the freshwater pulmoniferous *Gasteropoda* as in the freshwater pectinibranchous *Gasteropoda* and *Acephala*.

2nd. In a genus independent of climatal influence the extension of distribution is correspondent with the non-variation of form, and *vice versâ* in a genus subject to the climatal influence.

The following inferences applicable to geology may be drawn from these considerations:—

1st. If these views be correct, and if the great differences between the animals of the primæval world and those of the present depend on climatal conditions as is usually admitted, the difference between the generic and subgeneric forms of the pulmoniferous *Mollusca* in the ancient strata and those now living, should not be nearly so great as that between the ancient and existing marine fauna. And so we find it. When we look over a collection of fossil freshwater *Pulmonifera* we are at once struck by the circumstance of the absence of extinct genera and of the near alliance between the fossil and extinct forms.

2nd. But there should be a difference either as to the distribution or as to the character and number of species between the pectinibranchous *Gasteropoda* and *Acephala* of the present and of the fossiliferous past. Thus, as climatal causes affect the distribution of their genera and species, if Britain had a warmer climate in the early ages of the world, these tribes should evidence it. And such is the case. *Melania* and *Melanopsis* and *Ampullaria* counted numerous subjects at one time in our lakes and rivers; *Paludina* were once

far more abundant than they are now; *Cyrena* has disappeared, and *Cyclas* has dwindled into insignificance; nor does our weather hold out any prospect of bettering itself so as to induce a return of the analogues of our ancient visitants.

3rd. In a fossiliferous bed formed during a period when the temperature of Britain did not exceed that of the warmer regions of our world at present, there ought not to be the same difference in the comparative number of species, extinct and existing, in the marine and freshwater faunas, and scarcely any in the case of the freshwater Pulmonifera. In such a bed the freshwater Mollusks should either be nearly allied to, or identical with, existing species of warmer climates. I would refer to this rule the phænomena of the shell-bed at Grays, Essex, described by Mr. Morris, in which we find the pectinibranchous Gasteropoda and the Acephala presenting thermal characters, while the Pulmonifera are identical with the existing British species. These phænomena should lead us to consider that bed as of pleiocene and not of pleistocene origin.

4th. When there is no positive but an evident negative difference from the existing fauna in a tertiary or post-tertiary freshwater deposit, our conclusions as to the climate of the period in which it was formed must mainly depend on the consideration whether the negation is of Pulmonifera or of Pectinibranchia and Acephala; for in the former case it *probably* depends on the action of secondary influences, and in the latter it *possibly* may be owing to the same cause.

5th. If in calculating percentages we deduce them from lists including both freshwater and marine species, we draw false inferences as regards the genera in the older rocks and the species in the pleiocene and pleistocene beds. To correct this error we should in the former case calculate separate percentages for the marine and freshwater species, and in the latter consider the freshwater Pulmonifera by themselves.

XXVII.—*A Catalogue of Shells from the Crag.* By S. V. Wood, Esq., F.G.S.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,

THE following is part of a Catalogue of the fossil contents of the Crag Formation, including the Conchifera of Lamarck. I have endeavoured to make it as concise as possible, in order (should you think it worth publication) not to trespass too



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