following the approximate rule. It will be seen that for angles less than 15° this error is always less than one degree.

	(1)	(2)	(3)	(4)
	1 in	1 in		
1°	57·29	60	58′	2′
2°	28·64	30	1° 55′	5′
3°	19·08	20	2° 52′	8′
4°	14·30	15	3° 49′	11′
5°	11·43	12	4° 46′	18′
10°	5·67	6	9° 27′	33′
15°	3·73	4	14° 2′	58′
20°	2·75	3	18° 26′	1° 34′
25°	2·14	2·4	22° 37′	2° 23′
30°	1·73	2	26° 33′	3° 27′
35°	1·43			
40°	1·19			
45°	1			

Explanation.—3° is actually 1 in 19·08; the approximate rule gives it 1 in 20; 1 in 20 is 2° 52′; error from following approximate rule 8′.

In Fig. 1 the dip along AB is 4° or 1 in 14·30, the dip along AC is 15° or 1 in 3·73: AB=1430, AC=373, dropping the decimals. AD is found to be 290. Hence the full dip is 1 in 2·9 or 19° very nearly. A. H. Green.

Leeds, *July* 13, 1876.

MR. MILNE ON FLOATING ICE.

Sir,—When comparing the altitude of an iceberg above water with the depth immersed, Mr. Milne has not sufficiently considered the conditions of stable equilibrum. A berg of the shape figured on page 307 could not remain in that position, but must turn over. That this would be the case may be seen by placing a boxwood tetrahedron (out of a set of models of crystals) in water, where it will float only with one of its *angles* downwards.

The position of stable equilibrium depends on the shape of the floating body, and on its specific gravity. The specific gravity of boxwood being about 0·95, is so nearly the same as that of ice, that the positions assumed by a floating mass of either substance will as a rule be almost identical. O. Fisher.

THE OLDEST FOSSILIFEROUS ROCKS OF NORTHERN EUROPE.

Sir,—The evidence brought forward by Prof. Linnarsson in the June Number of the Geological Magazine, as being opposed to the views advanced by me, has been already disposed of to a great extent in the papers in which these views have been propounded.[1] That Prof. Linnarsson is unable to put forward stronger evidence in opposition to these views, is clearly a powerful argument in my favour, and I doubt whether he would have raised the objection at all had

[1] Quart. Journ. Geol. Soc. vol. xxxi. p. 552 *seq.*; Geol. Mag. Dec. II. Vol. III. Nos. IV. V. VI.

he gone over the papers still more carefully. In the paper first referred to I stated that in all the areas the first sediments thrown down on the old Pre-Cambrian land were either conglomerates, grits or sandstones, and which, being for the most part the result of a rather sudden encroachment of the sea on land, on which there was probably an abundance of loose material, would be heaped up rapidly. A period of rest would probably follow this rather sudden encroachment, and for a while fine sediments would be thrown down, not necessarily as the result of a very deep sea, but because all material would be washed off the exposed parts, and marine erosion on the hard rocks would yield but little sediment. In the Welsh areas we have evidence of several such successions in the sediments even in the Lower Cambrian epoch. The finer deposits being separated from each other sometimes by great thicknesses of sandy or gritty materials, showing the depression to have been great, and that a large land surface had probably been then submerged. From this it is clear that each depression would cause the first areas submerged to become more and more oceanic, and that each area also at one time or other must have been a shore-line. The fine sediments in the British area are of enormous thickness compared with those in Sweden, and that they were not heaped up rapidly is certain from the fact that the range of the species contained in them is often very limited indeed. The following table of the Lower Cambrian rocks will clearly show the several changes which took place at that time in the Welsh area, and the succession of the faunas:

Lower Cambrian.	Thickness in feet.
1. Conglomerates	60–200
2. Greenish flaggy Sandstones	460
3. Red fine-grained Shales or Slates affording the earliest traces of organic remains, viz. *Lingulella*, *Discina*, *Leperditia*, etc.....	50
4. Purple and greenish Sandstones	1000
5. Yellowish-grey Sandstones, Shales and Flags, containing the genera *Plutonia*, *Conocoryphe*, *Microdiscus*, *Agnostus*, *Paradoxides*, *Theca*, *Protospongia*, *Discina*, *Obolella*, *Lingulella*	150
6. Grey, purple and red Sandstones, alternating with Slates and Shales containing most of the above-mentioned genera (mostly new species)	1500
7. Grey flaggy beds containing *Paradoxides Aurora*, *Conocoryphe bufo*, etc.	150
8. The true beds of the "Menevian Group," for the most part calcareous Flags, Slates, and Shales, richly fossiliferous throughout, but chiefly in zones	600

Now, the only species which probably is common to the British and Swedish faunas in the Lower Cambrian rocks is *Paradoxides Forchhammeri* (*Hicksii*, Salter), and as this occurs high up in the Menevian group, and as each *Paradoxides* also has but a short range in the group, it seems reasonable to think that the *Paradoxides* schists in Sweden do not represent at the most more than the Menevian group. Hence, as there is no evidence of a previous fauna, it appears clear to me that this was the first fauna in that area after the first encroachment of the sea, for we have but one series of sandstones, and these are ripple-marked, showing shore conditions. If Prof. Linnarsson could but be brought to recognize this view of the gradual encroachment of the sea from a western or south-western direction over the European area, I am certain he would

feel none of those difficulties which now occur to his mind, nor would he bring forward a fossil like *Dictyonema*, which has so extensive a range, to prove or disprove the correlation of certain beds. I look rather to the general order of the deposits, and the general character of the fauna, for a clue, than to one doubtful fossil, and it is on this ground that I still maintain that the Russian faunas are, as far as we can yet make out, Silurian in type, and not Cambrian.

As to the depression in the British area being dependent upon the volcanic action, I must remind Prof. Linnarsson again that we have no evidence of volcanic action having taken place until the Arenig period, or until after the area had been depressed to a depth sufficient to allow from 15,000 to 20,000 feet of undisturbed sediments to have been heaped up. Here his argument fails from mistaking the cause for the result. For volcanic action in this case was undoubtedly the result of the depression, and not the cause of it.

HENRY HICKS.

AGE OF THE OTOTARA FORMATION.

SIR,—In the note by Dr. Hector, attached to Mr. H. Woodward's paper "On a Crab from the New Zealand Tertiary," I find the following: "From the comparison which this table affords with the recent fauna of the same area, the Ototara formation would seem to have no claim to a place among Eocene formations. This is confirmed by the occurrence of a few fossils of decidedly Cretaceous type, such as Saurian forms and fragments of the shell of *Inoceramus*, and the presence of many forms that are associated with decided Mesozoic fossils in the underlying strata."[1] In the table of formations given he makes the Saurians range up into the Ototara series, and in the section accompanying the note he also shows: "(*k*) Sandstones with Saurian bones, Ammonites, etc.," near Brighton.

The members present at the meeting seem also to have understood that Secondary fossils occurred in the Ototara formation; for in the discussion Mr. Charlesworth asked "whether the presence of the few Cretaceous fossils found in the deposit *which had furnished the New-Zealand Crab*," etc.

Now I wish to point out that no Cretaceous fossils have as yet been found in the rocks containing *Harpactocarcinus tumidus* and *Palæeudyptes antarcticus*; and I am not aware that any Cretaceous fossils or Saurian remains have ever been found on the west coast of the South Island. I have collected the fossils of the Ototara formation largely at Oamaru without finding any showing a Cretaceous facies.

F. W. HUTTON.

DUNEDIN, *May 5th*, 1876.

"ESMERILO PRETO."

SIR,—Can you, or any of your readers, kindly inform me what was the origin of the pebbles "Esmerilo Preto?"

H. LAPPINGTON.

PADIHAM, PRESTON, LANCASHIRE,
May 17, 1876.

[1] Quart. Journ. Geol. Soc., 1876, vol. xxxii. p. 56.