rare; *Krithe Bartonensis* (Jones), very rare; *Cytherella Dixoni*, Jones and Sherborn, very rare; *C. compressa* (Münster), rare; *C. Beyrichi* (Reuss), rare; *C. Reussi*, Jones and Sherborn, rare.

Cœlenterata *Turbinolia humilis*, Milne Edwards and Haime,[1] two specimens.

Foraminifera. *Miliolina trigonula* (Lamarck), very rare; *M. Schreibersii* (D'Orbigny), very rare; *Haplophragmium foliaceum*, Brady, rare; *Polymorphina gibba*, D'Orbigny, very rare; *P. lactea*, Walker and Jacob, very rare; *Nummulites variolaria* (Lamarck), excessively common.

NOTICES OF MEMOIRS.

I. — Marine Organisms and the Conditions of their Environment. By Dr. John Murray, F.R.S.[2]

THE ocean may be divided into two great biological regions, namely, the superficial region, including the waters between the surface and a depth of about 100 fathoms, and the deep-sea region, extending from the 100 fathoms line down to the greatest depths. The superficial region may be subdivided into two provinces, the shallow-water or neritic province around the land masses where the depth is less than 100 fathoms, and the pelagic province, embracing the superficial waters of the ocean basins outside the 100 fathoms line; these two provinces contrast sharply as regards physical conditions, which are of great variety in the neritic province, and very uniform over wide areas in the pelagic province.

Temperature is a more important factor in determining the distribution of marine organisms, mostly cold-blooded, than in the case of terrestrial species, mostly warm-blooded and air-breathing animals, the distribution of which depends rather upon topographical features than upon climatic conditions.

The pelagic tropical waters of the ocean teem with various forms of life, of which probably 70 to 80 per cent. are plants, converting, under the influence of sunlight, the inorganic constituents of sea-water into organic compounds, thus forming the original source of food of marine animals both at the surface and at the bottom of the sea.

The number of species living in the pelagic waters of the tropics may greatly exceed the number in polar waters, where, on the other hand, there is often a great development of individuals, so that there is probably a greater bulk of organic matter in the cold polar waters than in the warm tropical waters. The rate of animal metabolism is slower at a low than at a high temperature, and organisms inhabiting tropical waters probably pass through their life-history much more rapidly than similar organisms living in polar regions. Carbonate-of-lime-secreting organisms are most

[1] Previously recorded from the Barton beds of Hampshire.

[2] An Address delivered at the Royal Institution.

abundant in the warm tropical waters, decreasing in numbers towards the polar regions, and it has been shown that the precipitation of carbonate of lime from solution in sea-water takes place much more rapidly at a high temperature. The pelagic larvæ of bottom-living species are always present in the warm surface waters of the tropics, sometimes growing to an enormous size; but they are absent from the cold polar waters and in the deep sea, where the majority of the bottom-living species have a direct development.

The Arctic fauna and flora, both at the surface and at the bottom, resemble the Antarctic fauna and flora, and a large number of identical and closely related species are recorded from the two polar areas, though quite unknown in the intervening tropical zone.

The boundary-line between the deep-sea region and the neritic province is marked out by what has been called the "mud-line," where the minute organic and inorganic particles derived from the land and surface waters find a resting-place upon the bottom, or serve as food for enormous numbers of crustacea, which in their turn are the prey of fishes and the higher animals; this mud-line, in fact, appears to be the great feeding-ground in the ocean, and its average depth is about 100 fathoms along the borders of the great ocean basins.

The majority of deep-sea species are mud-eaters; some are of gigantic size; some are armed with peculiar tactile, prehensile, and alluring organs; some are totally blind, whilst others have large eyes and are provided with a kind of dark lantern for the emission of phosphorescent light. The deep-sea fauna does not represent the remnants of very ancient faunas, but has rather been the result of migrations from the region of the mud-line in relatively recent geological times.

The "Challenger" investigations show that species are most abundant in the shallow waters near land, decreasing in numbers with increasing depth, and especially with increasing distance from continental land.[1] This is true as a general rule, especially of tropical waters, but in polar regions there are indications of a more abundant fauna in depths of 50 to 150 fathoms than in shallower water under 50 fathoms.[2]

The various points touched upon regarding the distribution of marine organisms, might be explained on the hypothesis that in early geological times there was a nearly uniform high temperature over the whole surface of the globe, and a nearly uniformly distributed fauna and flora; and that with the gradual cooling at the poles, species with pelagic larvæ were exterminated or forced to migrate towards the tropics, while the great majority of the species which were able to survive in the polar areas were those inhabiting

[1] See 'Challenger' Reports, "A Summary of the Scientific Results," by John Murray, pp. 1430–6, 1895.

[2] See Murray, "On the Deep and Shallow-water Marine Fauna of the Kerguelen Region of the Great Southern Ocean": Trans. Roy. Soc. Edin., vol. xxxviii, p. 343, 1896.

the mud-line. The uniform physical conditions here referred to might be explained by adopting the views of Blandet[1] as to the greater size and nebulous character of the sun in the earlier ages of the earth's history.—*Nature*, March 25, 1897.

II.—The Palæolithic Deposits at Hitchin and their Relation to the Glacial Epoch.[2] By Clement Reid, F.L.S., F.G.S., of the Geological Survey of the United Kingdom.

CERTAIN excavations and borings at Hoxne, undertaken in the year 1896 at the cost of the British Association and of the Royal Society, threw much light on the relation of Palæolithic man to the Glacial Epoch.[3] It was thought advisable therefore to examine the similar deposits at Hitchin, to ascertain to what extent the conclusions already arrived at were supported by exploration at a fresh locality; and the cost of these investigations was defrayed by the Council of the Royal Society.

Palæolithic implements have long been known from Hitchin, and their position in and at the base of a stony brickearth was well ascertained. It was also known that this brickearth rested on loam and shell marl, with fresh-water mollusca and mammalian remains. All this had been made perfectly clear, principally by the researches of Prestwich, Sir John Evans, Mr. W. Ransom, and Mr. William Hill. The most important of the doubtful points were the relations of these ancient alluvia to the widespread sheet of Chalky Boulder-clay and to the valleys of the existing streams.

A preliminary examination of the neighbourhood of Hitchin convinced the author that the Palæolithic and ancient alluvial deposits of Hitchin occupied a small irregular valley, which had become silted up and almost obliterated. Attention was therefore mainly devoted to the search for Boulder-clay beneath the Palæolithic loams, and to the sinking of a trial-pit and bore at the point where the buried valley appeared to be deepest.

This exploration tended to show that the story told by the old valley at Hoxne was repeated at Hitchin. Indeed, the succession of events at the two localities was so similar as to leave scarcely a doubt that there was an equivalent set of strata, although unfortunately the series was less perfect, and the gaps discovered at Hoxne are still unbridged by any records yet found at Hitchin. Hitchin yields strong corroborative evidence in favour of the conclusions arrived at in the Hoxne Report, and adds somewhat to our knowledge of the temperate flora of the ancient alluvial strata lying between the Chalky Boulder-clay and the Palæolithic brickearth.

Hitchin lies in the valley cut by the Hiz, a small stream which rises within a mile of the town. Chalk is seen in the valleys, and rises irregularly through the thick sheet of drift that masks most of the area. The greater part of this drift consists of coarse

[1] Bull. Soc. géol. France, sér. 2, t. xxv, p. 777, 1868.
[2] Abridged from the Proc. Royal Society, vol. lxi, pp. 40–49, March, 1897.
[3] Rep. Brit. Assoc. 1896, p. 400.

flint-gravel, partly of Glacial, partly of Palæolithic age; and one of the greatest difficulties met with is the impossibility of deciding whether any particular pit is in Glacial or in Post-Glacial gravel, and whether the gravel passes under or over the Chalky Boulder-clay. The material being used again and again, the composition of the gravel is practically the same in each case, except for the occurrence of implements in the newer one.

The first thing to be done was to ascertain whether the Chalky Boulder-clay, an undoubted glacial deposit, passes under or over the Palæolithic brickearth. With this object, borings were made in the pits out of which implements have been dug. The author gives details of these borings, the results of which may be shortly summarized thus:—In Ransom's (New) Brickyard, after penetrating the Palæolithic brickearth and underlying fluviatile loam to a depth of 60 feet, some blue chalky clay was penetrated in Bore Hole No. 2, and in BH 1 derivative fossils from the Boulder-clay were obtained at about the same level in the lower part of the old alluvium. In each case boring was stopped by gravelly sand full of water. Other borings in Jeeves' Yard and in some old brick-pits on Maydencroft Farm yielded no trace of Boulder-clay. One only (BH 12) passed through undoubted Boulder-clay. The section is—

		feet.
Palæolithic.	Yellow brickearth and small stones ... ... { dug / bored	9 / 5½
Ancient alluvium	Yellow and white marl and silt	2
	Yellow loam and small chalk pebbles	½
	Chalky Boulder-clay	9
	Loamy chalky gravel (base of the Boulder-clay)	2
	Gravelly sand (boring stopped by large stones)	8
		36

The site of this boring is close to the western margin of the old channel, Chalk appearing at the surface within a short distance. The occurrence of the Chalky Boulder-clay at this spot at a high level, and its absence, or representation by derivative material, at lower levels in borings made nearer to the centre of the channel, suggest that the channel was, to a large extent, excavated, or re-excavated, after the deposition of the Boulder-clay, as was the case at Hoxne.

The course of the ancient silted-up channel cannot yet be defined. Loam with Palæolithic implements occupies a belt extending for about a mile south of Hitchin.

The underlying river alluvium is entirely overlapped and hidden by the Palæolithic brickearth, and is only to be seen where the brickearth has been dug away. It is found in Ransom's and Jeeves' brickyards, and it has now been discovered half a mile to the SSW., in two borings on Maydencroft Farm. It apparently occupies a narrow belt in the middle of the old valley. The greatest depth of this valley could not be proved, owing to the running sand and gravel, which made boring so difficult. The bottom lies at least as low as the level of the existing valleys

of the Hiz and Purwell, for five different borings were abandoned at about that level, without having reached Chalk. The trend of the buried channel seems to be from south to north, in this following the general slope of the ground and running parallel to the course of the existing streams.

The relation of the Boulder-clay to the alluvial deposits having been settled, attention was devoted to an attempt to penetrate to the bottom of the valley in its deepest part. A trial-pit was sunk in Ransom's old brickyard, within a few yards of the spot where a pit had been sunk by Messrs. Prestwich and Evans about 1879. In this brickyard a large number of implements had been obtained from the irregular gravelly base of the brickearth, where it rests on the older alluvial deposits. The newer brickearth, here about 24 feet thick, had been already entirely removed at the spot where the trial-pit was sunk. After sinking 14 feet through brown bedded carbonaceous loam, full of badly preserved shells and plant-remains, boring tools were used, and a further depth of 17½ feet of alluvial loam was penetrated before the gravelly sand below was reached. At the base of the alluvium was found a foot or so of hard black loam with fresh-water shells and fragments of Jurassic fossils derived from the Boulder-clay.

In working out the material afterwards, it became evident that from top to bottom the alluvial deposits below the Palæolithic brickearth belonged to one series, the same plants occurring throughout. Hence there were only two deposits to deal with—a stony brickearth yielding little or nothing but Palæolithic implements, and a series of ancient alluvial deposits below, full of plants and shells, but, as far as known, without trace of man. The mammalian remains were all said to come from the whitish marly silt which occurs locally immediately below the Palæolithic brickearth. They are mostly in Mr. W. Ransom's collection, and were determined by Mr. Sanford. The remainder of the animals and plants, with the exception of two species of mollusca, were obtained in the trial-pit just described. For the determination of the fishes, the author was indebted to Mr. E. T. Newton, and for the mosses to Mr. W. Mitten; the mollusca and flowering plants were identified by Mr. Reid himself.

Mammals.—*Ursus; Equus caballus*, Linn.; *Rhinoceros; Hippopotamus* (a waterworn bone); *Cervus elaphus*, Linn.; *Elephas primigenius*, Blumb.

Fishes.—*Perca fluviatilis*, Linn.; *Esox lucius*, Linn.; *Leuciscus rutilus*, Linn.; *Leuciscus erythrophthalmus*, Linn.; *Tinca vulgaris*, Cuv.

Insects.—Elytra of several genera of beetles, badly preserved; Galls.

Mollusca.—*Helix pulchella*, Müller; *Clausilia biplicata*, Mont.; *Carychium minimum*, Müller; *Planorbis albus*, Müller; *Planorbis carinatus*, Müller (recorded by Mr. E. T. Newton); *Planorbis complanatus*, Linn.; *Planorbis nautileus*, Linn.; *Planorbis nitidus*, Müller; *Planorbis spirorbis*, Müller (found by Mr. A. S. Kennard); *Limnæa auricularia*, Linn.; *Limnæa peregra*, Müller; *Limnæa stagnalis*, Linn.;

Velletia lacustris, Linn.; *Valvata piscinalis*, Müller: *Valvata cristata*, Müller; *Bythinia Leachii*, Shepp.; *Bythinia tentaculata*, Linn.; *Pisidium pusillum*, Gmel.; *Sphærium corneum*, Linn.; *Anodonta*.

Flowering Plants.—*Ranunculus aquatilis*, Linn.; *Ranunculus sceleratus*, Linn.; *Ranunculus repens*, Linn.; *Montia fontana*, Linn.; *Prunus spinosa*, Linn.; *Poterium officinale*, Hook. f.; *Pyrus torminalis*? Ehrh. (identical with seeds found at Hoxne); *Hippuris vulgaris*, Linn.; *Myriophyllum*; *Cornus sanguinea*, Linn.; *Sambucus nigra*, Linn.; *Eupatorium cannabinum*, Linn.; *Fraxinus excelsior*, Linn.; *Menyanthes trifoliata*, Linn.; *Lycopus Europæus*, Linn.: *Ajuga reptans*; Linn.; *Alnus glutinosa*, Linn.; *Quercus robur*, Linn.; *Ceratophyllum demersum*, Linn.; *Sparganium*; *Potamogeton crispus*, Linn.; *Potamogeton*, sp.; *Potamogeton*, sp.; *Naias marina*, Linn.; *Scirpus lacustris*, Linn.; *Scirpus*, sp.; *Carex*.

Mosses.—*Antitrichia curtipendula*, Brid.; *Homalothecium sericeum*, Bry. Europ.; *Hyocomium brevirostre*? Bry. Europ.; *Isothecium*?; *Neckera complanata*, Bry. Europ.; *Stereodon cupressiformis*, Brid.; *Zygodon*?

Characæ.—Several species indet.

Such trees as the oak, ash, sloe, cornel, elder, and alder point unmistakably to a temperate climate, and the fauna and flora as a whole suggest climatic conditions not differing greatly from those we now enjoy. Mr. Mitten writes of the mosses, that "all these are inhabitants of a sylvan temperate region . . . . and none point to a different environment from that now existing; they are not Arctic." The occurrence of *Naias marina*, now only found in Britain in two of the Norfolk Broads, is singular, although the plant was evidently more common in former times than at the present day. It has now been discovered in the Pre-Glacial deposits of Norfolk and Suffolk, beneath Palæolithic remains at Hitchin, and in a submerged land-surface of Neolithic date at Barry Docks, in South Wales.

The resemblance of the Hitchin Palæolithic brickearth to the Palæolithic brickearth of Hoxne, and the similarity of the old alluvia beneath, both in fossil contents and in the physical changes they suggest, are so striking that one is compelled to correlate them bed by bed. If, however, this correlation be correct, it is evident that the intermediate deposit full of leaves of Arctic willows, so conspicuous over part of the area at Hoxne, is missing at Hitchin. At each locality the same story is told. Some time after the passing away of the ice the land stood higher than now, so that the streams had a greater fall and valleys were cut to a somewhat greater depth. Then the land sank and the valleys became silted up with layer after layer of alluvium, to a depth of at least 30 feet, the climate remaining temperate. The next stage, when an Arctic flora reappeared, is only represented at Hoxne. The third stage in the infilling of the valleys is shown in the curious unstratified decalcified brickearth with scattered stones and Palæolithic implements, identical in character at Hitchin, Hoxne, Fisherton, and other localities, which irresistibly suggest a mingling of wind-transported material and rainwash.

It may be pointed out that if this hypothesis of the origin of the Palæolithic brickearths during the reign of "steppe" conditions be accepted, it will account for the non-correspondence of the ancient channels with the present valleys, a thing very difficult to explain if the infilling were caused by ordinary fluviatile action. If the Palæolithic brickearth be equivalent to the Palæolithic loess of the ancient deserts in Central Europe, it can be understood how during this period of cold drought the smaller streams ceased to flow and their valleys became so filled with rainwash and dust that when a moister climate recurred the streams had to seek new channels.

REVIEWS.

I.—Annual Report of the Geological Survey of the United Kingdom, and of the Museum of Practical Geology, for the Year 1896. By Sir Archibald Geikie, D.C.L., F.R.S., Director-General. 8vo. (London: Eyre & Spottiswoode, 1897.)

THE Annual Report of the Director-General of the Geological Survey since 1892 has contained particulars of the scientific and practical results obtained during the progress of the field-work, and by the officers of the palæontological and petrographical departments. Hitherto, however, the Report has been published only in the more bulky Report of the Department of Science and Art; and although reprints of the portion relating to the Geological Survey have been distributed, they could not be purchased separately by the general public. A new departure has now been made, and the present Report is published at the price of 6*d.*, and in advance of the larger departmental volume.

Occupying 107 pages of closely printed matter, this Report needs the index which has been added to it. A considerable amount of detail relating to all branches of geology, but more particularly to petrographical researches on the ancient schists, and on various other metamorphic and igneous rocks, will be found. Nearly all formations from those of Pre-Cambrian age to the Recent are dealt with, and some facts relating to the Antiquity of Man, to Lake Basins, and other controverted subjects, are included. The Report being in itself a summary of the observations made by the officers engaged on the Geological Survey, it is impossible here to do more than call attention to the publication, which will doubtless find its way into the hands of all working geologists.

II.—Catalogue des Bibliographies Géologiques. Par Emm. de Margerie. 8vo; pp. xx, 733. (Paris, 1896. Issued April, 1897.)

THIS Bibliography of Geological Bibliographies is probably the most valuable and useful work that has been issued under the auspices of the "Congrès Géologique International." It contains 3,918 references to lists and catalogues of papers, to papers and memoirs containing copious references to geological literature, and to memoirs and obituary notices of geologists all over the world.