

and suggestive notes on the characteristic petrological features of "transgression sandstones", "oscillation sandstones" and "regression sandstones", in which the references to the formation of glauconite and phosphorite, as well as the enrichment of sediments in those minerals, will especially interest British readers. We may be grateful to Dr. Hadding for the information he has collected and the immense amount of work he has undertaken in writing this volume, and may look forward with pleasurable anticipation to further publications on the fine-grained sedimentary rocks of Sweden.

GREENLAND: ITS NATURE, INHABITANTS AND HISTORY. By TH. N. KRABBE. Pp. xvi + 130, 170 plates, index and map. Copenhagen: Levin and Munksgaard; London: Humphrey Milford. 1930. Paper, 33s.; cloth, 40s.

THIS book is not in the strict sense geological, and is concerned rather more with the history and the inhabitants of Greenland than with the natural history; there is much, however, that is of value to geologists and physiographers. A feature is the large number of full-page photographs, all of them of merit and interest. The actual amount of letterpress devoted to geology is small, but this is more than counterbalanced by the wealth of illustrations, which do full justice to the beauty and character of Greenland scenery.

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LATERITE.

SIR,—In the January, 1930, number of the *GEOLOGICAL MAGAZINE* you kindly reprinted an article on laterite that I wrote originally for the Agricultural and Forest Departments of the Straits Settlements and Federated Malay States after the Fourth Pacific Science Congress. Since the article appeared correspondence has passed that prompts me to add to what I then wrote, primarily with a view to emphasizing the agreement between three Directors of Geological Surveys in tropical countries on the subject of tropical weathering.

It may be remembered that in 1909 (*GEOL. MAG.*, p. 431) I objected to a proposition put forward by a reviewer in the *Bulletin* of the Imperial Institute that only products of weathering containing free aluminium hydroxide in hot, moist climates should be considered as laterite. Since then many geologists have agreed to designate by the term "lateritization" or "laterization" the formation of aluminium hydrate as a product of weathering as distinguished from the formation of hydrated silicate of aluminium. The former is thought to be typical of tropical climates, the latter of temperate climates. Others include ferric hydrate as a product of lateritization, and I have learned recently that some hold that ferric hydrate alone is enough to justify the term.

In three tropical countries, however, Indo-China, which is all south of the Tropic of Cancer; the Netherlands Indies, which lie on either side of the Equator; and Malaya, close to the Equator and lying between Indo-China and Sumatra, the dictum that aluminium hydrate is the main product of tropical weathering instead of hydrated silicate will not hold, and doubts are entertained whether climate is the chief reason for the production of the former.

In fascicule 6, p. 14, vol. xviii of the *Bulletin du Service Géologique de L'Indochine*, the Director, Mons. F. Blondel, says when discussing the alteration of rocks in Indo-China, that in spite of the distinctly tropical character of the climate, the manner of weathering of the rocks is far from being entirely lateritic, by which he means the formation of aluminium hydrate. The granites decompose as in Europe to an "arène sableuse", and if the rhyolites, basalts, and eruptive rocks generally afford lateritic types of weathering with concentration of aluminium and iron, the process is never complete, but some clay is always present. In fascicule 3, p. 8, of the same *Bulletin*, Mons. Blondel comments on this as follows:—

"On est conduit à se demander, en conséquence, si le schéma classique qui divise les altérations des roches en altérations des pays tempérés et en altérations des pays tropicaux, correspond bien à la réalité et si le climat est bien la cause profonde de la différence reconnue entre les deux types extrêmes d'altérations."

Mr. A. C. de Jongh, the Director of the Netherlands Indies Geological Survey, permits me to quote the following passage from an advance copy he has let me see of a paper on soils in the East Indies:—

"In this connection I want to mention an hypothesis, at one time suggested to me by Mohr, and that was lately affirmed, I think, by V. M. Goldschmidt (cf. *Handbuch der Bodenlehre*, Band iii, note on p. 254), that the presence of free $\text{Al}(\text{OH})_3$ in a product of rock weathering is controlled not so much by the tropical climate, but rather by the mineralogical composition of the parent rock. There are, indeed, a number of observations, also from the Dutch East Indies, which seem to indicate that the weathering of orthosilicates (anorthite, nephelite), perhaps also of some metasilicates (leucite, pyroxene, amphiboles) often gives rise to allophane clays ($\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$ aq.) and Al-hydroxydes ('Allite' in the sense of Harassowitz), but that kaolin clays ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ aq. 'siallite') are the normal product, inside and outside the tropical zone, of the weathering of the more acid silicates, especially of the polysilicates albite and orthoclase.

"The predominance in Europe of acid igneous rocks (granite) that mainly consist of polysilicates, and the very common occurrence of basic igneous rocks in the tropics, perhaps have led to wrongly including the presence of Al-hydroxyde in the definition of 'tropical' weathering."

In Malaya there is no doubt that the main product of weathering in acid igneous rocks is an hydrated silicate of aluminium. If it

is not kaolin it is something so closely akin to kaolin as to be hardly distinguishable. I say this because the late Sir John Harrison, who kindly analysed some kaolinized orthoclase crystals for me, suggested that the silicate might be halloysite. Neither I nor anyone else has had reason to think that halloysite is the general weathering product. On the other hand, over basic rocks, such as the dolerite of Kuantan, aluminium hydrate is a general weathering product.

So far my contributions to the literature on laterite have been destructive criticism, as I would drop the word altogether unless used as Buchanan originally used it. I think I have good reason for this attitude because the originator of the term has been ignored by most geologists. One author went so far as to say that the "setting" property of laterite is not an essential characteristic, but that property is the chief reason, one might say the only reason, why the name exists. No analysis of Buchanan's type-rock has been made, though he described it 123 years ago, and in spite of the long discussion that began in 1909. A letter from the office of the Director of the Geological Survey of India, dated 23rd January, 1930, informs me that Buchanan's laterite is a detrital form varying from "limonitic hematite to argillaceous or siliceous limonite".

As Buchanan stated that his laterite was above granite I suspect that it is chemically as well as physically like some of our Malacca laterite and that hydrated silicate of aluminium is the general weathering product of granite in India as well as in Malaya, Indo-China, and the Netherlands Indies. To what an extent Buchanan's term is being misused has been brought home to me forcibly by finding that pedologists regard as a "lateritic" soil a soil in which hydrates of aluminium and iron are concentrated in the A or upper horizon of the soil, whereas a "podsol" is a soil in which the hydrates are concentrated in the B and C or lower horizons.

It will certainly be impossible for me to do enough work now in other countries to prove my ideas, but I put forward this constructive suggestion: wherever rocks weather an hydrated silicate is the main product of the feldspars in acid igneous rocks, but in basic rocks varying amounts of aluminium hydrate are formed. Sometimes in acid igneous rocks the hydrated silicate undergoes further decomposition to a hydrate, the cause not being yet determined, and bauxite is formed. Such rich concentrations of aluminium hydrate are commoner in basic rocks. So-called "tropical weathering" is only an intensification of weathering in temperate climes due to greater heat and greater moisture.

J. B. SCRIVENOR.

EDITORIAL NOTE.

In the hope of saving much correspondence, the Editor ventures to remind contributors that all plates and figures *must* have titles. This is essential for indexing purposes.