

## CORRESPONDENCE.

### KATA-METAMORPHISM OR HYPO-METAMORPHISM ?

SIR,—Van Hise, in his monumental work “ A Treatise of Metamorphism ” [Monograph XLVII, *United States Geological Survey* (1904), p. 43], recognizing the important influence of depth below the surface in determining the character of the alterations of rocks, classifies metamorphism into (1) alterations in the zone of kataborphism, and (2) alterations in the zone of anamorphism. The *zone of kataborphism* he defines as the zone in which the alterations of rocks result in the production of simple compounds from more complex ones. This zone, which is, of course, that lying nearer the surface, he subdivides into the belt of weathering, which extends from the surface to the level of ground water, and the belt of cementation, which extends from the ground-water level to the zone of anamorphism. The *zone of anamorphism* is defined by Van Hise as the zone in which the alterations of rocks result in the production of complex compounds from more simple ones. It is, therefore, the lower zone, and it extends from the base of the belt of cementation to as great depths as metamorphic effects extend. Briefly, the zone of kataborphism is that in which compounds are broken *down*, and the zone of anamorphism is that in which they are built *up*. In his use of these prefixes *kata* and *ana*, Van Hise is guided by the analogy with the biological terms katabolism and anabolism (l.c., pp. 162 and 169), and the selection of these prefixes is clearly a good one.

From the physico-chemical point of view, the distinction between these two zones is of fundamental importance, and these distinctions may be summarized in the following quotation (l.c., p. 186) from Van Hise :—

“ In conclusion of this part of the subject it may be said that in the zone of kataborphism the alterations are mainly controlled by the chemical law that reactions take place with liberation of heat, and this ordinarily results in increase of volume, provided the compounds which form remain as solids. In the zone of anamorphism the reactions are mainly controlled by the physical law that reactions take place with decrease of volume, and this commonly results in chemical reactions with absorption of heat. In the upper zone chemical law is the determinative factor in the reactions ; in the lower, physical law. In the upper zone the important chemical reactions are those of oxidation, carbonation (involving desilication), and hydration ; in the lower zone the important reactions are those of deoxidation, silication (involving decarbonation), and dehydration. In the upper zone

the minerals are few in number, of low specific gravity, and probably of simple molecular structure; in the lower zone the minerals are numerous, of high specific gravity, and probably of complex molecular structure."

These two terms katamorphism and anamorphism are clearly of the greatest use to geologists, and with their introduction, Van Hise proposed terms that have done much to stimulate clear thinking in the realm of the geology of metamorphic rocks. It is most desirable, therefore, that terms of such use, and with such a wealth of connotation, should not have their meanings obscured by subsequent use with a different meaning, either in their substantive or their adjectival form.

It is particularly to be regretted therefore that Grubenmann should have used the term Katametamorphose in a sense completely opposed to the meaning of the katamorphism of Van Hise. In his stimulating work *Die Kristallinen Schiefer*, of which the first or general part was published in 1904, and the second or special part in 1907, Grubenmann classifies the crystalline schists into twelve groups, based upon chemical composition; the members of each group he classifies into three divisions known as Epi-Gesteine, or epi-rocks, characteristic of the uppermost zone of metamorphism, meso-rocks, characteristic of the middle zone, and kata-rocks, characteristic of the deepest zone. Grubenmann does not in the first edition of his work actually use the phrases epi-metamorphism, meso-metamorphism, and kata-metamorphism, but in the third edition (*Die Gesteinsmetamorphose*, by Grubenmann and Niggli, 1924, i, pp. 374-5) the terms epi-zone, meso-zone, and kata-zone, and epi-metamorphism, meso-metamorphism, and kata-metamorphism, of course in their German form, are used. We observe, therefore, that a rock in passing from Grubenmann's uppermost or epi-zone to his lowermost or kata-zone would be undergoing the anamorphic changes of Van Hise, whilst rocks passing from the deepest or kata-zone of Grubenmann in the direction of the uppermost or epi-zone, would be undergoing the katamorphic changes of Van Hise.

This use of the prefix *kata* in two such diametrically opposed senses by these two different authors makes it difficult for students of metamorphic geology to use these terms at all. It is, therefore, fortunate that Grubenmann does not use the prefixes *epi*, *meso* and *kata* until the second part of his original work (compare page 60 of part i with page 172 and 21 of part ii), so that clearly priority in the use of the prefix *kata* belongs to Van Hise. Further, it may be noted that the date of Van Hise's letter of transmittal to the Director of the United States Geological Survey of the manuscript of his treatise is 30th April, 1903, whereas the date attached to the preface of part i of Grubenmann's treatise is June, 1904.

Therefore, it seems desirable to find a substitute for the prefix *kata* when applied to the lowest of Grubenmann's three zones.

*Epi* and *meso* are primarily prefixes of position, whereas *kata* carries with it more the implication of movement or change, and was not, I suggest, the proper prefix to select even if it had not been already pre-occupied. *Hypo* appears to be the more suitable prefix for *under*, and if we re-name Grubenmann's *kata*-zone as the *hypo*-zone and speak of *hypo-metamorphism* in the sense in which he and Niggli use the term *kata*-metamorphism, we shall be introducing desirable clarity into the nomenclature of metamorphism. I suggest, therefore, that writers upon metamorphic geology who have occasion to refer to the different zones of metamorphism should use *katamorphic* (or *kata-metamorphic*) in the sense proposed by Van Hise, and *hypo-metamorphic* (or *hypomorphic*) in the place of Grubenmann and Niggli's *kata-metamorphic*. As a parallel example of the use of the prefix *hypo* in conjunction with *epi* and *meso*, it is perhaps not out of place to point out to users of Becke's nomenclature as applied to the description of structures of metamorphic rocks, that biologists have a parallel trio in which the prefixes *epi*, *meso*, and *hypo* are used as prefixes of position, viz., *epiblast*, *mesoblast*, and *hypoblast*.

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THE HOLYWELL SHALES AND "BLACK LIMESTONE" OF  
NORTH FLINTSHIRE.

SIR,—Will you kindly allow me space to correct an error in my paper appearing in your last issue.

On page 259, last paragraph, first line, the *western* boundary of the Chert Beds is described as the "eastern".

H. C. SARGENT.

14th June, 1927.