

to subterranean convulsions which have happened within the tertiary epoch.

On the other hand, some mountain chains may have been lowered during the same series of ages, in an equal degree, and shoals may have been converted into deep abysses.\* Since this map was recast in 1847, geologists have very generally come to the conclusion that the nummulitic limestone together with the overlying fucoidal grit and shale, called "Flysch" in the Alps, belong to the older tertiary or Eocene group. As these nummulitic rocks enter into the structure of some of the most lofty and disturbed parts of the Alps, Apennines, Carpathians, Pyrenees, and other mountain chains, and form many of the elevated lands of Africa and Asia, their position almost implies the ubiquity of the post-Eocene ocean, not, indeed, by the simultaneous, but by the successive occupancy of the whole ground by its waters.†

*Concluding remarks on changes in physical geography.* — The foregoing observations, it may be said, are confined chiefly to Europe, and therefore merely establish the increase of dry land in a space which constitutes but a small portion of the northern hemisphere; but it was stated in the preceding chapter, that the great Lowland of Siberia, lying chiefly between the latitudes 55° and 75° N. (an area nearly equal to all Europe), is covered for the most part by marine strata, which, from the account given by Pallas, and more recently by Sir R. Murchison, belongs to a period when all or nearly all the shells were of species still living in the north. The emergence, therefore, of this area from the deep is, comparatively speaking, a very modern event, and must, as before remarked, have caused a great increase of cold throughout the globe.

Upon a review, then, of all the facts above enumerated, there appear grounds for inferring that the eras of the principal alterations in climate, as deduced from fossil remains, were coincident with the periods of the most remarkable changes in the former position and relative proportions of sea and land. A wide expanse of ocean, interspersed with islands, seems to have pervaded the northern hemisphere at the periods when the Silurian and carboniferous rocks were formed, and a warm and very uniform temperature then prevailed. Subsequent modifications in climate accompanied the deposition of the secondary formations, when repeated changes were effected in the physical geography of our northern latitudes. Lastly, the refrigeration became most decided, and the climate most nearly assimilated to that now enjoyed, when the lands in Europe and northern Asia had attained their full extension, and the mountain chains their actual height.

\* It may be observed, that the facts and inferences exhibited in this map bear not merely on the theory of climate above proposed, but serve also to illustrate the views explained in the third book respecting the migrations of animals and

plants and the gradual extinction of species.

† See Sir R. Murchison's Paper on the Alps; Quart. Journ. Geol. Soc. vol. v.; and my Anniversary Address for 1850, *ibid.* vol. vi.