between the greywacke and the upper division of the old red sandstone in Berwickshire, the middle and lower divisions of the old red and the whole of the Silurian system being deficient. Another circumstance worthy of remark is the absence of any formations more recent than the coal-measures, if we except alluvial deposits and the undetermined red strata formerly mentioned.

February 1.—W. Johnston, Esq., of Grosvenor Granite Wharf, and of Richmond, Surrey; James Baber, Esq., of 1, South Place, Knightsbridge, London; and Evan Hopkins, Esq., were elected Fellows of this Society.

A paper was read "On the Tertiary Strata of the Island of Martha's Vineyard in Massachusetts." By Charles Lyell, Esq., V.P.G.S., &c.

The most northern limit to which the tertiary strata bordering the Atlantic have been traced in the United States is in Massachusetts in Martha's Vineyard, lat. 41° 20′ north, an island about twenty miles in length from east to west, and about ten from north to south, and rising to the height of between 200 and 300 feet above the sea. The tertiary strata of this island are, for the most part, deeply buried beneath a mass of drift, in which lie huge erratic blocks of granite and other rocks which appear to have come from the north, probably from the mountains of New Hampshire. The tertiary strata consist of white and green sands, a conglomerate, white, blue, yellow, and blood-red clays and black layers of lignite, all inclined at a high angle to the north-east, and in some of their curves quite vertical. They are finely exposed near Chilmark on the south-west side of the island, and in the promontory of Gay Head at its south-western extremity, where there is a vertical section of more than 200 feet in height.

Attention was first called to this formation by Prof. Hitchcock in 1823, who appears to be the only American geologist who has examined them personally. He compared the beds at Gay Head to the plastic and London clays of Alum Bay in the Isle of Wight, to which, lithologically, they bear a striking resemblance, consisting in both cases of variously and brightly coloured clays and sands with lignite, all incoherent and highly inclined. Various opinions, however, have been put forth as to the relative age of the Martha's Vineyard strata, which were assigned by Prof. Hitchcock, at a time when the tertiary formations of the United States were less known, to the Eocene period, while Dr. Morton supposed them to be in part only tertiary, and that they rested on greensand of the cretaceous period.

The section at Gay Head is continuous for four-fifths of a mile, the beds dip to the north-east generally at an angle of from thirty-five to fifty degrees, though in some places at seventy degrees. The clays predominate over the sands. In one place Mr. Lyell found a great fold in the beds, in which the same osseous conglomerate and associated beds of white sand, on the whole fifty feet thick, were so bent as to have twice a north-easterly and once a south-westerly dip.

In the yellowish and dark brown clay near the uppermost part of the section at Gay Head, and in the greensand immediately resting upon it*, Mr. Lyell found the teeth of a shark, that of a seal, vertebræ of Cetacea, crustacean remains and casts of *Tellina* and *Mya*. These prevail at intervals through a thickness of nearly 100 feet, and are followed by beds of sand and clay with lignite. Mr. Lyell found no remains in the red clays. Many rolled bones were found in the osseous conglomerate.

In the section at Chilmark similar strata to those at Gay Head occur, but the general dip is south-west. Some of the folds, however, give anticlinal dips to the north-east as well as the south-west, and there are many irregularities, the beds being sometimes vertical and twisted in every direction. Several faults are seen and veins of ironsand, which intersect the strata like narrow dykes, as if there had been cracks filled from above. One bed of osseous conglomerate at Chilmark, four yards in thickness, is vertical, and its strike is well seen to be north 25° east, so that the disturbances have evidently been so great that it would be difficult without more sections to determine positively the prevailing strike of these beds. The incumbent drift is very variable in thickness, and large erratics, from twenty to thirty feet in diameter, are seen resting on quartzose sand. The author saw no grounds for concluding that any cretaceous strata occur anywhere in the island, nor could he find any fossils which appeared to have been washed out of a cretaceous formation into the tertiary strata, as some have suggested.

Mr. Lyell proceeds to the consideration of the organic remains collected by himself in Martha's Vineyard.

Mammalia.—1. A tooth, identified by Prof. Owen as the canine tooth of a seal, of which the crown is fractured. It seems nearly allied to the modern *Cystophora proboscidea*.

2. A skull of a walrus, differing from the skulls of the existing species (*Trichecus rosmarus*, Linn.), with which it was compared by Prof. Owen, in having only six molars and two tusks, whereas those of the recent have four molars on each side, besides occasionally a rudimentary one. The front tusk is rounder than that of the recent walrus.

3. Vertebræ of *Cetacea*, some of which are referred by Prof. Owen to the Whalebone-whales, and others to the Bottle-nosed (*Hyperoodon*).

Pisces.—Teeth of sharks resembling species from the Faluns of Touraine, viz. *Carcharias megaladon, Oxyrhina xiphodon, O. hastulis*, and *Lamna cuspidata*. With these were large teeth of two species of *Carcharias*, one resembling *C. productus*, a Maltese fossil. With the exception of the two last, Mr. Lyell found the same species in miocene strata near Evergreen, on the right bank of James River in Virginia.

Crustacea.—A species considered by Mr. Adam White as probably belonging to the genus *Cyclograpsus*, or the closely allied *Sesarma* of Say, and another, decidedly a *Gegarcinus*.

* Nos. 5 and 6 of Prof. Hitchcock's section.

Mollusca.—1. Casts of a *Tellina* allied to *T. biplicata*, a miocene fossil, and of another near *T. lusoria*. 2. Cast of a *Cytherea* resembling *C. Sayana*, Conrad. 3. Three casts of a *Mya*, one of which bears a close resemblance to *Mya truncata*.

Mr. Lyell concludes, from the various evidence here given, that the strata of Martha's Vineyard are miocene. The numerous remains of Cetacea of the genera *Balæna* and *Hyperoodon* are adverse to the supposition of their being Eocene, while such fossils abound in the miocene beds of America. The other fossils all point to a similar conclusion.

Letter from J. Hamilton Cooper, Esq., to Charles Lyell, Esq., V.P.G.S., "On Fossil bones found in digging the New Brunswick Canal in Georgia."

Mr. Cooper prefaces his communication by a description of the country surrounding the locality in which the bones were found. The portion described is that part of the sea-coast of Georgia which lies between the Alatamaha and Turtle rivers in one direction, and the Atlantic Ocean and the head of tide water on the other. For twenty miles inland the land is low, averaging a height of from ten to twenty feet, and reaching, in some instances, forty feet, and consisting of swamps, salt-marshes, sandy land, and clay loam. It then suddenly rises to the height of seventy feet, and runs back west at this elevation about twenty miles, at which point there is a similar elevation of between sixty and seventy feet. The whole of this district is a post-tertiary formation, and is composed of recent alluvium, and a well-characterized marine post-pliocene deposit. The recent alluvium is divided into inland-swamp, tide-swamp, and salt-marsh. The two last occupy a shallow basin having a depth of about twelve feet, the bottom and sides of which are the post-pliocene formation. This the author divides into three groups, in the last of which, constituting the elevated sand hills, no organic remains have been found; in the two former marine shells of existing species occur.

The fossil bones of the land mammalia discovered by Mr. Cooper, were found resting on the yellow sand and enveloped in the recent clay alluvium. Their unworn state and the grouping together of many bones of the same skeleton, render it highly probable that the carcasses of the animals falling or floating into a former lake or stream, sank to the sandy bottom, and were gradually covered to their present depth by the sedimentary deposits from the water. Among them were remains of the megatherium, *Mastodon giganteum*, mammoth, hippopotamus and horse. The fossil shells found in the post-pliocene, were species at present existing on the neighbouring shores.

The facts narrated by Mr. Cooper lead to the following conclusions:—1st. That the post-pliocene formation extends further south than Maryland, to which it has hitherto been limited. 2nd. The coexistence of the megatherium with the mammoth, mastodon, horse, bison, and hippopotamus. 3rd, That the surface of the country has