GEOGRAPHICAL EVOLUTION[1]

IN the future development of scientific geography one of the main lines of advance will be in the direction of a closer alliance with geology. The descriptions of the various countries of the globe will include an account of how their present outlines came into existence, and how their plants and animals have been introduced and distributed. The principles on which this evolutional geography will be founded have regard to the materials of which the framework of the land consists, to the various ways in which these materials have been built up into the solid crust of the earth, and to the superficial changes to which they have been subsequently exposed. The materials of the land consist mainly of compacted detritus, which, worn from previously existing terrestrial surfaces, has been laid down in the sea. Hence the land, as we now see it, has originated under the sea. But the common belief that over the whole globe land and sea have been continually changing places, and that wide continents may have bloomed even over the site of the most lonely abysses of the ocean, may be shown to be incorrect by a consideration of the character of the sedimentary rocks of the land on the one hand, and of that of the deposits of the sea-floor on the other. The sedimentary rocks, even in the most massive palæozoic formations where they attain depths of several miles, are shallow-water deposits, formed out of the waste of the land and always laid down near land. Nowhere among them, even including the thick organically-derived limestones, such as the chalk, is there any formation which properly deserves to be considered that of a deep sea. Recent researches into the nature of the sea-bottom across the great ocean-basins have likewise shown that the deposits there in progress have no real analogy among the rocks of the land. The conclusion to be drawn from the evidence is that the great ocean-basins have always existed, and that the terrestrial areas have also lain on the whole over those tracts where they still exist.

The way in which the sedimentary rocks have been tilted up and made to lie discordantly on each other shows that the marginal belt of sea-floor near the land has again and again been upraised and worn down. The ocean-basins appear from very early times to have been areas of subsidence, while the continental elevations have been lines of relief from the strain of terrestrial contraction. The land has been subjected to periodic movements of upheaval, sometimes of great violence, whereby not only large areas of sea-bottom were raised into land, but where, as huge earth-waves, lines of mountain-chain were ridged up. During these movements great changes were effected in the structure and arrangement of the rocks in the regions affected, original sedimentary masses being rendered crystalline, and even reduced to such a pasty or fluid condition as to be squeezed into rents of the more solid superincumbent rocks. Volcanic orifices were likewise opened, by which communication was established between the heated interior and the surface. The relative dates of these successive terrestrial disturbances can be satisfactorily determined by stratigraphical and palæontological evidence.

The history of the gradual growth of the European continent furnishes many interesting and instructive illustrations of the principles by which evolutional geography is to be worked out. The earliest European land appears to have existed in the north and north-west, comprising Scandinavia, Finland, and the north-west of the British area, and to have extended thence through boreal and arctic latitudes into North America. Of the height and mass of this primeval land some idea may be formed by considering the enormous bulk of the material derived from its degradation. In the Silurian formations of the British Islands alone there is a mass of rock, worn from that land, which would form a mountain-chain extending from Marseilles to the North Cape (1,800 miles), with a mean breadth of over 33 miles and an average height of 16,000 feet, or higher than Mont Blanc. The Silurian sea which spread across most of Central Europe into Asia suffered great disturbance in some regions towards the close of the Silurian period. It was ridged up into land inclosing vast inland basins, the areas of some of which are still traceable across the British Islands to Scandinavia and the west of Russia. An interesting series of geographical changes can be traced during which the lakes of the Old Red Sandstone were effaced, the sea that gradually overspread most of Europe was finally silted up, and the lagoons and marshes came to be densely crowded with the vegetation to which we owe our coal-seams. Later terrestrial movements led to the formation of a series of bitter lakes across the heart of Europe like those now existing in the south-east of Russia. Successive depressions and elevations brought the open sea again and again across the continent, and gave rise to the accumulation of the rocks of which most of the present surface consists. In these movements the growth of the Alps and other dominant lines of elevation can be more or less distinctly traced. It was at the close of the Eocene period, however, that the great disturbances took place to which the European mountains chiefly owe their present dimensions. In the Alps we see how these movements led to the crumpling up and inversion of vast piles of solid rock, not older in geological position than the soft clay which underlies London. Considerable additional upheaval in Miocene times affected the Alpine ridges, while in still later ages the Italian peninsula was broadened by the uprise of its sub-Apennine ranges. The proofs of successive periods of volcanic activity during this long series of geographical revolutions are many and varied. So too is the evidence for the appearance and disappearance of successive floras and faunas, each no doubt seeming at the time of its existence to possess the same aspect of antiquity and prospect of endurance which we naturally associate with those of our own time. The law of progress has been dominant among plants and animals and not less upon the surface of the planet which they inhabit. It is the province of the biologist to trace the one series of changes; of the geologist to investigate the other. The geographer gathers from both the data which enable him to connect the present aspects of Nature with those out of which they have arisen.

[1] Abstract of an Address given by Prof. Geikie, F.R.S., at the meeting of the Royal Geographical Society on March 24, 1879.

GEOGRAPHICAL NOTES

AT a recent meeting of the Board intrusted by the French Government with the care of granting missions for exploring foreign countries, it was decided that none of the regions proposed offered any special field for exceptional services rendered to science. The funds of the Government will be spent neither in exploring Central Africa nor in seeking the north pole, but in excavating Trojan ruins and examining some of the islands of the Asian Archipelago. It was also complained that no qualified traveller had been sent into civilised parts to study the progress of special arts and sciences. Such excursions as the celebrated "Voyage en Angleterre et en Irlande," accomplished by Baron Dupin in 1820 have rendered immense services to French industry, and the memory of it is not extinguished by the sixty years which elapsed. The sending of regular scientific missions abroad was inaugurated in France by the First Republic, for the purpose, not exclusively for cultivating anthropology, but for introducing into France the progress made by the foreign nations.