Bed 3 is again exposed in two little sections a few feet high, about twenty yards further west. These yielded specimens of *Turritella.*

Beds 4, 6, *and* 8. These three beds are like each other, and in composition resemble closely the last bed and beds 5, 7, and 9, but differ from them in their structure, which is hard and difficult to break with the hammer, owing to the rock immediately beneath the hammer-head becoming pulverised and acting as a cushion to the rest of the mass. Moreover, it does not break along bedding-planes (though the existence of these can be seen on a weathered surface), but into irregular lumps. These beds are conspicuous on the face of the section, for being harder they weather back less quickly than those above and below them. They contain traces of fossils, and a cast of *Thetis minor*, Sowerby, was found in a fallen block from one of them, lying in the bog beneath the section.

Beds 5, 7, *and* 9. These beds are like the last in composition, only not indurated, but rather sticky and coherent. No fossils were found in them.

Bed 10. This bed ushers in sandy conditions again, being really a passage bed between this zone and the zone of *Schlœnbachia rostrata* above, which consists of slightly loamy sands throughout, its base being marked by the lowest layer of Cowstones. As this layer is approached, bed 10 becomes more sandy, being more argillaceous in its lower part and containing a few fossil worm-tubes. In places it is characterised by small bright patches of blood-red iron oxide.

To sum up:—On the face of Black Ven the total thickness of the zone of *Hoplites interruptus* is about 38 feet, and lies between 315 feet and 353 feet above sea-level. The whole is seen in two sections. The beds are loams with varying proportions of sand and clay. They are sandiest at the top, becoming more argillaceous on descending, the predominance of the clay reaching a maximum in bed 3, at about 15 feet from the base of the zone. The bottom few inches of the zone also contain much clay, and are characterised by an impersistent pebble bed. Fossils occur sparingly throughout the zone above bed 3, but become abundant at the base of this bed, simultaneously with the maximum amount of clay. The bottom two beds may represent the zone of *Acanthoceras mammillatum*, but there is not a particle of fossil evidence to justify the assertion.

NOTICES OF MEMOIRS, ETC.

I.—Singleness of the Ice Age.

(Die Einheitlichkeit der Quartären Eiszeit. Von E. Geinitz in Rostock. Aus dem Neuen Jahrbuch für Mineralogie und Palaeontologie. Beilage-Band xvi, S. 1–98. Stuttgart, 1902.)

He who attempts to collect, harmonize, and arrange into a scheme of classification the accounts of the North European Drift in separate areas is confronted with divergence of view in every direction. The number of Glacial and Interglacial periods, their

importance, their equivalence, all present difficulties. He finds adjacent and probably equivalent fossiliferous beds ranked differently by different authors; a series will by one be designated Interglacial which another calls no more than a local deposit of sand or clay. The latest researches in Quaternary geology have led to the following conclusions:—For Sweden it has been shown that the Ice Age there was single, unbroken by Interglacial periods. Examination of the moraines south of the Baltic shows that these are no boundaries of ice-extension, but only mark stages of retreat. The so-called 'First Ice Age' covered a narrower area than the 'Second or Principal Glaciation'; the 'Third,' again, less than the Second. Views on the importance of the 'Upper' and 'Lower' Boulder-clays are more and more extending the domain of the Upper. The list of the fossiliferous 'Interglacial beds' is continually increasing.

It must be remembered that while in the northern districts removals of material will have predominated, accumulations will have been the rule in the centre, fluvio-glacial formations in the southern border-region. Glaciers, and in like manner ice-floes and ice-packs, will have produced plentiful disturbances of beds.

Considering everything, the author is driven to the conclusion that "for the southern area of glaciation as for the northern, the whole Drift is to be treated as a single sequence, only broken by oscillations"; that "only one Ice Age has existed, instead of the supposed three (or four) sandwiched in with Interglacial periods of long duration. Consequently the facies accepted as intermorainic must be ascribed only to somewhat larger oscillations of the ice-front, not to periods wholly free from ice."

He quotes Holst's views on an elevation of Scandinavia, which would increase its glaciers; while the increase of ice would produce depressions; and discusses the probable sequence and consequences.

Depressions would extend areas of submergence; connection with cold-water seas would bring deposits of Arctic forms; with warmer waters, temperate. On land, animals and plants would follow advances and retreats of the ice-front.

Discussing the records, he decides that "the fauna and flora of the Quaternary period indicate a climate like the present, only slightly warmer." But the mighty mass of ice affected climate, lowering it over North Europe. The northern ice advanced, with many oscillations, pushing forward especially into bays and valleys, leaving intervening areas free of ice. Consequent alterations of level would produce or remove submergences. Finally, the period of retreat seems a time of somewhat greater warmth than the present, and lasted considerably longer than the period of advance.

One may say that the Ice Age to a certain extent worked its own downfall—rise of Scandinavia and vast development of glaciers; consequent depression; access of warm currents and rise of temperature; commencement of melting.

The same considerations are applicable to Great Britain, where the marine deposits, in close relation to the Boulder-clay, play a yet more important part.

The author proceeds to give reasons for these views. Under a heading "First and Third Ice Age," he discusses the formations which have been attributed to these. There is no characteristic, he says, which can be relied upon for assigning a particular Boulder-clay to the Upper or the Lower Drift.

He enumerates and discusses in detail "the Fossiliferous Drift Deposits of North Germany and Denmark," classifying them as—(1) Lacustrine deposits: (*a*) Pre-Glacial, (*a*) River, (*β*) Subsidence deposits (these, he remarks, collectively lie along a line which he describes); (*b*) Interglacial fresh-water formations, (*a*) Peat-beds, (*β*) Diatom-beds, (*γ*) Beds with fresh-water shells. (2) Marine Diluvium or Pleistocene Drift: (*a*) Cimbrian Peninsula (the occurrences collectively indicate an extension of the Elbe Estuary 100 km. inland from Hamburg, also access of the North Sea to the Baltic, affecting Möen and Rügen); (*β*) Prussian Province (the occurrences collectively indicate an arm of the sea extending into the heart of East Prussia).

A folding page at the end gives the Author's Scheme of Interpretation:—(1) Rise of the Scandinavian Archæan massif, increase of ice, and production of the Norwegian and Baltic Ice-stream. (2) Floes and bergs in Atlantic and Baltic, with deposit of various materials. (3) Advance of ice into Germany. (4) Ice reaching maximum extension in Holland, Saxony, Silesia, Central Russia. Then a short period of rest. (5) Long period of melting, leaving remains of terminal moraines. (6) Further retreat of the ice, leaving well-known terminal moraines of the Baltic ridges. (7) Retreat to the Scandinavian *terra firma*. (8) Circumstances of to-day. A map marks the positions and natures of fossiliferous localities, lines of terminal moraines, areas indicating marine submergence, and southern limits of glaciation. E. H.

II.—International Geological Congress.

1.—Report of the Commission on International Co-operation in Geological Investigation laid before the International Geological Congress at Vienna in 1903. By Sir Archibald Geikie, President of the Commission.

HAVING been appointed at the last Congress to preside over the Commission formed at Paris in 1900 for international co-operation in geological research, I wrote individually to each of the members of this Commission asking them to be good enough to give me their views and suggestions on the subjects submitted to our consideration. To these letters I have only received two replies. I cannot therefore to-day—and it is to be regretted—submit to the Congress the conclusions of the full Commission. Nevertheless, the importance of the subjects proposed is such that it justifies me in recapitulating them to you. The questions submitted to the Commission were the following:—(1) What are the branches of geological research in which international action appears the most desirable; and (2) what are the best means of ensuring uniformity of method in the investigations?

1. With regard to the first of these questions it is obvious that international co-operation may be profitably adopted for the consideration of problems connected with dynamical geology—such as earthquakes, the movements of the terrestrial crust, the course, fluctuations and geological functions of glaciers, the rate of progress of denudation under the action of epigene agents in different climates.

2. The reply to the second question ought to be treated from two points of view. In the first place, there are international scientific investigations which by reason of their special character ought to be undertaken by geologists properly so called. For this kind of research the Congress has only to follow the lines already laid down by it, and the end will be attained by the organization of special commissions similar to those now in operation for the geological map of Europe, glaciers, petrography, which have already obtained such important results. New special commissions may have to be appointed, but this is not the place to propose them.

But there is a second series of international researches of capital importance to geology, the prosecution of which appears to me to require an organisation and resources superior to those of our Congress. For some years several scientific Associations have existed which, like our own, have proposed international combination for the furtherance of different branches of science. I think our Congress might profit by this tendency, and endeavour to effect a collaboration for the study of the problems which interest us and whose solution involves varied technical knowledge and considerable expense. Thus it is a problem of the greatest interest to geologists, whether a chain of mountains subject to earthquakes undergoes at the same time slow movements of elevation or depression. The solution of this question necessitates particular measurements, both numerous and prolonged. But why should geologists undertake it alone? It is as interesting for geodesists as for geologists; the accuracy of their methods would be most valuable to us. Now there already exists an "International Geodetic Association," established for the study of the shape of the earth. Why should we not seek the co-operation of our colleagues for investigations like these, where geodesy plays an all-important part, but which have also great geological value? On the other hand, since the Geological Congress met at Paris the "International Association of Academies," composed of delegates from all the Academies of the world, has been founded. It has the double object of co-ordinating scientific investigations and of obtaining from the Governments of the different countries definite and effectual support. This powerful Association appears to be so well adapted to deal with international scientific questions that we may well ask ourselves if it would not more easily and fully than our Commission determine the questions that I have submitted to the Congress.

If such should be your opinion, and the Congress should judge it fitting to apply to the "International Association of Academies," I would suggest that a Committee be appointed to define the

geological researches to be undertaken and to indicate the methods suitable for arriving at the desired end.

This programme, sanctioned by the authority and prestige of an International Geological Congress, would be submitted to the International Association of Academies at its next meeting, which will be held in London at Whitsuntide, 1904.

2.—Report of the Commission on the Raised Beaches of the Northern Hemisphere. Presented to the International Geological Congress at Vienna in 1903, by Sir Archibald Geikie, President of the Commission.

The Commission submits the following propositions for the consideration of the Congress :—

1. Hitherto the height of old coastlines (raised beaches) has been measured from high-water level, mean sea-level, from the zone of *Fucus*, etc. But no one of these boundaries is precisely defined, and they vary perceptibly in the same district. To determine them exactly it is necessary to have a point or level for each country cut, or marked in some durable manner, on the solid rock near the high tide. From this fixed point all the altitudes along the coastline should be measured or calculated.

2. Note should be taken of all the possible variations of the mean level of the sea, and to this end the archives of the ports should be consulted.

3. The height of a raised beach or strand-line should always be calculated from its interior or superior margin, where this is visible, but the height of the exterior or inferior edge should also be given when it can be observed, as an indication of the extent of tide at the time of that coastline.

4. It is important to follow the horizontal extent of a coastline from one end of a country to the other.

5. The variations in altitude of a coastline should be measured in two directions where that is possible : (1) along the coast, i.e. parallel to the axis of a country ; (2) transversely to this axis, in the bays or fjords.

6. It should be ascertained if a coastline or a series of these lines disappears in a given direction, and the conditions under which this disappearance takes place should be exactly stated. In Scotland, for example, the raised beaches, so clearly defined along the west and east coasts, disappear towards the northern extremity of the kingdom in the county of Caithness, and in the islands of Orkney and Shetland.

7. The diversities of character in a line of raised beach deserve to be registered. Parts have perhaps been cut in the solid rock (*seter* of Norway), others have been formed of deposits of detritus. The relations of these diversities to the contours and to other varieties of topographical configuration should be examined.

8. In a successive series of raised beaches it is important to determine with precision their relative variations in level, in such a manner as to demonstrate whether or not the movements to

which they owe their origin have been unequal, and to show the direction of these inequalities. Differences in the depth of the erosion of the solid rocks and in the breadth and the thickness of the detritic deposits should also be noted.

9. It is obvious that great importance attaches to the organic remains of the raised beaches. Not only should the detritic deposits be carefully looked over, but research should also be made in the rocky platforms, the cliffs, and caves, where one might find boring shells, cirripedes, or adherent corals.

REVIEWS.

I.—The Marine Tertiary Fauna of America and Europe. By Clement Reid, F.R.S.

THE completion of Professor W. H. Dall's monograph on the Tertiary Fauna of Florida, begun in 1885, places in our hands exceedingly valuable material for the study of certain problems that have much exercised European geologists.[1] It is at last possible to make some sort of comparison between the molluscan faunas inhabiting the two sides of an ocean in Tertiary times; fresh light is thrown on the vexed question of the connection or isolation of the Atlantic and Pacific Oceans at various periods; and incidentally we may perhaps learn something as to the former course of the Gulf Stream.

We are not prepared to criticise, and it is impossible to analyse in detail, the descriptions of the mollusca in so large a monograph. Attention should be drawn, however, to the beautiful way in which the book is printed and illustrated; and we must congratulate the Wagner Free Institute on the high standard which has been kept up. The only complaint that might be made from an artistic standpoint is that the numerous plates look perhaps a trifle hard. But anyone who has worked much at the critical determination of closely allied species will recognise that this, if a fault at all, is a fault on the right side; these illustrations, for scientific purposes, are far better than the soft and somewhat woolly lithographs to which we often have to refer.

The deposits which yield the mollusca range in time from Eocene to Pliocene, and include various strata on the western side of the Atlantic besides those of Florida. Almost all the species differ from those of Europe; and thus they do not support the idea, suggested by a study of the echinoderms, that during Oligocene times the Mediterranean region may have been connected with the Antilles by a continuous coast or belt of islands.

The discordance between the mollusca and the echinoderms, just referred to, raises a question of some interest. Is it not a discordance

[1] "Contributions to the Tertiary Fauna of Florida," by Professor W. H. Dall, Wagner Free Institute of Science, Philadelphia, pp. 1620 and pls. lx (1890–1903).