2. There must have been repeated sinkings of the dry land to allow of the growth of more than ten forests of fossil trees one above the other, an inference which is borne out by the independent evidence afforded by the Stigmaria found in the under-clays beneath coal-seams in Nova Scotia, as first noticed in South Wales by Mr. Logan.

3. The correspondence in general characters of the erect trees of Nova Scotia with those found near Manchester, leads to the opinion that this tribe of plants may have been enabled by the strength of its large roots to withstand the power of waves and currents much more effectually than the Lepidodendra and Sigillariæ, which are more rarely found to retain a perpendicular position.

Lastly, it has been objected that if seams of pure coal were formed on the ground where the vegetables grew, they would not bear so precise a resemblance to ordinary subaqueous strata, but ought to undulate like the present surface of the dry land. In answer to this Mr. Lyell points to what were undoubtedly terrestrial surfaces at the South Joggins, now represented by coal-seams or layers of shale supporting erect trees, and yet these surfaces conform as correctly to the general planes of stratification as those of any other strata.

He also shows that such an absence of superficial inequalities and such a parallelism of successive surfaces of dry land, ought to be expected according to the theory of repeated subsidence, because sedimentary deposition would continually exert its levelling action on the district submerged.

ART. XII.—*On the Coal Formation of Nova Scotia, and on the Age and Relative Position of the Gypsum and accompanying Marine Limestones;* by C. LYELL, Esq. F. G. S. &c. &c.

[Communicated to this Journal by the author.]

THE stratified rocks of Nova Scotia more ancient than the carboniferous consist chiefly of metamorphic clay-slate and quartzite, their strike being nearly east and west. Towards their northern limits these strata become less crystalline and contain fossils, some of which Mr. Lyell identifies with species of the upper Silurian group, or with the Hamilton group of the New York geologists.

The remaining fossiliferous rocks so far as they are yet known belong to the carboniferous group, and occupy extensive tracts in the northern part of the peninsula, resting unconformably on the preceding series. They may be divided into two principal formations, one of which comprises the productive coal-measures, agreeing precisely with those of Europe in lithological and palæontological character. The other consists chiefly of Red Sandstone and red marl, with subordinate beds of gypsum and marine limestone, but this series is also occasionally associated with coal-grits, shales, and thin seams of coal. A variety of opinions have been entertained respecting the true age of the last mentioned or gypsiferous formation, and it is the purport of this paper to show, first, that it belongs to the carboniferous group; secondly, that it occupies a lower position than the productive coal-measures. These last are of vast thickness in Nova Scotia, being largely developed in Cumberland County, and near Pictou, and recurring again at Sydney in Cape Breton. In all these places they contain shales, probably deposited in a fresh-water estuary, in which several species of Cypris and Modiola abound. The plants of these coal-measures belong to the genera Calamites, Sigillaria, Stigmaria, Lepidodendron, Pecopteris, Neuropteris, Sphenopteris, Nœggerathia, Palmacites, Sternbergia, Sphenophyllum, Asterophyllites, Trigonocarpum, with which are the trunks and wood of coniferous and other trees. Upon the whole nearly fifty species of plants have been detected, more than two-thirds of which are not distinguishable from European species, while the rest agree generically with fossils of the coal formation in Europe.

The internal cylindrical axis of petrified wood in the Stigmaria of Nova Scotia exhibits the same vascular structure, and the same scalariform vessels as the English specimens.

Mr. Lyell next describes the gypsiferous formation, especially the marine limestones of Windsor, Horton, the cliffs bounding the estuary of the Schubenacadie River, the district of Brookfield, and the cliffs at the bridge crossing the Debert River near Truro. Several species of corals and shells are common to all these localities, and recur in similar limestones in Cape Breton. In this assemblage of organic remains we find a Crustacean intermediate between the Trilobite and Limulus, Orthoceras, (two species,) Nautilus, Conularia, Encrinus and Cyathophyllum, besides some species of the carboniferous limestone of Europe, such as Euom-

phalus lævis, Pileopsis vetustus? Pecten plicatus, Isocardia unioniformis, Producta Martini, P. Scotica? Terebratula elongata, Fenestella membranacea? Ceriopora spongites, Goldf. For assistance in determining these the author has been chiefly indebted to M. De Verneuil.

The plants associated with these limestones consist of several species of Lepidodendron, Calamites, and others agreeing with carboniferous forms. With these Mr. Lyell found in Horton Bluff scales of a Ganoid fish, and in the ripple-marked sandstones of the same place Mr. Logan discovered footsteps which appear to Mr. Owen to belong to some unknown species of reptile, constituting the first indications of the reptilian class known in the carboniferous rocks. Several of the shells and corals of this group have been recognized by Messrs. Murchison and De Verneuil as identical with fossils of the gypsiferous deposit of Perm in Russia, and it had been successively proposed, (see Proceedings of the Geological Society, Vol. III, p. 712, and Mr. Murchison's Anniversary Address, Feb. 1843, Vol. IV, p. 125,) to refer these gypsiferous beds of Nova Scotia to the Trias, and to the period of the magnesian limestone. That they are more ancient than both these formations Mr. Lyell infers, not only from their fossils, but also from their occupying a lower position than the productive coal-measures of Nova Scotia and Cape Breton. In proof of this inferiority of position three sections are referred to; first, that of the coast of Cumberland, near Minudie, where beds of red sandstone, gypsum and limestone are seen dipping southwards, or in a direction which would carry them under the productive coal-measures of the South Joggins, which attain a thickness of several miles. Secondly, the section on the East River of Pictou, where the productive coal-measures of the Albion mines repose on a formation of red sandstone including beds of limestone, in which Mr. J. Dawson and the author found Producta Martini and other fossils common to the gypsiferous rocks of Windsor, &c. Some of these limestones are oolitic like those of Windsor, and gypsum occurs near the East River, fourteen miles south of Pictou, so situated as to lead to the presumption that it is an integral part of the inferior red sandstone group. Thirdly, in Cape Breton according to information supplied by Mr. Richard Brown, the gypsiferous formation occupies a considerable tract, consisting of red marl with gypsum and limestone. In specimens of the lat-

ter Mr. Lyell finds the same fossils as those of Windsor, &c. before mentioned. Near Sydney these gypsiferous strata pass beneath a formation of sandstone more than two thousand feet thick, upon which rest conformably the coal-measures of Sydney, dipping to the northeast or seaward, and having a thickness of two thousand feet.

To illustrate the gypsiferous formation the author gives a particular description of the cliffs bordering the Schubenacadie for a distance of fourteen miles from its mouth to Fort Ellis, which he examined in company with Mr. J. W. Dawson and Mr. Duncan. The rocks here consist in great part of soft red marls, with subordinate masses of crystalline gypsum and marine limestones; also three large masses of red sandstone, coal-grits, and shales. The strike of the beds, like that at Windsor, is nearly east and west, and there are numerous faults and flexures. The principal masses of gypsum do not appear to fill rents, but form regular parts of the stratified series, sometimes alternating with limestone and shale.

The author concludes by describing a newer and unconformable red sandstone, without fossils, which is seen to rest on the edges of the carboniferous strata on the Salmon River, six miles above Truro.

ART. XIII.—*On the Microscopic Structure of the Teeth of the Lepidostei, and their Analogies with those of the Labyrinthodonts;* by JEFFRIES WYMAN, M. D.—(with a plate.)

[Read before the Boston Society of Natural History, August, 1843.]

THE Lepidostei, like other Sauroid fishes, are provided with large conical teeth, intermixed with more numerous teeth of a smaller size. The larger teeth are found on the upper and lower maxillaries, and the intermaxillaries; the smaller ones are found on the same bones, and also on the vomer and palatines. On the two last they are arranged "en carde," except on the anterior portion of the vomer in the *Lepidosteus oxyurus*, where they are arranged in a linear series. The larger teeth, of which the microscopic structure is here more particularly described, are a little recurved, have a conical form, and sharp and slightly trenchant points; externally the surface is smooth near the apex, but more