CORRESPONDENCE.

MEAN THICKNESS OF THE SEDIMENTARY ROCKS.

Sir,—Permit me space for a few remarks on Mr. J. Croll's interesting paper in your last number, on the mean thickness of the sedimentary rocks.

The leading idea of Mr. Croll's calculations on this subject is, that the sedimentary rocks are *wholly* derived from the detritus carried into the ocean by rivers; and, consequently, that their volume formed in any specified time, can be accurately gauged by a knowledge of the annual amount of sub-aërial denudation. This appears from the subjoined passage (p. 98, ad. fin.). "If we know the rate at which the land is being denuded, then we know with perfect accuracy the rate at which the sedimentary deposits are being formed in the ocean. This is obvious, because all the materials denuded from the land are deposited in the sea; and what is deposited in the sea is just what comes off the land, with the exception of the small proportion of calcareous matter which may not have been derived from the land, and which in our rough estimate may be left out of account."

On this I would remark: 1st. That no allowance is here made for the vast quantities of sedimentary matter carried into the sea by littoral erosion.

2nd. Can it be allowable to leave out of the account as "of such small proportion as to be unworthy of notice, the calcareous matter which may not have been derived from the land,"—a category which would include all coral-reef formations, as well as all sediment from the outflow of calcariferous springs at the bottom of the ocean—a combination in which probably the far greater part of the calcareous sedimentary Rocks had their origin.

3rd. Neither is any notice taken by Mr. Croll of the enormous amount of argillaceous and siliceous matter spread over the bottom of the ocean after its eruption from submarine, as well as from sub-aerial volcanic mouths in islands or in the vicinity of the sea. This matter either subsides where it falls near the vent, or is distributed by waves and currents over the bottom of the ocean. The vast amount of such fragmentary conglomerate or ash which is annually produced and deposited on the floor of the sea may be guessed at from the fact that all known volcanic orifices are in close proximity to the sea, and the probability that a far larger number are in frequent eruption at its bottom, though outwardly unobserved. It is well known that during some violent volcanic eruptions, though lasting but a few days or weeks, areas of ocean several hundred square miles in extent have been covered with floating pumice and ash, while the finer dust has been spread in quantities over still larger spaces; all which matter must speedily subside to the bottom. Moreover, before a submarine volcano can rear its head above the sea-level, its loose materials have probably been again and again swept away by the waves and currents, to form sedimentary strata

on the floor of the surrounding ocean, as is known to have been the case with the Isle Julia, near Sicily, the Kaimenis in the crater of Santorino, and other instances.

Professors Ramsay and Geikie both bear witness to the large proportion of the sedimentary strata of early geological ages within the British Isles, that owe their origin to the fragmentary ejections of submarine or insular volcanos, wholly independent of sub-aerial denudations. So too Mr. Darwin, in his work on South America, describes an immense geographical area east of the chain of the Andes, as composed in great part of conglomerates alternating with beds of lava, all ejected from submarine volcanos.

These various sources of sedimentary accumulation at the bottom of the ocean, if added together, may fairly be considered as productive in the course of ages, of an aggregate mass of strata fully equal to that derived from the contemporary denudation of the land; and this, if admitted, would at the least double the figures in Mr. Croll's estimates of the mean annual amount of sedimentary strata produced by all causes combined. I should be the last of all geologists to underrate the effects of sub-aerial denudation. But it seems to me impossible to ignore the fact that immense accumulations of sedimentary strata are, and have always been, in course of production beneath the sea-level, by processes from which sub-aerial agencies are wholly excluded.

COBHAM, *March 14th*, 1871. G. POULETT SCROPE.

TERRACES OF NORWAY.

SIR,—Under this heading in your number for this month is a notice of a work by Professor Kjerulf. The Professor's facts accord exactly with the theory which I have had the honour to publish in your pages (GEOLOGICAL MAGAZINE, November, 1866, p. 519, and May, 1867, p. 1), and his theory would only differ from mine in this, that he supposes the alluviums of which the terraces are the remains to have been formed under a *permanent* "water-surface, which caused the materials washed down by the streams to be heaped up everywhere to the height marked out," p. 75; and I suppose them to be formed by deposit *on land* from repeated *temporary* overflows caused by rain or by melted snow which is frozen rain.[1] No one will dispute this as regards the marine alluvium of the Nile. It stands above the surface of the sea, and rises now by deposit from yearly overflow. But if the north of Africa were to rise ever so gradually, it would cause the Nile to *fall* into the sea. That is, directly as the rise of the land would be the fall of the river into the sea. Directly as its fall into the sea would be its power of deepening its channel. The river *would* deepen its channel, and a time would

[1] As I stated (GEOLOGICAL MAGAZINE, May, 1867, p. 2), the cause of every alluvium in the wide wide world is the stoppage of the lowering of the bed of the valley. The sea stops the lowering of the bed of every valley. Therefore the end of every valley next the sea is flat and alluvial.