from the preceding, under Gyrn Goch near Clynnog. The hand-specimen is rather coarsely crystalline; a dark-green ground with bronze-coloured bisilicates. Golden-coloured mica fairly abundant. Active effervescence with acid.

Microscope.—The predominant mineral in the slide is hornblende. Of this, there appear to be three varieties: (1) Seemingly an original constituent with characteristic cleavage, and strong dichroism, giving shades of brown; (2) perhaps an altered form of this, less strongly dichroic, giving shades of green; (3) certainly of secondary formation, a kind of tremolite, almost colourless. There is, however, some augite, also an original constituent. There appears to have been a fair amount of felspar, but it is now replaced by various secondary constituents, such as earthy matter, zeolites, calcites, etc. Opacite, perhaps magnetite, a little apatite, calcite, serpentinous looking, and other decomposition products are present.

[Cl. 1.] *Pentrebach*, a hill E. of Llanaelhaiarn near Clynnog; a purplish-grey, fine-grained felsitic rock with small brownish-yellow felspars; slight effervescence with acid.

Microscope.—The ground-mass is rather decomposed, but shows in places the remains of a wavy branching fluidal structure. With crossed Nicols we see it to be cryptocrystalline. There are some grains of quartz and a good many crystals of rather decomposed felspar; plagioclase seemingly predominating. There is a fair amount of iron peroxide, probably hematite, in most cases associated with and replacing parts of felspar crystals. We note also a little epidote and traces of a pyroxenic mineral. There is a curious case of one quartz crystal inclosing another. The rock was probably once a lava, akin to rhyolite.

T. G. B.

IV.—AN ACCOUNT OF VOLCANIC ERUPTIONS AND EARTHQUAKES WHICH HAVE TAKEN PLACE IN ICELAND WITHIN HISTORICAL TIMES.

By THORVALDR THORODDSEN.

FEW spots on the face of the globe of the extent of Iceland could be mentioned where, within the same space, an equal number of volcanos could be found. In that island, too, many volcanic eruptions have occurred, which have been, perhaps, of greater magnitude than any others recorded as having taken place anywhere else on the earth. And yet the volcanos of Iceland are but imperfectly known, and, with the exception of two or three, not one of the rest has ever been scientifically examined. Hence the fact, that geological manuals so frequently contain most erroneous statements concerning this subject. A general uncertainty prevails as to how many volcanos have actually been in a state of eruption within historical times; dates are dealt with in a confused manner; and frequently mountains come to figure as volcanos which have never shown any signs of eruptive activity.

Yet, by critically sifting Icelandic records on this subject existing in print and MSS., a pretty exact and accurate list may be drawn

up of volcanic eruptions and earthquakes, which, within historical times, have occurred in Iceland. And of these phenomena I beg to offer a short review, being an abstract of a larger work on the subject, which I have in preparation, wherein each eruption and each earthquake will be carefully and minutely described, and the authorities critically tested on which the evidence rests.

The following is a list of volcanos which within historical times have been in a state of volcanic activity, and of earthquakes which have occurred within the same period.

ELDBORG (Fire-burgh, $64^{\circ} 47'$ north lat. $34^{\circ} 54'$ west long. mer. Copenhagen¹) in the district of *Myrasysla* (Fen-bailiwick, Bailiwick of the Fen country), the first crater mentioned in history in a state of eruption in Iceland. It is about 200 feet high, situated in the midst of a plain, and surrounded on all sides by lava.

HEKLA (The Mantle; the name doubtless derived from its shape at a distance reminding the beholder of a bemantled corpulent woman, $63^{\circ} 59'$ n.l. $32^{\circ} 19'$ w.lo.), the most famous of all Icelandic volcanos; seven geographical miles inland from the nearest point of the coast. It is 4956 feet high, piled up of blocks of lava, masses of pumice-stone and ashes. Parallel with this somewhat strongly longitudinally shaped mountain, there run from S.W. to N.E. ridges of other mountains, composed of palagonite breccia and tufa. All around Hekla vast stretches of lava, produced by countless successive eruptions, extend in every direction. On the mountain itself, as well as in its immediate neighbourhood, a great number of craters may be observed. This is the most widely and most accurately known of all Icelandic volcanos.

RAUÐU-KAMBAR (Red Combes, $64^{\circ} 12'$ n.l. $32^{\circ} 25'$ n.lo.), a ridge of mountains following the direction of the line of Hekla, has, so far as is historically known, erupted only once, A.D. 1343. The land all about this range is covered with sand and ashes.

REYKJANES (Reek [= Smoke or Steam]-ness), volcanic throughout; it consists of alternate layers of tufa and trap, rising up to plateaux of 400 feet high, on the surface of which there is a long series of volcanos rising even to the height of 2000 feet, but now mostly extinct. This series of volcanic peaks takes the same direction as the line of Hekla. A number of volcanic springs and earthquake chasms are to be found all about this neighbourhood.

ÞURRÁR-HRAUN (Dry-river lava, 64° n.l. $33^{\circ} 55'$ w.lo.), the outcome of an eruption which happened A.D. 1000, on the upland plateau called *Hellis-heiði* (=Hollow-heath, i.e. the cavernous heath; even to-day it sounds cavernous in certain places, as the traveller rides over it); it took an easterly current over the plateau, and issued finally through a pass on the eastern, somewhat precipitous, side of it into the lowland plains below.

TRÖLLA-DYNGJA (Trolls' bower, $63^{\circ} 56'$ n.l. $34^{\circ} 14'$ w.lo.), one of the many peaks that stud the volcanic ridge of *Reykjanes*, is situated to the N.W. of the sulphur mines of *Krisuvík*. Six eruptions from

¹ The meridian of Copenhagen is used because it is the meridian employed in Gunnlögen's Map of Iceland, the largest, fullest, and most correct existing.

this peak are on record, which have been erroneously transferred by various writers to a volcano of a similar name in the north of Iceland.

ELD-EYJAR (Fire-isles), a series of volcanic rocks situate in the sea $1\frac{1}{2}$ geographical miles off the S.W. point of *Reykjanes*; about the neighbourhood of these rocks, and sometimes as far out at sea as eight miles from the land, volcanic eruptions are known to have taken place.

In the extensive complex of glaciers, comprehensively denominated as MÝRDALS-JÖKULL (Moor [= Fen] -dale-jökul [= icle, i.e. ice = glacier]), S.E. of Hekla, there are two volcanos: Eyja-fjalla-jökull (Isle-fell-glacier, deriving its name undoubtedly from the islands, called Vest-manna-eyjar, i.e., the West-mens' = [the Irishmen's] Islands, so called from the fact of their having been occupied, when the country was discovered, by Irish hermits,—a group of islands outside the coast from which the Eyjafjöll (Isle-fells) rise — $63^{\circ} 37'$ n.l. $32^{\circ} 16'$ w.lo.), 5432 feet high; and KATLA (Kettle, Caldron), which is not shaped like a volcano, but is merely a volcanic chasm, generally covered with ice. It is situate in the eastern part of Mýrdals-jökull ($63^{\circ} 37'$ n. l. $31^{\circ} 35'$ w. lo.); but has never been explored. Eyjafjalla-jökull has twice been in a state of eruption, but Katla thirteen times. It should be observed that eruptions from these last-named eruptive sources, as well as indeed from some other mountains in Iceland, are accompanied by enormous floods of water, bringing down huge blocks of ice, which covered the surface of the crater before the eruption took place. The lowlands below such volcanos represent extensive and entirely barren wastes, which have been produced by the masses of pulverized lava and the prodigious glacier-slips which are brought down by the inundations caused by the eruptions. To the N.E. of Mýrdals-jökull are many craters to be found in the so-called Varmár-dalr (Warm-river-dale), in the neighbourhood of *Skaptá* (Shaft-river?), as well as in the vicinity of Hverfisfjót (Wharf-fleet), which in 1783 emitted enormous masses of lava.

Along the borders of *Vatna-jökull* (Waters' glacier), a glacial upheaval of no less than 150 square geographical miles in extent, volcanos are found in great number. On its southern boundary, the easternmost is ÖRÆFA-JÖKULL (Desert-glacier, 64° n.l. $29^{\circ} 21'$ w.lo.), the highest mountain in Iceland, rising to 6241 feet. This mountain has been in a state of eruption three or four times. Some distance to the westward, on the borders of Skeiðarár-jökull, various craters are found, as also in the neighbourhood of *Grímsvötn* (Grim's waters), and *Síðujökull* (Side-glacier), where many and most violent eruptions have taken place. But these tracts constitute as yet a *terra incognita*. On the northern border of *Vatnajökull* we find *Kverk-fjöll* (Kverk = throat, $29^{\circ} 20'$ w.lo.), almost entirely unknown, although eruptions have taken place in that neighbourhood three or four times. To the north of *Vatna-jökull* is the so-called *Odáðahraun* (Misdeed-lava), 60 square geographical miles in extent, where there are a good many almost entirely unknown volcanos. The only volcanic spot in these tracts which has been examined is the *DYNGJU-FJÖLL*,

situated in the centre of this desert of lava. It is a complex of mountain-peaks rising up to even 4500 feet high, inclosing the circularly formed valley called *Askja* (=the Basket, measuring one square geographical mile in extent, and situate 3900—3500 feet above the level of the sea), where a terrific eruption took place in 1875. In the S.E. corner of this valley is found a 'dip' in the earth 750 feet "down," within which there is a round hot lake, 4000 feet in diameter. Around the edge of this dip many large craters are situated. The bottom of this valley is covered with lava, which represents an eastward incline of $1^{\circ} 26'$ towards the mouth of the valley, which opens into the surrounding lava-waste of *Óðáðahraun*.

About the lava-plateau, called *Mývatns-öræfi* (Mosquito-water-wastes), which stretches northward from the surroundings of *Dyngju-fjöll*, great eruptions occurred during the same year in which that of *Dyngju-fjöll* was going on (in 1875); and in a certain hollow in this tract called *Sveina-gjá* (Swains' rift) many new craters were formed rising to the height of 70 to 108 feet. These craters range on a line in the direction from S. to N.

All round *Mývatn* (Mosquito-water) there is an enormous number of craters, lava-formations, sulphur-mines and hot springs. This neighbourhood was visited by very severe eruptions during the period from 1724 to 1730. The chief volcanos are *KRAFLA* and *LEIR-NUKKR* (Clay-peak), which form ridges of palagonite running from S. to N. During the period of volcanic disturbance just mentioned similar activity was also going on in *Hrossa-dalr* (Horse-dale), *Bjarnar-flag* and about the site of the so-called *Reykjahlíðar-sel*.

I have now enumerated all the volcanos which are known to have been in a state of volcanic activity in historical times in Iceland. But besides these there is to be found in the country an enormous number of extinct volcanos; and some tracts of the island, as, for instance, the whole neighbourhood of *Mývatn*, are so thickly studded with these reminders of prehistoric convulsions as to give the beholder an impression of having before him a map of the Moon.

By observing the geological construction of Iceland, it will be found, that there are still two volcanic lines in active condition; lines, which manifest themselves not only by the direction which the craters generally represent, or by the rifts and chasms of the volcanos, but stand in close relation to the formation of the country generally. The one line goes from S.W. to N.E. represented by the *Reykjanes* peaks, *Hekla*, and several other volcanos of Southern Iceland. The other line runs from S. to N., on which, in straight rows, are standing the craters of the volcanos round *Vatnajökul* and *Mývatn*. These lines, we also observe, are represented by the mountain-ranges, valleys, firths, and rivers of the country. Hot springs and mines (sulphur), we observe, occupy the same lines, which are also followed by the earthquakes. Ranges of peaks, of trachyte, which have shot up through older formations, follow this same law, and submarine reefs go in the same drift.

The volcanos which are still active in Iceland seem to be mostly associated with palagonite-tuffa.

At the following dates eruptions and earthquakes have taken place in Iceland in historical times :

A.D.

- c. 900 Eldborg erupted about the year 900; there are no means of more accurately defining the precise year of this eruption.
- 894 First eruption from *Katla*. The land between *Eyjará* (Island-river) and *Hólmsá* (Holme's-river) was laid waste, and a whole district, *Dynskógahverfi* (Wharf of the rustling woods) was never afterwards inhabited. Ruins of homesteads destroyed this year were found in the beginning of the 17th century.
- 934 Second eruption from *Katla*. Then, as the tale goes, the *Jökulsá* on *Sólheimasandr* (Sun-home-sand) came into existence.
- 1000 Eruption from *Hellisheiði*, when *Purrárhraun* was formed, which flowed down into the close vicinity of the farm *Hjalli* in the district of Olves.
- 1013 Earthquakes about the country; 11 persons perished.
- 1114 First eruption from *Hekla*; the ensuing winter was called "sand-fall-winter."
- 1151 First eruption from *Trölladyngjur*; houses fell in, in many places, from earthquakes, and loss of life took place.
- 1157 Second eruption from *Hekla*, 19th Jan., accompanied by violent earthquakes.
- 1164 Earthquake in *Grimsmes*, loss of 19 lives.
- 1182 Earthquake, loss of 11 lives.
- 1188 Second eruption from *Trölladyngjur*.
- 1206 Third eruption from *Hekla*, 4th December, which continued far into the spring.
- 1211 First eruption off *Reykjanes* in the tract of the *Eldeyjur*. Great earthquakes about the South-country, loss of 18 lives.
- 1222 Fourth eruption from *Hekla*.
- 1225 The winter of this year is called "Sand-winter," but the locality of the eruption is unknown.
- 1226 Second eruption off *Reykjanes*.
- 1231 Third ditto.
- 1238 Fourth ditto.
- 1240 Fifth ditto. Excessively violent earthquakes throughout the South-country. This year, it is reported, one half of *Reykjanes* was laid waste.
- 1245 Third eruption from *Katla*. The glacier-slip swept over *Sólheimasand*. Ashes covered the earth to the extent of $\frac{1}{4}$ of an ell.
- 1260 Great earthquakes about the North country.
- 1262 Fourth eruption from *Katla*, swept over *Sólheimasand*.
- 1294 Fifth eruption from *Hekla*. Violent earthquakes; huge chasms opened in the earth; wells and fountains became white as milk for three days; *Rangá* (Wrong-river) changed its course; rivers were covered with pumice. Some new hot springs came into existence, others vanished.
- 1300 Sixth eruption from *Hekla*, July 13th, one of the most violent on record. The ashes were borne by a S.W. wind over the North-country and covered a large portion of it. Great earthquakes. Famine and great loss of life followed.
- 1308 Earthquakes throughout the South-country. Eighteen homesteads reduced to ruins.
- 1311 Fifth eruption from *Katla*, Jan. 25th, preceded by violent earthquakes; 51 homes fell in. A whole district near *Katla*, called *Lágeyjarhverfi* (Low-isle-wharf), was laid completely waste.
- 1332 Eruption somewhere about the district called *Siða* (the Side); exact locality unknown.
- 1339 Earthquake in the South-country; many homesteads fell in; a hot spring, forty fathoms in circumference, was formed in *Henglaßjöll* (= the overtopping-fells).
- 1340 Third eruption from *Trölladyngjur*.
- 1341 Seventh eruption from *Hekla*; the ashes fell all about the South-country, many homes were destroyed by earthquakes this year.
- „ Eruption from *Oræfajökull*.
- 1343 Eruption from *Rouðukambar*; eleven homesteads completely destroyed.
- 1349 or 1362 (the annals are most conflicting as to the date). A succession of most fearfully violent eruptions from *Oræfajökull* took place. When the ice-cover of the mountain was thrown off, and came down with the rush of the waters

- to the sea, it carried so much with it of stones, sand and debris, that, where formerly the sea measured a depth of 30 fathoms, there was a dry beach after the eruption. Five fertile districts were laid totally and irretrievably waste; forty homesteads and two churches were swept away in the flood.
- 1360 Fourth eruption from *Trölladyngjur*.
- 1370 Earthquakes; eleven homesteads fell in in *Olves*.
- 1388 Eighth eruption from *Hekla*.
- „ Fifth eruption from *Trölladyngjur*.
- „ Eruption from *Síðujökull*.
- 1391 Earthquakes throughout *Grimsmes*, *Flói* (the Bog) and *Olves*; fourteen homesteads damaged; loss of life. The earthquakes went northward as far as *Holtavörðukeiði* (Heath of the beacons on the hill-rises).
- 1416 Sixth eruption from *Katla*.
- 1422 Sixth eruption off *Reykjanes*.
- 1436 Ninth eruption from *Hekla*, eighteen homesteads destroyed.
- 1477 Eruption in the unknown Wildernesses, great fall of ashes in the North-country, followed by famine and loss of life.
- 1510 Tenth eruption from *Hekla*, July 25th; great fall of ashes, huge blocks of lava were cast at a long distance out of the mountain; many people were killed by these falling.
- „ Sixth eruption from *Trölladyngjur*.
- 1546 Earthquakes in *Olves* in the beginning of June, many homesteads tumbled down.
- 1552 Earthquakes on the 2nd of February.
- 1554 Eleventh eruption from *Hekla* towards the end of May; took its rise from the mountain range which goes in a N.E. direction from *Hekla*. Earthquakes so frequent and violent that people were obliged to live in tents the greater part of the summer.
- 1578 Twelfth eruption from *Hekla*, November 15th.
- 1580 Seventh eruption from *Katla*; several farmsteads destroyed.
- 1581 Great earthquake through *Rangarvellir*, May 30th.
- 1583 Seventh eruption off *Reykjanes*.
- 1584 Earthquakes.
- 1597 Thirteenth eruption from *Hekla*, excessively violent, began January 3; the loud reports were heard for twelve successive days even in the northernmost parts of the country; eighteen columns of fire were seen rising from the mountain. Left off in March, but the mountain continued to smoke even up to July; the ashes covered about one-half of the country, from *Borgarfjörðr* (Burg-firth) in the West to the district called *Lón* (Wash) in the east, and North as far as *Bárðardal* (Bárd's-dale). This same spring there occurred earthquakes about *Olves*, through which many farmsteads fell in and a large hot spring to the south of the farm-house of *Reykir* disappeared, and another opened elsewhere.
- 1598 Eruption about *Grimsvötn* and from *Orafajökull*.
- 1612 First eruption from *Eufajallajökull*.
- 1613 Great earthquakes in the South-country, many homesteads tumbled down.
- 1618 Earthquakes frequent in the autumn about the district of *Thingeyjarsýsla* in the North.
- 1619 Fourteenth eruption from *Hekla*. Great fall of ashes in the North.
- 1624 Earthquake in *Flói* in the month of November.
- 1625 Eighth eruption from *Katla*, September 2-4. Great fall of ashes; some ashes fell in *Bergen* in Norway.
- 1633 Earthquakes in *Olves*.
- 1636 Fifteenth eruption from *Hekla*; began May 8; thirteen craters opened; ashes fell mostly in the South-East of Iceland.
- 1638 Eruption in the wildernesses in the East-country, February 27th.
- 1643 Earthquakes on Christmas Eve.
- 1657 Earthquakes, many homesteads fell in in *Flyótshlíð* (Fleet-leeth).
- 1660 Ninth eruption from *Katla*, began November 3rd; such was the quantity of sand, stones and debris borne down with the flood from the mountain, that a dry beach was formed where formerly people fished in a depth of 20 fathoms; the coast was pushed 1000 fathoms out into the sea; five or six farmsteads were destroyed.

- 1661 Earthquakes during the summer.
- 1681 Eruption from *Skeiðarárjökull*.
- 1685 Eruption in the neighbourhood of *Grimsvötn*.
- 1693 *Sixteenth* eruption from *Hekla*, February 13th, left off in August. Four craters were active. The ashes fell all over the country, and were carried even over to Norway. The pumice masses drifted all the way to *Faro*.
- 1706 Severe earthquakes in *Olves* and *Flói*, April 1st and 20th. Twenty-four manors fell in and many cottages.
- 1716 Eruption in the neighbourhood of *Grimsvötn*.
- 1717 Eruption from *Kverkfjöll*, September 17th. *Thingeyjarsýsla* suffered great damage from the ashes, which also fell in *Eyjafjarðarsýsla* and *Múlasýsla*.
- 1721 *Tenth* eruption from *Katla*; began May 11th with excessive floods and glacier-slips; the ice-blocks grounded in depths of from 70-80 fathoms 3 (Danish) miles out at sea. A grass-grown neck of land was swept away, and in its stead was left a polished slab of rock 6750 square fathoms in extent. The ashes were borne westward, and fell so thick the first day that at homesteads 25 geographical miles distant from the crater the light was obscured to such an extent as to make reading of print impossible.
- 1724 Eruption from *Kröfla*, May 17th, great masses of ashes and pumice issued from a crater on its western side called *Víti* (Hell); on the eastern shores of *Myvatn* the layer of the ashes was $1\frac{1}{2}$ ell thick.
- 1725 Eruption from *Leirhnúkr*, January 11th, accompanied by severe earthquakes. Eruption from *Bjarnarfag*, April 19th; violent earthquakes on the 8th of September. Eruption in *Skeiðarárjökull*.
- 1727 Eruption from *Oræfajökull*, August 3rd, great floods from the glacier, which destroyed homesteads and killed cattle; the eruption abated May 25th, 1728. At the same time great disturbances were observed in *Skeiðarárjökull*, and on August 21st an eruption took place from *Leirhnúkr*.
- 1728 Eruption from *Leirhnúkr*, April 18th, preceded by severe earthquakes, the lava flowed almost close down to the parsonage of *Reykjahlið*; the same day an erupting crater opened in *Hrossadalr*, while another eruption also took place in *Bjarnarfag*. April 20th great masses of lava welled out in the neighbourhood of *Reykjahliðarsæl*, from a crater situate on the eastern slope of *Dalffjall*. December 18th *Leirhnúkr* was in eruption and this same year volcanic action was going on in the lava wastes round *Hekla*.
- 1729 Eruption from *Leirhnúkr*, January 30th, which continued through the year; huge masses of lava flowed from the volcano in the direction of *Reykjahlið*, which stead was destroyed, together with three others. Only the church of *Reykjahlið* was left standing.
- 1734 Earthquake in the *Flói*.
- 1749 Earthquakes throughout *Olves* and *Borgarfjörð*; the hot spring of *Skrifla* diminished and grew colder than before.
- 1752 Earthquake in *Arnessýsla*; 12 farmsteads were damaged and one church fell in.
- 1753 Eruption in the neighbourhood of *Síðujökull*, accompanied by great glacier floods; the river *Djúpa* (Deep river) rose by 200 feet, devastating the surrounding lands; the district of *Skaptártunga* was completely covered with ashes.
- 1754 Eruption in the lava fields to the westward of *Hekla* which lasted for three days.
- 1755 Severe earthquakes for six days, September 10-15, in the North-country, especially about *Húsavík*, during which twenty-one homesteads were destroyed. October 17th a formidable eruption began from *Katla*—the *eleventh*—which went on till August, 1756. Glacier-floods and ashes created vast devastation. The land all about *Skaptafellssýsla* was covered by a layer of ashes from $\frac{1}{4}$ to 1 ell in thickness, and fifty homesteads were destroyed.
- 1766 *Seventeenth* eruption from *Hekla*, accompanied by severe earthquakes to the S.W. of it all the way out to *Reykjanes*.
- 1774 Eruption in the wildernesses about *Skeiðarárjökull*.
- 1783 *Eighth* eruption off *Reykjanes*. Great eruptions about *Varmárdalur* along *Skaptá* began in June, and after some intermission were repeated towards the end of July about the sources of *Hverfisfljót*. These eruptions were of a magnitude unparalleled on the earth in historic times. The lava which they produced exceeds, on the authority of Sir Charles Lyell, in cubic contents the mass of Mont Blanc. These eruptions were followed by famine and great loss of life—

- in fact they proved fatal to 9,000 human beings, 21,000 cattle, 233,000 sheep and 36,000 horses. These eruptions are erroneously stated to have taken place in *Skaptárjökull*, where an eruption has never yet occurred.
- 1784 Earthquake in *Arnessýsla*, August 14-16, the severest in historical times, destroying 69 homesteads. Eruption from *Skeiðarýrjökull*.
- 1789 Earthquakes in the South-country, especially in the neighbourhood of *Thingvallavatn* (Thing-wall-water [lake]).
- 1808 Earthquakes in many places about Iceland.
- 1810 Earthquake, October 24th, to the east of *Hekla*.
- 1815 Earthquake, during the month of June, in the North-country.
- 1818 Slight earthquakes in the South-country.
- 1821 Second eruption from *Eyjafjallajökull*.
- 1823 Twelfth eruption from *Katla*, commencing June 26th, continued for 28 successive days. Same year eruption in the neighbourhood of *Skaptá* by *Farmardalur*.
- 1826 Earthquake in the North-country.
- 1829 Earthquake in the South, February 22nd; seven homesteads fell in.
- 1830 Ninth eruption off *Reykjanes*.
- 1838 Earthquakes from 12th to 19th June, both in the North and in the South.
- 1839 Earthquake in the neighbourhood of *Reykjavík*, July 28th.
- 1845 Eighteenth eruption from *Hekla*, commenced on the 2nd of September and continued for seven months. The ashes were carried over to *Shetland* and the column of smoke rising out of the mountain reached a height of 14,000 feet. The lava which this eruption produced contained a mass of 14,400 millions cubic feet.
- 1855 Slight earthquakes in the North.
- 1860 Thirteenth eruption from *Katla*, May 8-27; earthquakes in the autumn.
- 1862 Eruptive activity in the wildernesses about *Fatnajökull*.
- 1863 Earthquakes about *Reykjavík*, April 20-21.
- 1864 Earthquake February 16th.
- 1867 Eruption from *Kverkfjöll*, August 29—September 5.
- 1868 Earthquake in the South, November 1-3.
- 1872 Violent earthquakes at *Húsavík* in *Thingeyjarsýsla*, April 17th, the disturbances abated not till the middle of May, many homes came down.
- 1873 Eruption in *Kverkfjöll*, January 8-13; considerable fall of ashes in the East and the South.
- 1875 Eruption from *Dyngjufjöll*, January 3rd; February 18th, an eruption commenced in *Sveinagjá* on *Mývatnsöræfi*, which continued to the end of the year. March 29th, a formidable explosion took place in *Dyngjufjöll*, which covered the whole of Eastern Iceland with pumice and ashes; the latter being carried all the way to Norway and even Sweden.
- 1878 Earthquake to the N.E. of *Hekla*, accompanied by somewhat severe shocks of earthquake, commenced February 27th, terminated in May.
- 1879 Tenth eruption off *Reykjanes*, May 30 and 31.

I have enumerated the eruptions about which full certainty is obtainable. Lists of eruptions and earthquakes in Iceland have been drawn up by various writers, as, for instance, *Haldór Jakobsson* (1757), *G. Garlieb* (1819), *Eugen Robert* (1840), and *F. Zirkel* (1862); but into these accounts various mis-statements have crept, owing, partly, to the records being treated with lax criticism, and, partly, to insufficient familiarity with the topography of the country. The more recent writers have mostly followed *Haldór Jakobsson* and *Garlieb*, without studying the original records, and the errors which the writings of these authors contain are mostly traceable to their sources.

Of the volcanos, and volcanic localities, which the authorities referred to state to have been in activity at various times, the following may safely be struck out: *Asmundarnúpr*, *Thóreyjarnúpr*,

c. 900	Eldborg.
1211 1226 1231 1238 1240	Off Reykjanes about Eldeyjar.
1151 1188	Trölladyngjur.
1000	Þurrárhraun.
1114 1157 1206 1222 1294	Hekla.
1300 1331 1389	Rauðukambar.
1343	Eyjafjalla- jökull.
894 934	Katla.
1245 1262	Varmárdalur.
1311	Síðujökull.
1389	Grímsvötn.
1598	Skeiðarárjökull.
1683 1681	Öræfajökull.
1598	Eruptions in the Wildernesses.*
1477	Kverkfjöll.
1225 (?)	Dyngjufjöll.
1341 1332 (Sifða)	Sveinagjá.
1362	Krafla.
1477	Leirhnúkr.
1638	Hrossadalr.
1667 1673	Bjarnarflag.
1675	Dalfjall.

(The Volcanos are arranged according to the site they occupy in the country.)

* These eruptions did not occur in Hekla itself, but in the lava-wastes, and mountain ranges in the neighbourhood of it.

+ Eruptions which have occurred in the wildernesses are placed here because most of them have in all probability taken place in the vicinity of *Valnajökull*.

Hofsjökull, Baldjökull, Þestareykir, Fremri-Námar, Hverfjall, Sandfellsjökull, Herðubreið, Skaptárjökull, Sólheimajökull, Breiðamerkjökull, Þórsfjörk, Torfajökull, Mosfell, Helgafell.

The following eruptions are referred to wrong dates: *Hekla*, 1004, 1029, 1113, 1374, 1583, 1625, 1772; *Katla*, 1717, 1727; *Trölladyngjur*, 1475; *Herðubreið*, 1341, 1510; *Skaugjökull*, 1728; *Oræfajökull*, 1720; an eruption in *Breiðfjördr*, by *Snæfellsnes*, 1219, and 1345; *Hverfjall*, 1748-1752; *Þingvallahraun*, 1587; *Þórsfjörk*, 1300-1350.

NOTICES OF MEMOIRS.

I.—BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,
FIFTIETH MEETING, SWANSEA, AUGUST 26TH, 1880.

TITLES OF PAPERS READ IN SECTION C. (GEOLOGY).

Opening Address by H. C. SORBY, LL.D., F.R.S., President.—“On the Comparative Structure of Artificial Slags and Eruptive Rocks.” (See p. 468.)

C. E. De Rance, F.G.S.—Report on the Circulation of the Underground Waters in the Permian, New Red Sandstone, and Jurassic Formations of England; and on the quality and character of the water supplied to towns and districts from those formations.

A. R. Hunt, F.G.S.—Notes on the Submarine Geology of the English Channel off the Coast of South Devon.

Prof. W. Boyd-Dawkins, M.A., F.R.S.—On the Action of Carbonic Acid on Limestone.

F. C. J. Spurrell, F.G.S.—On the Site of a Palæolithic Implement Manufactory, at Crayford, Kent.

Prof. J. P. O'Reilly.—On the Relations to be Established between Coast-line-Directions represented by Great Circles on the Globe, and the localities marked by Earthquakes in Europe.

G. H. Kinahan, M.R.I.A., Pres. Geol. Soc. Ireland.—On the Hiatus said to have been found in the rocks of West Cork.

W. H. Dalton, F.G.S.—Note on the Range of the Lower Tertiaries of East Suffolk.

W. Pengelly, F.R.S., F.G.S.—Sixteenth Report of the Committee appointed to explore Kent's Cavern, Devonshire.

Prof. A. Leith Adams, F.R.S.—Report on the Exploration of Caves in the South of Ireland.

Prof. H. G. Seeley, F.R.S.—Report on the Viviparous Nature of the *Ichthyosauria*.

G. R. Vine.—Report on the Carboniferous Polyzoa.

W. Whitaker, B.A. Lond., F.G.S.—Report on the “Geological Record.”

Prof. W. J. Sollas, M.A., F.G.S.—On the Island of Torghatten, Norway; and on the Influence of Joints on Denudation.

Prof. W. J. Sollas, M.A., F.G.S.—On the Contortion of a Quartz-vein in Mica-schist from Bodö, Norway.