

THURSDAY, DECEMBER 9, 1880

BRITISH EARTHQUAKES

ON Sunday evening last week (28th Nov.) the northern parts of the British Isles were slightly shaken by an earthquake. The recent disastrous earthquake shocks in Croatia have called renewed attention to this still mysterious geological phenomenon, and now, while the subject is still fresh and under discussion, a milder visitation of the same nature reminds us that our islands are not wholly exempt from their share in the pulsations of the terrestrial crust. Save the vague and inexact newspaper paragraphs which chronicle the impressions of different observers, we have no information as to the direction of propagation of the earthquake wave of last week, its duration, relative intensity, and angle of emergence at different localities. It appears to have been one of the usual type of earth-tremors experienced in this country, and to have affected the region which, during the present century at least, has been most subject to such movements. It is reported as having been felt at many points in the central valley of Scotland and in the north-east of Ireland, also along the west coast as far north as the further end of the Long Island. Its effects appear to have been most marked over the area occupied by the crystalline schists. In Bute the house-bells rang. At Oban a portion of the plaster was detached from the ceiling of the parish church during the service of the Sunday-school. At Inverary also some plaster was loosened, and a sensation of nausea and giddiness is even said to have been experienced. At Blair Athole the oil in the table-lamps was thrown into undulations, which rose over half an inch up the side of the glass. Over the Lowland belt the effects were less perceptible, though they are alleged to have been distinctly felt as far as Edinburgh. By some observers the duration of the shock was estimated at two, by others at ten seconds. In some places the movement was thought to be from the north-west, in others, from the south-west. One of the phenomena duly chronicled in most of the narratives is the jingling and creaking made by crockery and furniture. Such is the usual meagre kind of detail out of which an explanation of the cause of earthquake movements in Britain is in truth hardly possible.

If we look back into the history of the subject numerous references to earthquake shocks will be found in the annals of the last seven or eight centuries in this country. And if the chroniclers are to be believed, some of these were of exceptional severity. According to the list compiled by Sir John Prestwich, shocks seem to have been specially numerous and severe in the twelfth century. Thus on the 2nd of August, 1134, England was shaken by an earthquake just at the very time that Henry I. was about to take ship for Normandy; "flames of fire burst forth with great violence out of certain rifts of the earth." On another occasion, in the same century, the bed of the Thames was laid bare at London. We read, too, of churches and other buildings having been from time to time thrown down, and of open rents having been left in the ground after the passage of the shock.

In the contemporary records of these phenomena the

geologist vainly searches for particulars that may serve to elucidate their origin. He finds much that is doubtfully correct, not a little that is obviously fabulous. Naturally the events were considered merely in their relations to the human population of the country, and those aspects of them were noted that bore special interest in that respect. Most frequently they were regarded in the light of divine judgments, and were connected with some real or imputed delinquency on the part of the inhabitants. We read, for instance, that on the 8th November, 1608, a rather smart shock of earthquake passed over Scotland. In the southern counties it was looked upon as a result of "the extraordinary drouth in the summer and winter before." But the more orthodox worthies in the farther north took a higher view of it. The kirk-session of Aberdeen met, and accepting the earthquake as "a document that God is angry against this land and against this city in particular for the manifold sins of the people," appointed a solemn fast for next day. On further reflection they came to recognise one sin in particular as having doubtless called down the judgment. For more than 150 years, in virtue of a bull granted by Pope Nicolas V., the proprietors on the banks of the River Dee had been accustomed to fish salmon on Sunday. These Sabbath-breakers were accordingly now summoned before the session and rebuked. Some of them agreed to give up their custom, but "some plainly refuset anyway to forbear." Again on 20th October, 1580, an earthquake occurred that particularly affected the house of the Master of Gray. The boy king, James VI. asking Fergusson, the minister of Dunfermline, "What he thought it could mean, that that house alone should shake and totter," was grimly answered by the divine: "Sir, why should not the devil rock his awn bairns?"

Doubtless many of the events chronicled in former centuries as earthquakes may not have been of that nature. Landslips and violent storms would account for some of the phenomena recorded. In looking over the lists of reputed earthquakes we cannot fail to notice that some districts of the country have been specially liable to the visitation. One of these has been the south-west of England, embracing the lower basin of the Severn with Somerset, Gloucester, Worcester, Cornwall, and the adjoining counties. Another notable area for a hundred years past has been the southern highlands of Perthshire.

After making every allowance for the vast multiplication of the means of recording passing events afforded by the extension of newspapers and the consequent increasing minuteness of detail in our domestic annals, there seems no reason to doubt that the number of earthquake shocks has increased during the present century, though possibly none may have reached the severity of some recorded in earlier periods. During the four years subsequent to September, 1839, upwards of 200 shocks were felt in Perthshire, some of which extended over nearly the whole of Scotland.

In searching for a possible solution of the problem presented by these terrestrial commotions one or two circumstances should be specially considered. In the great majority of cases where details of any kind have been preserved of the nature of the earthquakes, reference is made to noises that immediately preceded the actual

shock. In not a few instances these seem to have been the most alarming part of the phenomena. They are variously likened to the sound of a rushing wind, the roll of waggons, the muttering of thunder, or the rattle of cannon. With these aerial vibrations there are also recorded sounds as of a sudden snap or blow, or explosion in the earth underneath. Another feature of the earthquake-register is the persistence with which a relation is believed to exist between the commotion in the ground and the state of the atmosphere above. In some cases, indeed, the barometer is said to have suddenly fallen, and then to have risen after the shock had passed. Warm, damp, moist weather, heavy rain, thunder, strange electrical discharges, fire-balls, and other meteoric phenomena are chronicled as the concomitants of earthquakes. It may be said, of course, that the occurrence of these events together is only of the nature of a coincidence, and cannot conceivably be anything else. There can be no doubt, however, that in Britain, as on the Continent, earthquakes have been more numerous in the winter than in the summer half of the year. Of the fifty-nine earthquakes in Sir John Prestwich's list, as Prof. Prestwich has pointed out, eleven occurred in winter, eleven in spring, seven in summer, and eight in autumn. Out of 139 earthquakes recorded as having happened in Scotland up to September, 1839, eighty-nine occurred in the winter half of the year and fifty in the summer half. We cannot suppose that any variation in the meteorological condition of the atmosphere can directly give rise to an earthquake. Nevertheless it is conceivable that where the crust of the earth is in a condition of tension, rapid and extensive changes of atmospheric pressure may destroy an equilibrium that has previously been barely maintained. The observed relation between a low barometer and the more copious escape of fire-damp within coal-mines may possibly be of wider application.

It is evident, moreover, that the source of disturbance must be at no great depth from the surface. This is shown by the markedly local character of the phenomena. A shock of considerable violence which rends walls, overturns chimney-pots, rings bells, shakes furniture, and fills with alarm the inhabitants of a few parishes, but is quite unperceived in the districts around, cannot have a deep-seated origin. In looking at the districts specially liable to such visitations we notice in some degree a connection with geological structure. The earthquake area in the south-west of England embraces within its borders the ranges of the Malvern and Mendip Hills, which, with the surrounding country, point to a long succession of geological disturbances, while the hot springs that still rise there furnish additional indications of a connection between the heated interior and the surface. The most remarkable earthquake district in these islands at present is undoubtedly that of Comrie in Perthshire; where in the month of October, 1839, no fewer than sixty-six shocks were felt, the severest being perceived as far north as Dingwall, and as far south as Coldstream. During the last forty years the British Association has appointed two Committees to investigate the nature of the shocks so frequently experienced there. But their labours cannot be said to have as yet thrown much light on the subject. They have erected seismometers of

approved construction and sensitiveness, but in many cases shocks that have been distinctly perceptible to the inhabitants have not been registered by the instruments. Much speculation has been offered as to the cause that earth-tremors should be specially abundant in that district. Reference has been made by different observers to protrusions of granite and dykes of basalt which traverse the rocks, as if these igneous masses supplied a clue to the source of movement. But neither the granite bosses nor the dykes are specially conspicuous in the Comrie district. On the contrary, they are there small in area and few in number compared with their occurrence in other tracts where earthquake shocks are rare. A geological structure at Comrie, however, which so far as we are aware has not been dwelt upon in this connection, is the occurrence there of the great fracture by which the southern edge of the Scottish Highlands is bounded. The Old Red Sandstone with its associated volcanic bands has been thrown on end against the crystalline schists. Of the extent of the dislocation no precise measurements have yet been made; probably the amount of upthrow varies along the line. At the north-eastern end of the fracture the sandstones and conglomerates have been placed on their ends for about two miles back from the fault. The line of dislocation can be traced across the island from sea to sea and across the island of Arran, whence it points for Ireland. It is probably one of the largest, as it certainly is the longest, fracture within the British area. On its north-western side lie the crumpled schists of the Highlands; on its south-eastern boundary are the dislocated, curved, and even inverted strata of the Old Red Sandstone. Two series of rocks of very different structure and elasticity are here brought abruptly together along a vertical or at least steeply inclined face, which must descend for several thousand feet from the surface. So far therefore as geological structure can be supposed to govern the origin and effects of earthquakes there does not appear to be within these islands any line or district where terrestrial disturbances should be so readily felt as along the flanks of the Scottish Highlands. Shocks coming from the Lowlands will recoil against the crystalline wall of the Highland schists, and be consequently more perceptible there than over the more homogeneous formations lying to the south. Another area in which earthquakes have been frequently observed is that of the Great Glen. This longest, straightest, and deepest of British valleys has from early geological times been a line of weakness.

There seems every probability in the supposition that some at least of our earthquakes result from the sudden collapse of rocks that have been under great strain. Their occurrence along lines of powerful fault suggests that the rocks on one or both sides of these dislocations are still subject to great tension, and that occasional relief is obtained by a snap which is powerful enough to generate an earthquake, though it gives rise to no change of level at the surface. When we reflect upon the constant strain on the terrestrial crust as it settles down upon the more rapidly contracting nucleus, we may be allowed to be grateful that earthquakes are not everywhere more numerous and destructive.