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MAP OF SCOTLAND
Engraved
for the Outline of the
Mineralogy
OF THE SCOTTISH ISLES.
NORTHERN OCEAN
ORKNEY ISLANDS
PENTLAND FIRTH
SUTHERLAND SH.
CAITHNESS SH.
DORNOCH FIRTH
MORAY FIRTH
LEWIS
HARRIS
N. UIST
ROSS SH.
ELGIN SH.
BANFF SH.
ABERDEEN SH.
INVERNESS SH.
KINCARDINE SH.
BRITISH
ANGUS SH.
PERTH SH.
FIRTH of TAY
MULL
ARRAN
ARGYLE SH.
WESTERN
SEA
FIFE SH.
FIRTH of FORTH
STIRLING SH.
DUNBARTON SH.
RENFREW SH.
LINLITHGOW SH.
EDINBURGH SH.
HADDINGTON SH.
BERWICK SH.
OCEAN
LANERK SH.
PEEBLES SH.
SELKIRK SH.
ROXBURGH SH.
AYR SH.
RUMFRIES SH.
IRISH SEA
KIRKUDBRIGHT SH.
WIGTON SH.
WIGTON BAY
SOLWAY FIRTH
ENGLAND
IRELAND
Geographical Miles &c to a Degree.
Longitude West from London

MINERALOGICAL TRAVELS

THROUGH THE

HEBRIDES, ORKNEY AND SHETLAND ISLANDS,

AND

MAINLAND OF SCOTLAND,

WITH

DISSERTATIONS UPON PEAT AND KELP.

IN TWO VOLUMES,

ILLUSTRATED WITH MAPS AND PLATES.

BY ROBERT JAMESON,

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VOLUME I.

EDINBURGH:

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1814

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PREFACE.

I UNDERTOOK the journeys, of which I now preſume to lay the notes before the public, in order to acquire, from actual obſervation, a knowledge of the mineralogy of the Scottiſh Iſles.

I have choſen the form of a journal, becauſe I wiſhed to convey the information I had gleaned in the ſtile of detailed obſervation, and in that order which the appearance of the country naturally ſuggeſted. But, in adopting this form, I am anxious to caution the reader againſt expecting that entertainment, and kind of information, which form the groundwork of the many journals through the more intereſting parts of our iſland. If any one ſhall find this Outline of the mineralogy of theſe countries deficient in incident, in epiſodes and ſtories, and in deſcriptions of pictureſque and romantic

ſcenery; let him recollect, that to indulge in ſuch deſcriptions was incompatible with the deſign of this work. I do not deſpiſe thoſe ornaments; and I hope that I have not been inſenſible to the emotions which naturally ariſe from the retired and ſtriking ſcenes which often burſt upon me in the unfrequented tracts which my purſuits led me to explore: but I have thought it foreign to my purpoſe to obtrude theſe things upon the public.

Another reſolution I had formed to myſelf, and which partly indeed led me to chooſe the form of a journal, was, to ſhun the faſcinating evil of ſpeculation and hypotheſis, which mars all faithful obſervation. It would ill ſuit my talents to venture upon deep ſpeculation, were I inclined; and perhaps the ſtate of mineralogical knowledge forbids it. It is a fitter taſk for me to record faithfully what I have myſelf examined, and to give a fair report of the materials which were collected, than to expoſe myſelf, by the form or arrangement of the work, to the danger of having the facts twiſted and perverted by hypotheſis, the rage for which is as remarkable in this as in the other ſciences.

While, in mineralogical purſuits, there is much to intereſt a philoſophical mind, the object of true value is its application

to

to economical purpoſes. I fear that the theories of the formation of the earth, intereſting as they are, often miſlead the mind, and pervert the underſtanding; and thoſe who yield to them, become ſo involved in deluſive ſpeculations, ſo blind to fact and experience, that, like Archimedes, they find but one thing wanting to raiſe worlds.

Of the utility of this ſcience there can be no queſtion; more particularly when it is freed from the vague ſuppoſitions of the theoriſt. It is a ground-work, without which the obſervations of the geologiſt, and the labours of the miner, will ever be uncertain, and of little utility. It is a ſcience, the cultivation of which will raiſe a country to importance, by exciting new ſources of induſtry, even in ſituations where the labours of the huſbandman will be employed in vain. But, though I am well convinced that the importance of every thing in mineralogy is in proportion to its accuracy, I would not be underſtood to repreſent theſe notes as a complete account of the mineralogy of the countries of which they treat—I give them to the public as an imperfect outline. The mineralogical hiſtory of a country is to be accompliſhed only by ſtudying at leiſure all the varieties and diſpoſition of the ſtrata and veins, and the appearances of the mountains and valleys: an inveſtigation which the utmoſt care, in a rapid ſurvey, muſt leave in

many particulars imperfect, eſpecially when the mineralogiſt is perplexed with the difficulties of travelling among unfrequented iſlands.

I have in this, as in a former work, ſeparated the particular account of the ſtrata and veins from that of the particular foſſils; as the common method of conjoining them appears often to lead to confuſion, and can never be ſufficiently correct. In deſcribing the foſſils, the method and nomenclature of the beſt mineralogiſts has been followed. The chemical characters, which form even the foundation of many mineralogical ſyſtems, I have ſeldom employed; from a conviction that the chemical part of mineralogy, notwithſtanding the late improvements in the art of analyſis, is ſtill to be conſidered as imperfect. We have only to obſerve the contradictory reſults obtained by the beſt chemiſts in decompoſing the ſame foſſil, to be convinced that the analyſis of the preſent day, although much improved ſince the time of Bergman, is ſtill of no very great utility in mineralogy.

The drawings of ſcenery, and the mineralogical plans, which accompany this work, were executed by the elegant pencil of my friend Mr. Charles Bell. In the views of ſcenery, he has happily expreſſed the different characters which the rocks aſſume from the effects of the weather; a circumſtance which renders

renders them the more valuable. The mineralogical plans are of much conſequence in elucidating ſeveral curious facts, which otherwiſe would with difficulty have been underſtood. Theſe engravings are not to be judged of as pictureſque repreſentations—they were not intended as ornaments, nor were they ſelected as being the moſt beautiful: the deſign being to mark the characteriſtic features of the ſcene, not as a landſcape, but as a mineralogical delineation.

CON-

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INTRO-

INTRODUCTION,

CONTAINING

An Abſtract of the Wernerian Account of the different Kinds of Mountain Rocks; with Geognoſtic Obſervations on the Strata of the Scottiſh Iſles, and ſuch parts of the Mainland as are mentioned in this Work.

AS I ſhall frequently have occaſion to mention in this work the diviſion of rocks into Primary, Tranſition, and Stratified, it may be uſeful to many to know the characters by which theſe different rocks are diſtinguiſhed. I am the more anxious to do this, as we have not, as yet, in any Engliſh publication, an account of the diviſion. To this I ſhall add a few geognoſtic obſervations upon the different rocks to be found in the Scottiſh

iſles, and in thoſe parts of the Mainland which are mentioned in the following Outline.

According to the lateſt obſervations, all the ſtrata, of which our globe is compoſed, may be arranged under the following claſſes: The Primary, (Urgeburge); the Tranſition, (Ubergangsgeburge); the Stratified, which comprehends what are called the ſecondary ſtrata, (Flotzgeburge); and the Volcanic, Alluvial, (Aufgeſchwemmte.)

I ſhall now mention the diſtinction between theſe different kinds of ſtrata; and, firſt, of the

PRIMITIVE.

Theſe ſtrata are characteriſed by their never containing the remains of animals or vegetables, nor alternating with ſuch ſtrata as contain theſe relics. Humbold has alſo obſerved that the primitive ſtrata in Europe are always inclined towards the N. E., while the ſtrata of the ſecondary mountains dip towards the S. E.

It is to the celebrated mineralogiſt John Gottlob Lehman that

that we are indebted for the very important diſcovery of the diviſion of mountains into primary and ſecondary. Since he wrote, ſucceeding mineralogiſts have confirmed the truth of his obſervations, and have thus raiſed geology, from a vague and confuſed ſtate, to a high pitch of certainty and utility. A few writers have tried to overturn this diſtinction, *by aſſerting that it is* fanciful; yet theſe ſpeculations, like all others not founded on truth and accurate inveſtigation, have ſunk into deſerved oblivion.

The primitive ſtrata are the following: granite, gneiſs, micaceous ſhiſtus, ardeſia, ſienite, porphyry, primitive limeſtone, primitive greenſtone, greenſtone ſhiſtus, ſerpentine, quartz, pitchſtone, and topaz rock. Granite is conſidered by Werner as the fundamental rock, or that upon which all others are laid, and it is but very rarely that it alternates with other rocks. It is diſpoſed in layers or ſtrata, which are often enormouſly thick, and frequently horizontal, and extend thus for many miles through a whole chain of mountains. All the other primary ſtrata alternate with each other, but never with the tranſition or ſtratified rocks. The greenſtone, wacken, and pitchſtone are the only exceptions; the two firſt being common to the three firſt-mentioned formations, but the pitchſtone only to the primary, and ſtratified, or flotzgeburge. The

TRANSITION, OR UBERGANGSGEBURGE

comprehend all thoſe rocks, the lowermoſt ſtrata of which contain few or no petrifactions; in the higher they are more abundant; but only petrifactions, the originals of which no longer exiſt. Theſe mountains alſo abound in metallic veins and in grottos. Thoſe of Antiparos, Crete, &c. are in this kind of rock; as are the Hartz metalliferous mountains, and thoſe of Derbyſhire. They ſeem to have been formed after the primitive, and earlier than the ſtratified (flotzgeburge) rock. The ſtrata of this formation are the following: grawacken, grawacken ſlate, ſandſtone, ſome ſpecies of ardeſia, greenſtone, mandelſtone, limeſtone, and Dr Reuſs conjectures that ſome ſpecies of ſienite and porphyry * may belong to this claſs of rocks. The

STRATIFIED (*Flotzegeburge*)

appear to have been formed after the tranſition rocks. They conſiſt of ſandſtone, limeſtone, argillite, with numerous petrifactions;

* Mineralogiſche Geographie von Bohmen, 2 Band, § 177.

factions; alſo, baſalt, ſhiſtoſe porphyry, pitchſtone, greenſtone, wacken, and the various coal ſtrata.

From the view of theſe three formations, we obſerve that the greenſtone and wacken occur in every one of them, but the baſalt is peculiar to the ſtratified rocks. The

VOLCANIC

comprehends the various ſtony ſubſtances altered by action of fire: theſe are, lava, pumice, vocanic aſhes, and volcanic tuff. The

ALLUVIAL

conſiſt of gravel, ſand, clay, &c. and are the debris of the other ſtrata.

Having thus mentioned the diviſion of the different rocks, according to their relative antiquity, I ſhall now make a few general geognoſtic obſervations on the rocks of the Scottiſh iſles, &c. I ſhall firſt mention the

PRI-

PRIMARY ROCKS.

Granite. This rock forms but a ſmall portion of the Scottiſh iſles, it being found only in the iſle of Arran, and in the low part of Mull called Roſs, and in the Shetland iſlands. Upon the Mainland, however, I obſerved it forming mountains in Sutherlandſhire, a conſiderable part of the county of Aberdeenſhire ſeems to be formed of it, and alſo the lofty mountain of Cruachan upon the weſt coaſt. Granite veins are pretty frequent in ſeveral of the iſlands, as in Arran where they traverſe the common granite, and in Coll, Tiree, Rona, the Orkney and Shetland iſlands, &c. where they traverſe micaceous ſhiſtus, gneiſs, or hornblende ſlate. Upon the mainland, in the route from Bernera to Perth, the granite veins are extremely common.

Gneiss. This rock I obſerved in Coll, Tiree, Raſay, Rona, in the Shetland iſlands, and in ſeveral places upon the Mainland of Scotland; in particular it forms the ſummit of the high mountain called Ben Lomond. It ſometimes alternates with micaceous ſhiſtus and hornblende rock, and it is traverſed by granite veins, as is the caſe in Coll, Rona, &c.

Micaceous Shistus. This rock forms a portion of the iſles of

of Arran, Bute, and Mull; it is juſt to be obſerved in Coll, but a very conſiderable extent of the Shetland iſlands are compoſed of it. In the Mainland it appears to extend through the whole diſtrict of Cowal, and to the extremity of the iſthmus of Cantyre, and in all the country from Bernera to Dunkeld; and from Dunkeld to Loch Lomond by Inveraray, the micaceous ſhiſtus is the prevalent rock. Upon the eaſt coaſt it is frequent among the other primary ſtrata. It alternates with ſhiſtoſe quartz in the iſland of Mull, and with hornblende and gneiſs in the iſland of Coll; and it is to be obſerved in ſeveral places paſſing to ardeſia, and it is traverſed by granite veins, and has pieces of granite encloſed in it.

Ardesia. Primitive argillaceous ſhiſtus. This rock occurs in Arran, Bute, Iſla, Jura, Eaſdale, and Seil. In Iſla there is a ſpecies of it which contains pieces of granite, which, however, ſeem to have been formed at the ſame time with the ardeſia. In Eaſdale, Seil, Bute, and Arran, it it quarried for economical purpoſes; but the ſlate of Eaſdale is by far the beſt.

Sienite. A rock nearly allied to ſienite ſeems to form the craig of Ailſa; it alſo forms part of the iſland of Arran, and the lofty Cullin moutains in the iſland of Skye.

Por-

Porphyry. I obſerved fragments of porphyry among the granite mountains in the iſland of Arran, which is probably of primitive formation, and the porphyry, which forms ſo conſiderable a part of the hill of Glamoſcard in Skye, ſeems to be of primitive formation.

Primitive Limestone, or Marble. This rocks occurs in vertical ſtrata at I-columb-kill, alſo in the iſland of Tirie, and in ſeveral parts of the Mainland. I obſerved it alternating with primary rocks, particularly at Portſoy, where it is in vertical ſtrata and alternates with talcaceous ſhiſtus and ſerpentine.

Primitive Greenstone. I have not met with this rock in any part of Scotland excepting in the iſland of Iſlay, yet I think it very probable that a careful examination may diſcover it in many places.

Serpentine. There are no ſtrata of this rock in the Hebrides, nor the Orkney iſlands; but in Shetland it forms extenſive hills, and there it ſeems evidently to be of primitive formation. At the intereſting ſpot, Portſoy, there are great vertical ſtrata of ſerpentine alternating with marble, talcaceous, and hornblende ſhiſtus.

Quartz. In the iſlands of Iſla and Jura there are mountains of granular quartz, and it is there to be obſerved alternating with, and paſſing into micaceous ſhiſtus. In the iſle of Coll there are alſo conſiderable rocks of granular quartz. In the iſland of Tirie I obſerved the rare appearance of a vein of granular quartz traverſing ſtrata of micaceous ſhiſtus and hornblende ſlate. In Caithneſs the mountain of Scaraban is compoſed of quartz; and at Portſoy there is a hill which affords ſhiſtoſe quartz. In many places veins of quartz are to be obſerved traverſing the primary ſtrata, and in the iſland of Bute there is a quartz vein which preſents appearances irreconcileable with the Plutonic theory.

Pitchstone. The only ſpecies of this ſtone which I have ever ſeen, that may be conſidered as primary, is that upon the hill of Glamoſcard in the iſland of Skye. It there ſeems to alternate with porphyry, but of this I am not as yet certain. In the iſland of Arran there are appearances of pitchſtone in the form of veins traverſing the granite, but as all veins are of an after formation to the rocks which they traverſe, this cannot be reckoned equally old with the granite, or other primitive rocks.

TRANSITION ROCKS, *(Ubergangſgeburge.)*

Grawacken. This is a rare rock in the diſtricts through which I paſſed. The only appearance I ever noticed was a ſmall portion lying on ardeſia in the iſland of Seil.

Greenstone. The greenſtone of the iſland of Mull appears to belong to this formation, as it is found near to limeſtone that contains belemnites.

Limestone. This ſpecies is found in the iſland of Mull, and contains in it cornu ammonis and belemnites; hence I reckon it to belong to the tranſition rocks.

STRATIFIED ROCKS, *(Flotzgeburge.)*

Sandstone. Of this I obſerved two kinds, the ſiliceous and argillaceous.

The ſiliceous does not frequently occur. The ſandſtone of the iſland of Rume approaches nearly to this kind, and in the Orkney iſlands there are ſtrata of ſiliceous ſandſtone that alternate

ternate with argillaceous ſandſtone. Argillaceous ſandſtone forms the Cumbray iſlands, the ſouth extremities of Bute and Arran; and it alſo appears in the iſlands of Seil, Mull, Eigg, Skye, Raſay and Scalpa. Almoſt the whole of the Orkney iſlands are compoſed of argillaceous ſandſtone, but it forms a very ſmall portion of the Shetland iſlands. It alſo ſkirts the eaſt coaſt of Scotland from the Pentland Firth to the ſmall fiſhing town called Buckie; and again this ſandſtone makes its appearance near to Aberdeen, and continues along the ſhore all the way to the Frith of Forth.

Limestone. In the iſland of Arran there are conſiderable ſtrata of limeſtone which is covered by argillaceous ſandſtone; and in ſome places the limeſtone and ſandſtone alternate. In the Orkneys limeſtone is to be obſerved covered by ſandſtone, and even traverſed by veins of ſandſtone.

Argillite with numerous ſhells is found in the iſland of Arran, and in the iſland of Eigg.

Basalt. This rock, which, as we have before obſerved, is peculiar to the Flotzgeburge, is found in almoſt every part of Scotland, either in ſtrata, or in veins. I obſerved it diſpoſed in ſtrata in the iſland of Seil, at Oban, in the iſlands of Mull,

Eigg, Canna, and Skye; and theſe ſtrata either alternate with argillaceous ſandſtone, wacken, or greenſtone. Frequently alſo veins of baſalt traverſe theſe ſtrata.

Basalt Veins. Theſe veins are extremely common in moſt of the Hebrides, but are rarely to be obſerved in the Shetland or Orkney iſlands. I obſerved them traverſing granite, gneiſs, micaceous ſhiſtus, ſienite, porphyry, hornblende ſlate, ſandſtone, and limeſtone. In the iſland of Arran there are ſeveral very remarkable veins which are partly formed of baſalt. Thus in Glencloy there is a vein, (traverſing clay porphyry), which is compoſed of baſalt in the middle, but, upon one ſide is ſandſtone breccia, and, on the other is hard ſiliceous ſandſtone. At Tormore, upon the weſt ſide of the iſland of Arran, there are ſeveral other very remarkable veins partly formed of baſalt.

Basalt Tuff. I obſerved this rock at Dumbarton caſtle, and in the iſlands of Mull and Canna, where it always accompanies rocks of trap formation. In the iſland of Canna it is remarkable for having pieces of wood incloſed.

Pitchstone. This curious foſſil is found very frequently in the

the iſland of Arran, but generally in the form of veins. Theſe veins traverſe the common argillaceous ſandſtone, and are often of great magnitude. It is alſo diſpoſed in ſtratified veins along with other ſubſtances at Tormore in Arran. In the iſland of Mull it ſeems to lie between ſandſtone and baſalt; but in Eigg it forms conſiderable veins traverſing baſalt. This foſſil, which was before conſidered as very rare, is thus ſhewn not to be ſo uncommon; and I have lately learned that it has been obſerved in veins traverſing ſandſtone in Morven, and in veins traverſing baſalt at Ardnamurchan.

Greenstone. The country between the primary ſtrata at Dunkeld, and the banks of the Frith of Forth preſents many appearances of flotz greenſtone; and, in the ſame tract there is alſo wacken of a ſimilar formation.

Coal. In the iſland of Arran there is a ſtratum of blind coal incloſed in ſandſtone. In Mull, Eigg, Canna, Skye, it is obſerved always ſtratified with baſalt or wacken.

VOLCANIC ROCKS *

have never been diſcovered in Scotland.

ALLUVIAL.

Of theſe there are examples in the Highland vallies, where the debris from the mountains are depoſited in beds and covered by heath. The great banks of ſand, and the immenſe beds of peat which we find ſometimes alternating with beds of clay or ſand, are of this kind.

MINE-

* Of the pſeudo-volcanic rocks, which are different ſpecies of rocks that have been expoſed to accidental fire, we have inſtances in Fifeſhire. Upon the ſhore between Dyſart and Eaſter Wemyſs I picked up ſeveral fine ſpecimens of porcellanite, which ſeems to be the clay that accompanies the coal altered by fire, as maſſes of ſcoriæ and charcoal ſtill adhered to it.

TO

JOHN WALKER, DD. MD.

FELLOW AND SECRETARY TO THE PHYSICAL CLASS

OF THE ROYAL SOCIETY,

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AND

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THIS VOLUME,

OF THE

OUTLINE OF THE MINERALOGY OF THE SCOTTISH ISLES,

IS DEDICATED,

AS A TESTIMONY OF THE GREAT REGARD AND ESTEEM

OF HIS MUCH OBLIGED PUPIL,

AND OBEDIENT

HUMBLE SERVANT,

THE AUTHOR.

SHERIFF-BRAE, LEITH,
26. JULY, 1800.

MINERALOGY

OF THE

SCOTTISH ISLES.

CHAPTER I.

From Edinburgh, by Glaſgow, to the Craig of Ailſa.

IN travelling from Edinburgh to Glaſgow, by the Livingſtone road, the country continues, for a conſiderable way, pleaſant and well cultivated; but as we approach the Kirk of Shotts the ſcene is much altered. In place of incloſed fields, exhibiting the operations of thriving agriculture, extenſive moſs grounds appear, forming a ſtriking contraſt to the cultivated country through which we had juſt paſſed. Happily,

however, theſe moſſes are now viewed in a more favourable light than heretofore: the brown burnt-like aſpect of a peat moor does not now ſtrike the mind with ideas of bareneſs and ſterility; as we know, from experience, that labour and a little expence may ſoon convert them into luxuriant fields.—A few miles after paſſing this deſert, we come in ſight of Glaſgow; but its low ſituation, and the want of hills, render it, when compared with Edinburgh, far leſs intereſting as a pictureſque object. The nearer we approach the town the country improves, and is conſiderably diverſified with wood and cultivated fields.

The rocks which occur in this tract are all of ſecondary formation; which is commonly the caſe where the country is low and flat. As our journey was rapid, I can only ſay, in general, that the ſtrata are, ſandſtone, limeſtone, baſalt, wacken, mandelſtein, coal, with its accompanying ſhiſtoſe clay, &c. and iron-ſtone.

The ſandſtone is generally uſed for the purpoſes of building; but, from different quarries it is more or leſs durable. This fact leads us to remark, that chemical trials, combined with correct mineralogical obſervations, might, in many inſtances, enable us to determine, with ſome certainty, as to the probable

probable durability of ſtones employed in building. Indeed, thoſe who have been long in the habit of analyſing and examining ſuch ſtones, can, even by their appearance, judge of their probable durability *: a circumſtance ſufficient to encourage us to purſue a mode of inveſtigation which has hitherto engaged little attention.—The limeſtone which occurs in this diſtrict varies conſiderably in its appearance: but we had not an opportunity of obſerving it particularly. It is quarried in ſeveral places to a conſiderable extent, and then burnt, and uſed for manure, and for building. It is burnt for theſe purpoſes in the common draw-kiln, which is ill conſtructed, as there is not only a great waſte of heat, but, by expoſure to all the variations of the weather, the burning is rendered precarious and uncertain. My father remedied theſe defects in a kiln which he built eight years ago, and which he ſtill conti-

 nues

* We have a curious inſtance of this related of the late Mr Bayen; a gentleman who had paid much attention to the genera of marble and ſerpentine. Walking one day in the Place de la Revolution, at Paris, with his friend and colleague Deyeux, he pointed out to him ſeveral of the marble pillars, which, he ſaid, notwithſtanding their preſent ſolid appearance, would decay in a ſhort time, and in the particular places he mentioned. Accordingly, a year had ſcarcely elapſed when his prediction was fulfilled: many of the pillars began to decay, and even conſiderable hollows were quickly formed in ſome of them.—*Annales de Chymie.*

nues to uſe as economical, both with regard to time and fuel. It differs from the common kiln by having the body or cylindrical part very deep, and covered with a dome, which is connected with a vent that has a damping plate, ſo as to allow a very advantageous management of the heat. Beſides, it has another very conſiderable advantage over the common kiln, that is, it can be erected in a town without detriment to the neighbourhood, as all the noxious matter is carried away by means of the chimney †.

The country in the neighbourhood of Glaſgow, as far as I had an opportunity of examining, is compoſed, 1ſt, of baſalt, which

† A vulgar prejudice has long prevailed, that the noxious matter of limeſtone is more dangerous than that of common coal; and the many horrid ſtories on record, of ſudden deaths in the neighbourhood of lime-kilns, ſtill continue the deluſion with the ignorant.—The modern chemical diſcoveries have ſhown, that common coal, bulk for bulk, furniſhes more of the noxious matter (carbonic acid and carbonated hydrogen) than limeſtone: therefore, the noxious effects of the common kiln does not depend on any peculiar malignity of the vapour which iſſues from the ſtone, but upon the conſtruction of the furnace.

The patriotic Count Rumford has lately propoſed a new plan of a lime-kiln, which certainly deſerves to be tried: To us it appears objectionable, not only from the cloſe attendance that the fires require, but alſo that a conſiderable portion of heat is loſt by its being open at top.—See *Rumford's Eſſays*.

which has ſometimes in-lying cryſtals of felſpar, baſaltic hornblende, augit, leucit, mica, and a few interſperſed particles of quartz; 2. baſalt porphyry; 3. grunſtein; 4. limeſtone. The ſhort time I could afford to ſpend in Glaſgow, and my anxiety to get forward to the Iſlands, prevented me from examining the relation of the different ſtrata to each other; which, however, I the leſs regret, as that circumſtance is but ſlightly connected with my preſent object.

Profeſſor Faujas de St. Fond has given us a ſhort account of the mineralogy of the environs of Glaſgow; but his deſcriptions are unluckily obſcured by a rigid adherence to a theory which has no foundation in nature. He conſiders all the rocks we have now mentioned, as lavas; and thoſe he denominates baſaltic, porphyritic, and granitic lavas. I do not heſitate a moment in ſaying, that, in my opinion, there is not in all Scotland the veſtige of a volcano. I do not reſt this aſſertion upon my own authority, (for that would be preſumptuous;) but upon that of Dr. Walker, who has examined more of the mineralogy of Scotland than any man now living, and whoſe collection of Scotch foſſils is the largeſt that has ever been made. Beſides, it wars with every principle of ſyſtematic claſſification, to arrange and denominate foſſils from any *theory* we may adopt as to their formation.

We

We now purſued our journey from Glaſgow to Greenock, down the river Clyde: a voyage which preſents the traveller with many ſcenes of uncommon beauty. At Glaſgow the river is narrow, with low formal banks; but as we approach Dumbarton, the river becomes wider, the country more beautiful, and the ſcene is ſoon rendered intereſting by the appearance of the ſingular rock of Dumbarton. From this the mountains of Cowal extend, along the north ſide of the river, to Roſneath; forming a fine contraſt of Alpine wildneſs, with the comparatively low green hills which reach to Greenock upon the ſouth ſide of the river. The ſtrata between Glaſgow and Greenock, upon the ſouth bank of the river, are, ſandſtone, limeſtone, baſalt, and wacken. Thoſe of the north bank, to the town of Dumbarton, continue to be nearly of ſimilar rock; forming, in this rout, ſome conſiderable heights, particularly about Friſky Hall, where the rocks have a fine terraced appearance. Immediately below the houſe of Friſky, at the porter's lodge, we obſerved a ſmall quarry of wacken, which is now celebrated as affording fine ſpecimens of prehnite. The town of Dumbarton is ſituated in a plain of conſiderable extent; and the rock upon which the caſtle is built, riſes from it in a ſimilar manner with Arthur's Seat, near Edinburgh, but is much more ſtriking, from the great flatneſs of the country. It is compoſed of black baſalt; but, upon the ſide facing the town,

we

we obſerved a baſalt tuff covered by ſandſtone. Profeſſor St. Fond remarks that this rock is formed of a black baſaltic lava; but upon the lower part, facing the town, there is to be obſerved a current of muddy lava, having, intermixed, fragments of baſalt, more or leſs altered.—At different periods the rock of Dumbarton has been of conſiderable conſequence, on account of the ſtrong fortreſs which is built upon it. When Mary, the unfortunate and lovely Queen of Scotland, was impriſoned in England, and her kingdom wreſted from her, the ſolitary rock of Dumbarton held out againſt every attempt to take it; and was the only place in the kingdom that dared to acknowledge her authority.

If we glance over the country as it extends towards Lochlomond, we obſerve it riſing gradually until the proſpect is bounded by vaſt mountains, marking, by their height and ſhape, a change in the nature of the ſtrata, and forming the grand entrance into the Highlands upon this ſide of Scotland. If we examine the country more particularly, we find our conjecture right; for at Luſs, upon the banks of this beautiful loch, ſtrata of micaceous ſhiſtus, and other primitive rocks, make their appearance. Theſe ſtrata extend towards the Clyde, and form a conſiderable part of its north bank, from Dumbarton to Roſneath, a ſmall village oppoſite to Greenock.

Greenock,

Greenock, a populous and flouriſhing town, is ſituated upon the ſide of the river, at the bottom of hills of conſiderable height; and remarkable for the quantity of rain which falls during the year, which is ſaid to be more than in any other part of Scotland. The ſtrata in the immediate vicinity of the town are, baſalt, wacken, ſandſtone, limeſtone: and in ſome places the ſandſtone is to be obſerved traverſed with baſaltic veins; and the wacken, beſides zeolite, contains a curious foſſil nearly allied to leucit.

From Greenock our farther progreſs down the Clyde was more intereſting, from the grandeur and variety of the objects which now occupied our attention. After paſſing the Gouroch lighthouſe, we obſerved the beautiful iſland of Bute, with the neighbouring and Cumbray iſles ſtretching acroſs the view; and, farther diſtant, the wild mountains of Arran appeared over the low part of Bute towering among the clouds. The hills upon the oppoſite bank of the river are ſtrikingly contraſted. Upon the Cowal ſhore the country riſes into conſiderable hills of micaceous ſhiſtus, which are partly heath-clad, and join with the bare and ſterile mountains that extend from this ſhore through Argyleſhire. Upon the oppoſite bank of the river the country is much lower; there are no ſteep hills upon the ſhore; and the ſtrata, which are horizontal, are, red and white

white-coloured argillaceous ſandſtone, ſandſtone breccia, baſalt, and frequently baſaltic veins traverſe both theſe ſtrata. The breccia, as is often the caſe with this kind of rock when it occurs upon the ſea-ſhore, forms beautifully wooded cliffs, which extend to the ſweetly-retired village of the Largs. Theſe ſecondary ſtrata extend from the Largs to Saltcoats, and from thence far through Ayrſhire; while the primary rocks, on the oppoſite bank of the river, appear to extend to the Mull of Cantyre.—In a few hours after paſſing the Cumbray iſles, and the majeſtic iſland of Arran, we landed upon the great rock which is called

The Craig of Ailsa.

This ſtupendous rock is ſaid to be 400 feet high, and is about two miles in circumference. It is ſomewhat of a conical ſhape, and very precipitous on all ſides: the only landing-place being on the N. E. where there is a ſmall beach, formed by the fragments which have fallen from the neighbouring rocks. It is much lower now than it was formerly; as is evinced, not only by the numerous fragments lying on the beach, but alſo more fully by the nature of the bottom near it, which, according to the moſt accurate ſoundings, is gravelly to a conſiderable diſtance.

After having walked around part of it, and aſcended near to the ſummit, I was forced to return, as the captain of the veſſel was anxious to proceed to Arran. On this account, I was prevented from examining it ſo accurately as could have been wiſhed. This glance, however, was ſufficient to ſatisfy me as to the general nature of the rock of which it was compoſed.

The greater part ſeems to be formed of different ſpecies of very compact ſienite; which, particularly on the eaſt ſide, preſents immenſe groupes of columns, ſimilar in appearance to the baſaltic columns that occur ſo often in different parts of Scotland. In aſcending towards the ſummit, and a little below the ſolitary ruin of a caſtle, I obſerved two conſiderable baſaltic veins traverſing the ſienite.

CHAP.

CHAP. II.

Deſcription of the FOSSILS *mentioned in the preceding Chapter.*

PREHNITE—*Friſky-Hall.*

Silex Prehnites, Wern. *Halb Zeolith*, Eſthner. *Bostrichites*, Dr. Walker.

It is either in flat maſſes, cellular, or botroidal, or partly aſſuming a mammillary figure; is generally radiated and compoſed of ſmall priſmatic cryſtals—ſometimes ſo ſmall, and ſo near to each other, as to aſſume, in ſome degree, a compact texture, almoſt reſembling chalcedony.

Colour. Varies, from apple green, to yellowiſh green, pale yellow, and white; but, when affected by the weather, it acquires an ochry, or opaque white colour.

Luſtre. The external luſtre little glancing*; internal is pearly.

Tranſparency. It is ſemi-tranſparent; but, when acted upon by the weather, it becomes conſiderably opaque, and much reſembles certain ſpecies of ſulphat of barytes.

Hardneſs. Gives ſparks with ſteel; takes a pretty good poliſh.

 Fracture.

* *Wenig glänzend.* Germ.

Fracture. The fracture in the direction of the foliæ appears foliated, but acroſs the radii approaches to the conchoidal.

Fuſibility. Dr. Hope melted it, and, by ſlow cooling, had again a pretty regular cryſtalline texture.

It is contained in a ſpecies of wacken, which, by its degree of induration, appears paſſing to the ſtate of baſalt. It is frequently accompanied by calcareous ſpar. Another ſubſtance is often found with it, which is probably of the nature of zeolite.

It is formed of long priſmatic radii, which have the following character.

Colour. White.

Luſtre. Pearly.

Tranſparency. Nearly tranſparent.

Hardneſs. Difficultly ſcratched with a knife.

OBSERVATIONS.

The Prehnite has received many denominations, by different mineralogiſts: thus it has been called green felſpar, apple-green quartz, ſiliceous zeolith, cape-chryſolith, emerald, praſe, and cryſopraſe:—a ſtriking proof of the imperfection of mineralogical nomenclature. The juſtly-celebrated Mr. Werner, to whom

whom we owe ſo much of our moſt accurate information, names it Prehnite, after Colonel Prehn, a Dutch officer, who found it at the Cape of Good Hope, and firſt brought it to Europe. Since its diſcovery at the Cape of Good Hope, it has alſo been found in Dauphiné; and Dr. Groſcke of Mittau firſt diſcovered it at Friſky-Hall. This is not the only place in Scotland where this beautiful foſſil is found; for I have obſerved it in the caſtle rock and Arthur's Seat at Edinburgh, and we ſhall afterwards notice it in the iſland of Mull.

LEUCIT—*Greenock.*

Sarcite, Dr. Townſon's Tracts in natural hiſtory. *Borax Margodes*, Lin. ?

This foſſil is of a reddiſh-brown colour, and generally cryſtalliſed in the form of a 24 edron: it is alſo, in ſome inſtances, amorphous, with an earthy fracture *.

It has always occurred opaque, and of ſuch a hardneſs as to yield with difficulty to the knife.

With the blow-pipe it loſes its colour, and melts like felſpar.

It

* Dr. Hope has in his poſſeſſion a very fine ſpecimen of this foſſil, which he found at the Calton Hill. Dr. Townſon has figured it in his Tracts.

It is found in the cavities of wacken, and ſometimes imbedded in calcareous ſpar.

Abbé Huay remarks that this foſſil is conſidered as a zeolite †; and La Metherie, who had examined ſpecimens of a ſimilar foſſil from the Calton-Hill at Edinburgh, remarks, " On " trouve, au mont Calton-Hill, proche d'Edimbourg, un cri- " ſtal à vingt-quatre facettes trapezoidales, comme celui-ci. " Il eſt rougeatre, poreux, terne, comme de la brique.—On " croit qu'il doit entrer dans la zéolite leucitique ‡." Dr. Townſon, in his lately-publiſhed Tracts in natural hiſtory, conſiders it as a new genus, and names it Sarcite: this, however, cannot be admitted, until the foſſil ſhall be regularly analyſed. Mr. Camara of Liſbon, a moſt intelligent mineralogiſt, informed me, that he had frequently met with this foſſil in other countries, but always conſidered it as nearly allied to leucit. It appears, then, that it ſhould ſtill be reckoned of the nature of leucit, until it ſhall be more particularly examined in the way of chemical analyſis.

SIENITE—

† Annales de Chymie.

‡ Th orie de la Terre, tom. 2de, p. 308.

SIENITE—*Craig of Ailsa.*

Calomachus, Dr. Walker's Claſſes Foſſilium.

So far as I can determine at preſent, this rock appears to be a very compact ſpecies of ſrenite, in which the felſpar is the moſt prevalent ingredient. Sometimes the felſpar ſeems paſſing to the ſtate of earthy felſpar; and then it forms a baſis in which we obſerve red or white-coloured cryſtals of common felſpar and hornblende, and particles of quartz: thus forming a ſpecies of ſienitic porphyry.

ARRAN.

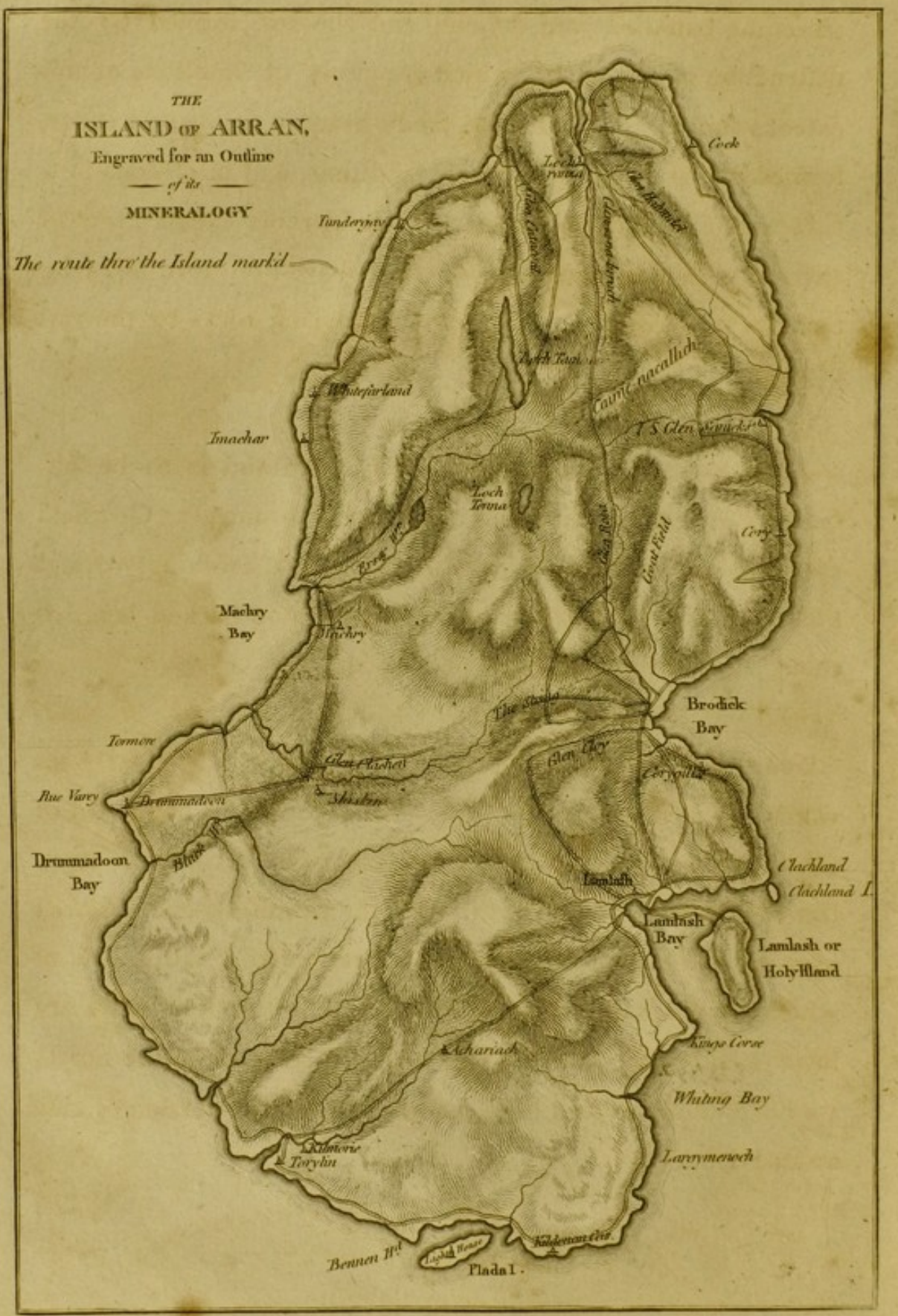
ARRAN.

CHAP. III.

Size and Situation of the Iſland. Cliffs, Mountains, Surface, &c. Brodick Bay, and its Environs; comprehending Cory-Gills, Glen-Cloy, Glen-Shirreg, Goatfield, and Glen-Roſa.

THIS iſland is about thirty-two miles long and twelve broad; ſituated in the mouth of the Frith of Clyde, about eight miles from Bute, and ſixteen from Saltcoats in Ayrſhire. Its ſhape is irregular, but not ſo much ſo as many of the Weſtern Iſlands which are expoſed to the Atlantic Ocean. Here, the vicinity of the Scottiſh and Iriſh ſhores prevents any great deſtruction of land; as is evident from the lowneſs of the cliffs round the iſland, which have not the precipitous, rugged and bold aſpect of many of the Weſtern Iſlands.

Cliffs. The cliffs are ſeldom above two hundred feet high; are generally precipitous: having frequently, however, an intervening


THE
ISLAND OF ARRAN,
Engraved for an Outline
— of its —
MINERALOGY
The route thro' the Island markd
Cock
Tunderyney
Imachar
Machry
Bay
Brodick
Bay
Drummadoon
Bay
Clachland
Lamlash
Lamlash
Bay
Lamlash or
Holylland
Whiting Bay
Kilmorie
Torylin
Laggmenoch
Bennen Hd
Pladda

tervening bank between the cliff and the ſea, formed by the deſtruction of the rocks, which are either of ſandſtone or micaceous ſhiſtus. Conſiderable ſandy beaches frequently occur, formed of the debris of granite, ſandſtone, and micaceous ſhiſtus; and ſometimes we remark a conſiderable extent of coaſt covered with enormous maſſes, which have been torn away by torrents, or ſeparated from the neighbouring rocks by the vaſt expanſive power of froſt.

Mountains. No regular ridge of mountains is to be obſerved: theſe being either in the form of groups, as Goatfield and the adjacent mountains, which preſent aſtoniſhingly grand peaked ſummits; or irregular, forming round-backed hills, as thoſe towards the ſouth part of the iſland.

Surface. The land is in general very high, particularly towards the north end, where the wonderful group compoſed of Goatfield, Caime-na-callich, &c. preſent mountains near 3000 feet high. Here Nature exhibits to the aſtoniſhed eye the moſt terrific and ſublime ſcenery; to convey even a faint idea of which would require an able pen. The ſouthern parts are lower; and in place of the bare rocky appearance of the north, we have heath-covered hills, and a conſiderable portion of cultivated land.

The iſland is divided into two pariſhes, Kilbride and Kilmory, belonging to three proprietors; the Duke of Hamilton, Marquis of Bute, and John Fullerton, Eſq. of Kilmichael; and yields about 5000 l. of yearly rent. This indeed might be much increaſed, were proper methods of cultivation followed; and were long leaſes and larger farms properly granted, more happineſs, induſtry and wealth would be the natural conſequence.

In deſcribing the iſland particularly, I ſhall begin with

Brodick Bay, ſituated on the eaſt ſide. This beautiful bay is bounded, on the S. by the hills of Cory-gills; on the W. by the vales of Glencloy and Glenſhirreg, and, on the N. the tremendous Goatfield forms a lofty boundary. It is of an irregular ſhape; about five miles long, and four broad; having about five fathoms water, with good anchorage ground: but it is only in moderate weather that veſſels can ride in ſafety. From this bay paſſage-boats go to Saltcoats, about ſixteen or eighteen miles diſtant, which renders this the principal thorough-fare in the iſland; ſo that the population is conſiderable. Many viſitors come from the mainland, during the ſummer months, to enjoy the free air, and admire the wonderful ſcenery of this intereſting iſland: but the want of a good inn is much to be regretted.

regretted. On the north ſide of the bay ſtands Brodick Caſtle, an old ruinous building, inhabited occaſionally during part of the ſummer by the Duke of Hamilton. It is ſituated upon the ſide of Goatfield, commanding a moſt extenſive and delightful proſpect; and might eaſily be made a beautiful ſeat. About two miles diſtant, in Glencloy, is ſituated the pleaſant ſeat of the worthy and moſt hoſpitable family of Fullerton, of Kilmichael, who have now reſided in the iſland upwards of 700 years.

Mineralogy. The mineral hiſtory of this part of the iſland is, in many reſpects, intereſting; not only on account of the variety of foſſils which it affords, but alſo in preſenting to us, in a ſhort ſpace, a repreſentation of the ſtructure and materials of nearly the whole iſland. On this account I ſhall be minute in my deſcription; as I may have occaſion to refer to this particular part, when deſcribing the other quarters of the iſland.

The ſouth ſide of the bay is low immediately upon the ſhore: it however riſes gradually; forming the hills in the neighbourhood of Cory-gills, and, towards the ſea, cliffs of conſiderable height, almoſt entirely compoſed of ſandſtone *. This ſand-

 ſtone

* M. de C. Laſſone has obſerved, that the ſurface of a ſandſtone, which had the

ſtone is pretty compact, of a reddiſh colour, much reſembling that found in Shetland; and is here and there alternated with ſtrata of breccia, compoſed of rounded fragments of quartz, with fragments of ſandſtone, of various ſizes and ſhapes; and both theſe ſtrata run at an angle of from 10° to 15°. In many places there are very conſiderable veins of baſalt, or what have been called Whin-dykes †, croſſing the ſandſtone in various

the year before been left uncovered, was inveſted with a ſiliceous cruſt, nearly as hard as agate: the particles of which it was formed muſt therefore have been conveyed and depoſited by water. *Mem.* Par. 1774. *Kirwan's Geological Eſſays*, p. 112.—This is a proof of the ſolubility of ſiliceous earth in water: a fact denied by the Plutoniſts. It is more demonſtrably confirmed by the following fact, from Mr. Kirwan's Geological Eſſays, p. 140. "About the year 1760, the Emperor "of Germany being deſirous to know the length of time neceſſary to complete a "petrifaction, obtained leave from the Sultan to take up and examine one of the "timbers of Trajan's bridge over the Danube at Belgrade. It was found to have "been converted into agate to the depth only of half an inch; the inner parts "were ſlightly petrified, and the central ſtill wood."

† The term Whinſtone, like many other popular denominations, does not convey a diſtinct idea of any particular genus of foſſils; but is uſed by the inhabitants of Scotland, and of the north of England, to expreſs thoſe foſſils which are of *trap formation*. Mineralogiſts, in many inſtances, appear to have uſed it in a very vague manner: thus ſome deſcribe trap, others baſalt; and not unfrequently wacken, greenſtone and indurated clay have been arranged under this name.

rious directions. Some may be obſerved riſing from the ſea, and penetrating the ſandſtone. In other places, where the ſuperincumbent ſandſtone has been completely carried away, veins can be remarked running, with little variation in diameter or direction, for nearly a mile. Theſe veins are not only to be obſerved upon the ſea ſhore, but can be traced running, in various directions, and of different diameters, through the ſandſtone and other rocks in the interior of the iſland, as we ſhall afterwards clearly demonſtrate. In aſcending the hill towards Cory-gills, a very conſiderable vein of dark leek-green pitchſtone makes its appearance, running from the cliffs upon the ſhore, thro' the ſandſtone, to the Lamlaſh road, where we ſoon loſe it among the ſandſtone in the neighbouring hills. This vein is of various breadths; in ſome places, as at the Lamlaſh road, being about eight feet. It does not appear to have altered the ſandſtone, where it is in contact with it; but, in ſome parts of the vein, the pitchſtone, as it approaches the ſandſtone, loſes much of its luſtre, and, in fracture and hardneſs, approaches to the nature of baſalt.

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name. It is much to be wiſhed that it could be entirely laid aſide; particularly when we perceive that the great Werner has framed ſatisfactory characters for theſe different rocks.

The appearence of pitchſtone in the form of veins, and in ſecondary ſtrata, has not as yet been obſerved by other mineralogiſts. Mr. Werner, from his own extenſive knowledge, and the accummulated information of his numerous pupils, is of opinion, that pitchſtone is always diſpoſed in ſtrata, and entirely confined to primitive mountains. The late Abbé Spallanzani deſcribes ſeveral veins of pitchſtone lava that he obſerved in the Euganean mountains; but it is difficult to determine with certainty whether this be the true pitchſtone *.

Higher up, above the houſes of Cory-gills, I obſerved a number of columns which are compoſed of clay-porphyry. Theſe pillars are in various directions: ſome are perpendicular to the horizon; others more or leſs inclined; and I obſerved, farther up, that they are quite horizontal. They are in the form of four or ſix-ſided columns, from ſix to ten feet long, and two or three feet in diameter, having a whitiſh cruſt from decompoſition. They are not jointed; nor is there any appearance of balls, or what the volcaniſts call *volcanic bombs*. I endeavoured to diſcover the poſition of the porphyry with regard to the ſandſtone, but could not detect them in contact with each other; yet, from the nature of the rocks all

* Spallanzani's Travels in the Two Sicilies, vol. 3d, p. 251, &c.

all around, I am inclined to believe that it reſts on the ſandſtone. In deſcending from this porphyry hill towards Lamlaſh, the ſandſtone again makes its appearance, but is ſoon loſt; being covered with a rock which is principally compoſed of dark-green coloured hornblende, with a little felſpar and quartz, and anſwers nearly to the greenſtone of the Germans. This greenſtone forms the ſummits of ſeveral hills in the neighbourhood, and may be remarked running towards the ſea, forming high cliffs. In one place I obſerved a great body of green-coloured pitchſtone, which runs quite in an oppoſite direction to the vein I obſerved croſſing the Lamlaſh road: in ſhort, it appears to be ſtratified, and to run immediately below the greenſtone. About twenty yards lower, another maſs occurs, about ten or twelve feet thick; and which, ſo far as I could determine, appears to form a ſtratum, running between the ſandſtone and greenſtone. I was informed that this maſs of pitchſtone had been traced to the face of a high cliff upon the ſea-ſhore, where it is ſaid to lie upon ſandſtone, which alſo covers it; and that it was there alſo ſplit into columns, like baſalt.

Having now mentioned the poſition of the veins and ſtrata upon the ſouth ſide; I ſhall return to the ſea-ſhore, where we obſerve

obſerve the bay riſing towards the weſt, forming the one ſide of Glencloy.

Glen-Cloy. This glen is nearly three miles long, and half a mile broad; open towards the eaſt, but bounded on the other ſides by high hills. At the top, or weſt part, of the glen, the hills are higheſt, forming a very romantic groupe of rocks. The north and ſouth ſides, which are of conſiderable height, become gradually lower as they approach the ſea, where they form part of Brodick Bay. The bottom of the glen riſes gently from the ſea, forming a ſmall angle with the hills that bound it. Immediately under the peat moſs, or heather, we diſcover boulder ſtones, which form a thick bed, from three to thirty feet thick; and in other places they are collected together in heaps, being thrown into this form by the force of water. Theſe bowlder ſtones are not of very conſiderable ſize, and vary but little in that reſpect at the top or bottom of the glen; which ſhews that the greater part of them have not received their rounded form by attrition in the water of the glen, but are derived from decompoſed breccia. They conſiſt of granite, porphyry, ſienite, breccia and ſandſtone, which are all to be obſerved in the neighbouring hills. Through the glen runs Glencloy burn, formed by the ſprings and rains from the

the

the hills: it is narrow, but, during violent ſtorms, it overflows a conſiderable part of the glen, and has thus laid bare the rocks, and ſhows us, in a ſatisfactory manner, the nature of the ſubjacent ſtrata. The bottom of the glen is compoſed of the common red-coloured argillaceous ſandſtone, and here and there are ſtrata of breccia; and both are traverſed with veins of baſalt, which run in very various directions, and are from three to twelve feet in breadth. Theſe veins, in their paſſage thro' the ſtrata, (to uſe the Huttonian language,) do not appear to have occaſioned in them any alteration with regard to hardneſs: on the contrary, we often find a ſpecies of ſemindurated clay interpoſed between the ſandſtone and baſalt, thus forming a ſtratified vein.

Reuſs, the celebrated German geologiſt, in his mineralogical hiſtory of Bohemia, deſcribes two ſtratified veins which he obſerved in the Bunzlauer circle. As it is of importance to turn the attention of the young mineralogiſt to thoſe curious, and, I believe, rare, appearances, I will ſhortly mention the nature of thoſe veins obſerved by Reuſs. One of the veins traverſes argillaceous ſandſtone, and is about a fathom wide; its ſides are of common argillaceous ironſtone, about five or ſix inches wide: to this ſucceeds a layer of wacken-clay, about half a foot wide; then a thin layer of wacken, or rather a rock

intermediate between wacken-clay and wacken; laſtly, the middle of the vein is baſalt. The other vein has argillaceous iron-ſtone for the *ſaalband* or ſides, but the middle is wacken clay. The ſandſtone, as it comes in contact with the vein, is remarkably great-grained and iron-ſhort *.

The hills on the north and ſouth ſides of the glen are of the ſame height; and the pente of the hills appears to correſpond pretty nearly with the elevation of the ſtrata. The hills on the ſouth ſide are formed of ſandſtone and breccia, which, towards the upper end, form very lofty precipices. Many veins of baſalt traverſe the ſandſtone, and looſe nodules of browniſh-black and black pitchſtone lie ſcattered about here and there. On the north ſide of the glen, near to Brodick wood, a conſiderable body of dark leek-green coloured pitchſtone makes its appearance; but it is ſo much covered with graſs, that it is difficult to ſay whether it forms a vein or a ſtratum. It is well worthy the attention of thoſe who may viſit Arran, to endeavour to determine this point. In aſcending the hills upon this ſide, after gaining a conſiderable height, the ſandſtone diſappears, when a clay

* Mineralogiſche Geographie von Böhmen, von Franz Ambros Reuſs, vol. 2.

a clay-porphyry is to be obſerved; and upon the brow of the hill, where the rains, &c. have broken down the porphyry, ſeveral curious phenomena appear. In the firſt place, I obſerved the porphyry in columns ſimilar to thoſe at Corygills: next, the baſaltic veins running in different directions through it. One great vein is to be obſerved riſing from the neighbouring ſandſtone, penetrating the clay-porphyry; and, as it riſes upwards, getting a conſiderable curve, when it branches: one branch riſes to the top of the hill; the other runs but for a ſhort way into the porphyry, in the form of a wedge. Near to the ſame place a curious *ſtratified* vein makes its appearance, running in an almoſt oppoſite direction to that we have juſt mentioned, and terminating in a wedge-like form. On the upper ſide it is formed of ſandſtone breccia; the lower is hard ſiliceous ſandſtone; but the middle is baſalt.—The weſt or upper end of the glen is formed of ſandſtone pretty much traverſed with veins of baſalt, which are more or leſs inclined, and of various diameters. Beſides this ſandſtone, we obſerve lofty precipices of ſienite, which form ſtrata elevated at an angle of about 30°. This rock is not only very much varied in the nature of its conſtituent parts, but alſo in the degree of intimacy of combination, which renders it very difficult to diſtinguiſh its different ſpecies. It is alſo traverſed with

veins of baſalt, but not ſo much ſo as the ſandſtone *. It forms the higher part of ſeveral of the hills betwixt the top of this glen and the Shiſkin, and is all along traverſed with baſaltic veins.

It appears, from the deſcription that has been now given, that the ſandſtone forms by far the greateſt part of the glen; the next in proportion is the porphyry, and laſtly the ſienite.

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* Dr. Hutton, in his ſpeculations upon the theory of the earth, remarks, "If it be by means of heat and fuſion that ſtrata have been conſolidated, then, "in proportion to the degree of conſolidation they have undergone from their "original ſtate, they ſhould, *cæteris paribus*, abound with more ſeparations in the "maſs. But the concluſion is found conſiſtent with appearances. A ſtratum of "ſandſtone does not abound ſo much with cutters and veins as a ſimilar ſtratum "of marble, or even a ſimilar ſtratum of ſandſtone that is more conſolidated: "they are in general interſected with veins and cutters; and in proportion as "ſtrata are deep in their perpendicular ſection, the veins are wide, and placed at "greater diſtances." This does not appear to be conſiſtent with the fact; for it is to be obſerved, in Arran, that the ſandſtone contains more veins than the ſienite, which laſt is harder than any ſandſtone in the iſland; and we obſerve that the ſienite contains a greater number of veins than the granite, although it be ſofter and leſs compact.

The determination of the relative poſition of ſtrata and veins is the great object of the geologiſt, and without it his labours will be of comparatively little value. It is, no doubt, of importance to know that a country is compoſed of particular kinds of rock: yet this will be very unſatisfactory, if we know not whether theſe rocks be primary or ſecondary, how they lie with regard to each other, and, conſequently, if they be favourable for the appearance of metallic veins, coal, &c. Many travellers, as my friend M. Camara de Bethencourt has obſerved †, ſatisfy themſelves, in their geological obſervations, by following a very ſuperficial and abſurd mode of inveſtigation. Thus, ſome are contented to ſit in their carriage and view the rocks as they paſs along; others, with more apparent curioſity, examine the debris at the bottom of the hills, and, by means of their teleſcopes, determine the nature of the higheſt mountain. It is plain that theſe practices muſt be very detrimental to the advancement of true geological knowledge: they are the more ſo, when we conſider, that the greateſt labour and aſſiduity is often employed in vain to delineate the true geological character of ſome parts of a country. In the courſe of my limited travels I have experienced the truth of this obſervation; for, after having ſpent many days in endeavouring to determine

† Neues Bergmanniſches Journal. B. i. § 272.

mine the relative poſition of certain ſtrata to each other, I have been obliged to reſt ſatisfied with a general concluſion drawn from the nature of the ſurrounding rocks. Thus, in Glencloy, I could not diſcover the porphyry and ſandſtone at their junction; yet, if we conſider that the porphyry, both here and at Corygills, is found upon the ſummit of ſandſtone hills, and that, in this place, we obſerve the ſame baſaltic vein apparently traverſing the ſandſtone and porphyry, we may preſume that they are of the ſame formation, and that the porphyry covers the ſandſtone. We have more certainty with regard to the ſienite, which appears to be of an origin anterior to the ſandſtone; as is pretty well ſhewn from the appearance of a breccia that lies upon its ſurface, which had been interpoſed between it and the ſandſtone, before the cauſes which formed the glen had removed the ſandſtone.

Glenshirreg. This glen is of conſiderable extent, bounded upon one hand by Glencloy, and on the other by Glenroſa. The hills towards the W. are not ſo rugged as thoſe at the top of Glencloy, and both the bottom and ſides are formed of the common ſandſtone, much traverſed with veins of baſalt; but towards the S. W. we obſerve a clay-porphyry, which forms part of the rocks higher up than the ſandſtone, and is, in fact, part of the maſs we obſerved before in Glencloy.

Goatfield.

Goatfield. This mountain, according to Profeſſor Playfair, is about 2945 feet above the level of the ſea, and is reckoned the higheſt in the iſland. It riſes pretty rapidly from the ſouth ſide of Brodick Bay, until we arrive at the region where the micaceous ſhiſtus diſappears. At this height there is a kind of irregular plain, from which the mountain riſes in the form of an obtuſe pyramid, and is very precipitous, being entirely formed of granite. On the W. where it forms part of Glenroſa, it is extremely ſteep, which is owing in a great meaſure to the want of micaceous ſhiſtus and ſandſtone; for, in general, wherever theſe occur the declivity is leſs ſudden. On the eaſt ſide the pente is more gradual; marking, according to the ſteepneſs, the preſence of granite, micaceous ſhiſtus, or ſandſtone. It declines a little towards the N. but it riſes again, forming one of the boundaries of the rude Glen-Sanicks: it alſo forms the top of the bare, rugged and ſterile Cory-Glen, and the top of the other two great hollows between the Cory-Glen and Glen-Sanicks.

The lower part of Goatfield is compoſed of the uſual red-coloured ſandſtone, and is traverſed by veins of baſalt; this continues for ſeveral hundred feet up the mountain, when it at laſt diſappears: the micaceous ſhiſtus riſes from under it, ſeparated only by a ſtratum of breccia, thus ſhewing the relative

poſition

poſition of the ſandſtone and micaceous ſhiſtus. The micaceous ſhiſtus continues until we arrive at the plain formerly mentioned; but the ſide of the mountain, in ſome places, is ſo covered with the debris of granite, micaceous ſhiſtus, &c. that it is only by the appearance of the granite, in the neighbourhood of this plain, that we are aware of its exiſtence, as the aſcent is hardly more ſteep over the micaceous ſhiſtus than the ſandſtone, which is not generally the caſe; for we find, when the ſtrata are not covered with debris, that the ſandſtone is far leſs ſteep than the micaceous ſhiſtus, and this laſt than granite. Even in this way, we have a kind of general rule for judging of the nature of mountainous ridges. If they be peaked, and very precipitous, we may preſume that they are of granite; if they be leſs lofty, and not peaked, but ſtill ſomewhat approaching to the conical ſhape, we may ſuppoſe them to be compoſed of micaceous ſhiſtus; and, laſtly, if we obſerve theſe ſkirted by lower mountains, with a trifling pente, we may conclude that they are compoſed of ſandſtone and limeſtone. Although theſe obſervations may hold true in general, yet they will ſometimes be found liable to conſiderable variations: thus we know that the ſhape, and other appearances, of mountains compoſed of ſimilar rocks, are apt to be varied by ſeveral circumſtances, particularly by the horizontality or verticality of the ſtrata, their degree of compactneſs, and their

aptneſs

aptneſs to be weathered. It would be an addition of ſome conſequence, if we had a few general rules on this ſubject. Sauſſure well remarks, " Les ſignes qui peuvent donner " quelque indice de la nature des montagnes, à de grandes " diſtances, et au travers des plantes qui les couvrent, ſont en " petit nombre, et meritent d'etre étudiés et conſacrés par des " termes propres."

The pyramidal part of the mountain has a very ſterile and wild aſpect; being completely covered with looſe blocks of granite, and deſtitute of all vegetation, excepting a few lichens, which only add to its bleak appearance. Theſe blocks differ very much in ſize, ſome being twenty feet long *, and generally of a quadrangular ſhape; and are ſo heaped upon each other, as to render the aſcent very difficult. Having, however, gained the ſummit, we are well repaid for our labour by a moſt extenſive view of a wonderful diverſity of country. To the

 northward

* Dr. Walker has obſerved immenſe ſolid maſſes of granite in different parts of the Highlands: but theſe are vaſtly inferior to others that have been found in other countries. About thirty miles from the Cape of Good Hope there is a large maſs of granite, called the Pearl Diamond, which is about half a mile in circumference, and 400 feet high. *Phil. Tranſ.* 1778, p. 102.

northward we look down upon the peaked ſummits and deep glens in the neighbourhood of Goatfield, whoſe arid and reddiſh appearance ſuggeſts to our minds the effects of a dreadful conflagration. Beyond theſe, the iſthmus of Cantyre; the iſland of Iſla, the lofty and dreary paps of Jura, the long mountainous ridges of Argyleſhire, and the far-diſtant mountains of Mull, which are faintly deſcried, preſent a view rather to be felt than deſcribed. On the E. the well cultivated iſland of Bute, the frith of Clyde, the Cumbray Iſlands, backed with the beautiful coaſts of Renfrewſhire, form a moſt pictureſque ſcene. Towards the S. we have, below us, the lower part of the iſland ſpread out like a map, forming a ſingular appearance of heath-covered mountains and cultivated glens: farther diſtant, the charming coaſts of Ayrſhire, the ſhores and mountains of Galloway, as far as the Mull, the ſtupendous craig of Ailſa, riſing from the boſom of the ocean, all delight the eye and raviſh the imagination. Laſtly, on the W. the coaſt of Ireland, from Fairhead to Belfaſt Loch, concludes the amazing view from this intereſting height.

Glenrosa. This very ſtriking glen, ſituated upon the weſt and ſouth-weſt ſides of Goatfield, is about five miles long, and half a mile broad, bounded by very high mountains. The bottom

bottom forms a conſiderable angle with the ſides, riſing gradually towards the upper, or north end, where it is formed partly by the mountain called Keid-voe, and partly by Goatfield. The mountains on the oppoſite ſides of the glen are of different heights, (being far higher on the eaſt than weſt;) but the inclination of the oppoſite ſlopes is the ſame, being about 70°. At its entrance upon the ſhore at Brodick Bay, it has Goatfield on the north, and Glenſhirreg on the ſouth. On the ſouth ſide, the ſtrata are common argillaceous ſandſtone, traverſed by baſaltic veins; but this continues only for a ſhort way, as the micaceous ſhiſtus ſoon makes its appearance. Upon the north ſide, a very little ſandſtone is to be obſerved at the bottom of the hill, the upper part being formed of micaceous ſhiſtus. Amongſt the debris of the micaceous ſhiſtus I obſerved great blocks of a rock, which is principally compoſed of hornblende, and now and then intermixed with quartz, and a ſubſtance that appears to be the ſame with the paliopetre of Sauſſure. The micaceous rocks upon both ſides of the glen lie upon granite, which ſoon preſents itſelf as we proceed up the glen, and forms the mountains upon both ſides to its further extremity. This granite, which is ſimilar to that of Goatfield, appears to be diſperſed in great ſtrata, that run N. and S. which is nearly in the direction of the glen. If we view them from

the bottom of the glen, they appear like great perpendicular walls, which are ſplit in many places into rhomboidal maſſes; but if we clamber upwards for ſome hundred feet, we at length diſcover the edges of the ſtrata, extending for a great way, and emerging here and there from above the looſe blocks of granite, which have fallen from the mountains, or have been formed by the ſplitting of the banks themſelves.

It was long believed, by geologiſts, that granite never occurred in ſtrata, but merely formed great maſſive mountains. This has been ſhown to be erroneous by many later obſervers; yet La Metherie, in the laſt edition of his Théorie de la Terre, ſpeaking of granite mountains, remarks, " Les maſſes ne ſont " ni par bancs, ni par couches, comme l'ont pretendu de ſa- " vans naturaliſtes. J'ai parcouru une grande quantité de ter- " reins primitifs, et je n'y ai jamais vu de couches. Quelque- " fois on appercoit des maſſes aſſez conſiderables de granites, " ayant une figure preſque rhomboidale, ſuperposés les uns " ſur les autres. Mais on ne ſauroit regarder ces ſuperpoſi- " tions pour des couches, puiſqu'elles n'ont rien de regulier, " et que ces maſſes, preſque rhomboidales, ne ſe rencontrent " que très rarement. Le plus ſouvent ces granites ſont fen- " dues, en differens ſens. Ces fiſſures ſe correſpondent

" quelque-

" quelquefois; ce qu'on prendroit, au prémier coup-d'œil, " pour des éſpèces de couches; mais un éxamèn plus appro- " fondi en fait bientôt reconnoitre la difference †." To theſe obſervations we will oppoſe that of ſeveral geologiſts who have obſerved ſtrata of granite, ſimilar, I imagine, to thoſe which occur in Arran, in different parts of Europe. The late celebrated M. Sauſſure, whoſe accuracy of obſervation is not to be queſtioned, diſcovered granite diſperſed in ſtrata in many parts of Europe; as may be ſeen by conſulting his moſt intereſting and elegant volumes. Reuſs, in his mineralogical geography of Bohemia, has detailed minutely many ſimilar appearances; and my learned friend Dr. Mitchell informs me, that the Reiſenbergs, a chain of mountains which ſeparate Sileſia from Bohemia, are compoſed of granite, for above fifty miles, and in this long courſe it is invariably diſpoſed in ſtrata nearly horizontal ‡.

Upon the eaſt ſide of the glen ſeveral curious appearances are to be obſerved. Of theſe, the moſt intereſting are the baſaltic veins,

† Tom. iv. p. 352.

‡ Mr. Kirwan, in his Geological Eſſays, refers to ſeveral other authors who deſcribe granite diſpoſed in ſtrata.

veins, which traverſe the granitical ſtrata, as they do the porphyry and ſandſtone *. The firſt vein which I diſcovered, being between three and four feet in diameter, is to be obſerved riſing through the granite, ſeveral hundred feet above the bottom of the glen. Its lower part is hid by the heather, and looſe blocks of granite, which cover the ſides of the mountains. As it riſes upwards it becomes gradually narrower, and at laſt divides into two branches, which run through the granite, contracting and enlarging their diameter from a few inches to more than two feet. The extremity of one of theſe branches appears either to have been broken, or ſo ſunk inwards as to cauſe one part of the branch to appear ſeparated from the other, as is repreſented in the plate; where A is the granite, B the baſalt vein, C the branch having the appearance of being ſeparated from D by intervening granite ‡. In the body of the great vein

* However commonly we obſerve baſaltic veins traverſing the granite in this iſland, yet it appears to be a rare occurrence in other countries. Reuſs never obſerved it in Bohemia; and Sauſſure, in a late communication to the Bibliotheque Britannique, aſſures us that he never obſerved any baſaltic rock among granite. *Bibl. Brit.* vol. vii.

‡ Rocks which are diſpoſed in ſtrata preſent ſimilar appearances with the vein above deſcribed, and of this we have a curious example in Saliſbury Craigs near Edinburgh. This hill, which is entirely compoſed of rocks of trap formation,

vein there is immerſed a conſiderable wedge-ſhaped piece of granite, marked in the plate at E; which has the uſual hardneſs, colour, &c. of that ſpecies of which Goatfield is formed. The granite and baſalt are not intermixed at their junction; no matter is interpoſed; and they are not altered in the leaſt by being in contact with each other. In the neighbourhood of this vein were found ſpecimens of rock cryſtal in cavities of the granite; and ſome of the cryſtals were of conſiderable ſize, but generally of a ſmoke colour. I alſo picked up a ſpecies of granite ſimilar to the pierre graphic which is found at Portſoy *; alſo a ſtone much reſem-

tion, affords ſome fine views of its ſtratification, in a lofty cliff that extends around a conſiderable part of it. Towards the north extremity of this cliff, the red-coloured ſandſtone, which lies below the baſaltic rock, is much waved in its courſe, and, at one place, a part of the ſandſtone ſtratum appears detached and immerſed in the baſaltic rock. The incloſed piece of ſandſtone is of great ſize, ſtill preſerves its ſtratified-like aſpect, only it is very hard. Dr. Hutton reckons it a ſtrong proof of the truth of his theory: but Mr. Deriabin, an intelligent mineralogiſt, who examined it along with me ſome time ago, thinks, that the ſtratum is not broken, only that it ſinks behind the baſalt, as I have conjectured may be the caſe with the vein above deſcribed. Dr. Hope informs me that ſeveral ſimilar appearances are to be obſerved in the neighbourhood of Edinburgh.

* I found a ſimilar rock among ſome foſſils ſent me from Hudſon's Bay; and, by a late memoir of Patrin in the Bibliotheque Britannique, (vol. 8. p. 78.) it proved alſo to be a production of Corſica.

reſembling the veined granite of M. Sauſſure; and likewiſe a curious ſpecies of granite, where the quartz, felſpar and mica were diſtributed in a radiated form, as is the caſe with many zeolites.

Near to the ſummit of Goatfield I picked up ſeveral pieces of rock, which is evidently the ſame with the paliopetre of Sauſſure, which he found looſe near to the ſummit of Mont Blanc in Switzerland †. Lower down, but upon the ſame ſide of the glen, many fragments of baſalt are to be obſerved, lying upon the ſides of the mountains, ſhowing the preſence of baſalt veins; and at the Keid-voe a great vein is to be ſeen, riſing perpendicularly through the granite. Nearly at the ſame place, I was much ſurpriſed to find ſeveral columns of dark leek-green coloured pitchſtone lying amongſt the debris of the granite; but, after conſiderable labour, I was not able to diſcover its ſituation.

Not far diſtant from this, in aſcending towards the ſummit of Goatfield, amongſt the looſe blocks of granite which cover its ſides, I obſerved a curious appearance. Upon breaking

† Voyages dans les Alpes, tom. 7me, p. 275.

breaking theſe rocks, with an expectation of diſcovering rock cryſtal, I found in ſeveral of them maſſes of compact granite, of different ſizes, either rounded or angular. Somewhat ſimilar appearances have been obſerved by other mineralogiſts: thus Mr. Werner has in his poſſeſſion a maſs of granite which contains pieces (geſchiebe) of gneiſs *; Mr. Roſter found between Ellbogen and Schlackenwalde, in Bohemia, a great-grained granite †; and Mr. Sauſſure obſerved a maſs of granite which contained an oval piece of gneiſs ‡. Mr. Werner reckons his ſpecimen a proof that the gneiſs is of earlier formation than the granite; in other words, that the pieces of gneiſs have been broken off a ſtratum which was depoſited before the granite. Mr. Sauſſure, however, is of an oppoſite opinion: he is inclined to believe that theſe pieces of granite or gneiſs have been formed ſimultaneouſly; and that they have, by ſome peculiar circumſtance, affected a rounded form, which is not manifeſted in the other parts of the rock. This conjecture is rendered more probable from the following fact: "I have often ſeen, ſays he, in veined granite, rounded pieces of a far

* Werner, Kurze Klaſſification der verſchiedenen Gebirgsarten.

† Emmerling Lehrbuch der Mineralogie. B. 3.

‡ Voyages dans les Alpes.

" finer grain, which nevertheleſs had been formed ſimultane-
" ouſly, ſince we obſerved the continuity of the layers of the
" fine-grained, with that of the granite in great grain and
" thick layers."

The weſt ſide of the glen is formed in part by a granitical mountain, named Ben-echleven, which preſents to us the great flat ſides of the granitical ſtrata. Its top is covered with enormous blocks of granite, which reſt upon it in a moſt fantaſtical manner. This mountain declines rapidly towards the N. E. forming a tremendous hollow, named Cory-dain, whoſe bottom is far elevated above that of Glenroſa, but is lower than the bottom of the next hollow, named the Feun-hody, which is raiſed far above either, preſenting to the bewilder'd eye an amazing ſcene of ridged and peaked rocks of granite. In the Cory-dain, the granite, at firſt ſight, appears to be ſtratified horizontally; but an examination ſhews us that is owing to the ſplitting of the granite. Here alſo we obſerve the granite diſintegrating in the form of ſand, and, what is more rare, decompoſing in the manner of ſome ſpecies of baſalt, that is, in cruſts *. Sauſſure, ſpeaking of this kind of decompoſition, remarks:

* Granite decompoſes in concentric layers.——Charpentier Mineralogiſche Geographie der Churſachſichen Lande. § 31.

marks : " Un autre fait, dont je trouvai la ſolution en exami-
" nant ces granites de prés et avec attention, c'eſt celui de ces
" exfoliations que j'avois obſervées dans la vallée ſuperieure.
" C'eſt un fait connu de tous les minéralogiſtes, que la plupart
" des pierres ſont plus tendres dans le ſein des montagnes qu'à
" leur exterieur, et qu'elles acquierent à l'air un degré de
" dureté ſenſible. Il ſuit de-là, que la partie exterieure, ou le
" bord de la tranche verticale d'une grande aſſiſe de granite,
" doit ſe durcir par le contact de l'air, tandis que l'interieur
" de la meme aſſiſe conſerve un certain degré de molleſſe. Et
" tant que les aſſiſes inferieures demeurent un peu molles, le
" poids enorme de toutes celles qui repoſent ſur elles doit à la
" longue les comprimer. Mais les parties exterieures, durcies
" par le contact de l'air, ne ſont pas ſuſceptibles de la meme
" compreſſion. Elles doivent donc s'en ſeparer, et former ainſi
" les exfoliations que l'on obſerve *."

* Voyages dans les Alpes, tom. 6me, p. 318.

ARRAN.

CHAP. IV.

Deſcription of the FOSSILS *mentioned in the preceding Chapter.*

PITCHSTONE.

ARGILLA PICEA, Werner. *RETINITE*, La Metherie. *OPALUS PICEUS*, Gmelin.

PITCHSTONE *from Lamlaſh Road.*

Colour. Dark leek-green.

Luſtre. Internally it is glancing *, with a waxy luſtre ‡; is often beautifully irideſcent, and this is particularly the caſe at the thin edges of the ſplinters.

Hardneſs. Gives a few feeble ſparks with ſteel, but is very brittle.

Fracture.

* Glänzend. ‡ Wachsglanz.

Fracture. More or leſs perfectly multiplied conchoidal, or ſplintery; often ſhiſtoſe; and rarely preſents diſtinct concretions.

Fragments. Almoſt always in the form of four-ſided irregular columns.

Tranſparency. Tranſmits a very little light at the edges.

Fuſibility. At 23° of Wedgewood's ſcale, it becomes black, is much rent, and internally a little porous; at 55° it had formed a porous enamel; and at 70° it became perfectly white, and the enamel was little porous.

It frequently contains a few cryſtals of white felſpar, which appear of the nature of adularia; and I obſerve interſperſed grains, apparently of quartz. This ſpecies is often intermixed with one ſimilar to that obſerved at Brodick wood.

PITCHSTONE—*Brodick Wood.*

Colour. Dark leek-green; but the number of diſtinct concretions often give it a lighter hue.

Luſtre. Little glancing *, with a greaſy luſtre ‡.

Tranſparency. Tranſmits a very little light at the edges.

Hardneſs.

* Wenig glänzend. ‡ Fett glanze.

Hardneſs. Gives a few ſparks with ſteel.

Fracture. Uneven, conchoidal, and ſometimes ſplintery, with numerous diſtinct concretions; in the groſs is often ſlaty.

It ſometimes contains cryſtals of white felſpar and quartz, cryſtalliſed in ſix-ſided pyramids.

It decompoſes, by the action of the weather, in the form of a white tegmen, which is often ſeparable into layers; and, by the decompoſition of the felſpar, it gets a cellular appearance, when it requires an experienced eye to diſtinguiſh it from ſome of the productions of Lipari. It is alſo frequently traverſed with another ſpecies, which has a greater degree of luſtre, and is more difficultly decompoſable by the action of the weather; ſo that ſpecimens of this kind, when decompoſing, preſent a ſtriped ſurface of dark-green and white, the dark-green being the undecompoſed ſpecies. Gerhard, in his Mineral Syſtem, mentions a ſpecies of gneiſs, or granite, that contains obſidian, a ſtone much allied to pitchſtone. Dr. Townſon, in his Travels through Hungary, remarks, that this gneiſs is a ſpecies of obſidian, with black and white layers, containing alſo, probably, a few cryſtals of adularia and ſcales of mica. The ſtone I have now deſcribed appears to be of the ſame kind, and this is rendered more probable from its ſometimes containing felſpar.

BROWNISH-

BROWNISH-BLACK PITCHSTONE—*South Side of Glencloy.*

Colour. Browniſh-black.

Luſtre. Little glancing, with waxy luſtre.

Tranſparency. None.

Hardneſs. Gives a few ſparks with ſteel.

Fracture. Uneven, with a tendency to the conchoidal.

Fuſibility. At 21° it intumeſced a little; its colour was ſlightly altered; the ſurface glazed, and, internally, porous. At 31°, intumeſced conſiderably, and ſoftened. It had then, externally, a browniſh glazed covering; internally, colour is grey, and very porous. At 65° it had intumeſced very much; forming an externally cavernous, yellowiſh-brown coloured maſs. At 100° it became more compact.

There are generally a few cryſtals of white felſpar diſperſed through it; and it acquires, by the action of the weather, a ſlight brown tegmen.

BLACK PITCHSTONE.

Colour. Black.

Luſtre. Little glancing, with a waxy luſtre.

Tranſparency.

Tranſparency. None.

Hardneſs. Gives a few ſparks with ſteel.

Fracture. Straight, ſlaty; and the ſlates appear to be formed by the ſuperpoſition of ſmall foliæ. The plates are alſo ſometimes covered by a metallic yellow-coloured illinition.

Smell. When powdered, it emits a bituminous ſmell; which renders it probable it may contain inflammable matter *.

It has generally a few cryſtals of white felſpar diſperſed, and theſe by decompoſition acquire a brown colour: ſometimes we alſo obſerve a yellow-coloured, nearly tranſparent ſubſtance accompanying the felſpar.

Theſe different kinds of black pitchſtone appear to paſs into baſalt. A curious ſpecimen of this kind occurred to me in the neighbourhood of Kilmichael-Houſe, in Glencloy. One part is common black pitchſtone, but it gradually loſes its luſtre; its fracture paſſes from the conchoidal to the plain ſplintery; then it gives a grey ſtreak, is not at all fragile, in ſhort, is a fair baſalt.

OBSER-

* Mr. Kirwan has found ſeveral pitchſtones to contain inflammable matter. *Kirwan's Mineralogy.*

OBSERVATIONS.

When pitchſtone was firſt diſcovered, it was believed by mineralogiſts to be the lapis obſidianus of Pliny *: its reſiny or pitchy colour, however, ſufficiently diſtinguiſhed it from the true obſidian, which was afterwards found in Hungary, Iceland, the South-Sea Iſlands †, &c. It was firſt diſcovered in Saxony; but it has not till now been deſcribed as a Britiſh foſſil.

From its great reſemblance to certain volcanic productions, it has occaſioned a conſiderable warfare between the Neptunian and volcanic philoſophers. The volcaniſts reſt their opinion on the following facts. 1. Pitchſtone has been obſerved to paſs into obſidian; a ſtone which is found in the neighbourhood of Mount Hecla in Iceland, and hence reckoned volcanic. 2. Pearlſtone, which ſeems only a ſpecies of pitchſtone, is

* Baron Veltheim has endeavoured to ſhew that the obſidian of Pliny correſponds to ſeveral other ſtones.

† Newes Bergmanniſches Journal. B. i. § 94.—The whole of the Iſle of Aſcenſion, according to Foſter, is compoſed of obſidian.

found not only to incloſe balls of obſidian, but even to paſs, on the one hand, to obſidian, and, on the other, to real pumice *. Mr. Camara, who had examined the pitchſtone of Hungary, was convinced, from its alternation with rocks decidedly Neptunian, that it could not claim a volcanic origin; and he rendered his proof more complete, when he demonſtrated, that the obſidian was converted into a porous ſpongy maſs by the blow-pipe, intimating that it had never been expoſed to the action of volcanic fire †. More lately, Lampadius, profeſſor of chemiſtry at Freyberg, has found, that the pitchſtone is affected by fire in the ſame way as the obſidian ‡; and has completely overthrown the volcaniſts, by the diſcovery, that the true obſidian contains 2 lb. 5 oz. of water per cent. ‖

As the pitchſtone which occurs in Arran is convertible into a porous or fibrous maſs by the action of the fire, and forms veins

* Eſmark N. Bergmanniſches Journal. Vol. 2.

† Bermanniſches Journal, 1794. B. 2. § 245.

‡ Neues Bergmanniſches Journal. B. 1. § 84.

‖ A whole pound weight of obſidian was diſtilled in a porcelain retort, and afforded 145 grains of pure water.

veins in ſandſtone, a volcanic formation cannot be attributed to it.

Fuſibility of Pitchſtone. Pitchſtone has been found by mineralogiſts to poſſeſs ſo very different degrees of fuſibility, that it leads me to enquire if they have all employed the true pitchſtone in their experiments. Mr. Morveau Guyton found the pitchſtone of Menil mountain, near Paris, to remain unaffected at a very high degree of Wedgewood's ſcale *. Mr. Kirwan, who has made many experiments on their fuſibility, found that the moſt fuſible formed an enamel at 130° of Wedgewood; but in general were far more refractory, ſome remaining unchanged at 160° †. It is plain that theſe foſſils are quite diſtinct from the pitchſtone of Arran: indeed, were they proved to be the pitchſtone of Werner, I would not heſitate to arrange the Arran ſtones as a new and diſtinct genus. It is now known, however, that ſeveral ſtones, which formerly paſſed for pitchſtone, belong to the ſemiopal. Dr. Mitchell informs me that the infuſible pitchſtones of Hungary are ſemiopals; and Dolomieu remarks, that the pitchſtones of the iſland of

 Elbe,

* Journal Polytechnic.

† Elements of Mineralogy. Vol. 1. p. 293, 294.

Elbe, Piedmont, and the wood which is converted into yellow and white pitchſtone from Hungary, are all very difficultly fuſible, and he therefore reckons them reſiniform chalcedonies †, (or, more properly, ſemi and wood opal.) It is not then improbable that the pitchſtones, which Mr. Kirwan and Morveau Guyton examined, were ſemiopals, or ſtones nearly allied to it.

The real pitchſtone, according to Emmerling, is eaſily fuſible ‡; Dolomieu found the pitchſtones of the Iſles Ponces and of the Paduan mountains eaſily fuſible; and, laſtly, Meſſrs. Camara, Deriabin and Lampadius obſerved a ſimilar fuſibility. Theſe facts agree with my trials on the Arran pitchſtone, and entitle me to reckon it the pitchſtone of Werner.

BASALT.

Basaltes, Marmor. Agricol. *Borax Basaltes*, Lin. *Basaltes Columnaris*, Waller. *Argilla Basalte*, Werner. *Common Trap*, Kirwan.

Basalt—

† Journal de Phyſique. Vol. 40. p. 215.

‡ Lehrbuch der Mineralogie. B. 1. § 264.

BASALT—*South Side of Glencloy.*

Colour. Black.

Luſtre. A number of ſhining particles diſperſed through it, which is probably hornblende *.

Tranſparency. None.

Hardneſs. Scarcely gives fire with ſteel.

Fracture. Even earthy, but is very compact.

By decompoſition acquires a browniſh-coloured tegmen.

BASALT, *which forms a vein running in the porphyry—Head of Glencloy.*

Colour. Lavender blue, intermixed with yellowiſh green; by decompoſition, red.

Luſtre. None.

Tranſparency. None.

Hardneſs. Yields pretty eaſily to the knife.

Fracture.

* Hornblende having been found to contain charcoal, or probably carbone, as a conſtituent part, has been ingeniouſly mentioned by Dr. Walker, as one fact, to ſhew the tranſition from plumbago to hornblende, which he imagines he has obſerved in ſeveral other inſtances.

Fracture. Rather uneven fine ſplintery.

Fuſibility. Melted at 103°.

BASALT, *which forms veins traverſing the granite—*
Eaſt Side of Glenroſa.

Colour. Greyiſh, or black.

Luſtre. A number of cryſtals of hornblende, diſperſed through it, give it a ſlight degree of luſtre.

Tranſparency. None.

Hardneſs. Gives a few ſparks with ſteel.

Fracture. Uneven earthy.

Gives a grey trace.

Fuſibility. Melted at 58°. This fuſibility diſtinguiſhes it from the ſpecies of baſalt examined by Mr. Kirwan. He found them fuſible from 120° to 130°; and the figurate trap, or columnar trap, melted at 100°.

It contains yellow-coloured olivin, and in greater quantity than I have obſerved in other ſpecies.

In the former edition of this work, I conjectured that both the pitchſtone and baſalt might contain potaſh. Since that period, Dr. Kennedy has analyſed baſalt, wacken-porphyry and greenſtone, and theſe he finds to contain a ſmall portion of ſoda

ſoda and muriatic acid ‡. Dr. Mitchell, to whom I communicated Dr. Kennedy's experiments, has lately repeated them upon the famous baſalt of Stolpen, but obtained a very different reſult. Having detected a ſmall portion of muriatic acid, he then powdered a quantity of the ſtone, and mixed it with ſulphuric acid; then diſtilled to dryneſs, and lixiviated the ſolution: the ſolution was decompoſed by the acetite of lead; the ſupernatant liquor was then evaporated to dryneſs, and the acetous acid burned off. The reſidue, which was pure alkali, afforded, with nitrous acid, priſmatic nitre: a deciſive proof of potaſh.

SIENITE.

Sienites, Marmor. *Pyropoecilus*, Plin. et Al. *Syenites*, Dr. Walker's Claſſ. Foſſil. *Granites Sienites*, Gmelin. Syſt. Nat.

This rock we have remarked forming ſtrata at the head of Glencloy, and it occurs in many other parts of the iſland: I ſhall now mention its external characters. To prevent repetition, I will ſhortly detail the different ſpecies, placing the ingredients in their order of proportion.

1. Felſpar;

‡ Tranſactions of the Royal Society of Edinburgh, vol. 5th.

1. Felſpar; reddiſh.
   Hornblende; green, and ſometimes black.
   Quartz; white, and ſometimes brown.

This ſpecies is more or leſs compact, and is ſometimes ſhiſtoſe.

2. Hornblende; green.
   Quartz.
   Felſpar.

This aggregate, which is almoſt entirely compoſed of hornblende, has the following characters:—

Colour. Dark leek-gren.

Luſtre. A number of ſhining points diſperſed through the the maſs, owing to the hornblende.

Tranſparency. None.

Hardneſs. Gives fire with ſteel, but not very plentifully. —Leaves a grey trace. It is difficultly diſtinguiſhable from many ſpecies of baſalt, and is often intermixed with patches of the firſt ſpecies.

3. Quartz.
   Felſpar.
   Hornblende.

This ſpecies, owing to the great proportion of quartz, has much the appearance of a ſandſtone.

4. Horn-

4. Hornblende.

Quartz.

Felſpar; greeniſh-coloured.

The hornblende, in this compound, has ſometimes a metallic luſtre, approaching to the nature of ſchiller ſpar; and the felſpar is tinged green, owing to the diffuſed matter of the hornblende.

OBSERVATIONS.

The different ſpecies of ſienite were long confounded with baſaltic and granitic rocks: a circumſtance which was owing, not only to the want of an appropriate name, but to the difficulty of diſtinguiſhing the gradations. Werner firſt named it greenſtone; but he now calls it Sienite, from a conviction that it was a ſimilar ſtone which Pliny deſcribed as being found at Sienna in Upper Egypt. In antient times it was quarried in great quantities at Sienna; and from thence was brought to Rome for the building of great public edifices, and for the uſe of the ſtatuaries, who worked it into pyramids, obeliſks, &c. The famous Sarcophagus of Cheops, and Pompey's Pillar at Alexandria, are now known to be of ſienite.

As the diſcovery of metallic veins is one of the great objects of mineralogy, we think it not out of place to introduce, among the general obſervations we may have occaſion to make during the courſe of the work, a ſhort account of the different veins of ore which have been obſerved traverſing ſimilar rocks in other countries. In purſuance of this plan, we may remark, that ſienite, in ſome places, is rich in metals: thus, at Schauffenberg there are veins of ſilver and lead, and part of the productive Altenberg mine-works are in ſienite: we believe that the veins of Strontian in Argyleſhire run in a ſimilar rock.

CLAY PORPHYRY—*Cory-Gills.*

Thon Porphyry, German.

Colour. Browniſh baſis; by decompoſition, acquires a white tegmen.

Luſtre. None.

Tranſparency. None.

Hardneſs. Is difficultly ſcraped with a knife.

Fracture. Splintery.

Smell. Strong earthy ſmell, when breathed on.

Felspar—Is of a browniſh colour; ſometimes white and cryſtallized.

Quartz—Is of various colours, white, yellow, or ſmoke; of different ſhapes, angular, rounded, or regularly cryſtallized, preſenting often ſix-ſided pyramids, which is a rare appearance in porphyry: it is alſo ſometimes diſperſed through the baſis in the form of ſtrings.

Porphyry—*Glencloy.*

The baſis of this porphyry differs, in general, but little from that of Corygills: in particular inſtances, however, we obſerve it nearly in the ſtate of hornſtone, and having the following characters:

Colour. Grey.
Luſtre. None.
Tranſparency. A very ſlight degree at the edges.
Hardneſs. Gives a few ſparks with ſteel.
Fracture. Even.
Smell. A ſtrong ſmell, when breathed on.

The cryſtals of felſpar are much larger than in the clay-porphyry; and, beſides, I obſerved it to contain a ſoftiſh ſubſtance, probably ſteatitical.

GENERAL OBSERVATIONS.

The true porphyry was long confined by mineralogiſts to a particular ſtone which was ſuppoſed to have a jaſpideous baſis; but Werner has extended its ſignification much farther, and now reckons eight different kinds. It would be uſeful here to follow the Linnæan mode, by dividing them into diſtinct genera; and then the ſpecies might be deſcribed in ſhort characters, as has been done in botany. This will probably be reckoned uſeleſs labour by thoſe who think that foſſils are not capable of ſuch arrangement: we are well convinced, however, that, in the preſent inſtance, as well as in many other parts of mineralogy, much good may be done by ſuch attempts.

In modern times, porphyry has been principally uſed for ornamental purpoſes; and, where compact, it has been found to anſwer well for millſtones. The Greeks and Romans uſed it for the conſtruction of their fineſt edifices; and the ſtatuary often cut it into buſts, vaſes, &c. of the moſt exquiſite workmanſhip.

The

The porphyry in this iſland, ſo far as my experience goes, does not afford any veins of ore; yet in other countries it is ſometimes productive. Thus, in different parts of Germany, a ſpecies, ſimilar to what we obſerve in this iſland, has been found to contain veins of tinſtone, iron ore, manganeſe, galena, and molybdæna.

SILICEOUS SHISTUS.

Gemeiner Kieselschiefer, Wern. *Hornflint.*

Among the debris which covers the bottom of Glencloy, I diſcovered ſpecimens of a rock which ſeems to be ſiliceous ſhiſtus; but I could not diſcover it *in ſitu*. It preſents the following characters:

Colour. Grey, or greyiſh black.

Luſtre. None.

Tranſparency. Tranſmits extremely little light at the edges.

Hardneſs. Gives fire plentifully with ſteel.

Fracture. In the groſs, ſlaty; of the ſingle plates, more or leſs fine ſplintery, inclining to the even.

It has diſperſed through it grains of quartz, and very minute

nute particles of a ſofter ſubſtance, whoſe nature I could not determine.

GRANITE.

Granites genuinus, Lin. *Granites durus*, Cronſted. *Saxum quartzo, ſpato ſcintillante et mica in diverſa proportione mixtis, compoſitum;* Waller, Syſt. Miner. vol. i. p. 407.

The granite of this iſland is, in general, pretty compact; of a whitiſh-brown colour, owing to the ſlight-brown tinge of the felſpar. To deſcribe all the varieties that occur might be uſeful; but that is more adapted for a ſyſtematic treatiſe of mineralogy than an outline of this kind. I ſhall only, therefore, give a particular account of two ſpecies; the Great-grained, or Common Species, and the Small-grained.

I. Great-grained Granite.

This ſpecies is not only remarkable by its forming a very conſiderable part of the ſolid materials of the iſland, but alſo on account of the peculiarity of its compoſition; as it frequently contains three ſpecies of felſpar, and the quartz is often cryſtallized.

1ſt Species, FELSPAR—Is of a white colour, with a ſlight tendency to the brown; having the uſual luſtre, tranſparency, and hardneſs.

2d Species, ADULARIA?

Colour. White.

Form. Either in amorphous maſſes, or cryſtallized in hexahædral priſms, bevelled at both ends.

Luſtre. External, like that of cryſtals not much poliſhed; internal, ſame.

Tranſparency. Sometimes objects can be ſeen pretty diſtinctly through the cryſtals; but when they are a little decompoſed, opacity is produced.

Fracture. Plain foliated, and ſometimes ſtriated.

Hardneſs. Gives fire plentifully with ſteel.

Fuſibility. At 100° the ſurface was formed into a yellow-coloured enamel.

3d Species—Is of a white colour, having nearly the uſual hardneſs, fracture, &c. of the common felſpar; differing principally in the luſtre, which is like that of poliſhed metals, reflecting, in certain directions, a ſilver light.

QUARTZ—

Quartz—Is frequently colourleſs; alſo greyiſh, pale yellow, pale, or dark brown, and ſometimes nearly black, when it is called Morion.

Is very often cryſtallized; and either in the form of hexangular priſms, terminated by hexangular pyramids at one or both ends, and the priſms are ſeamed acroſs. The cryſtals are ſometimes found ſeveral inches long, and from two to three inches diameter; of a pale brown, or rather ſmoke colour. Theſe laſt are much valued by the lapidaries.

Mica—Is often black; ſometimes golden yellow, tombac brown, or green. It is generally in the form of irregular plates; and pretty frequently hexagonal plates occur, which, being ſuperimpoſed upon each other, form a hexagonal figure of ſome magnitude. It is the mica lamelleuse hexagone of Rome d'Iſle, (vol. ii. p. 509.) and the hexagonal mica of the Abbé Huay, (Miner. vol. v. p. 296.)

The conſtituent parts of the granite are very various in their proportion; but, in general, the felſpar forms the moſt conſiderable part, then the quartz, and laſtly the mica.

II. Small-

II. Small-Grained Granite

Is very compact, with an uneven fracture; compoſed of felſpar and quartz, in nearly equal proportions, with very few ſcales of black mica. It is ſubject to much variety; not only on account of the ſize of the particles, but alſo from their relative proportion, their degree of compactneſs, &c. Some varieties are ſo compact, and have ſuch a general appearance, as eaſily to paſs for ſandſtone: but a careful examination of the figure of the particles, the want of ſubſtramen or baſis, and, laſtly, its ſituation in the earth, afford ſufficiently diſtinct marks of difference. It is generally found in fiſſures, which traverſe the great-grained granite in all directions; but it alſo occurs in patches diſperſed through it *.

BRECCIA.

I have already remarked that the common breccia, which runs among the ſandſtone, is formed of fragments of ſand-

 ſtone

* It has been obſerved in the mountains of the Hartz, that granite affects the magnetic needle; but it is ſaid only in maſs, and in a perpendicular vein. Mr. Deriabin, however, informs me, that this is not quite correct; for he has obſerved it to act in detached pieces.

ſtone and quartz, immerſed in an arenaceous baſis. Another ſpecies occurs upon the ſummit of the ſienite hills, back from Glencloy. It has an arenaceous baſis, approaching, in appearance, to baſalt; and containing rounded or angular maſſes of granite ſimilar to that which forms Goatfield, micaceous ſhiſtus, quartz, porphyry like that of Glencloy, baſalt, and paliopetre. I was not able to diſcover its real ſituation; but its compoſition ſhewed that it was probably interpoſed between the primary and ſecondary ſtrata. The circumſtance of its containing granite, explained a phenomenon which long puzzled me—the appearance of rounded maſſes of granite upon the ſummit of ſeveral high hills; theſe evidently owing their origin to the decompoſing breccia.

ARRAN.

CHAP. V.

Cory; Cock of Arran; and Loch-Ranza.

HAVING now given a pretty extended deſcription of the ſtrata and foſſils in the neighbourhood of Brodick Bay; I ſhall, in the next place, proceed to trace the ſtrata round to Loch-Ranza, which is ſituated upon the north-weſt ſide of the iſland.

From Brodick Bay, the cliffs all around are low, and, for a great way, compoſed of the uſual red ſandſtone, which is much traverſed by veins of baſalt, of various widths, and running in different directions. Coves occur in ſeveral places, but none are of conſiderable ſize: frequently calcareous ſtalactites hang from their roofs. The action of the ſea upon the ſandſtone has given a ſingular aſpect to the whole ſhore; owing

to ſoft ſandſtone being waſhed away, while the more compact and hard, which appears to have been formed in fiſſures, is left ſtanding in long ridges, or criſtæ. The ſandſtone, as it riſes upwards, forms part of the lower region of Goatfield, in the vicinity of the micaceous ſhiſtus, which it, in all probability, covers. About a mile from the Cory, nearly one hundred feet above the level of the ſea, there is a ſtratum of limeſtone, about twelve feet thick, running at an angle of 20°, and covered with red-coloured argillaceous ſandſtone; but, below, interpoſed between the limeſtone and ſandſtone, there is a layer of a red ſhiſtoſe clay. In this clay I obſerved regular ſeries of ſhells, depoſited in layers, (all appearing of the ſame ſpecies,) with their convex ſides regularly downwards. The ſtratum is ſometimes ſtraight, but often waved and twiſted. It alſo frequently contains radiated calcareous cryſtals, which are of a reddiſh colour, owing to the admixture of iron. In a fiſſure of the ſandſtone, above the limeſtone, I obſerved ſtalactites of peat, of conſiderable ſize and conſiſtence, which appear to have been formed by the infiltration of the ſoluble peat-matter through the ſandſtone. To the N. of this ſtratum there is a conſiderable ravine, which luckily afforded me an opportunity of obſerving the junction of the different ſtrata. Here I traced the common red-coloured argillaceous ſandſtone from the ſhore to a conſiderable height, and, in ſome places, obſerved

ſerved it intermixed with fragments of quartz; thus forming a kind of breccia. As we approach the primitive rocks, the ſandſtone ſtrata become more elevated; and, at length, I obſerved it lying on a compact ſhiſtoſe rock, which appeared to be of the nature of micaceous ſhiſtus; but it was ſo much decompoſed by the action of the weather, that I could not well determine exactly as to its particular deſignation. This micaceous ſhiſtus? continues but for a ſhort way, when it is to be ſeen lying on the granite, which riſes upwards, forming a very ſteep aſcent, which leads to the rugged and ſterile-looking Coryglen. This glen is very precipitous on all ſides; is broader than any in the Goatfield groupe, but is comparatively ſhorter: its bottom is higher than that of Glenroſa, but not ſo much elevated as that of the Cory-dain or Feun-hody. It is entirely compoſed of granite; which is here ſplit, as uſual, into immenſe blocks, that are piled in vaſt tumuli upon the tops of the ſurrounding mountains, or cover the ſides and bottom of the glen, as with ruin and deſolation.

Having returned again to the ſea-ſhore, I continued my journey; and, as I approached the Cory, obſerved a vein of ſoft, red, ſhiſtoſe ſandſtone, containing rounded pieces of argil running through the ſandſtone N. E. and S. W. At the Cory, where there are a few houſes, I obſerved quarries of

ſandſtone,

ſandſtone, of a beautiful white colour, and of good conſiſtence for building. Theſe quarries are now worked, by a company, for the conſtruction of the Crinan Canal. Here there is alſo a ſtratum of limeſtone, about thirty feet thick, conſiderably inclined to the horizon, running N. N. W. and divided into ſtratulæ, as the ſtratum formerly mentioned, with intervening clay and ſhells, but the clay is more or leſs indurated. From this towards Weſt Sanicks, the ſhore is compoſed of the common red-coloured ſandſtone, interſected here and there with veins of baſalt; but it is often ſo covered with bowlder ſtones of different kinds, as to render travelling very difficult. The rounded maſſes of granite, ſcattered up and down here, are of a moſt aſtoniſhing ſize; ſome of them hundreds of tons weight. Near to the Sanicks, there is an immenſe ſtratum of breccia, which is compoſed of rounded fragments of quartz, and micaceous ſhiſtus, cemented by an arenaceous ground. The breccia is in many places much broken. Immenſe maſſes of it, many hundred tons weight, lying ſeparated from the ſtratum only a few feet, render it probable, that theſe maſſes were diſunited by froſt. In one place, I obſerved, a conſiderable ſection of the breccia, which I examined very carefully, in order to diſcover if the maſſes of quartz, were compreſſed and ſmaller at the lower than the upper part, but no difference could be obſerved. Very remarkable inſtances of this kind have been obſerved

ſerved in other countries; thus in Bergm. Erde-Beſch. 182, we are told that in the mountains of Quediliæ and Portfiællet in Norway, which conſiſt of an argillaceous puddingſtone, the ſiliceous pebbles it contains, are obſerved to be compreſſed to the thickneſs of the fourth of an inch, in the lower parts of the mountains, but to increaſe in ſize and roundneſs in proportion as their ſituation is higher. Alſo in the Vivarois, the loweſt ſtrata of primitive limeſtone, have been found of the thickneſs of one-tenth of an inch; but in proportion to their elevation in the mountain their thickneſs increaſes, until at its ſummit, it arrives at thirty or forty feet. 1. Soulavie, 178. Ferber made the ſame obſervation in England.

At a little diſtance from the ſhore, is the entrance into the deep South Glen-Sanicks, which is about four miles long, running nearly E. and W., and bounded on both ſides by lofty mountains. As I obſerved a conſiderable ſtream of water running through this glen, I determined to examine it, as it was probable that the ſtrata would be well expoſed. Having walked for upwards of a mile in the direction of the glen, I deſcended into the ravine formed by the water, but found ſtill the uſual red-coloured argillaceous ſandſtone. As we continued clambring upwards, I obſerved ſeveral veins of ſulphat of barytes, ſome nearly four feet wide, traverſing the ſandſtone;

ſtone; and, by a little care, I obtained ſpecimens pretty well cryſtallized. About a quarter of a mile further on, a very compact arenaceous breccia (principally compoſed of rounded pieces of quartz, and a ſpecies of baſalt, which has, interpoſed, grains of felſpar, and a yellow ſubſtance,) makes its appearance; and this extends to a conſiderable diſtance; but it is at length apparently interrupted by a ſtratum of hornblende rock. This ſtratum of hornblende rock is only a few feet wide; and it appears to lie immediately on the granite. I have to regret that I could not obtain more ſatisfactory views of the junction of theſe ſtrata, owing to the great covering of debris. I am ſomewhat confident, however, that the diſpoſition of the ſtrata is pretty nearly as now ſtated, viz. that in the lower parts, and for a conſiderable way upwards, is argillaceous ſandſtone; next, arenaceous breccia; then a bed of hornblende rock; and, laſtly, granite.—The glen is now bounded by lofty granite mountains: on the N. is the Caimes, with part of Caime-na-caillich; and, towards the S., Keich-na-hien and Goatfield form boundaries awfully grand. Its ſides are much furrowed by the action of the rain: which circumſtance, with the red colour of the decompoſing granite, the immenſe granitic blocks which cover the ſides and tops of the mountains, form altogether a ſteril and tremendous ſcene.

In

——— In lonely regions, here, retired
From little ſcenes of Art, great Nature dwells
In awful ſolitude.

Here I obſerved ſeveral veins of baſalt traverſing the granite; and, in ſome places, I could trace the perpendicular veins from the top to the bottom of the mountains. At the top of this glen is the hollow called Cory-na-huave, which is bounded by Caime-na-callich and Keid-voe. Its bottom is higher than that of Glen-Sanicks; and is entirely compoſed of granite, traverſed with veins of baſalt, ſome of which have a conſiderable degree of curvature.

Having examined this glen as far as my time would permit, I was again proceeding toward the ſea-ſhore, when I thought it might be intereſting to examine the junction of the granite and ſhiſtus in ſome of the neighbouring glens. I therefore changed my courſe, as ſoon as we came to the rock of breccia which I have juſt deſcribed; and from this I croſſed over a hill of ſimilar rock to North Glen-Sanicks. Here we obſerved a ſtream running through the glen, and in it I found the ſhiſtus in immediate contact with the granite. The ſhiſtus appeared to be a very compact micaceous rock; but the granite was not intermixed with it at the junction, nor were there any veins

to be obſerved ſhooting from the granite into the micaceous rock. We now croſſed over the hills into another glen, where I obſerved another junction of the granite and ſhiſtus, but it preſented nothing remarkable.

I now returned again to the ſhore, below the entrance of South Glen-Sanicks; ſo that I might proceed regularly on my tour through the iſland. After paſſing the Sanicks burn, I found the ſandſtone, breccia and baſaltic veins ſtill continuing; but the appearance of the mountains was much changed. The peaked ſummits, and almoſt perpendicular, furrowed ſides, now diſappeared: the mountains were cloathed with heather to their ſummits, which were more or leſs round-backed: intimating an alteration in the materials of which they are compoſed; which is really the caſe, as the granite had now diſappeared, the ſummits of the largeſt hills being of micaceous ſhiſtus, which, in ſome places, alternated with talcaceous ſhiſtus. I now wandered along a mile or two of ſhore compoſed of ſandſtone; when my attention was arreſted by the remains of workings for coal, at a little diſtance from the ſea-mark the Cock of Arran. This coal ſtratum, which is but of ſmall extent, runs in the ſandſtone, accompanied by the uſual coal metals, as, argillaceous ironſtone, ſhiſtoſe clay containing numerous vegetable impreſſions, &c., and at the bottom of a mountain

mountain of micaceous ſhiſtus. It is ſimilar to that which is found at Kilkenny in Ireland, and is called blind-coal *. I obſerved two pits, about fifteen feet deep, which had been dug in cutting the coal ſtratum; but, as the coal ſoon diſappeared, the pits were left, and the ſalt-pans which had been erected were rendered uſeleſs. The ſituation of this ſtratum is ſuch, as to preclude all hopes of finding any conſiderable quantity of coal, although freſh ſections were made: for we invavariably find it to be the caſe, that wherever coal ſtrata come into the vicinity of high mountains, they then moſt certainly decreaſe in breadth, and become bad, owing to the great admixture of earthy matter. Thus, many of the ſeams of coal which have been found in France are trifling, and continue but for a ſhort way; owing to their ſituation, being found in vallies that are bounded by granite, or other primary rocks †.

* Dr. Hutton conceives that this ſpecies of coal preſents an irrefragable proof of the truth of his theory. Here, ſays he, is a coal having all the properties of that which has been ſubmitted to the action of heat; the bitumen is ſeparated, and charcoal remains. To the Neptuniſts, this affords one of the ſtrongeſt arguments againſt the theory. The ſeparation of bituminous matter ſhows a want of immenſe compreſſion, which is the grand fundamental baſis of the hypotheſis. It is indeed this circumſtance, principally, which diſtinguiſhes it from the volcanic theory, and has led Mr. Kirwan to name it the Plutonic.

† Journal des Mines.

The great frequency of baſaltic veins is another cauſe which may render the coal, if it ſhould again be deemed worthy of attention, of an indifferent quality, and difficult to work.

From this ſtratum to the Cock, which is the moſt northern point of the iſland, the ſhore is covered with immenſe maſſes of ſandſtone and breccia, which have tumbled from the neighbouring hills by the action of the weather. Ironſtone is found ſcattered upon the ſhore, and is probably connected with the coal workings. The Cock is not, as I expected, a headland, but merely an enormous maſs of ſandſtone, lying looſe upon the ſhore, having a fancied reſemblance to the head of the cock. Here the cliffs are of conſiderable height, compoſed of ſandſtone and breccia, traverſed with veins of baſalt of various ſizes. One of theſe veins is compoſed of a reddiſh brown-coloured baſalt, with, interſperſed, white-coloured, apparently cryſtallized ſpecſtein of Werner; and the baſalt, where it is in contact with the ſandſtone, is hard, and much reſembles hornſtone. After leaving this, a ſtriking appearance preſents itſelf to our view, of the whole face of an immenſe ſtratum of breccia, which was ſhattered to pieces, and rolled towards the ſea, by an intenſe froſt ſome years ago: the craſh of its fall was heard far off. The ſandſtone upon this part of the coaſt is alternated with layers of ſhiſtoſe clay; and where the clay is waſhed away

away, the ſandstone lies expoſed, having the appearance of a regular pavement. If we examine it more nearly, we find the ſandstone strata ſplit into two, four, or ſix-ſided irregular figures, and connected together by the clay, which gives it an artificial aſpect; by the decompoſition of the clay, the pieces of ſandstone are ſeparated, and lie ſcattered on the ſhore, and are apt to be taken for the work of art. From this to within a mile of Loch Ranza, the ſandstone, as uſual, forms the cliffs upon the ſhore, and is backed by mountains of micaceous ſhistus, upon which it rests. Here, however, the ſandstone diſappears, and the micaceous ſhistus now forms the cliffs, which become higher as we approach Ranza. At the place where the ſandstone diſappears, there is a great baſalt vein, about thirty feet wide, running in a rock intermediate between ardeſia and micaceous ſhistus. As we approach nearer to Loch Ranza, the ſea has expoſed ſeveral other ſimilar appearances, but far more distinct than the first. Theſe veins are of various ſizes; ſome are curved in their direction; one, in particular, is forked, or divided into two branches, which run in very different directions through the micaceous ſhistus. A few hundred yards from the entrance of the Loch, the ſea has formed an intereſting ſection of the ſtrata, which demonſtrates, in a ſatisfactory manner, the relative poſition of the ſandſtone, limeſtone, and micaceous

caceous ſhiſtus. The micaceous ſhiſtus which forms the ſhore, is inclined at an angle of 45° and dips to the S. E.; the ſecondary ſtrata, are inclined at an angle of 45°, but dip to the N. W. ſo that the two kinds of ſtrata meet together, ſimilar, as Hutton remarks, to the two ſides of a lambda, or the roof of a houſe. The ſecondary ſtrata are of red coloured argillaceous ſandſtone, (which ſometimes appears paſſing into breccia:) which alternates with limeſtone. This limeſtone ſometimes contains maſſes of hornſtone, a fact, ſomewhat ſimilar to the occurrence of flint in the chalk beds of England. Sauſſure remarks that hornſtone is confined to the ſecondary limeſtone, quartz being the ſporadic matter which he has obſerved in primitive limeſtone. Many other veins may be obſerved traverſing the micaceous ſhiſtus, before we arrive at the entrance of Loch Ranza, but any detailed account of theſe would be but a repetition of what has been already mentioned.

Glen-Ranza. This glen is about two miles long, and half a mile broad, running nearly north and ſouth, bounded on both ſides by lofty round-backed mountains, that riſe at a very conſiderable angle, and are nearly of the ſame height on both ſides of the glen. The inclination of the oppoſite mountains is the ſame, and the ſtrata run at the ſame angle.

The



JUNCTION OF THE PRIMARY & SECONDARY STRATA NEAR LOCH RANSA

A A *Sand-Stone* B B *Lime Stone Strata* C *Micaceus Shistus*
D *Basaltic Vein*



EAST SIDE of GLEN ROSA

The bottom of the glen is but little elevated, and nearly level; about one half is covered with a ſalt water loch, which adds greatly to the beauty of this romantic ſpot. The hills are compoſed of micaceous ſhiſtus, containing a greater or leſſer proportion of quartz and mica; indurated chlorite is alſo diſperſed through it, and towards the mouth of the loch there is a conſiderable ſtratum of ardeſia, or primitive argillaceous ſhiſtus, bounded by the ſtrata of micaceous ſhiſtus.

GLEN-ES-NA-BIRACH. From the top of Glen-Ranza, we enter, by a narrow paſſage, into a long deep glen, running nearly in the ſame direction, called Glen-es-na-birach, bounded on both ſides, with mountains of compact micaceous ſhiſtus, which lie upon the granite. The granite and ſhiſtus are often intermixed at their junction, and ſometimes ſmall granite veins are to be obſerved iſſuing from the maſſive granite, and traverſing the ſhiſtus. This latter appearance was conſidered by Dr Hutton, as a demonſtration of the truth of his theory, with regard to the formation of granite. I will not now make any obſervations on this particular opinion, as I intend to conſider it ſomewhat fully in a ſubſequent part of the work. As we advance further up the glen, the micaceous ſhiſtus diſappears, when both ſides are formed of granite, of the ſame kind with that of Goatfield. The bottom is alſo formed of granite, as is well

demonſtrated.

demonſtrated by the ſtream, or burn, which has laid bare the rocks through the whole extent of the glen; it is indeed by rivulets of this kind that we are often enabled to have a diſtinct view of the mineral ſtructure of highland countries. From the further extremity of this glen, is the aſcent to Caimena-caillich, which is in ſeveral places rugged and difficult, from the number of looſe blocks of granite ſpreading all around. Upon aſcending, we firſt ſtop at the edge of what is called the Garife-hodie: Here a wonderful and moſt tremendous ſcene preſents itſelf to our view. An immenſe hollow, many hundred feet deep, dreadfully rugged and broken, almoſt entirely ſurrounded with mountains, whoſe ſerrated ſummits are covered with immenſe tumuli of granite, exhibits to us, in very legible characters, the vaſt operations of nature, in the formation and decompoſition of our globe. What man, poſſeſſed of reaſon, contemplating this awful ſcene, could doubt of the exiſtence of that BEING, whoſe power and wiſdom are far beyond the reach of human comprehenſion? If ſuch a man exiſt, vanity, not ſoundneſs of judgment, is the diſtinguiſhing feature of his character. Few, indeed, of thoſe who deny, or even doubt the exiſtence of Deity, have ever beheld, far leſs ſtudied, the ſtupendous and awful works of nature. It is not, then, much to be wondered at, that the pride and arrogance, which ſo often characteriſe the cloſet philoſopher, ſhould find

their

their way to mix with their daring and impious ſpeculations; which have for their end the propagation of the worſt principles, the diſſolving of all the bonds, and deſtroying the ſweeteſt endearments of human ſociety.

Upon the edge of the hollow, I obſerved ſeveral fragments of porphyry, but I could not diſcover any fixed rocks of it, owing to the blocks of granite ſcattered all over the ſides of the mountains. In aſcending from this, to Caime-na-callich, ſeveral other appearances of porphyry, and alſo fragments of baſalt and pitchſtone, preſented themſelves. After conſiderable fatigue I was ſo fortunate as to diſcover two veins of baſalt, upon the ſide of Caime-na-caillich looking into the Garifehodie; and, between theſe, there appeared a perpendicular vein of pitchſtone, all running in the common granite. This pitchſtone, is of a green colour, much reſembling that from Brodick wood. It forms a vein, about two feet wide, and, what is remarkable, it is formed into two regular columns, from two to twelve inches diameter, and having from three to ſix irregular ſides *. I could not, however, diſcover the ſituation of

* It would be worthy the attention of future travellers to determine whether the baſalt be not included in the ſame vein with the pitchſtone, thus forming a ſtratified vein.

the porphyry, although it was ſcattered in ſome places of the mountains in conſiderable quantities. Having gained the ſummit of this great mountain, which is nearly of an equal height with Goatfield, I had a very grand view; yet not ſo extenſive as that from Goatfield.

Its ſummit has a moſt ſingular appearance, owing to its being covered with enormous piles of quadrangular maſſes of granite, which reſt upon each other in a moſt fantaſtic manner, and have much the appearance of artificial tumuli. Such appearances are by no means peculiar to Caime-na-callich, for I have already remarked them upon the top of ſeveral of the granite mountains in the iſland. Here we can trace the granite in its various ſtages of decompoſition, from the ſolid rock to the looſe ſand; in its beginning diſintegration it ſplits into maſſes, having a greater or leſſer tendency to the quadrangular form; but theſe maſſes have ſtill a degree of connection amongſt themſelves, as is the caſe upon the mountain top. The next ſtep is the enlargement of the fiſſures, by which the maſſes are looſened from their connection, and tumble down from their elevated ſituations, upon the ſummits of the neighbouring mountains, or are hurried with impetuous velocity down the mountain ſide, covering the bottom of the glens with theſe ſtupendous ruins.

Laſtly

Laſtly, theſe detached maſſes, by the action of the weather, are completely diſintegrated, forming a looſe ſand, which is left upon the tops or ſides of the mountains, or is carried in great quantities to the ſea ſhore by the torrents *. Sauſſure, at ſec-

* Dr Hutton remarks, that the ſtony matter of this globe has been formed by the decay of a former world, whoſe debris has been collected by various means, at the bottom of a former ocean. This part of the Huttonian theory differs but little from that of Count Buffon, yet it is ſo material for the general ſupport of the whole, that if it ſhall be diſproved, the ſolidity of the theory in general will be much impaired. If we examine a few of the numerous facts on this ſubject, we ſhall find no proof of the debris being carried to the fathomleſs depths of the ocean; on the contrary, we will obſerve it diſpoſed of in a very different way. Thus in ſome caſes, the looſe materials waſhed from the mountains, are obſerved filling up great hollows; and in other inſtances, rivers depoſit their earthy matters, and form extenſive plains, and not unoften the debris having reached the ſea ſhore, is thrown back upon the ſame or other ſhores. The following facts are in proof of theſe remarks. The plains of Crau and Camarque, in lower Languedoc, were formed by depoſitions from the Rhone, and the plains of Lombardy from that of the river Po; the lands of Holland and the Delta of Egypt, ſeem alſo to be depoſitions of the debris, brought to the ſea ſhore by great rivers. In Egypt, the gathering of debris is very great, as is well authenticated by hiſtoric evidence: thus, we are told, that the town of Damietta, in lower Egypt, about the year 1243, was upon the ſea ſhore, but is now about twelve miles from it: and the town of Foc-ah which, three hundred years ago, was ſituated at the mouth of the Nile, is now ſeven miles diſtant. The country about the Baltic is alſo gradu-

ally

tion 604 of his Voyages dans les Alpes, remarks, that granite is diſpoſed in ſtrata, but that they are not always to be diſtinguiſhed, particularly in the granite of low countries and plains. This he conceives to be owing to the granite of low hills containing a great quantity of pierre de corne. This

ally incroaching upon the ſea. Linnæus remarks that the ſea ports of eaſt and weſt Bothnia are every year decreaſing, and becoming incapable of admitting veſſels; the inhabitants of the ports are obliged to change their ſeats, and ſometimes remove a quarter of a mile nearer the ſea. On the eaſtern ſide of Gothland, near Hoburg, the increaſe of the continent for theſe laſt ninety years, is about two or three toiſes annually. The inhabitants of weſt Gothland remark that the ſea decreaſes every ten years four or five lines perpendicularly, which, amounts, to forty or fifty lines in a century. According to this calculation, 600 years ago the ſea was 25 inches deeper than it is at preſent. In Arran we have alſo a ſtriking proof of the formation of land by the accumulation of debris. Innumerable other inſtances might be mentioned. But we will not cite more, but conclude this note with the following ingenious obſervations from Mr Kirwan's Geological Eſſays. "Mariners were accuſtomed, ſays he, for ſome centuries back, to diſcover their ſituation by the kind of earth or ſand brought up by their ſounding plummets, a method which would prove fallacious, if the ſurface of the bottom did not continue invariably the ſame. Fortis in his Travels through Dalmatia, p. 285, relates that urns thrown into the Adriatic upwards of 1400 years, ſo far from being covered by mud, were found in the ſame ſituation, as they could have been ſuppoſed to have been the firſt day of their fall; therefore, notwithſtanding many particles of earth are, by rivers, conducted to the ſea, yet none are conveyed to

any

This pierre de corne, he continues, contains a great proportion of argillaceous earth; and as moſt ſtones, which have this earth as a conſtituent part, and in conſiderable proportion, ſplit into rhomboidal maſſes, ſo he concludes that it is the earth of the pierre de corne which is the cauſe of the ſplitting of granite, thus forming the numerous maſſes which prevent us from obſerving the ſtrata. This explanation, however ingenious, does not hold true with regard to the granite of this iſland: no argillaceous ſtone of that kind enters into its compoſition, yet ſtill it ſplits into very numerous rhomboidal maſſes.

Glen-Halimidel. Upon the eaſt ſide of Glen-Ranza there is an opening leading to a glen, named Halimidel, which is about

any diſtance, but are either depoſited at their mouths, or rejected by currents or by tides; and the reaſon is, becauſe the tide of flood, is always more impetuous and forcible than the tide of ebb, the advancing waves being preſſed forwards by the countleſs number behind them; whereas the retreating are preſſed backward by a far ſmaller number, as muſt be evident to an attentive ſpectator; and hence it is, that all floating things caſt into the ſea, are at laſt thrown on ſhore, and not conveyed into the mid regions of the ſea, as they ſhould be, if the reciprocal undulations of the tides were equally powerful." Kirwan's Geological Eſſays, p. 440, 441.

about two miles long, running W. N. W. and E. S. E. but which ſoon changes its direction, running nearly in a line with Es-na-birach. It is narrow at the bottom, but widens upwards, owing to the inclination of the ſides, which form an angle of about 60°; and the bottom alſo riſes, forming a conſiderable angle with the ſides. It is compoſed of various ſpecies of micaceous ſhiſtus and quartz. In ſeveral places baſalt veins may be obſerved traverſing the micaceous ſhiſtus, many hundred feet above the level of the ſea: even in the bottom of the glen, where the burn has expoſed the micaceous ſhiſtus, we obſerve baſalt veins croſſing it. Upon the eaſt ſide of the glen, ſeveral hundred feet above the level of the ſea, there are two quarries, which were formerly worked for ardeſia, but are now diſcontinued. The ardeſia is of various colours; generally bluiſh or green, and is intermixed with white quartz; the fiſſures often contain cryſtals of actynolite, and a ſpecies of quartz penetrated with actynolite, forming a ſtone ſomewhat reſembling praſe.

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CHAP. VI.

Deſcription of the FOSSILS *mentioned in the preceding Chapter.*

LIMESTONE—*Cory.*

Colour. Grey.

Luſtre. A very faint degree of luſtre.

Tranſparency. None.

Hardneſs. Scrapes with a knife.

Smell. Emits a ſtrong earthy ſmell.

Fracture. Even, fine, ſplintery, and very compact.

Fuſibility. At 140° Wedgewood, no appearance of fuſion.

Another ſpecies is alſo found at the Cory; of a dark-brown colour, minutely foliated, difficultly ſcraped with a knife, and wanting tranſparency.

LIME-

LIMESTONE—*near the Cock.*

Colour. Brick red.

Luſtre. A ſlight degree of luſtre from ſome diſperſed foliæ.

Tranſparency. None.

Hardneſs. Pretty difficultly ſcraped with a knife.

Fracture. Generally foliated, paſſing to the compact earthy.

INDURATED LITHOMARGA?—*found looſe on the ſhore between Brodick Bay and the Cory.*

Colour. Light blood-red.

Luſtre. None.

Tranſparency. None.

Hardneſs. Yields to the knife with conſiderable difficulty; gives a pink ſtreak.

Fracture. Even, bordering upon fine ſplintery.—Does not ſtain the finger; feels dry; does not acquire a poliſh by friction; after immerſion in water for two days, no appearance of diſintegration.

BASALT

BASALT—*from a vein near the Sanicks.*

Colour. Greyiſh green.

Luſtre. None.

Tranſparency. None.

Fragments. Uneven earthy.

Hardneſs. Pretty eaſily ſcraped with the knife.

Fuſibility. Melted at 58°.

BLIND-COAL.

Kohlenblende, German. *Native Mineral Carbon*, Kirwan.

Colour. Black; when freſh broken, reflects a golden yellow, or violet colour.

Luſtre. That of metals not much poliſhed.

Hardneſs. Yields rather with difficulty to the knife.

Fracture. Plain foliated.

Is not coated with illinitions, as that from Kilkenny in Ireland. It does not ſtain the fingers.

Hardly burns until wholly ignited, when it conſumes ſlow-

ly, with a light, lambent, blue flame, which continues for a ſhort time. According to Mr. Kirwan's method, it contains, in the 100 parts, 93 of carbon and 7 of aſhes.

Mr. Kirwan, in the ſecond volume of his Mineralogy, remarks, that coals are not ſoluble in acids. I have obſerved, however, that the coal of Arran is rendered ſoluble in water, by means of the nitrous acid, the carbonaceous baſis appearing to be converted into an oxyd.

This ſubſtance has been placed in various parts of the mineral ſyſtem, as with black-lead, molybdæna, manganeſe, &c.; but the late correct analyſes that have been made, ſhow it is carbon nearly in a pure ſtate. Mr. Kirwan, upon conſideration of its great purity, places it at the head of the coals, with the name of Native Mineral Carbon.

ARDESIA.

Argillite, Kirwan. *Primitive Argillaceous Shistus*. *Dachschiefer*, Emmerling. *Ardesia Tegularis*, Linn.

Colour. Greyiſh blue, or greyiſh green; ſometimes both colours are intermixed in the ſame ſpecimen.

Luſtre.

Luſtre. Silky.

Tranſparency. None.

Fracture. Streight, ſlaty.

Fragments. Tabular.

Hardneſs. Yields pretty eaſily to the knife.

Streak. Grey.

Does not adhere to the tongue; feels rather greaſy, particularly the green-coloured; does not ſtain the fingers. There are often contained in the fiſſures, cryſtals of glaſſy actynolite.

MICACEOUS SHISTUS.

Lepidotes, Dr. Walker. *Shistose Mica*, Kirwan. *Glimmer Schiefer*, Werner. *Gneissum Micaceum*, Gmelin.

The few obſervations I have to make on this genus of rock ſhould, in ſtrict order, have been introduced in chapter ſecond; but I wiſhed previouſly to examine a greater number of ſpecimens, ſo as to be better able to give a general idea of the whole.

It would be inconſiſtent with the brevity of this outline to

deſcribe all the ſpecies of this rock: I ſhall therefore only mention it in general.

Mica. The mica, in general, is of a grey, or black colour; the ſcales very ſmall, and indeed often hardly diſtinguiſhable.

Quartz Is of a white colour; is ſometimes diſpoſed in layers; and, in ſome ſpecimens, has a granulated appearance.

Talkerde, Werner; *Talcite*, Mr. Kirwan; *Lepis*, Dr. Walker. This ſubſtance occurs very frequently, indeed more ſo than the mica; yet, as I am not well acquainted with the names given to its admixture with other foſſils, I ſtill retain the term Mica for the whole, in ſpeaking in general.

Theſe three ſubſtances are often conjoined, forming a ſpecies of ſlate; in other examples we obſerve only quartz and mica conjoined, or quartz and talcite; and, laſtly, felſpar, indurated chlorite and hornblende add to its variety. In general, the rock which theſe ſubſtances make is very compact; and often they are ſo intimately combined, that it is difficult to determine whether it be mica, talcite or chlorite that is intermixed with the quartz. Frequently we ſee the

the quartz a-wanting, when the mica paſſes to the ſtate of ardeſia.

Use, &c. Several kinds of this rock, particularly the quartzy, have been uſed for the building of ovens and furnaces, on account of their great infuſibility. No rock is more favourable for metallic veins; indeed, many of the richeſt mining countries are formed of it: we may inſtance the vaſt mines of Sweden, which are almoſt entirely ſituated in micaceous ſhiſtus.

ARRAN.

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CHAP. VII.

Glen-Catacol, Glen-Erſay, Glen-Clachan, Shiſkin, Tory-Lin, Benin-Head, Whiting Bay, Lamlaſh Bay, Lamlaſh Iſland.

HAVING glanced over the glens and ſtrata in the neighbourhood of Loch-Ranza, I will now proceed around the iſland by Glen-Catacol, which is about a mile and a half from Ranza. The ſhores in this direction are bounded by cliffs, which are neither very high nor rugged, but beautifully adorned with low ſhrubs, giving a richneſs of appearance ſeldom obſerved upon the ſhores of this iſland. The cliffs and mountains in the vicinity are formed of micaceous ſhiſtus, of various degrees of hardneſs, owing to its being more or leſs intermixed with quartz. They are ſeparated from the ſea by low beaches, of conſiderable extent, which, in ſome places, are cultivated. The entrance to the glen is bounded by lofty, precipitous mountains

tains of micaceous ſhiſtus; but this ſoon diſappears, as the glen changes its direction, running N. N. E. and S. S. W.: then the mountains are formed of granite ſimilar to that of Goatfield. In ſeveral places of the glen fragments of baſalt occur; demonſtrating the preſence of veins traverſing the granite, as we have already obſerved upon Caime-na-callich and Glenroſa. Upon one ſide of the glen we obſerved a narrow valley, into which we entered, but found that the granite was ſtill the prevailing rock. At one place, indeed, I diſcovered great maſſes of porphyry; but I could not detect them *in ſitu*. It is probable, however, that it forms veins running in the granite, as the quantity of debris is too ſmall for ſuppoſing the exiſtence of ſtrata. After a very fatiguing walk, I reached the top of the glen, when I obſerved a conſiderable plain, in which is ſituated a lake, about a mile long and half a mile broad, which is named Loch-Tan. It is bounded upon two ſides by lofty granite mountains; but is open towards the others; one leading to Glen-Erſay, the other to Catacol. The margin of this partakes much of the ſterility of the ſurrounding ſcenery: vegetation hardly ſhews its head: a few lichens and tufts of heather are the only ornaments of which it can boaſt:

——————— A joyleſs coaſt.
Around a ſtormy lake.

Yet

Yet here the grandeur and ſublimity of the ſurrounding granite mountains, envoloped in clouds and miſt, excited in my mind a vaſt variety of ideas; for,

> Surely there is a hidden power that reigns
> 'Mid the lone majeſty of untam'd nature,
> Controlling ſober reaſon.

Upon aſcending the granite mountains on the eaſt ſide of the loch, I obſerved conſiderable quantities of the debris of baſalt upon the top of the mountains, ſhowing that the veins had reached to the very ſummit *.

I walked onward to Glen-Erſay, and, in my way, obſerved large blocks of a beautiful dark leek-green coloured pitchſtone-porphyry, remarkable not only for the number, but alſo for the ſize and beauty, of the cryſtals of felſpar. I was not ſo fortunate as to find it forming a fixed rock in the neighbouring granite mountains; yet it is probable that future obſervers may diſcover it in veins, ſimilar to that obſerved on the ſide of Caime-

* Sauſſure obſerved fragments of greenſtone upon the ſummit of Mont Blanc; very probably originating from a vein of greenſtone which reached to the ſummit of this great mountain. Voyages dans les Alpes, tom. 7me, p. 280—288.

Caime-na-callich. Some mineralogiſts will rather be inclined to ſuſpect that it alternates with granite: as this is ſaid to be the diſpoſition which it affects when among the granite mountains of other countries. According to Charpentier †, who made this obſervation, porphyry containing pitchſtone alternates with granite near Meiſſen in Saxony. Dr. Mitchell, who was lately on the particular ſpot deſcribed by Charpentier, informs me, that he could not obſerve any ſuch alternation, and therefore preſumes that the obſervation of Charpentier is erroneous. Having reached the ſide of Glen-Erſay, I obſerved it taking its riſe from the lower part of Caime-na-callich and the neighbouring mountains, and running, in an irregular courſe, towards the ſea. It is ſaid to be nine miles long, and is reckoned the moſt extenſive glen in the iſland. Its ſides and bottom are formed of granite, which continues until we come within a mile of the lower extremity of Loch-Erſay, when ſtrata of micaceous and talcaceous ſhiſtus make their appearance. Theſe ſtrata continue to the entrance of the glen on the ſea-ſhore; and here they are covered and ſucceeded by red argillaceous ſandſtone and ſandſtone breccia.

† Charpentier Mineralogiſche von Churſachſen, § 63.

As I had an opportunity, upon my former viſit to this iſland, of walking along the ſhore from Catacol to the entrance of Glen-Erſay, I will now ſhortly mention the nature of the rocks that occur in this tract, and then continue the deſcription onwards to the other parts of the iſland.

From Catacol to Whitefarland, a farm belonging to Fullerton of Kilmichael, the cliffs are low, compoſed of micaceous ſhiſtus, but defended from the action of the ſea by intervening ſea-banks ſimilar to thoſe noticed between Catacol and Loch-Ranza. Near to the farm of North Tundergay, I obſerved a remarkable vein of baſalt penetrating the micaceous ſhiſtus. The micaceous ſhiſtus is much waved; but, as it approaches the ſide of the vein, it loſes its ſhining glimmery appearance, breaks into thick plates, and, where in immediate contact with the baſalt, it forms a compact kind of ardeſia. The vein, as it riſes from the ſea, is fairly croſſed by a ſpecies of micaceous ſhiſtus approaching to breccia; and here alſo the baſalt and micaceous ſhiſtus are much jumbled together, and ſome pieces of the vein are apparently inſulated in the micaceous ſhiſtus. Here, then, we have two facts; the former, the apparent tranſition from micaceous ſhiſtus to ardeſia; the other, maſſes of baſalt immerſed in the micaceous ſhiſtus, in a ſimilar manner to the baſalt I obſerved embedded in the granite upon the eaſt ſide of Glen-Roſa. At Whitefarland there is a conſiderable extent of natural

natural wood, which adds greatly to the beauty of its appearance, which is much heightened by the lofty granite mountains that bound it on one hand, with the ſea and long-extended iſthmus of Cantyre on the other. From this to Imachar the ſame micaceous ſtrata continue, forming beautiful cliffs and conſiderable ſea-beaches. At Imachar the micaceous ſhiſtus is undulated, and traverſed with quartz, ſo as to give the whole a kind of maculated aſpect; and it continues to form cliffs until we come to the ſtream which iſſues from the entrance of Glen-Irſa. Upon one ſide of this ſtream I obſerved primitive ſhiſtus, but upon the oppoſite ſide ſandſtone cliffs make their appearance. Theſe cliffs have a conſiderable beach interpoſed between them and the ſea; and the ſtrata of ſandſtone and ſandſtone breccia are elevated at a greater angle than any I have obſerved in the other parts of the iſland. The retreat of the ſea from theſe cliffs is not only marked by the conſiderable beach we have juſt mentioned, but alſo by the caves which are diſperſed in them. Theſe cliffs ſoon diſappear, when porphyry is to be obſerved; but we can only trace it a little way, the covering of graſs preventing any further examination. The country is now low and flat, ſo that we have an eaſy walk to the houſe of the Shiſkin; and the only rock I noticed was the red argillaceous ſandſtone, which I obſerved in the bottom of ſeveral burns: thus intimating that the whole ſtrata over which I had

paſſed, after leaving the porphyry, was ſandſtone. At the Shiſkin the land is low and flat. The mountains in the neighbourhood have a different appearance from thoſe about Loch-Ranza; are lower; their ſides leſs precipitous; in ſhort, have much of the general aſpect of thoſe about Glencloy, all announcing a change in their compoſition. We have a good opportunity of determining the truth of this conjecture, in the Clachen glen, which is but a ſhort diſtance from the Shiſkin. The ſandſtone ſtrata, which we have juſt mentioned as forming the low country around the Shiſkin, ſtretches up the glen for a conſiderable way. At one place, on the ſouth ſide, I obſerved a conſiderable ſtratum of limeſtone, which is covered, and even, in ſome places, intermixed, with ſandſtone breccia; and, nearer the upper extremity of the glen, ſhiſtoſe clay, richly impregnated with iron, makes its appearance. As we proceed upwards the glen becomes very deep; and, upon the north ſide, conſiderable rocks of clay-porphyry occur, apparently covering the ſandſtone, as I conjectured may be the caſe at Glencloy and Corygills. As we approach ſtill nearer to the upper extremity of the glen the ſandſtone diſappears, when a ſienite, ſimilar to that at the head of Glencloy, is to be obſerved, and, ſo far as I could determine, riſes to the ſummit of the neighbouring hills.

About

About two miles N. W. from the Shiſkin, after paſſing through a mooriſh flat, we come to Tormore, which is the promontory of this plain. Here are cliffs of conſiderable extent, which contain a range of extenſive caves, celebrated by tradition as the reſting place of Fingal, the father of our great Oſſian, who, it is ſaid, uſed to retire here after the fatigues of the chace. In the farther extremity of the greateſt, or what is called the King's Cove, are a few ſcratches, made by idle fiſhermen or ſmugglers, which, by ſome, have been referred to the Fingalian age.

As the appearances at this promontory are very intereſting, I ſhall make the deſcription as diſtinct as poſſible; and, to be regular, I ſhall begin at the north-eaſt end, or Machry Bay, and ſo on to Drumoodon point. The bay is of conſiderable extent; and the ſhore, all around to Irſa, is formed of ſandſtone. The bottom of the bay is a low ſandy beach; but, towards Tormore, it riſes, forming cliffs, which are continued all around to Rue-varey, or the columnar promontory, for the ſpace of about a mile and a half: and theſe cliffs are from forty to one hundred feet high. Between the cliffs and the ſea there is a conſiderable ſandſtone beach, which is remarkable for the great variety and the number of veins that traverſe it, in different directions: theſe, at firſt ſight, appear confuſed; but

a little

a little attention ſoon diſcovers a beautiful and diſtinct diſplay of a moſt curious diſpoſition of rock. As the pitchſtone veins are the principal objects of curioſity, I will deſcribe theſe firſt; and, to make the detail accord with the engraved plan, I will begin from the extremitv of the great pitchſtone vein as it riſes from the ſea, and ſo trace it back to near Machry Bay.

The great vein of green-coloured pitchſtone, D, as it riſes from the ſea, is ſeveral feet wide, has a conſiderable inclination to the horizon, is ſlightly bent in its courſe, and traverſes the common red-coloured argillaceous ſandſtone. It has, for ſome yards, the character of a *ſtratified vein;* that is, it contains layers or ſtratulæ of different ſubſtances depoſited in the ſame fiſſure along with the pitchſtone. Upon the ſide of the vein next the ſea, there is a layer, A, of a ſubſtance which appears inclined at an angle of 60°, dips in the ſame direction with the pitchſtone D, and has a ſimilar curve. It is not untike a compact ſandſtone; but it is probably of the ſame nature with B on the oppoſite ſide of the vein, only more altered by the action of the weather and the ſea. Upon the oppoſite ſide of the pitchſtone, we obſerve a layer, B, which appears to be of the nature of hornſtone, or, rather, verging to quartz: it has a ſimilar curve and dip with the pitchſtone. Immediately beſide it there


VIEW of ARRAN from the ISLAND of BUTE.
A
D
B
C
E
P
K H
G
F
L
L
M
M
Q
O P
O
P
N
N of the PITCHSTONE and other VEINS
TORMORE
ARRAN.

there is a thin layer of baſalt, C, which is decompoſing in balls; and this, again, is bounded by the common argillaceous ſandſtone ſtrata. The vein continues thus ſtratified for about twenty yards, when the layers, A, B, C, appear to come nearly horizontal, and ſoon they entirely diſappear under the debris. Further on, where the pitchſtone is almoſt free from the covering of debris, it appears to be bounded on both ſides by the common argillaceous ſandſtone; yet this is doubtful, as there may be ſmall portions of the other ſtratulæ, which the debris prevents us from obſerving.

At a little diſtance from where the ſandſtone appears to form the ſide of the great vein D, we obſerve E, which is a vein of rock ſimilar to that of B, is from ſix to eight inches wide, and is waved in its courſe. At ſome diſtance from this, there is a vein of baſalt, P, about five feet wide, running nearly E. and W. which is much the ſame direction with the laſt mentioned vein. The next vein which we meet with is about thirty feet feet wide; runs N. W. and N. and N. E. and E. which is nearly in an oppoſite direction to the great vein. Upon one ſide, there is a layer, F, of a wax-coloured ſubſtance, intermediate between hornſtone and pitchſtone; next, is a layer, G, of high olive-green coloured pitchſtone, about two feet wide; again, we have a layer, H, about half a foot wide, of the ſame pitchſtone-

hornſtone,

hornſtone as F; then, a layer of indurated clay, K; and, after this, the whole vein is formed of baſalt, L. The ſandſtone which bounds this vein, in place of being red, the uſual colour, is partly a yellowiſh-white colour. I endeavoured to diſcover its junction with the great vein D, but without ſucceſs, owing to the great covering of debris: I obſerved it, however, upon the oppoſite ſide of D, but at a diſtance, entering into the neighbouring ſandſtone cliffs. At a little diſtance from this, we meet with another remarkable vein: the ſides, M, M, are of baſalt *; but the middle, L, is of breccia †. Still nearer to Machry Bay, another curious vein is to be ſeen: it is about eight feet wide; the ſides, P, P, are of fine white-coloured argillaceous ſandſtone ‡; next, are two layers, O, O, of baſalt ‖, which

* This baſalt does not differ from that from the ſouth ſide of Glencloy, deſcribed at page 53.

† This breccia is formed of variouſly-ſhaped maſſes of common and arenaceous quartz, and indurated clay, connected by a baſis which is only an agglutination of ſmaller particles of the ſame kind.

‡ This ſandſtone only differs from the ſtratified kind by its having a white colour.

‖ This baſalt has a black colour; and has, diſperſed through it, cryſtals of hornblende, calcareous ſpar, aud iron pyrites: this laſt, by decompoſition, often gives the whole a brown colour.

which decompoſes in balls; and the middle, N, is formed of a rock which has cryſtals of felſpar and rounded pieces of quartz, immerſed in a baſis that ſeems one of the gradations from pitchſtone to hornſtone. The laſt vein, Q, which I obſerved running, in a croſs direction, to the great vein of pitchſtone D, is about ten feet wide, and entirely compoſed of green-coloured pitchſtone.

The great vein continues viſible for a little way after paſſing the vein Q, and is nearly of the ſame diameter; but, as we approach very near to Machry Bay, it is not to be further traced, on account of the covering of debris. Near to its termination, however, I obſerved the hornſtone pitchſtone ſubſtance forming a layer upon one ſide, and even, in ſome places, intermixed with it.

I have to regret that this intereſting piece of mineralogy is ſo imperfectly detailed; yet I truſt it will ſerve to excite others, better qualified, to give it a more particular examination. I would particularly recommend an attention to the appearances preſented by the junction and croſſing of the veins; which I had not an opportunity of exploring, on account of the great covering of debris: a hindrance which ſome future action of the ſea may remove.

The next object which claims our notice, is, the determination of the relative position of the ſandſtone and porphyry. The cliffs, beſides the ſandſtone, of which they are principally compoſed, are, in ſome places, varied by a clay-porphyry, very ſimilar to that of Glencloy; with this difference, that the cryſtals, felſpar and quartz are larger. The porphyry, ſo far as I could determine, does not ſeem to lie on the ſandſtone, but merely to ſkirt it. Several baſalt veins are to be obſerved traverſing it, in different directions. One vein, about ſeven feet wide, runs through it in a perpendicular direction, and gradually narrowing towards the top of the cliffs, when it is loſt among the ſandſtone that lies behind. Another runs more in a horizontal direction, and between the ſandſtone and clay-porphyry. Another vein, which is nearer to Machry Bay than the other two, is to be obſerved running with porphyry on the one ſide, and ſandſtone on the other: it ſoon divides; one branch penetrating the porphyry, the other running between the ſandſtone and porphyry.

To the W. of the King's Cove, I obſerved great maſſes of green-coloured pitchſtone ſcattered upon the ſhore; but I could not diſcover whether they belonged to the great vein D on the other ſide of the caves, or had been ſeparated from other veins or ſtrata. Upon the top of the cliffs, at the ſame place, I obſerved

ſerved a variegated pitchſtone, which was decompoſed, in ſome ſpecimens, almoſt to a browniſh-white earthy powder, cropping through the graſs; but I could not diſcover whether it formed a vein or ſtratum.

From this to within a ſhort diſtance of the columnar promontory of Drumoodon, the cliffs are of ſandſtone; but, in ſome places, they appear covered with a porphyry: of this, however, I cannot ſay any thing ſatisfactory. I obſerved many baſaltic veins traverſing this ſandſtone; and, upon examining the connection of the veins and ſtrata, I found the baſalt and ſandſtone, at their junction, in ſeveral places, intermixed; and alſo the baſaltic veins, beſides the angle they form with the horizon, had a conſiderable inclination of themſelves.

At a little diſtance from the columnar promontory, I obſerved low, ſhelving rocks of clay-porphyry, which extend beyond the point Rue-Varey on the one hand, and ſeem to be connected with the porphyry on the other. The promontory is a ſtriking object; is pretty high; and compoſed of red-coloured argillaceous ſandſtone, which is covered by irregular columns of a porphyry which, in ſome places, has much reſemblance to baſalt-porphyry, in others is evidently clay-porphyry. This fact is a preſumptive proof that the conjecture I have

made, with regard to the ſituation of the porphyry of Glencloy and Corygills, may be true.

Having paſſed Rue-Varey, which is the moſt weſtern point of Arran, we came to the farm of Drumoodon, which is ſituated upon the ſea-ſhore, with a conſiderable ſandy beach before it, and, behind, the ſandſtone cliffs are ſtill continued. Here we find, reſting upon the ſandſtone, a curious ſpecies of rock, having a tendency to ſplit into columns; but of which I cannot give a determinate opinion, as I do not find any deſcription, in the mineralogical works I have conſulted, that correſponds with it. I have marked it, in the ſhort deſcription that is detailed in the following chapter, as intermediate between baſalt and ſandſtone. Theſe cliffs become gradually lower, and at length diſappear, being ſucceeded by an extenſive beach covered with fragments of the neighbouring rocks. After paſſing this beach, which forms one ſide of the plain of the Shiſkin, conſiderable cliffs now riſe before us, which are formed of clay-porphyry of conſiderable height, but much ſplit by the action of the weather, which gives an indiſtinct idea of ſtratification, ſimilar to the granite obſerved in the Cory-Dain, at the head of Glen-Roſa. Theſe cliffs contain ſeveral caves, but none of them are of any conſiderable ſize; and the ſhore is covered with great maſſes,

maſſes, which have been ſeparated from the cliffs by the action of the ſea and weather. Theſe maſſes have a peculiarity of form, which characteriſes the rock from which they have been ſeparated. This remark may appear fanciful; but ſeveral circumſtances lead me to imagine, that one accuſtomed to obſerve with attention the debris upon the ſea-coaſts, &c. may often gueſs as to the peculiar nature of the rocks themſelves, by obſerving the ſhape of the fragments. The whole ſhore, to Tory-Lin, appears to be compoſed of clay-porphyry, and in ſome places ſandſtone is to be obſerved, and both are traverſed with veins of baſalt. I picked up fragments of dark leek-green-coloured pitchſtone, in different places, among the debris of the neighbouring rocks; but had not leiſure to determine its ſituation. From the Shiſkin to Tory-Lin,there is a tolerable road; which is a rarity in this iſland, and extremely agreeable to the traveller, after having ſcrambled around the ſhore from Brodick Bay. The land now becomes lower, and has more of the rural appearance of the Lowlands of Scotland: agriculture is followed with ſome ſpirit, and even many of the ſea-beaches are cultivated.

Tory-lin conſiſts of a few houſes, pleaſantly ſituated in a hollow, at a little diſtance from the ſea ſhore, and ſurrounded with

with ſandſtone hills. In the burn which runs by the houſes, I obſerved veins of baſalt traverſing the ſandſtone in different directions, and amongſt the bowlder ſtones which cover its bottom, fragments of a light blackiſh green-coloured pitch-ſtone preſented themſelves, ſhowing the exiſtence of veins or ſtrata of that foſſil in the neighbourhood. Upon the ſhore a curious ſpecies of porphyry, (different from wacken-porphyry,) makes its appearance, and ſeems to be traverſed with veins of common baſalt, which are here of very great ſize.

On my ſecond viſit to Arran, I walked a-croſs from Tory-Lin to Lamlaſh harbour, which gave me an opportunity of obſerving a part of the iſlands, with which I was before unacquainted. I will therefore ſhortly mention what occurred in that route; before proceeding to mention the very few obſervations I made on the ſouthern part of the iſland. After leaving Tory-Lin, we aſcend for ſome time over the uſual red-coloured argillaceous ſandſtone, it at length diſappears, and the higher grounds are formed of porphyry. This porphyry continues until we come to the farm of Achariach, when red-coloured argillaceous ſandſtone is to be obſerved in the bottom of a burn, and is apparently traveſed by a vein of white-coloured ſandſtone. As we proceed onwards, we aſcend ſome high grounds, where the porphyry again appears, and it now

continues

continues all the way to the hills upon the ſide of Lamlaſh bay. Theſe hills are compoſed of white-coloured ſandſtone at the top, but lower down of common red-coloured ſandſtone.

The ſhore from Tory-Lin to the Benin-Head, the moſt ſouthern part of the iſland, is principally compoſed of ſandſtone, traverſed with veins of baſalt, which are ſometimes of great ſize, and run in a great variety of directions. The hills back from the ſhore appear to be entirely compoſed of porphyry*, but are not of any great height. The whole country to the Benin-head is conſiderably cultivated, and is here and there diverſified with ſmall villages, which give to the whole a pictureſque feature, which we have ſeldom an opportunity of obſerving in this iſland. At the Benin-head, the cliffs are of conſiderable height, and are compoſed of ſandſtone, porphyry, and baſalt. The porphyry and baſalt have a tendency to the columnar form, and both are traverſed by baſalt veins, which are often of a great ſize.

From this to Whiting Bay, the cliffs are low, formed of ſandſtone, and traverſed with baſalt veins, which run in a great

* I find in my notes, that ſienite is marked as one of the rocks of this part of the country. I am now ſomewhat doubtful of that fact, and will therefore leave it as an object for future enquiry.

great variety of directions. The hills, however, up from the ſhore, now change their appearance, preſenting broad, bare, perpendicular faces, ſimilar to thoſe which occur in all baſaltic countries; and upon examination, we find them to be compoſed of various ſpecies of baſalt,* lying upon a red-coloured ſandſtone, which is intermixed with grunerde, and a grey ſhiſtoſe clay. This baſalt is often columnar, and the perpendicular crags, being ſcattered in various directions, and often riſing in groupes above each other, have a pleaſing effect. Near to Whiting bay, there are conſiderable rocks of greenſtone of nearly the ſame ſpecies with that found near Corygills; it is not in any conſiderable quantity, and appears to be the rareſt rock in the iſland.

At Whiting bay, the cliffs diſappear, and are not to be obſerved until we come to the entrance of Lamlaſh bay; in their place we have an extenſive beach, bounded by gradually riſing ſandſtone hills, much traverſed with baſaltic veins. When the tide ebbs, the bottom of the bay exhibits a moſt aſtoniſhing collection of baſaltic veins, which have been laid bare

* Stucke, a German chemiſt, on breaking a certain cellular baſalt, found the cells to contain water. He analyſed 20 ounces of this water, and found it to contain fourteen and a half grains of ſilex. *Stucke* Unterſuch. 119. *Kirwan*, Geological Eſſays, p. 118.

bare by the action of the ſea; here they are to be ſeen running in every direction, meeting and croſſing each other in a moſt curious manner; in ſhort, this is one of the beſt parts of the iſland for obſerving the various croſſings, &c. of theſe ſingular appearances *. At the entrance of the bay of Lamlaſh, the ſandſtone forms conſiderable cliffs, which continue a ſhort way of conſiderable height, but are gradually lower as we approach the village of Lamlaſh, where there is an extenſive flat beach. Theſe cliffs are alſo traverſed with veins of baſalt, and in ſome places a few hundred yards from the ſhore, I obſerved many detached maſſes of green pitchſtone, indicating its exiſtence in the neighbourhood.

Lamlaſh bay, which is the beſt harbour in the iſland, and one of the beſt in the Firth of Clyde, is of a ſemi-circular ſhape, and is formed in part by Holy iſland or the iſland of Lamlaſh, which lies acroſs it, leaving two entrances, one from the north, the other from the ſouth, which laſt is always preferred

* It will be ſomewhat difficult to explain the appearance of ſo many veins in ſo ſmall a ſpace of ground as Whiting bay, according to the Wernerian Theory. For ſurely had all theſe been at one time open fiſſures, the ſandſtone would not at the ſame time have ſupported itſelf. Sauſſure, imagines, that this objection may be removed, by ſuppoſing, that theſe fiſſures were formed ſucceſſively.

ferred by mariners. It is bounded upon the Arran ſide by hills of red and white ſandſtone, traverſed by baſaltic veins. Upon the eaſt ſide of the bay, attempts have been made to diſcover coal, but without ſucceſs.

Lamlaſh or Holy iſland, is about three miles long, and half a mile broad, precipitous on the eaſt, alſo conſiderably abrupt on the weſt ſide, but the north and ſouth ends are low. It is compoſed of red-coloured ſandſtone, which is in ſome places formed into ſmall caves; one is celebrated for being the reſidence of the holy diſciple of St. Columba, St. Mool-jos, or the ſervant of Jeſus. This ſandſtone is covered in many places with a ſpecies of baſalt, very ſimilar to that near Whiting bay, and with difficulty diſtinguiſhable from ſandſtone. I have been very much at a loſs with regard to the particular denomination to be given to this rock; and I muſt ſtill remain in doubt †. It forms in many places regular columns, generally ſix-ſided, which riſe range above range, giving a faint idea of the ſtupendous ſcenery of Staffa or Bo-ſhe-la.

† Sauſſure mentions a baſalt much reſembling ſandſtone, having a priſmatic rhomboidal form, and containing hornblende cryſtals. Obſervations ſur les Collines du Briſgau—Journal de Phyſique, An Deuxieme, p. 329.——Nay, even ſandſtone has been found columnar: thus the columnar boulaſtein, found in Iceland, is a ſandſtone.—Eggert Olafsen Reiſe durch Iceland.

la. Upon the weſt ſide, the columns are of greater ſize than upon the eaſt, and the ſame matter appears to form the ſummit of the iſland, which is reckoned about ſeven hundred feet high. Upon the ſouth-eaſt part of the iſland, I obſerved a rock principally formed of cryſtals of hornblende, which is in ſome places traverſed by baſalt veins*, and alſo ſtratified with the common ſandſtone; and towards the ſouth-weſt extremity, baſalt veins are ſeen traverſing the ſandſtone.

* This baſalt has a very great ſpecific gravity, owing to its being abundant in iron.

ARRAN.

CHAP. VIII.

Deſcription of the Foſſils, occurring in the preceding Chapter.

PITCHSTONE—*From Tormore.*

THE following ſeries of foſſils affords us a curious example of the gradations, which we often obſerve between the different kinds of rock. Theſe gradations were either overlooked, or but vaguely underſtood, until the time of Werner, who by the beautiful diſcovery he made in thus tracing the ſteps of nature, attracted the attention of mineralogiſts. An eminent mineralogiſt of our own country, has made great progreſs in this intereſting enquiry, and it is to be hoped, he will ſoon gratify us with the reſult of his labours.

No. I.

PITCHSTONE—*from the great vein* D.

Colour. Browniſh.

Luſtre. Little glancing, and greaſy.

Tranſparency. None.

Fracture. Uneven, approaching the ſplintery.

Hardneſs. Gives a few ſparks with ſteel.

Quartz, and a reddiſh ſubſtance like garnet is diſperſed through it.

No II.

PITCHSTONE *paſſing to Hornſtone.*

Colour. Light wax yellow, yellowiſh green, weak reddiſh brown.

Luſtre. None.

Tranſparency. None.

Fracture. Even, ſplintery, ſometimes uneven.

Hardneſs. Hardly touched by the knife.

Smell. Gives a ſtrong earthy ſmell when breathed on.

Fuſibility. At 55° was covered with a ſlight enamel; at 69° became

became white, ſlightly ſoftened, and was then ſomewhat porous. A fragment from a ſix-ſided column ſoftened at 81°, and at 118° a compact brown vitreous maſs was formed, which had interſperſed white grains.

By decompoſition it acquires a white, and in ſome varieties a brick-red colour. It has diſperſed through it cryſtalliſed and amorphous quartz, chalcedony, a very few cryſtals of white felſpar, calcareous ſpar, and alſo minute dark leek-green-coloured cryſtals, probably pitchſtone.

N° III.

Foſſil which appears pretty nearly of the nature of Hornſtone, or rather verging a little to Quartz—from the ſtratulum B.

Colour. Pale blackiſh brown; or, dark grey, approaching to black.

Luſtre. Very little glancing.

Tranſparency. A very ſlight degree at the edges.

Fracture. More or leſs fine ſplintery, and very compact.

Hardneſs. Gives fire plentifully with ſteel.

Pieces of quartz are diſperſed through it, as in the former; and a few cryſtals of felſpar now and then occur.

N°

N° IV.

Foſſil ſtill more nearly approaching to Quartz, which is intermixed with the green pitchſtone of the great vein D.

This ſpecies of rock differs little in colour from the preceding; but has more luſtre and tranſparency, and is a little harder. It acquires a white cruſt by the action of the weather. It has alſo, interſperſed, cryſtals of quartz.

OBSERVATIONS.

Theſe different gradations are all to be obſerved in the ſame vein, and appear to graduate or paſs into each other. Thus, the firſt, or browniſh-coloured pitchſtone, by its little luſtre, ſeems verging to the ſecond; and, in reality, we often obſerve, in the ſame ſpecimens, the one paſſing into the other. The pitchſtone-hornſtone ſubſtance, N° II. as its name implies, has partly the character of the pitchſtone, and partly that of hornſtone. The degree of fuſibility intimates that it is ſenſibly different from the pitchſtone, yet not ſufficiently refractory for hornſtone. Klaproth found a ſubſtance of this kind fuſible; and Mr. Kirwan mentions a greeniſh-white hornſtone, from Lorraine, which, from its being fuſible, ſeems analagous to this.

We

We are ſometimes ſo lucky as to find ſpecimens where the ſecond paſſes into the third; and often we obſerve the third paſſing to the fourth.

Theſe four kinds of rock, then, preſent to us a complete gradation from pitchſtone to hornſtone; and we have a few ſteps towards quartz. In other countries, we have accounts of nearly ſimilar appearances; and theſe I may ſhortly mention, as they will add freſh intereſt to the detail we have now given. Reuſs informs us, that he obſerved pitchſtone paſſing, by various ſtages, to hornſtone, at Garſeback, near Meiſſen *. Eſthner remarks, that the Saxon pitchſtone paſſes ſometimes to hornſtone †. and Mr. Kirwan, in his Elements of Mineralogy, obſerves that it paſſes to hornſtone.

CLAY PORPHYRY, *when paſſing to hornſtone—Tormore.*

Colour. Greyiſh.

Luſtre. None.

Tran-

* Sammlung Naturhiſtoriſcher Aufsatze, &c. von Franz. Ambros Reuſs, § 362.

† Eſthner, Mineralogie, B. ii. § 445.

Tranſparency. A little at the edges.

Fracture. Even, paſſing to the fine ſplintery.

Hardneſs. Gives a few ſparks with ſteel.

It contains, immerſed in the baſis, cryſtals of common red felſpar, and white felſpar approaching adularia. The cryſtals are of conſiderable ſize; and this is one of the principal diſtinctions between this ſpecies and ſome of thoſe found in Glencloy. It decompoſes, in the form of a brick-red cruſt, ſimilar to ſome of the ſtones which are intermediate between pitchſtone and hornſtone.

In other ſpecimens, the porphyry, as it comes in contact with the veins of baſalt, has a baſe conſiderably reſembling it; and at the columnar promontory of Drumodoon, the ſpecimens often cannot be diſtinguiſhed from what is called trap-porphyry.

A ſubſtance intermediate between ſandſtone and wacken, having a tendency to the columnar form—Farm of Drumoodon.

Colour. Yellowiſh.

Luſtre. None.

Tranſparency. None.—It feels much like a ſandſtone.

Fracture. Even earthy, with the appearance of rounded concretions.

Hardneſs. Gives a few ſparks with ſteel: but it contains confuſed fragments of quartz, which may have been the cauſe of this.—Emits a ſtrong earthy ſmell, when breathed upon *.

Fuſibility. Melted at 79°.

OBSER-

* Lampadius has diſcovered that hornblende contains charcoal diffuſed thro' it; and Mr. Kirwan has ſhown that ſome ſpecies of pitchſtone contain it. It is conjectured that it may exiſt in other foſſils, and cauſe the peculiar earthy ſmell which we perceive by breathing upon them.

OBSERVATIONS TO BE MADE,

FOR THE FARTHER ELUCIDATION OF THE

MINERALOGICAL HISTORY OF ARRAN.

VEINS.

I. TO examine the baſalt, wacken, and pitchſtone veins, (which occur in ſo many parts of the iſland,) with a view to diſcover if they be *ſtratified.* We ſhould deſcribe accurately the diſpoſition of the ſtratulæ of ſuch veins, as it will enable us to determine their relative antiquity: thus, according to Werner, the parts neareſt the ſides of a vein are the moſt antient, thoſe in the middle the moſt modern, and the intermediate of a middle age.

II. In the examination of veins, it will be of conſequence to obſerve how they croſs each other; which, Mr.

Werner remarks, will enable us to determine their relative antiquity: thus, if two veins croſs each other, the moſt modern is that which croſſes the other; and, of two veins, the one which interrupts or ſtops the other is the moſt antient.

III. To examine carefully the country in the vicinity of veins, ſo as to determine if there be any beds of a matter ſimilar to that which fills the veins. It follows, from Mr. Werner's theory, that we ſhould generally obſerve ſuch appearances.

IV. To examine if the ſides of the veins be more or leſs hard; where in contact with the granite, micaceous ſhiſtus, porphyry, ſienite, or ſandſtone.

V. To examine the baſalt, and other veins, with a view to obſerve whether they contain petrifactions, or even wood unaltered; alſo, if they contain boulder ſtones.

STRATA.

STRATA.

VI. To determine the direction and inclination of all the ſtrata throughout the iſland; ſo as to know whether they have much the ſame general arrangement, and if they are frequently ſituated in a ſimilar manner with the ſtrata at the mouth of Loch-Ranza.

VII. To examine particularly the ſtrata of ſienite; ſo as to diſcover its connection with the granite, porphyry and micaceous ſhiſtus.

VIII. In examining the great glens, as Glen-Roſa, Sannicks, &c. it will be of conſequence to examine very particularly as to the diſpoſition of the granite in ſtrata; thus either to confirm or refute the obſervations on the ſtratification of the granite.

IX. To diſcover whether the porphyry, which is obſerved among the granite mountains, be diſpoſed in veins or ſtrata.

X. To

X. To endeavour to diſcover the ſituation of the horn-blende and paliopetre which is obſerved in blocks at the entrance of Glen-Roſa.

XI. In traverſing the hills of micaceous ſhiſtus, to be careful in obſerving if any rocks of trap formation occur in *ſtrata*.

XII. To determine the poſition of the breccia, with regard to the other rocks, at the head of Glencloy; and alſo, to examine, more particularly, the extent and poſition of the breccia of South Glen-Sanicks.

XIII. To examine very particularly the appearance of the granite, at its junction with the micaceous ſhiſtus and ardeſia, in different parts of the iſland. In this inveſtigation it will be neceſſary to obſerve, 1. If the ſhiſtus, where in immediate contact with the granite, be not harder than it is at a diſtance. 2. If veins of granite are to be obſerved ſtretching from the granite, and traverſing the ſhiſtus. 3. If the granite veins have the ſame grain with that of the granite of the neighbouring mountains. 4. If the granite and ſhiſtus be irregularly intermixed at their junction. 5. If the granite and ſhiſtus ever alternate

alternate with each other. This Werner conſiders as a rare appearance. I have not obſerved it in Arran. 6. If the micaceous ſhiſtus, where it covers the granite, can be obſerved gradually changing its character, and at laſt, where in junction with the granite, not diſtinguiſhable from it: a fact which has been obſerved in other countries, and demonſtrative of the granite and ſhiſtus being formed nearly at the ſame time.

BUTE.

B U T E.

CHAP. IX.

Outline of the MINERALOGY *of the Iſland of* BUTE; *with Obſervations upon the Formation of the Bed of the* CLYDE, *aud an Account of the Route from* BUTE *to the Iſland of* JURA.

THIS iſland is about eighteen miles long; and the broadeſt part, extending from eaſt to weſt, is five miles. It is ſeven miles diſtant from the iſland of Arran; but is ſeparated from the diſtrict of Cowal by a channel which is only about half a mile broad, and, in ſome places, ſixteen fathoms deep. Towards the north end it riſes into hills of conſiderable height; but theſe are neither ſufficiently high nor extenſive to afford ſcenes ſo ſublime as thoſe which characteriſe the mountains of Arran. The ſouthern part of the iſland is, in general, (excepting at its moſt ſouthern extremity,) low, well cultivated, and, in ſeveral places, beautifully ornamented with wood, particularly

ticularly near to Mount-Stewart, the charming ſeat of the Marquis of Bute. Although this iſland be deſtitute of fine mountainous ſcenery; yet, the extenſive cultivation, and the general appearance of buſtle and life, form a ſtriking contraſt to the lone waſtes of the iſland of Arran.

Rotheſay, the only town in the iſland, is pleaſantly ſituated upon the ſhore of a conſiderable bay of the ſame name. It is principally ſupported by the herring fiſhery, and a very conſiderable cotton manufactory.

The iſland ſeems to be traverſed by three irregular vallies, which run from eaſt to weſt. One croſſes the iſland at the town of Rotheſay; the ſecond at Kaimes Caſtle, in the north; and the other at Cil-Chattan, in the ſouthern part of the iſland.

The mineralogy of this iſland, ſo far as I examined it, does not appear to be particularly intereſting: but a cloſer inveſtigation may diſcover many things which eſcaped my notice; as I examined it in very unfavourable weather, and, beſides, had the misfortune to loſe the ſpecimens I had collected.

The whole of the iſland to the north of Rotheſay is compoſed of primitive rock, which riſes into conſiderable hills about Kaimes Caſtle, the ſeat of Lord Bannatyne. This half of the iſland is pretty nearly ſurrounded by the neighbouring land of Cowal, ſo that the ſea can have little power over its ſhores, which are indeed very low; but the narrow channel, as I have already remarked, is very deep. The ſtrata, in general, are, micaceous ſhiſtus, ardeſia, and ſhiſtoſe talc; and they alternate, and paſs into each other. Sometimes we alſo obſerve chlorite; which is either maſſive, or forms a ſpecies of ſlate; and not unoften I remarked quartz, more or leſs penetrated with the chlorite, forming a dark-green-coloured ſtone, ſimilar to that I found in Arran. In ſeveral places conſiderable veins of quartz are ſeen, traverſing the ſtrata in different directions; and ſometimes they exhibit curious phenomena. I obſerved upon the ſea-ſhore, about a mile and a half ſouth of Kilmichael ferry, a vein of quartz which deſerves to be particularly noticed. As it riſes from the ſea, it is very narrow; but it ſoon becomes wider, and then divides into ſeveral conſiderable branches, which traverſe the ſtrata in different directions. One of theſe branches preſents an appearance ſimilar to that obſerved in Glenroſa, in the iſland of Arran, and deſcribed at pages 38, 39. This branch, having traverſed the ſtrata for ſeveral feet, is interrupted by a maſs of micaceous ſhiſtus; but it again

gain appears at a little diſtance, and ſtill in its former direction. Maſſes of micaceous ſhiſtus are alſo to be obſerved in the midſt of the quartz vein. The appearance of a maſs of micaceous ſhiſtus, which is a fuſible ſtone when compared with quartz, in the midſt of a quartz vein, muſt be conſidered as deciſive againſt the theory of Dr. Hutton: for it is impoſſible to ſuppoſe that it ſhould remain unaltered in a heat capable of melting quartz, or keeping it in a ſoft ſtate.

The baſaltic veins, which occur ſo often in Arran, are alſo pretty common in this iſland, and are found from two to ten feet wide, traverſing the primitive ſtrata in various directions; and I even noticed them upon the top of the higheſt hills.

Near to Lord Bannatyne's caſtle there are ſeveral ſlate quarries, which have been worked for ſome time, and are ſtill continued. Theſe ſlates, however, are not ſo much uſed as thoſe from Eaſdale, which are, even here, preferred for economical purpoſes. In ſome parts of Germany, as at Ruhla *, they employ a compact micaceous ſhiſtus for the roofing of houſes;

* Voight Mineral Reiſen durch das Herzogth. Weimar. Th. 2. Se. 24.

and it is preferred to ſome kinds of ardeſia, from its great durability. Probably ſome ſpecies of micaceous ſhiſtus, equally uſeful with that uſed in Germany, may be found among the hills in the northern parts of the iſland. Mr. May, the chamberlain of Bute, informed me, that trials had been made for lead in the northern parts of the iſland, but without ſucceſs. This I reckon no ſatisfactory proof that lead is not to be found in the iſland; as, in all probability, the perſons, employed to make the trials, were but little verſed in the buſineſs.

The north ſide of Rotheſay bay is entirely compoſed of primitive rock, ſo is alſo the north ſide of Scalpa bay, which is ſituated upon the weſt ſide of the iſland, and nearly oppoſite to Rotheſay; but the ſouth ſides of theſe bays are compoſed of red argillaceous ſandſtone, and ſandſtone breccia. The junction of theſe primary and ſecondary ſtrata, is therefore to be looked for in theſe bays.

The country between Rotheſay and Cil-Chattan bay; which is the loweſt, moſt beautiful, and beſt cultivated part of the iſland; is compoſed of ſtrata of red argillaceous ſandſtone, and ſandſtone breccia, alternating with each other, and both are traverſed with baſaltic veins. Upon the ſhores, on both ſides of this part of the iſland, there are inland cliffs, ſimilar to thoſe

near

near the north end of Arran, and in ſeveral places we remarked banks of coral and ſea ſhells *, conſiderably above the high water mark. Theſe appearances, as well as thoſe that occur in Arran, are proofs of the land gaining on the ſea.

From Cil-chattan bay, to the ſouthern extremity of the iſland called Gurroch-head, the face of the country is much altered; it now becomes nearly as high as in the north end, riſing into irregular hills with abrupt perpendicular crags, that are almoſt characteriſtic of a baſaltic country. From the little opportunity I had of obſerving this part of the iſland, I can only ſay in general that it is compoſed of argillaceous ſandſtone, ſtratified with baſalt, and traverſed by baſaltic veins. The baſalt is ſometimes columnar, and frequently contains much hornblende. I was told that lime had been found in this part of the iſland.

GENERAL

* Theſe banks are uſually made of the Millepora polymorpha, of which there are many curious varieties.

GENERAL OBSERVATIONS ON THE CLYDE.

Having now finiſhed the outline of the mineralogy of the iſlands in the Clyde, I ſhall make a few obſervations upon the mode which nature appears to have followed in the formation of the bed of the river, the rocks and iſlands.

The appearance of iſlands in any quarter of the globe, naturally ſuggeſts to the mind, the idea of ſome powerful agent which has convulſed and broken the ſolid land, and formed it into detached maſſes. This opinion is not fanciful, for appearances, in many countries, ſhow us, that the greater number of iſlands have been formerly joined together, and muſt have conſtituted part of the adjacent continent. Thus, if we examine the rocks upon the oppoſite ſides of the Clyde, we ſhall find a great ſimilarity in their nature. 1. At Campbeltown, which is only a few miles from the extremity of the iſthmus of Cantyre, we obſerve a ſmall portion of ſecondary ſtrata, which correſponds to that upon the oppoſite coaſt of Ayrſhire. 2. The rocks upon the north and ſouth ends of the iſland of Arran correſpond exactly with the ſtrata upon the north and ſouth ſides of the Clyde. 3. The north end of Bute is compoſed of a ſimilar rock with that of Cowal, and

the

the ſouthern extremity is compoſed of the ſame rock with the Cumbray iſlands, and theſe are of the ſame rock with that of the Largs, which is on the ſouth bank of the river. Theſe facts would ſeem to indicate, that the oppoſite banks of the Clyde were at one time joined together, forming a very conſiderable extent of ſolid land. If this be admitted, (and there ſeems little doubt of its truth,) we muſt now endeavour to diſcover what means were employed to break down the land.

Philoſophers in their ſpeculations on this ſubject, have generally mentioned two agents, which they imagine have produced theſe ſtriking and awful phenomena; theſe are the waves of the ocean, and earthquakes. The firſt opinion has been ſtrenuouſly contended for by the late Dr. Hutton, who affirms, that all bays, peninſulas, iſlands, &c. have been formed by the long continued action of the waves of the ocean. This ſpeculation at firſt ſight ſeems very plauſible, but a more attentive conſideration diſcovers to us a very exaggerated account of a comparatively partial operation; and this is indeed pretty evident from the following facts. The channel between Italy and Sicily, is nearly the ſame to day, as in the time of the Romans. The iſthmus of Corinth has not been viſibly altered for upwards of 2000 years. Scylla, of which Homer has given a correct deſcription, is now nearly in the

ſame

ſame ſtate as when he wrote *. The ruins of Beritta, the favourite ſeat of Auguſtus, are ſtill to be obſerved in their original ſituation, upon the bank of the ſea, and ſo ſituated, as to be out of the reach of the waves ‡. Ancona built by the Syracuſians, is ſtill by the ſea ſhore †. Here, then, we have inſtances of the land reſiſting the powerful waves of the Mediterranean for upwards of three thouſand years.

Dr. Hutton who was aware of ſome of theſe facts, remarks, that " Our land is waſted by the ſea; and there is alſo a natural progreſs to be obſerved, which naturally takes place on this occaſion; for the coaſt is found variouſly indented, that is to ſay, more or leſs, according as the land is expoſed to this waſting and wearing operation of the ſea, and according as the waſted land is compoſed of parts reſiſting, with different degrees of power, the deſtroying cauſe. The land, thus being worn and waſted away, forms here and there peninſulas, which are the more durable portions of that which had been deſtroyed around; and theſe remaining portions are ſtill connected with the mainland, of which they at preſent form a part.

" But

* Spallanzani's travells through Sicily, vol. 4. p. 172.

‡ Maundrell's travells from Aleppo to Jeruſalem in 1669, &c.

† Maundrell, ibid.

" But thoſe promontories and peninſulas are gradually de-
" tached from the mainland, in thus forming iſlands, which
" are but little removed from the land. An example of this
" we have in Angleſey, which is but one degree removed from
" the ſtate of being a promontory. Theſe iſlands again, in
" being ſubdivided, are converted into barren rocks; which
" point out to us the courſe in which the loſt or waſted land
" upon the coaſt had formerly exiſted.

" To be ſatisfied of this, let us but look upon the weſtern
" coaſt of Scotland, from the iſlands of St Kilda to Galloway,
" on the one ſide, and to Shetland on the other; in this tract,
" we have every teſtimony for the truth of the doctrine that
" is conſiſtent with the nature of the ſubject. The progreſs
" of things is too ſlow to admit of any evidence drawn imme-
" diately from obſervation; but every other proof is at hand;
" every appearance correſponds with the theory; and of every
" ſtep in the progreſs, from a continent of high land, to the
" point of a rock ſunk below the ſurface of the ſea, abundant
" examples may be found. We do not ſee the beginning and
" ending of any one iſland, or piece of country; becauſe the
" operation is only accompliſhed in the courſe of time, and the
" experience of man is only in the preſent moment. But man
" has ſcience and reaſon, in order to underſtand what has al-

" ready been from what appears; and we have but to open " our eyes and ſee all the ſtages of the operation, although not " in one individual object. Now, where the nature of things " will not admit of having all and every ſtep of the progreſs " to be perceived in one object, an indefinite progreſſion in " the various ſtates of different objects, ſhowing the ſeries or " gradation from a continent to a rock, muſt form a proof in " which no deficiency will be found *."

This is very probably a correct delineation of the mode which nature follows in altering the land, in ſome few inſtances; but it cannot be general, as it would give an age to the world quite inconſiſtent with the Hebrew chronology; we muſt therefore conſider it as untenable. It may be reckoned unphiloſophical thus to ſhelter ourſelves under the cover of what has been, by ſome, conſidered a traditional tale; when facts and reaſoning ſhould decide the truth of the argument. I am by no means of this opinion, and however unfaſhionable it may appear, I am firmly perſuaded, that any chain of reaſoning, that does not coincide with that chronology, is falſe. As I have now proved the inſufficiency of this theory, I might proceed to conſider the other; yet to prevent the ſceptical, from the uſe of any undue argument, I will endeavour to ſhow, that allowing Dr. Hutton's obſervations to be correct, they will be

* Theory of the Earth, vol. 2d. p. 265.

be found quite inſufficient to explain the breaking of the land of the Clyde, &c. From the account I have already given of the nature of the ſtrata upon both ſides of the Clyde, it is evident, that the ocean, in its ſuppoſed action, has broken down the hard primary ſtrata, in preference to the ſofter ſecondary ſtrata; a fact which ſtrongly indicates the agency of ſome other power than the ſea. Thus we find a conſiderable portion of the primary ſtrata carried away from the north end of Arran, and Bute, while the ſecondary and ſofter ſtrata at the oppoſite ends of theſe iſlands, with the ſandſtone iſles the Cumbrays, ſtand in the middle of the Firth, defying the rage of the waves. Further, if we look at the map, we will find that all the arms of the ſea which are connected with the Clyde, in place of being ſituated in the ſecondary ſtrata, upon the ſouth bank of the river, are only in the north ſide traverſing a mountanious country which is entirely compoſed of hard primitive rock. The great depth of theſe lochs or arms of the ſea is very deciſive againſt Dr. Hutton's explanation. Loch Fyne, at its upper extremity, nearly oppoſite to Inveraray, is about 60 fathoms deep: Loch Strevin, a ſmall arm of the Clyde, almoſt incloſed at its entrance by the iſland of Bute, is yet 38 fathoms deep: Loch Goyle, ſituated further up the Clyde, is, at its upper extremity, where it is not a mile broad, about 37 fathoms deep: and Loch Long, near its head, is 28

fathoms deep. Theſe lochs are far removed from any violent action of the ſea, or of currents; ſo that it is impoſſible that they could have been formed as Dr. Hutton conjectures, allowing millions of ages for the purpoſe.

The other opinion which we have mentioned, viz. "that the land has been often ſubmerged and broken by earthquakes," ſeems to afford us a leſs improbable explanation of the preſent ſtate of the Clyde, than that advanced by Dr. Hutton. The frequent occurrence of earthquakes, in the different quarters of the globe, affords us numerous inſtances of the ſubmergence and breaking of the land: yet we are acquainted with none ſo extenſive as that of the Clyde. This, however, is of little importance; as it is not improbable, that theſe cataſtrophes were more frequent at a former period, than now. It would extend theſe obſervations to a great length, were I to enter into a detail of all the effects of earthquakes; I ſhall therefore only ſelect a few facts as illuſtrative of the preſent opinion. In 1692, when the town of Port-Royal, in Jamaica, was deſtroyed by a dreadful earthquake, vaſt maſſes of land were ſunk far beneath the level of the ſea, and mountains of conſiderable extent ſunk down, leaving in their place extenſive lakes. In 1693, the iſland of Forca diſappeared, being ſwallowed up by the ocean during a tremenduous earthquake. In 1678, there

was

was a great inundation in Gaſcony, cauſed by the ſinking of a part of the Pyrenees: the mountains having diſplaced the waters, which exiſt in the cavities that are contained in the bowels of the earth. In the late moſt awful earthquakes that have ravaged Peru, large mountains have been divided into two parts and ſeparated; others ſunk down, when large and often bituminous lakes have riſen in their place; and laſtly in the earthquakes that devaſtated Calabria, there are inſtances of mountains ſinking into the bowels of the earth *.

Theſe facts entitle us to conclude, that at ſome former period, this country was convulſed by great earthquakes, when the beds of the Clyde, and its numerous lochs were formed, by the ſubmergence of the ſolid land: at the ſame time Arran, Bute, &c. received their inſular form, being part of the land that had eſcaped the power of the earthquakes. Theſe iſlands, as well as the lands on both ſides of the river, have, no doubt, ſince that period, experienced ſome alteration from the long continued action of the weather and the waves of the ocean.

Route

* The earthquake that was felt in Canada, in 1663, overwhelmed a chain of mountains more than three hundred miles long. Clavigero's hiſtory of Mexico, p. 221.—Kirwan's Geological Eſſays, p. 502.

Route from the Iſland of BUTE *to the Iſland of* JURA.

In travelling from the iſland of Bute to the Weſtern Iſles, we have the choice of different tracks, as may be ſeen from the map. That which we purſued, although not the moſt convenient, was yet intereſting, as it allowed us to glance at a conſiderable extent of highland country.

Having examined Bute as much as circumſtances would permit, we croſſed the Kyles to a ſmall houſe called the Kerry, ſituated in the diſtrict of Cowal. In croſſing, we perceived, at a diſtance, ſeveral boats, filled with men dreſſed in black, ſlowly rowing up the ſound. So unexpected an appearance did not fail to attract our attention; and we were told that it was a funeral proceſſion to a burying-place in the adjacent mountains of Cowal. Surely we could have hardly witneſſed a more ſtriking ſcene. Mortality is at all times awful; but it was here preſented to us in a moſt impreſſive manner. The wild and lofty mountains riſing from the ſides of the channel; the almoſt perfect ſtillneſs of the water, which could be faintly heard dying away along the ſhore; the univerſal ſilence, not even diſturbed by the ſcream of ſea-fowl—ſeemed as if nature was unwilling

unwilling to diſturb the performance of the laſt and melancholy ſervices to the dead.

At the Kerry, the ſhore is adorned with ſweetly-riſing natural wood; ſo that we left it with regret, to traverſe a country where grey, rugged mountains, and brown heaths, are the only objects to which our attention could be directed. Having walked for about five miles through a dreary mountainous country, principally compoſed of micaceous ſhiſtus, interſperſed with chlorite, and traverſed with quartz veins; we came to the next ferry-place, which is ſituated upon the banks of Loch-Fyne. We croſſed from this to Eaſt Tarbet, a diſtance of about nine miles; and obſerved the mountains on both ſides of the loch, all the way to Loch-Gilp Head; having the ſame general appearance, and being probably compoſed of ſimilar rocks with Cowal.

Eaſt Tarbet is ſituated upon the narroweſt part of the peninſula of Cantyre; for it is here only about two miles to the ſea on the weſt ſide, which is called Weſt Tarbet. There is a tolerable road from the eaſt to the weſt ſide; which is of ſome uſe, as this is not only the principal thorough-fare to the iſlands of Iſla and Jura, but boats coming from the Weſtern Iſlands have their cargoes unloaded here, and then are drawn acroſs the

iſthmus,

iſthmus, in preference to the circuitous and dangerous voyage by the Mull of Cantyre. It was once propoſed to cut acroſs this narrow neck of land; but the bad ground at Weſt Tarbet inclined the canal company rather to cut a canal from Crinan to Loch-Gilp Head, through a more conſiderable track of ground, but reckoned more favourable for ſhipping. The canal is now far advanced; but it is very probable that its utility will by no means coincide with the ſanguine expectations that have been raiſed, by the company, and the country in general.

The country, about Eaſt Tarbet, is bleak and rugged. The hills riſe to a conſiderable height; and are compoſed of micaceous ſhiſtus in the lower part, but gneiſs is to be obſerved towards the ſummit, and now and then indurated chlorite is found among the debris. Weſt Tarbet preſents a more pleaſing ſcene, from the natural wood that grows there with conſiderable exuberance.

From Eaſt Tarbet I now continued my journey towards the iſland of Jura, along the banks of Loch-Fyne, which is adorned with natural wood, giving a rich and pictureſque effect to the high cliffs that riſe above the road. The ſtrata are, in general, micaceous ſhiſtus, in ſome places alternating with conſiderable ſtrata of hornblende rock, and traverſed by baſaltic veins: and

I was

I was told that conſiderable limeſtone quarries were opened among the neighbouring hills, and conſequently muſt be primitive limeſtone. In many places we obſerved perſons cutting down the wood, for the purpoſe of making charcoal for the uſe of the iron forge near Oban. This is to be regretted; for, in a ſhort time, the whole wood will be deſtroyed, and the country deprived of one of its greateſt ornaments; and merely for the ſupply of the working of an iron furnace, that probably might be carried on equally well by a carefully-carbonized peat.

Having walked for ſeveral miles along the bank of the loch, we now changed our courſe, and croſſed through a long, dreary moor, and over hills, when we deſcended to the plain at the head of Loch-Kiliſled. The rocks are, all the way, of micaceous ſhiſtus, which is, in many places, quite diſintegrated, the looſe mica forming banks ſeveral feet thick. This mica, if free from iron, might be of conſiderable value; as we find Mr. Wedgewood uſing the fine white mica of Cornwall for the manufacture of porcelain and his very uſeful pyrometers ‡. It is therefore worthy the attention of the proprietors to examine the neighbouring country, where probably conſiderable quarries of colourleſs

‡ Journal des Mines, No. 3. p. 119.

mica might be found. At the head of Loch-Kiliſled I obſerved a conſiderable ſtratum of blue-coloured, granularly-foliated limeſtone, ſtratified with micaceous ſhiſtus. The micaceous ſhiſtus is here frequently mixed with felſpar, forming a ſpecies of gneiſs difficultly diſtinguiſhable from ſandſtone.

After leaving this plain, we had a difficult aſcent for a conſiderable way, but the tedioufneſs of the track was a little relieved by the natural wood through which we paſſed; this, alſo, ſoon diſappeared, when brown moſſes, and grey, bleak hills, were again characteriſtic of the country. Having walked for ſeveral miles through this dreary and deſert ſpot, we were ſuddenly ſtopped upon the brow of a hill, from which we had a view of the grey, ſteril mountains of the mainland, riſing into various rugged forms, and intermixed with lochs, thus preſenting a wild and deſolate ſcene. Soon afterwards, we came in ſight of the rugged iſland of Jura, the iſland of Iſla, and, farther diſtant, the mountains of Mull. Theſe we viewed with much pleaſure, as they were ſoon to be objects of our particular attention. We now deſcended from the mountains to the ſea-ſhore; where we obſerved an old, gloomy, ruinous building, called Caſtle Swein, ſituated in a wretched-looking country. Even the few inhabitants we ſaw, had ſomething ſo melancholy and depreſſed in their appearance; their miſerable huts were in ſuch uniſon with

with the ſcenery—as to occaſion in us an unuſual lowneſs of ſpirits. We haſtened, therefore, from this ſpot, and croſſed a ſmall ferry, and then walked about three miles to the ſhore oppoſite the iſland of Jura. The ſtrata, all the way from Kiliſled to this place, ſeem to be principally micaceous ſhiſtus, frequently paſſing to talcaceous ſhiſtus.

We here were fortunate in getting a boat, in which we paſſed to the iſland of Jura.

We now examined a part of this iſland, and then croſſed to Iſla, where we remained a few days; and again returned to Jura, previous to our voyage to the Slate Iſlands. As it would be irregular, and little ſatisfactory, to detail the obſervations in the exact order in which they were made, I prefer firſt giving an account of Iſla, and then of Jura.

ISLA AND JURA.

CHAP. X.

Abſtract of the Mineralogy of the Iſlands ISLA *and* JURA.

ISLA.

THIS iſland is thirty-two miles long, and, in ſome places, nearly as broad. It is the moſt ſouthern of the Æbudæ, or Hebrides; and its name is traditionally derived from Iſla, the daughter of one of the kings of Lochlin, or Norway, who was buried in the pariſh of Kildalton. Dr. Campbell, in his Political Survey of Great Britain, remarks that it is the Epidium Inſula of Ptolemy; and he imagines (erroneouſly, however) that it is denominated Iſla, or The Iſle, as being the ſeat of government when the Weſtern Iſles were ruled by the princes of the Iſles.

It

It approaches ſomewhat to a ſquare ſhape, and is much interſected by the ſea, in particular by two conſiderable lochs, one on the weſt ſide, called Loch Graynard, the other upon the ſouthern extremity, called Loch-in-daal. It is bounded upon the N. E. by the rugged and ſteril iſland of Jura; on the E. by the iſthmus of Cantyre; towards the S. it is ſeparated only about 20 miles from Ireland; but on the W. it is expoſed to all the violence of the Atlantic Ocean.

The cliffs around the coaſts of the iſland are, in ſome places, of conſiderable height, particularly at Macarthur's Head, where they riſe with great grandeur and magnificence. The ſhores are often covered with immenſe maſſes which have fallen from the neighbouring cliffs; but, in other quarters, the cliffs diſappear, when we have ſhores bounded by conſiderable ſandy beaches. Beds of cailloux roulés, or boulder ſtones, are to be obſerved upon the ſhore, but placed a conſiderable diſtance above high-water mark; and in the ſpace of ground between the two lochs juſt mentioned, there is an extenſive links, or down, where we find, under the thin covering of graſs, ſand, boulder ſtones, and ſhells. Theſe appearances, which are proofs of the retiring of the ſea from the land, are to be ſeen in many parts of the Weſtern Iſlands.

This

This iſland, when compared with many of the Hebrides, is low; none of the hills being above 1700 feet above the level of the ſea. The low grounds are pretty flat, often well ſheltered; and, through the exertions of the preſent proprietor, Walter Campbell, Eſq, of Shawfield, improvements are carried on with ſpirit: the moſs lands are daily rendered arable: thus beautifying the iſland, and rendering it the moſt productive of the Hebrides, its yearly rent being now about 10,000 l. *

Mineralogy. To render the few obſervations I have to make on the mineralogy of this iſland diſtinct and ſatisfactory, I will firſt deſcribe that ſpecies of rock which forms the interior, with its accompanying veins, and then trace the other ſtrata around the coaſts of the iſland.

Mining Field. The interior, or middle part of the iſland, from its containing a great number of metallic veins, and being the ſeat of all the workings, may be called the Mining Field.

It

* On the forfeiture of the Macdonalds, Iſla, Jura and the lands of Muckrain were given to Campbell of Calder, upon condition that he would pay 500 l. of yearly feu-duty out of Iſla. Campbell, about fifty years ago, ſold theſe lands to the Shawfield family for 12,000 l. which is now their yearly rent: a moſt ſtriking examp'e of what may be done by ſpirited improvements.

It is entirely compoſed of blue-coloured limeſtone, which is ſuppoſed to occupy about thirty-ſix ſquare miles; extending in diſtance (ſo far as I could obſerve) to the ſea-ſhore; neither does it riſe to any conſiderable height, for other rocks generally take its place when it riſes to a few feet above the level of the ſea. The limeſtone ſtrata dip towards the S. W. Numerous ſymptoms of galena occur in this limeſtone, and ſeveral veins have been worked with conſiderable advantage. The principal ſeat of theſe workings ſeems to have been in the neighbourhood of Garthsneſs, which is ſituated about the middle of the limeſtone diſtrict. At this place there are the remains of a lead vein, which runs S. E. and N. W. and dips towards the S. Beſides the galena, there alſo occurred, in the working, rich copper pyrites; and it is ſaid that, at one time, ſpecimens of ſulphurated manganeſe had been diſcovered. At Glaſgow-beg there is another vein of galena, running E. S. E. and W. N. W.; but it is traverſed by a baſaltic vein, which runs nearly S. S. W. and N. N. E. At a little diſtance ſouthward from this, we obſerve an open caſt vein, which runs E. and W. and dips to the S.: it is alſo croſſed by a baſaltic vein, as that at Glaſgow-beg: the baſaltic vein is about nine feet wide, and has thrown the lead vein about three feet from its original direction. There are many other mineral appearances beſides theſe now mentioned; but it would extend theſe notes too far to ſpecify more of them.

Many

Many other baſaltic veins are alſo to be ſeen: ſome traverſe the metallic veins; others croſs each other: in ſhort, a plan of this mining field would repreſent a limeſtone diſtrict divided into a number of angular and ſquare fragments.

The baſaltic veins are of various ſizes, from one to twelve feet in width. Many of them run parallel to each other; ſome run in a croſs direction, marking, according to the manner in which they interſect, their relative antiquity †; and not unoften theſe veins ſtand up like artificial walls, owing to the limeſtone being more eaſily acted upon by the weather, and being conſequently firſt carried away.

Beſides the galena, conſiderable quantities of copper pyrites have been found, but the quantity too ſmall to be of any conſequence. Alſo, upon the ſouth ſide of the limeſtone diſtrict, near to Loſſit hill, iron ore has been quarried; but its ſituation is not yet well aſcertained; and I am afraid, from the accounts I have heard, that it will be trifling. The workings in theſe veins have never afforded fluor ſpar; they produce only barytes and calcareous ſpar. Fluor ſpar is a rare production in Scotland:

† Werner Neue Theorie von der Entſtehung der Gange.

Scotland: I have only obſerved it twice; once in Shetland, as will be mentioned afterwards; and in a vein among the granite mountains of Aberdeenſhire.

Before concluding this ſhort deſcription of the mining field, I ſhall mention two remarkable facts, which ſeem well authenticated.

1. *Silver.* It is confidently affirmed that a lump of capillary ſilver, weighing ſixteen ounces, was found with the galena, in the vein at Garthsneſs. This is an intereſting fact; and, ſhould the veins be again opened, will prove a freſh incentive to carry on the working with ſpirit, as it is not improbable that veins of ſilver may be found. We know that ſcarcely three years have elapſed ſince native ſilver was diſcovered in Great Britain, and it is of conſequence to obſerve, that it occurred in a ſituation ſomewhat analogous to that in Iſla, the ſilver forming a ſtring, branching from the ſide of a vein of galena †.

2. *Quickſilver.* A quantity of this valuable metal was diſcovered in a peat moſs ſome years ago; and Dr Rotheram informs me that it is now in the poſſeſſion of Mr Campbell. Some ſlight ſearch has

† It was at Hurland, in Cornwall, where this ſilver was diſcovered.

been made to diſcover its ſituation, but without ſucceſs. This muſt not, however, be conſidered as a proof that no veins exiſt; for, to determine this, it will require a more regular mode of inveſtigation than has yet been purſued. Farther, the following facts ſhow that limeſtone rocks are not unfavourable to the production of quickſilver: 1. It is found in globules, in white limeſtone, at Marſala, in Sicily; (*Mineralogie Sicilienne*, par Borch, Turin 1780.) 2. Behind Guancavelica, in South America, the ardeſia paſſes into limeſtone, which is rich in ſilver and mercury; (Helm *Tagebuch reiſen durch Peru*, p. 431.) In the mineralogical collection at Paris there are ſpecimens of limeſtone, brought from the neighbourhood of Grenoble, which contain quickſilver *.

Obſervations. The mineral treaſures of this iſland, from their being ſituated ſo near the ſurface, muſt have early attracted the notice of the inhabitants; particularly as the Norwegians, the former maſters of the iſland, were early celebrated as miners. We do not, however, find any mention of theſe mines, until the time of Boethius ‡, who wrote 300 years ago; but

* Journal des Mines de la Republique Francoiſe, No. 1. p. 77.

‡ Boethius Scotor. Reg. Deſcript.

but even at that period they ſeem to have been of much conſideration, for he remarks, " cum frumenti ferax, tum metallorum dives." Since that period they have paſſed through many hands; but do not appear, in any of them, to have been conducted with all the judgement neceſſary for ſo difficult and important a buſineſs. It is a matter of much regret that theſe mineral appearances, as well as many others, equally intereſting, in different parts of Scotland, have not been proſecuted with more advantage. Many circumſtances have contributed to this want of ſucceſs; but, we apprehend, the principal one is to be found in the ignorance of the generality of miners, who are too often men of little education, and obſtinately wedded to their own fooliſh practices. Even in Cornwall, where the mining buſineſs ſhould be beſt underſtood, we obſerve them often working in an expenſive manner. In Scotland particularly, wanderers from other countries, not regularly bred in the principles and practice of mining, have often impoſed upon landed proprietors, by holding out to them flattering proſpects of great gain, and have thus thrown a temporary obſtacle in the way of improvement. It is to be hoped that the increaſing taſte for chemical and mineralogical ſtudies will enable proprietors to treat ſuch pernicious pretenders with that contempt they ſo juſtly deſerve.

Having deſcribed the mining field, I ſhall now proceed to examine the rocks around the ſhores of the Iſland; and to do this with regularity, will begin at Portaskeg, a ſmall harbour ſituated upon the ſound of Iſla. Here the cliffs are low, and compoſed of compact micaceous ſhiſtus; which paſſes either to Ardeſia, or Gneiſs; and in all theſe gradations, are to be obſerved, rounded or irregular ſhaped pieces of granite. This granite, which is compoſed of red-coloured felſpar, and white quartz, and ſometimes iron pyrites, cannot be ſaid to be connected by a paſte in the manner of a breccia, as the granitic maſſes and ſhiſtus paſs into each other, ſhowing that they have been formed at the ſame time. Ferber *, who has obſerved ſimilar appearances in the mountains of Ruſſia, agrees with Pallas †, in ſuppoſing that gneiſs, micaceous ſhiſtus, and ardeſia, are formed from the detritus of granite mountains; and upon this theory, he explains the appearances we are now conſidering. He conjectures, that the groſſer particles of granite, having undergone a little alteration, are agglutinated in the form of granite, and incloſed by an aggregation of the ſmaller parts, which become argillified, forming the ardeſia. This explanation is untenable, and unneceſſary, when we conſider

* New Tranſactions of the Imperial Academy of Peterſburg, vol. 11.

† Obſervations ſur les Montagnes, 4to. Peterſburgh.

ſider that after the greater part of the granite was precipitated, ſtill a ſmall quantity might remain, which would be depoſited along with the ardeſia, and form thin ſtrata incloſed in it ‡, or irregular ſhaped diſperſed pieces, as in the caſe at Portaſkeg.

From Portaſkeg the coaſt becomes gradually higher as we approach Macarthur's-head, and is formed for a conſiderable way of rocks ſimilar to thoſe I have juſt mentioned, which the ſea has in ſome places hollowed out into conſiderable caves. As we approach nearer to this great head-land, the cliffs become much higher, and the micaceous ſhiſtus, &c. diſappears; a granulated quartz taking its place *. Immediately upon the ſhore, I obſerved a large baſaltic vein traverſing the granulated quartz, riſing up through it like an immenſe wall, and

‡ Karſten 3 Helvet. Mag. and Monnet 25 J. Phyſique, 85.

* Mr Mills, in his account of ſome ſtrata in Ireland and Scotland, detailed in the Philoſophical tranſactions of the Royal Society of London, for 1790, has given a deſcription of Iſla. As it differs conſiderably from the obſervations I am now to detail, it will be neceſſary as I proceed, to contraſt our obſervations; ſo that future travellers, may be enabled to judge, who is in the right. Speaking of this part of the iſland, he ſays, "that it is compoſed of chert, which extends to Macarthur's-head.

and extending along the ſhore to a conſiderable diſtance; in ſome places forming a powerful barrier between the ſea and a few cottages, which are built at the bottom of the cliffs. Having reached the head-land, I obſerved the cliffs riſing to a great height, and compoſed of ſtrata of arenaceous quartz, elevated at an angle of 45°; and the rocks being tinged of a red colour, give a very wild character to the ſcene. This arenaceous quartz extends to a conſiderable diſtance; but is at length interrupted by a rock, which has much the appearance of a breccia, being compoſed of variouſly ſhaped pieces, (and ſome of great ſize) of the granulated quartz, connected by ſmaller particles of the ſame quartz; which has intermixed mica, and talc *. Frequently the whole has a red colour, which is owing either to the decompoſition of the mica, or ſulphuret of iron, which is ſometimes diſperſed through it. As we wandered along the ſhore, I obſerved this breccia interrupted by a vertical ſtratum of micaceous ſhiſtus: upon one ſide of the ſtratum, is the breccia; on the other, is the diſtinct granulated quartz. I would recommend this appearance to the particular attention

* Dr Townſon in his travels among the Carpathian Alps, obſerved great ſtrata of granulated quartz, (what he calls primitive ſandſtone) lying upon granite, and he obſerved it in all the ſtates from fine granulated quartz to that of breccia, as in the caſe with the rock of Iſla.—Travels through Hungary, 4to.

tion of future travellers, for I muſt confeſs, I was ſo fatigued when I reached this ſpot, that I could not give it that attention it undoubtedly deſerves. The granulated quartz now forms cliffs along the ſhore, until we come to a ſmall bay, where ſtrata of micaceous ſhiſtus appear; and here the hills riſe to a conſiderable height, being compoſed of micaceous ſhiſtus upon the lower part, and towards the ſummit, probably of granulated quartz. We now croſſed over ſome higher grounds until we reached Ben-vinkie, which is ſaid to be the higheſt hill in the iſland, although it is not more than 1700 feet above the level of the ſea. The lower region of this hill is compoſed of micaceous ſhiſtus; but as we go upwards, granulated quartz makes its appearance; and upon the ſouth-weſt ſide, which is very ſteep, a great vein of baſalt reaches very nearly to the ſummit. The country becomes lower after paſſing this hill, and is pleaſantly diverſified with ſmall irregular hills, that are intermixed with natural wood. The cliffs upon the ſhore are not very high, but are much broken by the action of the ſea, which has formed many detached rocks; and theſe, having a grey colour, preſent a ſtriking picture of ſterility. Along with the micaceous ſhiſtus, we have now ſtrata of ardeſia, chlorite-ſlate, hornblende rock*; and theſe

* Theſe Mr Mill includes under the name of Hornſtone.

theſe continue to Loch-Kuneſtle, a ſmall harbour on the coaſt. At this harbour, we obſerved a low hill called Knock Kuneſtle, which is compoſed of ardeſia, chlorite-ſlate, &c. in its lower part; but upon the ſummit, decompoſing greenſtone makes its appearance. I could not determine whether it forms a ſtratum or a vein; but obſerved, that when in a ſtate of decompoſition, it affected the compaſs at the diſtance of four feet. From this to Lugwillan, the coaſt and country continue rugged, and compoſed of the ſame rocks as thoſe which extend from Macarthur's-head to Loch-Kuneſtle. This little village, unluckily for the traveller, is extremely wretched; preſenting a ſad picture, if not of poverty, yet of dirtineſs and ſloth. It would certainly be much for the advantage of the proprietors, as well as conducive to the comfort of the peaſantry, if commodious houſes were built, and ſtrict regulations with regard to cleanlineſs enjoined. I mention with pleaſure, that Mr Campbell, has already in part begun this meritorious plan, and it is not to be doubted that he will ſoon feel the advantages of it.

After leaving Lugwillan, we met with a ſmall harbour named Leodamis, or Lowdinas bay, which affords ſhelter to ſmall veſſels; but like other harbours upon this coaſt, it is dangerous from the number of ſunk rocks, which extend to a conſiderable diſtance. The rocks in this neighbourhood are com-

poſed

poſed of micaceous ſhiſtus, which by its decompoſition forms a fine white ſand, that covers the ſhore; and at the upper extremity of the harbour, I obſerved ſeveral pieces of melanteria, or black chalk, which ſeemed to have been detached from ſtrata that probably alternate with the micaceous ſhiſtus. We now walked for ten miles, through a level country, to Loch-laggan, a ſinuoſity upon the ſide of Loch-in-daal. The rocks in this tract, are compoſed of micaceous ſhiſtus, and the general appearance of the country, to the extremity of the iſland, where it is terminated by the lofty Mull of Kinhouth, announce a ſimilarity of compoſition. From Loch-in-daal to the village of Bowmore, we paſſed thro' a level country, formed principally of micaceous ſhiſtus *, which appears, in ſome places, to alternate with greenſtone. This laſt mentioned foſſil, as alſo wacken, have been obſerved, in other countries, in a ſimilar ſituation; but baſalt, as Dr Mitchell informs me, is peculiar to the flotzgeburge, or ſtratified mountains. We are, therefore, to conſider the obſervations of the celebrated Charpentier ‡ and

* Mr Mills remarks, that the whole extent to Kenhouth-head, and ſo on to Bowmore, is hornſtone.

‡ 4 Helvet. Mag. 445. 546. Ibid. 3. 236. Charpentier, 81, 187.

Faujas St. Fond †, who aſſert that baſalt ſtrata occur in primitive mountains, as indicating only greenſtone or wacken.—The village of Bowmore, which is the principal one in the iſland, is pleaſantly ſituated upon the banks of the loch, and is the centre of all the buſineſs in the country. From this to Kiliru the roads lead through a flat country, part of which ſeems to have been gained from the ſea. Near Kiliru is the ſeat of Mr. Campbell, which is pleaſantly ſituated at the head of the loch, but is much expoſed, from the want of planting. From Kiliru to the point of Runs, the iſland is in general low, excepting about the Runs, where it riſes into hills, of which Bentarvil is the higheſt. Being diſappointed in examining that part of the iſland, we croſſed from Kiliru to Kilchoman. The country, in this direction, is low, interſperſed with ſmall lochs, and in ſome places well cultivated; and micaceous ſhiſtus, traverſed with quartz veins, is the only rock that occurs. Near to Kilchoman, I obſerved an old, ruinous, gloomy building, which was once the ſeat of the turbulent Macdonald, prince of the Iſles, but is now peacefully inhabited by the miniſter of the pariſh. From Kilchoman to the ſea-coaſt, the country is low; and the rocks, which extend along the ſhore, continue to form low, broken cliffs of micaceous ſhiſtus, alternating

† Faujas ſur le Trap, p. 86.

ternating with ſand banks, until we come to Saneg-more. Here the cliffs riſe to a conſiderable height: and, being much expoſed to the ocean, are broken into many fantaſtic forms, preſenting a grand and romantic piece of ſcenery. Knowing, from Mr. Pennant *, that there was a fine cave in theſe cliffs, we wiſhed to examine it. Accordingly, having procured guides, through the goodneſs of Mr. Campbell of Sanicks, we deſcended a ſteep precipice to its entrance, when we found ourſelves ſurrounded by lofty, rugged precipices, which towered far above us. The grandeur of the ſcene was much heightened by the turbulence of the ſea, which came rolling in ſlowly, but with awful majeſty, daſhing among the rocks, with a noiſe that reſounded on all ſides like the diſcharge of artillery. Having entered the cave, we found it pretty extenſive, but damp and black, owing to the water falling from above. At a little diſtance, the guides directed us into a narrow opening on one ſide, into which we ſcrambled with ſome difficulty, but found only a dark, dreary cavity, of little extent. As we walked onwards, the cave became larger; but we were ſoon ſtopped by a pool of water, which appeared to be pretty deep. The guides croſſed through it, and walked to the further extremity of the cave; and the effect produced by the retiring of the lights,

* Voyage to the Hebrides.

was not the leaſt intereſting part of this ſcene. Formerly, when the cave was dry, the gentlemen of the country uſed to illuminate this wild grotto, and collect all the beauty of the iſle to dance to the bagpipe.

We now left the cave; and, in our aſcent, obſerved ſeveral baſaltic veins traverſing the micaceous ſhiſtus. From this to the mouth of Loch-Grynard, is an alternation of ſandy beaches and low cliffs of micaceous ſhiſtus and ardeſia, in ſome places traverſed with baſaltic veins, of various ſizes, from a few feet to nearly forty feet wide. Theſe appearances are ſo numerous, that I could not poſſibly afford time to examine them all minutely; ſo that it will not be ſurpriſing that after travellers ſhould find, in ſome places, ſtrata inſtead of veins. Loch-Grynard is of conſiderable extent; is uſually bounded by ſandy banks, but ſometimes low rocks of micaceous ſhiſtus appear; and at its head are the links or downs we have already mentioned, which extend nearly to Loch-in-daal. From this loch to the great caves which are ſituated upon the north-weſt part of the iſland, the ſhore is, as uſual, an alternation of low, rugged cliffs of micaceous ſhiſtus and ſandy beaches; but, as we come nearer to the caves, the cliffs are much higher, and, in place of micaceous ſhiſtus, we have rugged precipices of granular quartz. We deſcended a path made in theſe cliffs,



VIEW of the GREAT CAVE *of* ISLA *looking outwards.*

cliffs, which brought us among rocks terribly broken by the ſea; and after walking a few hundred feet, the caves preſented themſelves with much dignity. The height of the rocks in which they are ſituated; the wild and rugged grandeur of the neighbouring hills; the ſolitude of the place; all add freſh intereſt to this ſtriking ſcene. The great cave, or what is called, in the Erſe language, Ea-maur, is about thirty-three yards wide at its entrance, and from ſix to eight yards high: as we go inwards, the roof becomes higher, but it ſoon again contracts in all its dimenſions; and about 150 yards from its entrance, it is ſo narrow and low, as to prevent any one from getting farther. It is ſituated in granular quartz, as is the caſe with the other ſmaller caves. The celebrated Sauſſure has lately publiſhed a ſeries of experiments upon the temperature of caves, in which he obtained ſome curious reſults. I repeated them carefully in the great cave, but did not find a difference of more than 8° of Fahrenheit between the temperature of the cave and that of the ſhade.

At a little diſtance from the caves, I obſerved the granular quartz covering a ſpecies of ſhiſtoſe talc, and, alſo, a ſpecies of marl, in the neighbourhood of the granular quartz and micaceous ſhiſtus: but I had not an opportunity of examining their relative poſition.

* Mr Mills remarks that the caves are in rocks of chert.

poſition. From this we croſſed a very fatiguing moor to Portaskeg: the rocks, all the way, are of granular quartz, (extending even to the ſummit of the higheſt hills,) excepting a few places upon the ſea ſhore, where micaceous ſhiſtus appears.

JURA.

THIS iſland is about 32 miles long, and 6 broad; but at Tarbet it is nearly divided, being only a mile and a half broad. It is bounded on the E. by Knapdale and Cantire; on the S. by the iſland of Iſla; upon the W. by Colonſay, Oranſay, Mull, &c.; and towards the N. the Slate iſlands. It is in general very mountainous, particularly upon the S. W. extremity, where are ſituated the high hills called the Paps of Jura. None of the Hebrides preſent ſuch a maſs of rugged barrenneſs. The hills are often grey and bare; and the ſcanty portions of the lower ground which are cultivated, ſeem ill managed. The ſhore upon the eaſt ſide is in general low; but upon the weſt it riſes frequently to a great height, and is broken into many ſtriking forms; particularly we obſerve extenſive caves, which afford

ſhelter



CAVES *on the* WEST COAST *of the* ISLAND *of* JURA.

ſhelter to the deer and goats that browze among the neighbouring rocks.

Mineralogy. The mineralogy of this iſland, as far as I examined it, is but little intereſting, as it does not differ materially from that of the ſhores of Iſla. I ſhall not omit, however, to give a ſhort account of it, as its mineralogy has not engaged the attention of any writer.

Immediately below Ardfin, the ſeat of the hoſpitable Archibald Campbell, Eſq. I obſerved ſtrata of granular quartz, inclined at an angle of 45°; yet they are not regularly ſo, for I obſerved them inclined at different angles in other parts of the iſland. This rock forms the coaſt of the iſland all along the ſound of Iſla, and, as far as I could obſerve, it appears to extend along the whole weſt coaſt. The cliffs are, in ſome places, of conſiderable height; and the great maſſes which are ſeparated from them have, in general, a tendency to the pyramidal ſhape. This is another fact, ſimilar to what I obſerved in Arran, ſhowing that particular rocks break in ſuch a manner as to be characteriſtic of their peculiar nature. Theſe quartzy maſſes, by further decompoſition, fall into ſmall cryſtalline grains, which cover the ſhore, in ſome places, to a conſiderable extent;

extent; and form a ſand, which is aſſuredly among the pureſt that nature affords. It has been uſed with much ſucceſs in the making of fine glaſs; and I have little heſitation in ſaying, that it is worthy of being more generally known as an article for glaſs-making: indeed it might alſo be advantageouſly uſed for the making of ſmalt, and different kinds of porcelain, in the place of powdered quartz, or flint.

Many baſaltic veins are to be ſeen traverſing theſe quartzy ſtrata, which extend along the ſound of Iſla and the weſt coaſt of the iſland: and it is curious to obſerve the manner in which theſe two rocks decompoſe; for upon this circumſtance depends the varied appearance of the rocky ſcenery on the weſt coaſt of Jura. Sometimes the baſalt decays firſt, leaving only the empty ſpace which the vein had formerly filled; and this afterwards is much enlarged by the decaying of the quartz: thus forming caves ſuch as are repreſented in the plate. In other inſtances, the granular quartz decays firſt; and either falls away from the ſide of the baſaltic vein, or is waſhed away by the ſea: thus leaving the baſaltic rocks extending acroſs the beach like immenſe walls. Theſe great maſſes of baſalt are often broken into various ſhapes; but

the



Engraved by R. Scott Edin.r

A View of a PERFORATED BASALTIC VEIN, *N.W.? coast of the* ISLAND OF JURA.

the moſt ſtriking appearances are formed by the central part of the vein decaying firſt, which leave magnificent arches: but the engravings of this coaſt will convey a more lively idea of the character of theſe rocks, and the general appearance of the ſcenery, than any deſcription.

There are many caves upon this coaſt, and ſome of them of vaſt ſize; but my time did not allow me to viſit the moſt remarkable.—In wandering among the rocks, I obſerved ſeveral banks of coral ſand; which I was happy at obſerving, as it will be of great uſe to this iſland, heretofore deſtitute of all kinds of calcareous matter, and abounding with much improvable peat moſs.

Paps of Jura. Theſe mountains, which are the moſt elevated in the iſland, are diſtinguiſhed by different names. The three moſt remarkable are, Beinn-a-chaolois, or, the Mountain of the Sound; Beinn-ſheunta, or, the Hallowed Mountain; and Beinn-an-oir, or, the Mountain of Gold. The laſt mountain is the higheſt; being about 2600 feet above the level of the ſea; and is, like the others, ſomewhat of a conical ſhape.

We clambered to the ſummit of one of theſe hills, but found the aſcent very ſteep, and fatiguing, from the number of ſmall looſe ſtones that cover its ſides: but our fatigues were

ſoon forgot in the immenſity and variety of the proſpect now before us. Immediately below was the rugged ſcene of the grey, ſtorm-beaten rocks of Jura, interſperſed with numerous lakes; conveying, as Mr Gilpin remarks, the idea of complete ſterility. To the S. the iſland of Iſla ſeemed ſpread under our feet; and, farther diſtant, appeared the coaſt of Ireland. To the W. we obſerved the ſmall iſles of Gigha and Cara, the iſthmus of Cantyre, and the lofty red-coloured granite mountains of Arran, forming a ſtriking contraſt to the ſombre hue of the mountains of Cantyre; and, ſtill at a great diſtance, our view was bounded by the diſtant county of Ayrſhire. On the N. E. we obſerved the wild alpine ridges of Argyleſhire, extending all the way to Ben-Lomond. To the W. the Hebrides appear, ſcattered through the ocean: the iſles of Colonſay and Oranſay are in our immediate neighbourhood; farther diſtant, is the mountainous iſland of Mull, the celebrated I-colmkill, with the adjacent iſles; and the long-extended iſles of Coll and Tirie appear like a haze in the horizon.

Theſe mountains are principally compoſed of ſtrata of a granular quartz, elevated at an angle of 45°, and dipping to the ſouth-weſt. From the ſummit of the hill, the ſtrata appear to run in different directions; ſome curved, and others nearly horizontal: theſe appearances, however, are probably more owing

owing to the ſituation from which I viewed them, and the ends of the ſtrata being worn down by the rain, &c. than to any alteration in their dip or direction. The fragments of rock which cover the ſides and tops of theſe mountains, are broken into ſmall angular fragments; which, obſerved at a diſtance, and even with a teleſcope, would ſhow us, that they are formed of a rock very different from granite; as the latter almoſt always decompoſes in large rhomboidal maſſes.

I frequently obſerved maſſes of this granular rock; which, from its containing felſpar and mica, is to be conſidered as a true granite. This fact, will be reckoned, by certain geologiſts, as deciſive againſt the opinion of Mr Werner; who affirms, that granite is the oldeſt rock, and conſequently, that upon which the others reſt. It cannot be denied, that there are ſeveral facts, detailed by the moſt intelligent geologiſts, which ſhow, that granite is ſometimes of a cotemperaneous formation with ardeſia *, micaceous ſhiſtus †, and gneiſs ‡; yet they are ſo rare, that I can only conclude from them, as I have before mentioned, that after the greater part of the gra-

* Reuſs Mineralogiſche Geographie von Bohmen, B. 2. 180.

† Journal de Phyſique. New ſeries, vol. 1.

‡ Emmerling's Mineralogie, B. 3.

nite had been precipitated, ſtill a ſmall portion remained in ſolution; and was afterwards depoſited along with the gneiſs, or other primary rocks. The opinion of Mr Werner, on the other hand, is ſupported by ſo vaſt a maſs of evidence, as bears down all oppoſition. Thus, according to Sauſſure, the granite of the Alps, excepting in one or two inſtances, is always covered with other ſtrata; itſelf forming the interior, and often the higheſt parts of the mountains. The ſame obſervation has been made by Baron Born, and Eſmark in the mountains of Hungary and Wallachia; by Palaſſo, La Peyrouſe, and Carbonieres in the Pyrenees; by Reuſs in the mountains of Bohemia; Lazius in thoſe of the Hartz; by Patrin, Herman, Pallas in the vaſt extended empire of Ruſſia; by the French mineralogiſts in all the granite mountains of France; alſo in the granite mountains of the Weſt Indies, and in the few which have been examined in England † and Scotland.

Having mentioned the different kinds of rock which form the coaſt and hills, from Ardfin, along the ſouth and weſt parts of the iſland. We will now proceed along the eaſtern ſhore

† In the great mine in Cornwall, called the Cooks Kitchen, I have been told, that the granite has been found above the ardeſia (or killas). I have not as yet had it accurately confirmed.

ſhore, from the ſame place. Upon the ſhore, at a little diſtance from Ardfin, ſtrata of micaceous ſhiſtus, alternating with rocks intermediate between talcaceous ſhiſtus and ardeſia, appear, and continue forming low cliffs along the ſhore to the harbour of the ſmall iſles *. Theſe rocks are ſometimes very compact, and have a tendency to break into irregular columns; ſo that in ſome points of view, they are not unlike columnar baſalt: we alſo obſerved baſaltic veins traverſing them in many places. From this the country gradually riſes as we approach the high hills, the paps of Jura; and in ſome places, as upon the road leading from Ardfin to Small Iſles, chlorite-ſlate is to be obſerved alternating with the other rocks. This chlorite-ſlate, ſometimes paſſes to hornblende rock, by a mixture of green hornblende; and it ſometimes contains calcareous ſpar, and cryſtals of yellowiſh-green actynolite diſperſed; but this latter is a rare appearance. Not unoften I obſerved the chlorite penetrating the quartz, forming a dark green coloured ſtone; and here I was ſo fortunate as to diſcover that rare foſſil, the cryſtalized chlorite, of which a particular deſcription is given in the following chapter. If we ſtill continue our courſe towards the high hills, we at

* About a mile diſtant from Ardfin, we landed upon a ſmall low iſland, which is compoſed in general of a coarſe talcaceous ſhiſtus; and between the ſtrata we obſerved layers of beautiful hornſtone.

at length find the granular quartz riſing from under the micaceous ſhiſtus, at an angle of 45°, and from this, the whole country to the ſummit of the mountains is formed of the ſame rock.

We would naturally conclude, from finding the quartz ſtrata lowermoſt, that it had been depoſited before the micaceous ſhiſtus; this is only true in part, as we ſometimes obſerve the micaceous ſhiſtus paſſing to granular quartz, at a great diſtance from the junction †.

As far as my experience goes, mountains of granular quartz are to be conſidered as rare occurrences in Scotland: in Caithneſs, I obſerved quartz mountains, as will afterwards be mentioned: and Mr Williams tells us of quartz mountains in Roſsſhire *: but theſe are the only inſtances I am acquainted with. It is even an unfrequent rock in other countries; in the Carpathian Alps, Dr. Townſon informs us, he obſerved what he calls primitive ſandſtone lying upon granite; and Mr Deriabin, to whom I ſhowed the Jura rock, aſſures me that it is ſimilar

† In Brainſdorf, in Saxony, granular quartz has been obſerved paſſing into micaceous ſhiſtus. 2 Crell. Leytr. 64.

* Williams's Mineral Kingdom, vol. 2. p. 52.

ſimilar to that which forms ſo great a portion of theſe mountains.

As the diſcovery of limeſtone would be of much ſervice in the agricultural operations of this iſland, we were anxious to aſcertain if any ſuch ſtrata exiſted between the Small Iſles and the Sound of Iſla. To determine this, we examined not only the ſhores, but the ravines upon the ſides of the hills, yet without ſucceſs. This failure in our reſearches does by no means imply that limeſtone does not exiſt in this diſtrict, particularly when we recollect that theſe rocks are not unfavourable to it. We have many inſtances of limeſtone being found in micaceous ſhiſtus, in different parts of Scotland, as at Dalmally, near Blair in Athol, &c. ‡ It may even occur in granular quartz; as Eſcher has obſerved limeſtone among granular quartz in the valley of Reuſs.—Townſon upon the granulated quartz (primitive ſandſtone) of the Carpathian Alps, &c.

The harbour of the Small Iſles is rendered pretty ſafe by three

‡ Werner has obſerved limeſtone alternating with micaceous ſhiſtus and ardeſia, in Saxony: ſo has Charpentier, and that in great ſtrata. Werner, Kurze Claſſific. 14. Charpent. 55, 56, 57, 174, 201, 400.

three or four ſmall iſlands, that defend it from the violence of the ſea. It will admit veſſels of ſeveral hundred tons; yet, as the iſland and the neighbouring country are but thinly inhabited, few veſſels are to be ſeen enlivening this ſolitary ſcene. The country in the neighbourhood riſes gradually as it approaches the Paps of Jura, which here preſent a magnificent and ſtriking mountainous ſcene. The ſtrata, from the ſhore to the vicinity of the Paps of Jura, are compoſed of micaceous ſhiſtus; excepting at one place, about half a mile north from Mr Macnicol's houſe, where we obſerved a ſtratum of ardeſia tegularis (roof ſlate) cropping through the heath. This ſtratum, which appears to be of conſiderable breadth, is bounded by the micaceous ſhiſtus; and, near the junction, the micaceous ſhiſtus contains cubical cryſtals of iron pyrites *.

From the Small Iſles to Luggan, the ſtrata of micaceous ſhiſtus ſtill continue, often very compact, and frequently traverſed by baſaltic veins. At Tarbet, which is the narroweſt part of the iſland, the land immediately upon the ſhore is low; and the eye is refreſhed by the appearance of a beautiful

* May not the preſence of cubical pyrites, in micaceous ſhiſtus, be indicative of the vicinity of ardeſia tegularis?

tiful green flat, at the bottom of the grey hills which bound the ſhore. From this to Kenawochrach, the northern extremity of the iſland, micaceous ſhiſtus appears to be the general rock, but it is ſometimes alternated with ardeſia tegularis. At one place the ardeſia has been quarried; and, from what we could learn, there can be little doubt that, with well-directed experience, the working may become of conſequence.

ISLA AND JURA.

CHAP. XI.

Deſcription of the FOSSILS *mentioned in the preceding Chapter.*

GRANULAR QUARTZ.

CYAMEA, Dr Walker's Claſſes Foſſilium. *PRIMITIVE SANDSTONE*, Mr Kirwan's Geological Eſſays, p. 208. *QUARTZ*, Ibid. p. 179.

This rock, which we have ſo often obſerved in the iſlands of Iſla and Jura, is deſcribed by Dr Walker under the name of Cyamea Juræ; and, more lately, Mr Kirwan, in his Geological Eſſays, deſcribes ſimilar rocks under the names of Arenaceous Quartz and Primitive Sandſtone. There are many ſpecies of this rock in theſe iſlands; but I will only mention three of the moſt remarkable.

1. COM-

1. COMPACT.

Colour. White, or grey.

Luſtre. Little glancing.

Tranſparency. Tranſmits light at the edges; but when the ſpecimen is thin, the light paſſes through the whole.

Hardneſs. Strikes fire with ſteel.

Fracture. Even, coarſe ſplintery, and frequently ſhiſtoſe in the groſs.

Intermixed with quartz, (which is ſo compact as to render the granular character difficultly obſervable,) I always obſerved a number of white ſpecks, which are either felſpar or mica, or both, uſually in a ſtate of decompoſition. Sometimes veins of compact quartz are to be obſerved traverſing this ſpecies.

2. MICACEOUS. This ſpecies is compoſed of quartz, and a ſmall portion of mica. The mica is always in ſmall ſcales, and is either yellow, brown, or white. Often the mica is ſo abundant, that we have a true micaceous ſhiſtus.

3. GRANITIC. In this ſpecies, the granular appearance is more evident: and, intermixed with the quartz, are numerous cryſtals of red and white felſpar, of various ſizes, from a pin-

head to half an inch; and a few ſcales of mica alſo, now and then, occur. Not unoften cubical cryſtals of iron pyrites are intermixed with the other ingredients, and, by their decompoſition, cauſe the ſtone to acquire a brown colour, or to diſintegrate altogether. This ſpecies, therefore, is to be reckoned an approximation to the granite, from which it differs but in the proportion of felſpar and quartz.

MICACEOUS SHISTUS.

This rock occurs in Iſla and Jura, and is conſiderably varied in its appearance. The quartz is of various colours, as black, blue, or white; and is generally granular. The mica is alſo of different colours, as black, brown, greeniſh, or white: the ſcales are, in general, ſmall; the largeſt are thoſe in the rocks in the ſtrata that extend to the north end of Jura. The micaceous ſhiſtus at Lag in Jura, at a diſtance, is not unlike baſalt; but a nearer examination diſcovers a compound of black and dark-blue coloured quartz, with ſmall ſcales of black mica very cloſely compacted together. It often alſo contains iron pyrites, which, by its decompoſition, forms a number of ruſt-coloured ſpots. Sometimes cryſtals of felſpar occur when it paſſes to gneiſs; or the quantity of quartzy particles increaſe when it paſſes to the ſtate of arenaceous quartz.

ARDESIA.

ARDESIA.

Colour. Bluiſh or blackiſh grey.

Luſtre. Silky. This ſilky gloſs, Mr Kirwan remarks, intimates magneſia.

Tranſparency. None.

Fracture. Streight, ſlaty; the laminæ are undulated upon the ſurface.

Hardneſs. Eaſily ſcraped with a knife: but this degree of ſoftneſs is probably owing to the influence of the weather, as the ſpecimen now deſcribed was taken from the ſurface of the ſtratum.

Streak. Grey.

Smell. Emits a ſtrong earthy ſmell when breathed on.

Cubical cryſtals of iron pyrites are diſperſed through it; and theſe, by the eſcape of the ſulphur, are converted into brown iron ore. It is worthy of remark, that the pyrites which occurs in the primary ſtrata is much leſs liable to decompoſition than that which we find in the ſecondary; and farther, that altho' we find pyrites very abundant in the primary ſtrata, yet the combinations of the ſulphuric acid with earths are rarely to be obſerved.

obſerved *. Mr Kirwan, in the ſecond volume of his Mineralogy, explains to us the difference between thoſe pyrites that effloreſce and decompoſe quickly, and the others which decompoſe more ſlowly. He remarks, that thoſe pyrites which effloreſce ſpontaneouſly, contain iron in a metallic ſtate; but the others which decompoſe more ſlowly, and by the ſeparation of their ſulphur, have the iron in the ſtate of an oxyd.

CHLORITE SHISTUS.

Slaty Chlorite, Kirwan's Mineralogy. *Argilla Chlorites Shistosus*, Werner.

Colour. Dark-green.

Internal Luſtre. Little glancing.

Tranſparency. None.

Fracture. Slaty; lamellæ pretty eaſily ſeparable.

Hardneſs. Yields eaſily to the knife.

Streak.

* Gypſum has been diſcovered mixed with mica in Mount St. Gothard; 44 J. de Phyſique. Pallas has obſerved gypſum aſſociated with felſpar in Siberia; 5 Nord. Beytrage. Sulphat of Barytes has been obſerved in gneiſs in the mountains of Savoy, as mentioned by Werner. Theſe are the few inſtances that are known.

Streak. Green.

Smell. Has a ſtrong earthy ſmell, when breathed on.

Frequently grains and layers of quartz are to be obſerved mixed with the chlorite; and ſometimes the quartz is penetrated with it, forming a foſſil not unlike praſe. Iron pyrites are ſometimes intermixed with the chlorite, and, by their decompoſition, colour the rock brown. Cryſtals of green hornblende are alſo to be obſerved intermixed with the chlorite; and according to the quantity of hornblende, the rock paſſes more or leſs to the ſtate of hornblende rock.

FOLIATED CHLORITE.

Blattriger Chlorite, Werner, Eſthner's Mineralogie, Emmerling's Mineralogie.

The *colour* is that of the common chlorite.

It is found not only maſſive, but alſo diſperſed, and cryſtallized.

The cryſtals are in the form of a double conical pyramid, with truncated apices; and are to be obſerved alſo in the form of a cylinder, with a cone or conical pyramid upon each extremity.

The

The cryſtals are ſmall, with little luſtre on the outſide, but ſtrong glancing † internally.

Luſtre. Intermediate between the greaſy and mother of pearl.

Fracture. Foliated; but moſt commonly curved foliated.

Tranſparency. Semi-diaphanous; or ſuch as to permit light to paſs thro', but ſo little that objects cannot be diſtinguiſhed.

Hardneſs. Not eaſily ſcratched with the nail, yet yielding eaſily to the knife.

Fragments. Tabular; feels a little fatty; and is not remarkably heavy.

It is found inveſting white-coloured quartz, but more commonly well cryſtallized in cavities of the quartz. I have only obſerved it in the iſland of Jura, among the ſtrata of chlorite ſhiſtus, upon the road from Ardfin to the harbour of the Small Iſles. According to Emmerling, it is a very rare foſſil; as it has been obſerved in one other place only, that is, upon the mountain of St. Gothard, in Switzerland, where it is accompanied by cryſtals of adularia, reddiſh-brown ſchorl, and rock cryſtal.

HORN-

† Stark glänzend.

HORNSTONE.

Achates Petrosilex, Lin. *Silex Corneus*, Wern. *Nicomia*, Dr Walker. *Chert*, Angl.

Colour. Pale brown; in ſome parts green, when intermixed with the magneſian rock in which it lies.

Luſtre. None.

Tranſparency. Tranſmits a little light at the edges.

Fracture. Fine ſplintery.

Hardneſs. Strikes fire plentifully with ſteel.

Where it is in contact with the magneſian rock, it is much intermixed with it, has a green colour, and at length fairly paſſes into the talcaceous ſhiſtus of which the iſland is formed. Sometimes we find veins of cryſtallized calcareous ſpar traverſing it.

TALCACEOUS SHISTUS.

Lapis Ollaris, Waller. *Talcum Ollaris*, Lin. *Talc Schei-fer*, *Verharteter Talc*, Germanor. *Talcum Proprium Ollari*, Werner.

Colour. Dark-greeniſh black, or yellow.

Luſtre. Nearly as ſhining as ſilk.

Tranſparency. Sometimes tranſmits a little light at the edges; in other ſpecimens, when it paſſes to ardeſia, it is opaque.

Fracture. Shiſtoſe.

Hardneſs. Yields to the knife eaſily; but, as it paſſes to the ſtate of argillite, becomes harder.

Streak. Grey.

This rock is to be obſerved paſſing, upon the one hand, to the chlorite ſlate, and, on the other, to ardeſia. It is found in different parts of the iſlands of Iſla and Jura, as has been mentioned in the preceding chapter.

LIME-

LIMESTONE.

Colour. Dark blue.

Luſtre. Very weak, principally from a few ſhining particles diſperſed through it.

Tranſparency. None.

Fracture. Even, fine ſplintery.

Hardneſs. Yields with ſome difficulty to the knife.

Streak. Grey.

It forms the central part of the iſland of Iſla, and contains no petrifactions; which renders it probable that it is of primitive formation. It may be objected to this, that all primitive limeſtones have a ſcaly or granular grain. We cannot doubt that, in general, this obſervation is perfectly correct; but it ſeems liable to exceptions: as Mr Kirwan, in his Geological Eſſays, mentions, upon the authority of the Helvetic Magazine, that the mountains of Wetterhorn, Wellhorn and Burghorn are formed of primitive limeſtone having a ſplintery fracture; and I ſhall afterwards mention primitive limeſtone, or marble, with a ſplintery fracture, as occurring in the Hebrides. Mr Kirwan further mentions, that, as ſome traces

of muriatic acid are to be found in ſecondary limeſtone, and none in the primary, this may ſerve as a good teſt for diſtinguiſhing them. I have not, however, made any experiment, with this view, upon the Iſla limeſtone.

COMPACT MARL—STONE MARL.

Verharteter Mergel, Germanor. *Calcareus Marga Indurata*, Werner.

Colour. Yellow, or yellowiſh white.

Luſtre. None.

Tranſparency. None; but, when much penetrated with ſiliceous matter, tranſmits a little light at the edges.

Fracture. Fine ſplintery.

Hardneſs. Yields with difficulty to the knife; and, when penetrated with ſiliceous particles, ſcarcely yields to the knife.

Is ſlowly acted upon by acids, and feels heavy.

It is uſed for the purpoſes of agriculture, but it requires ſeveral years before it falls.

MELAN-

MELANTERIA, Pliny—BLACK CHALK.

Shistus ſcriptura atra, ater inquinans, Linn. *Argilla nigrica*, Werner. *Shistus nigrica*, Waller. *Melanteria*, Dr Walker.

Colour. Bluiſh black.

Luſtre. Longitudinal fracture extremely little glancing, and the croſs fracture none.

Fracture. Longitudinal fracture, curved ſlaty; but the croſs, fine earthy.

Streak. Little glancing. Colours black, but without the luſtre of plumbago.

Hardneſs. Pretty eaſily ſcratched with a knife.

This foſſil occurs often in the neighbourhood of aluminous ſhiſtus; and is always found, diſpoſed in beds, in the primitive mountains, particularly in ardeſia. As it writes upon paper, and has a bluiſh-black colour, it has often deceived the uninformed, who have imagined they have diſcovered black lead: the difference of luſtre, and other characters, however, ſufficiently diſtinguiſh them. It has alſo been taken for coal, or reckoned a proof of the vicinity of coal ſtrata. Thus, Dr Reuſs,

Reuſs †, in travelling through Bohemia, tells us, that he obſerved a ſhaft ſunk ſeveral fathoms through ardeſia, and, upon enquiry, he found it was in ſearch of coal. This coal, however, upon examination, he found to be a ſpecies of aluminous ſlate, very nearly reſembling black chalk. This ſhould ſerve as a ſtrong caution againſt making trials, without having firſt examined carefully the rocks which we think indicate the preſence of coal; and farther, whenever any coal-like ſubſtance (which was the caſe here) is obſerved only among primitive rocks, it ſhould excite a ſtill ſtronger doubt, when we recollect that coal has never yet been detected, nor probably ever will, in any quantity, in primitive mountains.

SEIL,

† Mineralogiſche Geographie von Boehmen, Zweiter band, § 202.

SEIL, EASDALE AND OBAN.

CHAP. XII.

Voyage from JURA *to the Slate Iſlands of* SEIL *and* EASDALE; *thence to* OBAN *and the Iſland of* MULL.

HAVING found it very inconvenient to examine the weſt and northern parts of Jura, Mr Macnicol, the miniſter of the iſland, (to whoſe kindneſs we were much indebted,) procured a boat, and we ſailed from the harbour of the Small Iſles to the iſland of Seil, a diſtance of about 30 miles. As the weather was charming, we kept cloſe along the ſhore of Jura, which gave us an opportunity of landing upon different parts of the iſland. Having reached the northern extremity, the wind increaſed a little; ſoon after, we heard the great whirlpool, the Coryvrekan, raging, in the ſound between Jura and the iſland of Scarba.

We

We now paſſed the rugged iſland of Scarba, which is apparently compoſed of micaceous ſhiſtus traverſed by baſaltic veins; next, the iſland of Luing, ſaid to afford much ardeſia; ſoon after, the ſmall iſle of Balinahuia, where there is an extenſive quarry of ardeſia; and, at ſome diſtance, we obſerved the iſland of Garveloch, where there is a conſiderable quarry of ſhiſtoſe marble*, firſt diſcovered, many years ago, by Dr Walker. After much oppoſition from an extremely violent tide, we at length landed upon the iſland of

SEIL.

THIS iſland, about 3 miles long, and 2 miles broad, is ſeparated from the iſland of Eaſdale by a ſtrait a few hundred feet broad, and from the mainland by a narrow paſs over which a bridge has been thrown. The iſland is in general flat, yet not without hills, from the higheſt of which we have a pleaſant view, of the many

* This marble riſes in flags of a conſiderable ſize, ſome 3 feet by 2, and even 4 feet by 3; takes a good poliſh; and is of a white or grey colour, and is ſometimes clouded; and has a fine grain.

ny ſmall iſles ſcattered over the ocean, with the diſtant mountains of Mull and Jura.

The greater part of the iſland is compoſed of rocks of primitive formation, and theſe are micaceous ſhiſtus and ardeſia. Baſaltic veins are alſo very frequent, traverſing both kinds of ſtrata; and, where the ſtratified matter is waſhed away, or has fallen down by decompoſition, the perpendicular veins appear often like baſaltic crags, and, at firſt ſight, may be taken for ſtrata. Conſiderable veins of quartz are alſo to be obſerved traverſing the primary ſtrata upon the ſouth and eaſt ſhores of the iſland; and, near to the ſouthern extremity, I obſerved a vein of quartz which contained a quantity of iron pyrites, but apparently too ſmall to be of any importance.

Beſides theſe primary ſtrata, I obſerved, upon ſeveral parts of the iſland, ſmall portions of the tranſition (uebergangsgeburge) and flotz rocks (flotzgeburge). Near to Mr Campbell's houſe, I obſerved the ardeſia covered by grauwacken, and both apparently traverſed with the ſame baſalt vein; which leads us to ſuppoſe that they were formed at the ſame time; and, in ſupport of this, I may mention, that German mineralogiſts have obſerved theſe rocks to alternate *. Upon the ſide of the

* Emmerling, Band. 3. § 105.

they are divided into quarriers and day labourers. The quarriers are paid annually at a certain rate for every thouſand ſlates: from 10d. to 15d. I believe, as their work has been attended with more or leſs difficulty. The day labourers are employed at the company's expence in opening new quarries, and have from 10d. to 1s. a day.

OBAN.

AS the weather continued very pleaſant, we preferred going to Oban by ſea, in place of the circuitous rout by land. Having procured a boat, we left Seil, with a fine breeze; our voyage was agreeable, with ſcenery often ſtriking; on one hand, was the lofty coaſt of Mull, extending from Loch Bay to Crogan, all apparently baſaltic; on the other, the mainland riſing into ſmall hills, alſo with a baſaltic aſpect. Having paſſed the iſle of Kerrera, which lies acroſs the bay of Oban; in a ſhort time afterwards, we landed at the village. The bay of Oban is of a ſemicircular form; is from 12 to 14 fathom deep, with good anchoring ground, and will contain 500 ſail of

of merchant ſhips. The village is pleaſantly ſituated at the upper part of the bay, a ſtation excellently adapted for the fiſhing. The decline of this branch of trade, has indeed been unfavourable to the riſe of Oban; but it is, notwithſtanding, the moſt conſiderable village on this part of the coaſt, containing about 586 inhabitants. It is to the exertions of the two brothers, the Meſſrs. Stevenſons, who ſettled here in 1778, that Oban is chiefly indebted for its preſent flouriſhing condition.

As we were anxious to proceed on our journey through the iſlands, well knowing the variable ſtate of the weather in theſe highland countries; we took but a glance of the rocks in the neighbourhood of Oban. The ſtrata immediately upon the ſhore, on both ſides of the town, are formed of dark blue coloured argillaceous ſhiſtus; immediately above this, I obſerved in ſome places baſalt, or baſalt porphyry. As we approach Dunolly caſtle, which forms the extreme point of land upon one ſide of the bay, vaſt rocks of breccia appear; and theſe continue all the way to Dunſtaffnage caſtle *. Both theſe caſtles

* At Boregonium, which is a few miles from Dunſtaffnage, there are, according to Dr. Garnet, undoubted volcanic appearances. Dr Walker informs me, that the pumice, which Dr. Garnet mentions, is the ſcoriae from the iron furnaces, which were worked at that place by our anceſtors.

tles are built upon rocks of breccia, which is compoſed of variouſly ſhaped pieces of granite, micaceous ſhiſtus, and ſandſtone, connected by an arenaceous breccia. Upon different parts of the coaſt, and in the interior of the country, this breccia ſeems to lye upon a red coloured argillaceous ſandſtone. From Oban, the country becomes gradually higher as we approach the great mountain of Cruachan; and the ſtrata alſo change. If we walk by the Inveraray road, we obſerve wacken, and ſometimes baſalt covering the ſandſtone; and in many places great rounded maſſes of granite, which formerly conſtituted part of the breccia, are to be ſeen ſcattered about. Theſe ſandſtone and baſalt ſtrata, probably continue until ardeſia and micaceous ſhiſtus, which form the lower region of Cruachan, make their appearance; and this is ſucceeded by the granite, which riſes through it, and continues to the top of the mountain *.

Mr. St. Fond has given us a chapter upon the lithology of Oban, in his travels through Scotland; but he has here, as uſual, intermixed his theoretical ſpeculations with the deſcriptions of the ſtrata. He denominates the blue argillaceous ſhiſtus

* I owe this information, with regard to Cruachan, to my friend Mr. Caddell.

ſhiſtus of Oban, a limeſtone; this, he ſays, is an aquatic production; but the baſalt, he imagines to have been ſuperinduced in a melted ſtate under water, which prevented the limeſtone from being altered; and further, he deſcribes the breccia as a volcanic matter, which has been thrown up in a ſimilar manner with thoſe volcanic erruptions "in which water heated to the higheſt degree of ebullition, enters into concourſe with fire, and the different elaſtic emanations generated by ſubterraneous combuſtion." I muſt confeſs my inability to comprehend this explanation; at any rate, it is now uſeleſs to attempt ſupporting this part of the volcanic theory, as it has been demonſtrably refuted by Mr Kirwan, in his paper on baſalt.

Voyage to Mull.

HAVING arranged every thing for the continuance of our journey, we ſet ſail for the iſland of Mull, which is about 15 miles from Oban. In our way, paſſed near to the iſle of Kerrera, of which Faujas gives the following account. "A part of this iſland is volcanic; on the coaſt fronting Mull, there are

" are collections of compact lavas in maſſes, and in large cur-
" rents. This baſaltic lava appears ſometimes in the form of
" priſms, which are not very regular; at leaſt in the places I
" had an opportunity of examining. I alſo found ſome rocks
" of micaceous ſhiſtus of a whitiſh colour, and others which
" were greeniſh, with a porous texture. Theſe ſhiſtus, or
" gneiſs, are compoſed of quartz, ſteatites, and ſmall ſcales of
" mica.

" Near the rock of micaceous ſhiſtus, there is found com-
" mon ſlate of a deep grey colour, approaching to black; the
" beds of which are almoſt even with the ground; quar-
" ries might eaſily be opened here with great advantage to
" the country. They would even become an object of com-
" merce. Among the ſlate, there are found ſome brilliant
" pyrites, the cryſtallizations of which are cubical ‡."

We next paſſed the iſland of Liſmore, which is about nine miles long, but very narrow: it is according to Williams, compoſed entirely of limeſtone, traverſed with baſaltic veins. Dr. Mitchell ſuppoſes that the limeſtone belongs to the tranſition rocks.

‡ Travels through Scotland, &c.

rocks (uebergangsgeburge). From the greater part of the iſland being formed of limeſtone, at the ſame time well ſheltered, it is rendered one of the moſt productive ſpots in the Highlands. After a ſhort voyage, we came cloſe in with the coaſt of Mull, but on account of the tide, we were obliged to pull along the ſhore for ſome miles, which gave me an opportunity of examining the ſhore, until we landed on the coaſt below Achinacraig.

M U L L.

CHAP. XIII.

Outline of the MINERALOGY *of the Iſland of* MULL.

THIS iſland is about 22 miles long, and 16 miles broad. It is reckoned by ſome writers to be the Maleos of Ptolemy *; and Cambden is of opinion, that it is the Mille of Pliny ‡. On the north, it is bounded by Ardnamurchan; on the eaſt, by the rugged ſterile looking mountains of Morven, and the iſle of Liſmore; to the ſouth, are the iſles Jura, Scarba, and Slate iſles; and on the weſt, I-kolmkill, Staffa, Coll, and Tiree.

The coaſt of this iſland is much diverſified in its appearance; in many places we obſerve a great extent of ſteep and bold rocky

* Campbell's Political Survey, vol. I. p. 599.

‡ Britannia, p. 848.

rocky ſhores, forming tremendous precipices; particularly upon the ſouth ſhore near Loch Buy. Often the ſhores are low, but ſtill rocky and dangerous; ſeldom is there any ſandy beach, the coaſt being generally covered by the immenſe maſſes that have fallen from the neighbouring cliffs. It is low, however, towards the S. W. extremity which is called the pariſh of Roſs.

The iſland is very mountainous, and ſome of the mountains riſe to a conſiderable height; particularly Ben-More, which is reckoned the higheſt in the iſland. It is much interſected upon the weſt ſide, where there are two conſiderable lochs or arms of the ſea, called Loch Skriddan, and the other Loch-na-gaul.

Mineralogy. Achnacraig, where we landed from Oban, is ſituated at a little diſtance from the ſea ſhore, with ſome conſiderable flats near it; and theſe being cultivated, and in ſome places wooded, enliven the ſcene conſiderably. The rocks are in general baſalt and wacken, which are in many places traverſed with baſaltic veins. The occurence of veins of baſalt croſſing a ſimilar rock, ſeems to be very rare; as I am well informed, that foreign mineralogiſts, have never obſerved ſuch appearances. Mr Faujas St. Fond, in deſcribing

this part of the iſland, ſeems to have been much ſtruck with one of theſe veins, which he compares to a circus; and has given a long detail of the way in which it may have been formed. This was all very unneceſſary, as this vein does not differ from many others to be obſerved in the iſland; and the idea which Mr St. Fond raiſes of its magnificence, is far ſtretched—it is trifling when compared with the grand appearances upon the coaſts of Iſla and Jura. As we advance towards Loch Speleve, the cliffs upon the ſhore do not increaſe much in height; but there are land cliffs behind them conſiderably higher. The rocks are almoſt entirely of baſalt and wacken, all the way to the loch, as alſo the hills in the neighbourhood. About half a mile from Achnacraig, I obſerved a ſtratum of blue coloured limeſtone, covered with calcareous ſandſtone; but theſe ſtrata are viſible only for about 80 feet, when they are loſt under the baſalt. This limeſtone contains in it belemnites, and is therefore to be reckoned with the tranſition rocks; and is what Mr Kirwan conſiders as the moſt ancient of the ſecondary ſtrata*.

As there is a good road, along the ſhore of the iſland, from Achnacraig to Tobermory, we preferred it to coaſting by ſea. Having

* Geological Eſſays, p. 226.

Having left Achnacraig, we paſſed, for about a mile, through little wooded glens, which are extremely pleaſant, particularly in a country where wood is truly a rarity. The ſtrata ſtill continued baſaltic, excepting at one place where I obſerved a ſtratum of blue-coloured limeſtone cropping thro' the ſoil. As we journeyed along the ſhore at the bottom of the high hills which bound it, I judged it neceſſary to examine ſome of them to their ſummits; that I might obtain more diſtinct information of their nature, and have an opportunity of ſurveying the neighbouring country. The day being fine, we began to aſcend a high hill, about two miles from Achnacraig. The aſcent was very ſteep, until we reached an extenſive plain ſeveral hundred feet above the level of the ſea. The ſtrata, to this height, were baſalt and greenſtone, and both frequently traverſed with baſaltic veins. The greenſtone, even at a conſiderable diſtance, has a ſingular ſcorified-like aſpect, from the felſpar having decayed, and the remaining hornblende, reſembling a dark green, or blackiſh cellular maſs, not unlike the ſcoria of an iron furnace. The plain was covered, to its whole extent, with looſe ſtones of an iron-brown colour. Hardly a trace of vegetation could be ſeen; and the deep ſilence of this deſert was diſturbed only by the ruſhing of the cold piercing wind acroſs the mountain. The looſe maſſes of rock juſt mentioned, I found to be of breccia, which is compoſed of va-

rioufly

rioufly ſhaped maſſes of quartz, earthy felſpar, hornſtone, and granite, connected by a baſalt or wacken? baſis ‡. It is probably of the nature of baſalt tuff; which, according to German mineralogiſts, is a rock with a baſalt or wacken baſis, having, immerſed, fragments of other rocks, as granite, quartz, &c. We now walked towards the ſummit of the mountain, which we reached, after having paſſed over a ſucceſſion of ſmaller plains, or platforms, ſeparated from each other by ſteep baſaltic craigs. The ſummit is compoſed entirely of baſalt, which contains much hornblende; and this rock has the property of reverſing the compaſs at a conſiderable diſtance, and even in detached pieces. From this elevated ſituation we had a fine view of the iſland. Towards Tobermory the mountains appear to become gradually lower; but, upon the weſt ſide, a tremendous groupe of variouſly-ſhaped mountains appears before us, and among them Ben-more riſes with much dignity. The glens, which we obſerved run from the mountain, are of great depth, very ſteep, and apparently compoſed of ſtrata of baſalt and greenſtone. Theſe ſtrata, however, run in a direction contrary to that of the vallies, which intimate that the land has

‡ I am obliged to mark this doubtful, as I unluckily loſt the ſpecimens, which would have enabled me to determine the nature of the baſis.

has ſunk down, as we have already explained in our ſpeculations upon the formation of the bed of the Clyde. We now deſcended from the mountain, but by a different route from that which we followed in aſcending; and although it was fatiguing and difficult, it afforded us an opportunity of obſerving the baſalt and greenſtone alternating with each other, and elevated nearly to an angle of 45°.

We now continued our journey along the Tobermory road, with hills upon one hand, but in a ſhort time the land on the other became low, ſtretching out towards the ſound of Mull, to a point on which is ſituated Duart Caſtle. The hills, as alſo the hills near the ſhore, are ſtill baſaltic; but we were informed that there is, at the caſtle, a great ſtratum of limeſtone, which affords cornua ammonis and ſhells. As we approached Achnacroſh, we obſerved, upon the ſhore, ſtrata of argillaceous ſandſtone, with interſperſed bituminous and coaly matter, as is uſually the caſe with ſandſtone in coal countries; and, at a little diſtance, a rock, which ſeems to be analogous to greenſtone, of which a particular deſcription is given in the following chapter.

From this to Arros the ſhores are low, but the hills riſe to a conſiderable height; and both are formed of baſalt, greenſtone,

and

and wacken, which I ſometimes obſerved traverſed with baſaltic veins. The baſalt, but more particularly the wacken, contains zeolite, which is either compact, fibrous, or cryſtallized. I regretted extremely that I had not an opportunity of examining this part of the country more particularly, as there can be no doubt but that it would afford much curious information with regard to the rocks of trap formation. I have however to offer as an apology, (if ſuch a thing is becoming,) that, in travelling over all that track of country, we were envelopped in thick clouds and pouring rain; ſo that the few obſervations as to the nature of the hills, were made by examining the debris in the ravines, or were now and then aſſiſted by the partial diſperſion of the clouds. I may now alſo remark, that, in travelling theſe countries with a view to the particular examination of their mineralogy, it will be abſolutely neceſſary for the traveller to carry along with him a tent, and other conveniences, ſo that he may encamp among the mountains, and examine them leiſurely, and with that ſcrupulous accuracy which the importance of the ſubject requires.

At Arros there is a ſmall colonade of baſalt, upon which there are ſtill the remains of an old caſtle, once inhabited by Macdonald prince of the Iſles. In the bed of the river of Arros, (a ſmall ſtream of water which comes from the neighbouring

baſaltic

baſaltic hills,) I obſerved numerous blocks of granite, ſimilar to thoſe upon the hill near Achnacraig. Theſe blocks ſeem to be derived from a baſalt tuff ſimilar to that obſerved near Achnacraig; and it is probable that ſuch a rock may be diſcovered in the neighbouring hills. It will be an object worthy the attention of future travellers, to aſcertain, whether this baſalt tuff? merely covers the baſalt, as has been obſerved by Reuſs in the mountains of Bohemia, or alternates, as is the caſe with the baſalt tuff in the iſle of Canna, and in other parts of Scotland. It matters not in which of theſe ſituations it be found: it is ſtill to be conſidered as a ſecondary rock, and, like theſe, to have been depoſited from an aqueous fluid. Probably ſome may think that theſe maſſes have been ſeparated from the decompoſing baſalt itſelf, as it ſometimes contains pieces of granite. This, however, is an appearance ſo rarely to be obſerved in this iſland, that I can hardly imagine the granite blocks to be derived from that ſource.

Profeſſor St. Fond has ſpeculated upon this ſubject, as he obſerved ſimilar appearances in different parts of the iſland. For the information of my readers, I will extract the following paſſage from his Travels. "Theſe lumps of granite (ſays he) may have been "ejected from granite quarries, which perhaps exiſted at great

" depths under theſe ancient volcanoes, by the exploſions which " took place at that epoch, when extenſive combuſtions waſted " theſe countries, and formed groups of iſlands, which ſeem " to have the ſame origin.

" It is, beſides, within the verge of poſſibility, that thoſe " parts of the mountains where they are now found were not, " at that period, elevated ſummits, but rather formed part of " the bottom of the ſea, and that theſe granite blocks were " rolled from a diſtance by the currents. It is poſſible that " circumſtances of ſubterraneous exploſion, equally terrible " with thoſe which formed the iſle of Santorini in the Archi- " pelago, or Montenove in Italy, may have raiſed up the bot- " tom of the ſea into volcanic peaks; or, if it ſhould appear " more plauſible to ſome, we may refer to a period when " mountains ſtill higher were covered by the ſea: a fact, which " cannot be doubted, ſince marine bodies are found in great " abundance in beds of limeſtone, or clay, ſituated on the Alps " or Appenines, at a height three or four times greater."

At Arros, we changed our route; and in place of going on to Tobermory, we took our courſe acroſs the iſland to Luggan Ulva. The road, which is but indifferent, leads us among hills of no conſiderable height, to the plain of Knock, ſitu-

ated

ated at the head of Loch-na-gaul. The hills are compoſed of ſtrata, of baſalt, and wacken; which are ſometimes traverſed with baſaltic veins. The loch, which is of conſiderable extent, is bounded upon one ſide by the mountain of Ben-more, with other neighbouring hills, that extend towards the ſea ſhore, forming lofty crags, not unlike thoſe of Saliſbury Hill near Edinburgh; on the oppoſite ſide, are the hills that bound the road which leads towards Luggan Ulva. Ben-more, which is the higheſt mountain in the iſland, is of conſiderable magnitude; and Mr St. Fond remarks that it has much the appearance of the famous volcanic mountain Vesuvius. We did not aſcend this mountain, ſo that I cannot give any account of the rocks of which it is compoſed; but I have had the opportunity of examining ſpecimens brought from it by Mr. Caddel. It would ſeem from theſe, that it does not differ from the other parts of the iſland which I have already deſcribed, being compoſed of baſalt and greenſtone; even to its very ſummit. This agrees pretty nearly with the obſervations of Mr. St. Fond, who tells us, that it is compoſed of lava; that is baſalt. We purſued our journey along the oppoſite ſide of the loch, which led us to Luggan Ulva; I found little variety of rock; the baſalt and wacken ſtrata traverſed with baſaltic veins, ſtill continu-

ing. The wacken, however, affords many beautiful ſpecimens of zeolite, and alſo a rarer foſſil, the prehnite.

Nearly oppoſite to Luggan Ulva, lies the ſmall iſland of Ulva, which is evidently compoſed of the ſame rocks; and farther diſtant, is the iſle of Geometra, which is alſo baſaltic.

As ſoon as the weather, which had been for ſome time tempeſtuous, became moderate, we croſſed at the mouth of Loch-na-gaul, and landed immediately under the high cliffs, which we had ſeen from the head of the loch. We now walked along a conſiderable extent of ſhore, which is bounded by lofty crags, compoſed of baſalt and wacken ſtrata, and both traverſed by baſaltic veins, which run in very different directions. Immediately upon the ſhore, I obſerved ſtrata of argillaceous ſandſtone, and ſandſtone breccia; and we were told, that both coal and lead had been diſcovered in ſeveral places in the neighbourhood. About 200 feet above the level of the ſea, on the tract which takes us acroſs the mountains to Loch Skriddan, our attention was arreſted by the appearance of a curious ſpecies of breccia. It is compoſed of fragments of quartz, micaceous ſhiſtus, compact limeſtone containing flint, and the whole cemented by an arenaceous baſis; ſometimes it has a calcareous baſis, when it has a yellow colour, owing

to

to a decompoſition of the limeſtone. Below the breccia we obſerved a compact micaceous ſhiſtus. In going higher up, we had a more diſtinct view of the ſtratification; which is as follows: 1. Micaceous ſhiſtus. 2. Breccia covering the micaceous ſhiſtus. 3. Sandſtone, more or leſs of the nature of breccia, covering the breccia. 4. And higher up the mountain appeared the baſalt; but we could not determine correctly its ſituation with regard to the ſtrata juſt mentioned. The appearance of micaceous ſhiſtus in a baſaltic country, is a ſingular phenomenon, well deſerving the attention of future travellers.

From this, we continued our journey in the direction of the great Bourg head, (a lofty promontory at the entrance of Loch-ſkriddan,) over which we croſſed, and deſcended to the ſhore of Lochleven or Skriddan. The ſtrata in this tract are ſtill baſalt and wacken; and both are traverſed with baſalt or wacken veins; and contain much zeolite. I accidentally diſcovered a piece of black pitchſtone porphyry, ſimilar to that which is found in Glencloy, in the iſland of Arran. This Loch, which is pretty extenſive, is bounded on both ſides by baſaltic hills; and at its upper extremity, there is a grand groupe of baſaltic hills that congregate nearly to the oppoſite ſide of the iſland, about Loch Spelve. We croſſed the loch

near

near its mouth, and walked along the ſhore, which is low and baſaltic, until we approach Artown, when it juts out into a promontory, which preſents ſeveral very beautiful ranges of baſaltic columns. Upon the N. E. ſide of the promontory, we obſerved, immediately upon the ſhore, a ſtratum of coal, which has for its roof a maſs of imperfectly ſhaped baſaltic pillars; and its floor is alſo baſalt. The ſtratum is about 12 inches thick; and ſometimes interpoſed between it and the baſalt there is a thin layer of blaes (ſhiſtoſe clay), which is mixed with the coal, and deteriorates its quality. We could only obſerve the ſtratum running for a ſhort way, as the ſea has thrown up debris along the bottom of the rocks, where the coal is ſituated: yet we were told, that it is to be ſeen cropping out upon other parts of the coaſt. As the country is low in the neighbourhood of the coal; it is certainly worthy the attention of the proprietors, to endeavour by trials ſkilfully conducted, to know how far this ſtratum extends; and whether other ſtrata exiſt near to it. It has been objected to this, that if any trials ſhould be made, it would merely ſatisfy curioſity, without the probability of ſucceſs; as it is imagined that baſaltic rocks are very unfavourable to coal. We cannot deny the fact, that coal is ſeldom ſo regular under baſalt, as under ſandſtone; yet, in a country where the beſt part of the year is waſted in the operations of cutting and drying peat, there

there can be no doubt, that the diſcovery of a bed of coal, (although it ſhould not be ſo extenſive as thoſe in the ſand-ſtone countries), would be of the higheſt importance.

We are further encouraged to make regular trials, when we know that in other parts, conſiderable beds of coal have been found among ſimilar rocks. Thus at Borrowſtounneſs, according to Mr. Williams, we find thick ſtrata of baſalt interpoſed between beds of coal, which are worked to a great extent: and in the Bathgate hills, coal and baſalt alternate with each other *. In Bohemia, according to Reuſs, coals inlaid in baſalt are worked †; in the Faroe iſlands, coal is found in ſtrata among baſalt ‡: at Meiſſen, in Heſſia, a bed of coal from 6 to 90 feet, is found covered with baſalt, to the height of 600 feet ‖.

Mr Mills, in the paper which I have already mentioned, when deſcribing Iſla and Jura, gives an account of a remarkable appearance near Artown, which unluckily I had not an opportunity of viewing. As it will be intereſting for future travellers

* Williams's Mineral Kingdom, vol. 1. p. 70.

† Mineralogiſche Geographie von Boehmen.

‡ Haidinger Gebergsarten.

‖ Bergm. Journ. 1792, 319, and Kirwan Geological Eſſays, p. 311.

travellers, I ſhall here inſert his deſcription, and make a few obſervations on it.—" About a quarter of a mile from the " ſpot where the bearings were taken, is a deep glen, running " N.N.E. to the ſea. It is about 30 yards in length, and 20 in " breadth. The ſtrata are diſpoſed in the following manner: " The uppermoſt is 10 yards of lava, with horizontal diviſions, " and vertical joints, taking the form of rude pillars. Under " this, is a horizontal bed of perfectly vitrified ſubſtance, " which appears to have been a ſhale, and is from 1 to 2 inches " in thickneſs. Beneath this, is about three yards of ſiliceous " gravelly concrete; below which, are horizontal beds of in- " durated marle of various thickneſs, from 6 to 12 inches. " The whole of theſe beds taken together, are about four " yards; and there is a large fiſſure in them, on the weſt ſide of " the glen. Laſtly, are 10 yards of rude lava, containing ſpecks " of quartz, and mica unaltered; pieces, apparently of gra- " nite; and in ſome, nodules of calcined chert. The whole is " incumbent on regular baſalt pillars of various dimenſions, " from 18 to 6 inches in diameter, varying in their number of " ſides; ſome having 5, ſome 6, others 7, &c." This gentleman, by denominating his foſſils upon theoretical principles, has thrown a conſiderable degree of obſcurity over his deſcription. To me, the following appears to be the true account:—

Lava

Lava.—This is probably baſalt: for he appears to uſe this term in different parts of his memoir, as expreſſive of all kinds of baſalt.

Vitrified ſubſtance.—This is certainly the ſame with the black pitchſtone which we have already obſerved upon the oppoſite ſide of Loch Skriddan; and which we were told had been found near Buneſan and at Bennenoch.

Siliceous gravelly concrete.—Probably a coarſe ſandſtone? If this ſuppoſition be correct, it is another example of pitchſtone being contained between ſandſtone and a rock of trapp formation, ſimilar to that I ſuſpected in the iſland of Arran.

Indurated marle.—This is probably the ſame with the limeſtone, which contains flint upon the coaſt between Loch-na-gaul, and Loch-Skriddan.

Calcined chert.—This is likely hornſtone; which, however, is a rare occurence in baſalt. Emmerling. B 3. § 187.

We now left Artown, and walked on to Buneſan; the country ſtill continued to be formed of baſalt, containing many

beautiful ſpecimens of zeolite paſſing to chalcedony, and alſo prehnite. Near to this place, there is a little river which marks the termination of the ſecondary, and the beginning of the primary ſtrata. Upon the eaſt bank, I obſerved the baſalt; but upon the weſt, the ſtrata are of micaceous ſhiſtus. I endeavoured, as far as my ſhort time would allow me, to diſcocover the junction of the ſtrata, but was not ſo fortunate as to obſerve them in actual contact: yet, I think it not improbable, that the baſalt lies upon the micaceous ſhiſtus. This ſuppoſition, may to ſome appear to invalidate the obſervation I have made in a former part of the work, viz. that baſalt is never found among primary ſtrata. This is by no means the caſe; for here, the baſalt forms a great extent of country; and in ſome places, as at Artown, it contains coal; ſo that, although it lies on micaceous ſhiſtus, without any intervening breccia, it cannot be conſidered as primitive. It appears to me a good mode of aſcertaining whether a rock be primary or ſecondary, to examine whether it alternates with ſtrata decidedly primitive; and whether, at its junction with the primary ſtrata, it ſeems to be in part intermixed, and partly aſſuming the nature of theſe ſtrata; thus intimating that they have been depoſited at the ſame time.

The

The micaceous ſhiſtus extends quite acroſs this part of the iſland; and continues for about a mile after we leave Buneſan, in going to the ſouthern extremity of the iſland. In this extent it is ſomewhat varied in its appearance, being more or leſs compact, ſometimes containing garnets, and traverſed with baſaltic veins. In other places, as upon the ſide of Loch-Artineg, I obſerved it alternating with ſtrata of quartz, from one to three feet thick, and which broke into thin layers.

To the micaceous ſhiſtus ſucceeds beautiful red granite, which continues to the extremity of the iſland, forming low, round-ſhaped hills. This part of the iſland, which is called Roſs, is low, interſected with ſmall lakes, and diverſified with natural wood. The ſhores are low, but rugged and broken; and in ſome places we obſerved large empty fiſſures, which appear to have been formerly filled, either with an earthy matter, as baſalt, or with a metallic ore. The granite appears to be diſpoſed in beds, as we have already mentioned to be the caſe in Arran. Dr Walker, many years ago, obſerved this diſpoſition of the granite, not only in Mull, but in many other parts of Scotland; which is a further and deciſive proof of the fallacy of La Metherie's obſervations. The granite ſometimes ſplits into rhombs, and what is more uncommon, into columns, not unlike baſalt. This appearance of columnar granite is,

I believe, rather a rare occurrence; at leaſt I do not find it mentioned but by Reuſs, who diſcovered beds of granite ſplit into columns, not unlike baſalt *. In many places I obſerved baſaltic veins traverſing the granite; and theſe are of various ſizes, and run in very different directions. Upon the ſide of Loch-Artineg I obſerved a vein running through the granite, viſible for nearly a mile, and often branching out in different directions. Sometimes I obſerved pieces of granite included in the baſalt veins; and in one inſtance I obſerved the granite, which bounds the ſide of the vein, mixed with the baſalt.

The ſouth ſide of Roſs continues to be formed of granite and micaceous ſhiſtus, until we come upon a line with Buneſan, when the baſaltic rock commences. From this to Loch-Buy the country and coaſt are principally formed of baſalt and wacken, excepting at Gribun, where ſandſtone and limeſtone are to be obſerved, and at Carſeg, where there are conſiderable appearances of limeſtone. The rocks upon this coaſt, in ſome places, riſe to a moſt tremendous height, particularly at Innimore, where we obſerve many ranges of baſaltic columns towering

* Mineralogiſche Geographie von Boehmen, Erſter band, § 120. I think that Sauſſure, ſomewhere in his Travels, mentions a ſimilar appearance.

towering above each other with vaſt magnificence. This ſtupendous ſcene is rendered doubly intereſting when its rocks are obſcured by a tempeſt: the daſhing of the furious ocean below, and the fall of vaſt caſcades from the rugged ſummits, ſeen dimly thro' the clouds, preſent a ſcene of uncommon ſublimity.

There are ſeveral appearances of coal upon this coaſt, but the moſt remarkable is that upon the hill called Beinan-ini. This hill is compoſed of horizontal ſtrata of baſalt and wacken, which alternate, and riſe to the top of the hill like great natural terraces. The coal appears in the bed of a rivulet upon the ſide of the mountain; is about three feet thick, and is immediately covered by baſalt. It is one of the greateſt ſtrata of coal that has yet been diſcovered in the Weſtern Iſlands, and conſequently is worthy of particular attention. Several trials have been made with a view to the working of it; but of a nature ſo trifling, that they can deſerve notice only as ſhowing how little the importance of the ſubject has been underſtood. Sir David Murray of Stanhope, ſo far as we can learn, was the firſt gentleman who ſeems to have been aware of its conſequence; for, about the beginning of the laſt century, he purchaſed this hill ſolely on account of the coal which it contains. He propoſed to open the ſtratum in a very extenſive manner,

and

and to work it until he ſhould be ſatisfied whether it was practicable to continue it to advantage. This ſcheme was unfortunately fruſtrated by a failure in his affairs, which made him ſtop working a ſhort time after he had begun. Since that period, the property has come into the poſſeſſion of Sir James Riddell of Ardnamurchan, who ſeemed inclined to continue the work of his predeceſſor; but the buſineſs appears to have been committed to perſons who were ſatisfied with making very ſuperficial and unſatisfactory trials. This is much to be regretted, when we conſider, that the eſtabliſhment of coal-works, in ſo centrical a ſpot of the Hebrides, would not only be a great comfort to the inhabitants of the iſlands, where peat is ſcanty, and not to be procured without difficulty, but would make all the operations of the farmer to go on with new life, and would, in every way, contribute much to the improvement of the Weſtern Iſlands. It is therefore worthy of the public ſpirit of the highland proprietors, to form a general ſubſcription, ſo as to enable them to determine the queſtion, whether the coal of Mull can be worked ſo as to be advantageous to the inhabitants of the weſt coaſt of Scotland and the Hebrides.

Having ſpent a few days in Roſs, which gave us an opportunity of examining I-colum-kill, we walked again to Loch-Skriddan,

Skriddan, where we took a boat, and rowed along the lofty coaſt to Luggan-Ulva. In our way we paſſed the ſmall iſland of Inch-Kenneth, remarkable not for its variety of foſſils, as it is compoſed of red-coloured ſandſtone and limeſtone? but for the intereſting account which Dr Johnſon has given of the happy family of Sir Allan Maclean.

We now walked from Luggan-Ulva to Torloiſk, the ſeat of the late worthy Mr Maclean. The ſhore is rugged; but the country is in ſeveral places conſiderably cultivated, particularly near Torloiſk. The rocks, all the way, are of baſalt and wacken; and both contain beautiful ſpecimens of zeolite, which are generally fibrous, and ſometimes appear paſſing to chalcedony. I obſerved, in ſome places, a red-coloured wacken alternating with the baſalt. I alſo remarked blocks of granite ſimilar to that we obſerved at Arros.

From Torloiſk to the northern extremity of the iſland, the ſame baſaltic rock continues; and, ſo far as I could judge, the whole of the coaſt towards Tobermory is of the ſame nature.

General

General Observation. From this rapid and imperfect outline, it appears, that a great portion of this iſland is compoſed of rocks of trap formation, and that they even form many of the high hills. The primary ſtrata, upon the other hand, form a very ſmall part; being confined (as far as my experience goes) to the pariſh of Roſs, and the ſmall patch upon the ſhore between Luggan-Ulva and Loch-Skriddan.

MULL.

M U L L.

CHAP. XIV.

Deſcription of the FOSSILS *mentioned in the preceding Chapter.*

IT may appear unneceſſary again to introduce an account of the ardeſia tegularis, as I have deſcribed it in Arran and Jura. The deſcription which now follows, however, is that of one of the moſt celebrated ſlates in Britain, and therefore it ſhould not be omitted.

ARDESIA TEGULARIS—*from Eaſdale.*

Colour. Dark blue.

Luſtre. Little ſhining.

Tranſparency. None.

Fracture. Perfectly ſlaty.

Fragments. Tabular.

Hardneſs. Yields pretty eaſily to the knife.

Streak. Of a lighter colour than the ſlate itſelf; and the powder does not feel greaſy.

Adheſion. Does not adhere to the tongue.

Smell. Pretty ſtrong earthy ſmell when breathed on.

This ſpecies differs from that of Bute, in containing leſs magneſia, and being more durable. It frequently alſo contains cubical cryſtals of pyrites, and theſe long reſiſt decompoſition.

GRAUWACKE, German—*Iſland of Seil.*

Rubble Stone, Kirwan's Mineralogy.

This ſpecies is compoſed of fragments of ardeſia and quartz, with ſcales of mica, or talc, connected by a reddiſh argillaceous matter. This genus of rock was for ſome time imagined to be peculiar to the Hartz (the great mining country belonging to the Elector of Hanover), but later inveſtigators have obſerved it in other parts of the continent of Europe. We have much information concerning it in Lazius's obſervations upon the Hartz.

LIME-

LIMESTONE—*Achnacraig*.

Colour. Dark blue.

Luſtre. A degree of luſtre owing to diſperſed foliæ.

Tranſparency. None.

Hardneſs. Difficultly ſcraped with the knife.

Fracture. Earthy; ſometimes approaching ſplintery.

Has pyrites diſperſed thro' it; and ſometimes I diſcovered it to contain Belemnites. By decompoſition it acquires a yellowiſh colour, and this is much aided by the preſence of the iron pyrites.

GREENSTONE?—*Achnacroſh*.

Colour. Whitiſh, from the great proportion of felſpar?

Luſtre. None.

Tranſparency. None.

Hardneſs. Gives fire pretty freely with ſteel.

Fracture. Earthy.

This rock appears to conſiſt principally of a whitiſh-coloured matter, which is probably of the nature of compact felſpar; and, intermixed with it, I diſcovered ſmall portions of a green-coloured ſubſtance reſembling hornblende, with a few interſperſed cryſtals of common felſpar and iron pyrites. It acquires a browniſh-white tegmen by decompoſition.

GREENSTONE—*Hill near Achnacraig.*

Grunstein, German. *Saxum Ferreum*, Waller. *Saxum Grandævum*, Linn.

The greenſtone found upon this hill is compoſed uſually of equal portions of white-coloured felſpar and dark-green hornblende. I alſo obſerved ſpecimens where the hornblende forms the greater part of the ſtone, and the felſpar imbedded in it as a baſis. In others, the felſpar and hornblende are ſo intimately combined together, that it is only by the decompoſition of the ſtone that we diſcover its compound nature.

HORN-

HORNSTONE—*Hill near Achnacraig.*

Colour. Brown.

Luſtre. None.

Tranſparency. Tranſmits a little light at the edges.

Fracture. Fine ſplintery.

Hardneſs. Gives ſparks freely with ſteel.

By decompoſition it takes a cream colour, and an earthy fracture; and, in this ſtate, the diffuſed particles of quartz are rendered more diſtinct, from their longer reſiſting the influence of the weather.

EARTHY FELSPAR.

Continuous Felspar, Angl. *Felspar en masse*, Dolomieu.
Petrosilex, Journ. de Phyſ. New Series, vol i. La Mether. Theorie de la Terre.

Colour. Brick red.

Luſtre. None.

Fracture. Earthy.

Trans-

Tranſparency. None.

Hardneſs. Give ſparks freely with ſteel.

Dolomieu, in a paper publiſhed in the Journal de Phyſique *, endeavours to prove that this foſſil is diſtinct from felſpar, and, after a long chain of obſervation, he concludes by naming it Petroſilex. La Metherie, who ſeems of the ſame opinion, denominates the true hornſtone of the Germans Keratite, and agrees with Dolomieu in applying the term Petroſilex to this foſſil ‡. I am, however, ſtill inclined to think, that it will be more correct to uſe the terms hornſtone and petroſilex in the ſignification as adopted by Werner; and that the petroſilex of Dolomieu is to be conſidered as a ſpecies of felſpar; or, if it be truly diſtinct from every other foſſil, that it ſhould be diſtinguiſhed by a name that has no reference to one already in uſe. Dolomieu always refers it to the rocks of primary formation; yet this is not quite correct; for Reuſs † mentions a ſpecies of porphyry, with a baſis of earthy felſpar, reſting on ſandſtone.

LIME-

* Vol. i. New Series.

‡ Theorie de la Terre, tom. ii. p. 173.

† Reuſs, Aufzatze, § 388. Mineralogiſche von Boehmen, B. ii. § 124.

LIMESTONE—*between Loch-na-gaul and Loch-Skriddan.*

Colour. Yellowiſh.

Luſtre. None.

Tranſparency. None.

Fracture. Fine ſplintery.

Hardneſs. Scarcely yields to the knife, and ſometimes ſtrikes fire with flint.

Contains, ſometimes, cryſtallized rhomboidal calcareous ſpar; alſo diſperſed particles of quartz; which are frequently ſo plentifully intermixed, as to increaſe the hardneſs very much. But the moſt remarkable intermixed ſubſtance is flint and hornſtone.

The flint has the following characters:

Colour. Greyiſh black.

Luſtre. Like that of common flint.

Tranſparency. Tranſmits light pretty freely, but objects cannot be diſcerned.

Fracture.

Fracture. Conchoidal; ſometimes multiplied conchoidal.

Hardneſs. Gives ſparks plentifully with ſteel.

It has immerſed in it particles of quartz ſimilar to thoſe we obſerve in the limeſtone; and alſo intermixed is the hornſtone, which has the following characters:

Colour. Light blue.

Luſtre. None.

Tranſparency. Allows light to paſs at the edges.

Fracture. Nearly even.

Hardneſs. Gives a few ſparks with ſteel.

It has alſo, interſperſed, calcareous ſpar and quartz. By action of the weather, it becomes opaque and white; and the quartz and calcareous ſpar falling out, cauſes the hornſtone to have a cellular appearance. Not unoften we obſerve the hornſtone paſſing to flint, and *vice verſa*.

Dr Walker, in his mineralogical lectures, informs us, that, although he has travelled over a conſiderable extent of Scotland, he has ſeldom obſerved any appearance of flint. This warrants us to conclude that it is a rare production in Scotland.

land. Similar limeſtone rocks, containing flint, occur in the north of Ireland, in Switzerland ‡, and my friend Mr Deriabin informs me that he obſerved a rock reſembling that of Mull in Tranſylvania.

GRANITE—*from Roſs, in Mull.*

This granite, which forms the coaſt of Roſs, in Mull, is compoſed of beautiful fleſh-coloured felſpar, white quartz, and black mica. Sometimes the granite is very ſmall-grained, with a great proportion of black mica, which gives it a blackiſh colour; or we obſerve it where the felſpar is in the greateſt proportion, when it has a fine uniform red colour. Rarely we obſerve whitiſh-coloured cryſtals of felſpar, and ſteatites; which laſt, according to the obſervations of Werner, is formed by the decompoſition of the mica.

‡ Helv. Mag. 116.

BASALT—*Torloiſk, Luggan-Ulva, &c.*

Colour. Black.

Luſtre. Slight degree, from a number of very minute, ſhining particles.

Fracture. Even, paſſing to conchoidal.

Hardneſs. Gives a few ſparks with ſteel.

Streak. Grey.

The weather ſeems to have very little effect upon it, excepting when it contains iron pyrites. It frequently contains zeolite, which is generally radiated; and is ſometimes to be obſerved paſſing, by imperceptible gradations, to fine milk-coloured chalcedony. As the late Mr Pelletier of Paris has ſhown that zeolite contains potaſh, and as it here paſſes to chalcedony, it is not improbable that ſome ſpecies of chalcedony may afford alkali.

WACKEN,

WACKEN, highly impregnated with Iron—*Torloiſk.*

Colour. Tile or copper red.

Luſtre and Tranſparency. None.

Fracture. Even.

Hardneſs. Yields with conſiderable difficulty to the knife.

Is very heavy, and emits an earthy ſmell when breathed upon. I obſerved it paſſing into common wacken.

ON COAL.

CHAP. XV.

Method of diſcovering COAL.

AFTER the deſcription which I have given of the different appearances of coal in the iſland of Mull, I intended to have added a ſhort account of the method to be followed in diſcovering coal ſtrata or veins; but I found that this would be more diſtinct if detailed in a ſeparate chapter. I ſhall now, therefore, ſtate the obſervations.

If a certain extent of country is ſuppoſed to contain coal, we ſhould begin our examination by determining the extent of the primary ſtrata; which will conſiderably abridge our labour, as theſe ſtrata never contain coal.

We

We ſhould next examine the nature, direction, dip, and relative extent of the different ſecondary ſtrata; which will give us an opportunity of diſcovering any appearances that indicate the preſence of coal. Theſe particular places are to be examined with the moſt ſcrupulous accuracy; and the coal ſtrata to be ſought for by digging, or boring, according to the nature of circumſtances.

Such is the general mode of proceeding in theſe reſearches. I ſhall now mention, particularly, the rocks which are indicative of coal; then the method of determining whether coal ſtrata do exiſt in a certain ſituation—firſt, as determined by the appearance of fragments of coal, and, ſecondly, by boring, where no actual appearance of coal is diſcovered.

The principal rocks, which are mentioned by mineralogiſts as indicative of coal, are the following:

1. White argillaceous ſandſtone. If this ſandſtone has, interſperſed, bituminous or carbonaceous matter, it is reckoned a good ſymptom of the vicinity of coal.

2. If

2. If bituminous ſhale, ſhiſtoſe clay and argillaceous iron-ſtone are obſerved, it is a further, and a very favourable ſymptom of coal.

3. If ſandſtone and limeſtone alternate, and be accompanied with bituminous ſhale, it is reckoned favourable for coal.

4. Sometimes where ſandſtone and baſalt alternate, coal has been found.

5. Mr Kirwan remarks that there is great probability of finding coal in the neighbourhood of mountains of argillaceous porphyry †.

6. Although coal has never been obſerved alternating with primary ſtrata, yet it has ſometimes been found in their immediate vicinity; and coal has even been obſerved lying on granite. I believe, however, that ſuch coal ſtrata are generally trifling.

Having

† Geological Eſſays, p. 347.

Having, from an accurate inveſtigation, diſcovered ſuch ſtrata as render the preſence of coal probable; we muſt next endeavour to diſcover its actual exiſtence. To do this, we muſt examine the beds and banks of rivulets, where, if ſmall pieces of coal appear, we may be pretty certain that coal ſtrata exiſt near at hand. Ditches are to be examined; for, in forming them, it is often neceſſary to cut thro' the thin covering of gravel and ſand which conceals the crop from our view. We ſometimes obſerve a ſooty-like matter ſpread on the ground: this is formed from the decompoſition of coal, and is therefore a good ſymptom of its vicinity. Not unfrequently we obſerve maſſes of coal, or bituminous wood, immerſed in the breccia which is obſerved in coal countries: but this is often a fallacious appearance; for, upon cutting thro' the breccia, we find that the ſubjacent rocks contain no coal; ſo that the pieces of coal or wood, which the breccia contains, are to be conſidered as merely accidental.

After having obſerved any of the above-mentioned appearances; our next endeavour is to obſerve the crop, or the outburſt, of the ſtrata. This is a matter of much difficulty; and requires particular attention to the diſpoſition of the fragments of coal, &c. If they be found upon the banks or bed of a rivulet,

vulet, we muſt ſearch from one extremity of the ravine to the other, to diſcover the crop of the ſtratum. If the ſoot-like matter is obſerved, it will be neceſſary to remark whether it lies upon a declivity or a plain; as inattention to theſe circumſtances has often been the cauſe of great diſappointment and expence to the coal-miner in overſhooting the ſtratum, that is, cutting beyond its real ſituation. Upon a declivity, we know that the decompoſing and looſe matter of a crop will naturally ſpread downwards, in proportion to the ſteepneſs of the ground. On this account, wherever appearances of coal occur upon a declivity, we muſt trace the debris upwards; when we ſhall find it increaſe in depth towards the crop, and the coal is leſs and leſs decompoſed as we approach nearer to it. On the other hand, where the ſooty matter occurs upon a plain, we always find it thicker, and far leſs ſpread, than upon a declivity; and, what is of conſequence, it often ſpreads in a direction contrary to the riſe of the ſtrata. If we are ſo lucky as to obſerve the crop, we now endeavour to detect the ſtratum; which we do, either by digging towards its dip, or by following the fragments of coal until we have the ſtratum fairly under our eye.

It often happens, however, that a country may be, in general, very favourable for coal, yet no pieces of coal or ſooty matter are to be obſerved, owing to the coal ſtrata lying deep: in ſuch caſes a good deal of diſcernment is neceſſary to determine the particular places where the trials are to be made. As it would be very expenſive, in ſuch caſes, to dig down until we ſhould meet with the coal, the common practice is to bore the ground; by which, at a ſmall expence, we can know the magnitude and nature of the ſtrata, to a great depth.

In ſearching for coal, by boring, our firſt object is, to determine the point to which the ſtrata riſe; as it is this which enables us to determine at what place we ſhall begin to bore. The plan, at the end of this chapter, will ſufficiently explain the mode of proceeding in this operation. Suppoſe A B C D to repreſent a tract of country which is ſuſpected to contain coal, and where the riſe of the ſtrata is towards A. We there make the firſt perforation, which will paſs thro' the ſtrata 4, 3, 2, 1, to the depth of ten or twelve fathoms. If no coal occurs among theſe ſtrata, it is better to make a new perforation, than to ſink deeper. We therefore proceed onwards to B, where we ſuſpect that the ſtratum 5 is ten or twelve fathoms deep. We here bore through the ſtrata, 8, 7, 6, to 5;

and, as no coal occurs, we do not bore deeper, but proceed to the point C, where we make a perforation through the ſtrata 11, 10, 9, to 8. By being ſtill unſucceſsful, we proceed onwards to D, where the ſtratum 11 will be about ten or twelve fathoms deep, and here we find coal at 12.—By this practice, it is plain that that no ſtratum of coal can eſcape notice, as the laſt perforation always reaches down to the ſtratum which was neareſt to the ſurface in the former bore.

Having diſcovered the breadth of the ſtratum, either by digging, when it is near the ſurface, or by boring, when it is covered by a great load of other ſtrata; our next concern is, to determine whether it be of ſufficient importance to be worked. If it is not more than 15 inches in breadth, even altho' pretty near the ſurface, it is not worth working; but if it be two feet, or two feet and a half wide, and of good quality, it can be worked in moſt ſituations with advantage.

The quality of the coal is aſcertained from the following circumſtances:

1. Its general appearance: whether it be more or leſs mixed with ſtoney matter; or if there be laminæ of bituminous ſhale

or

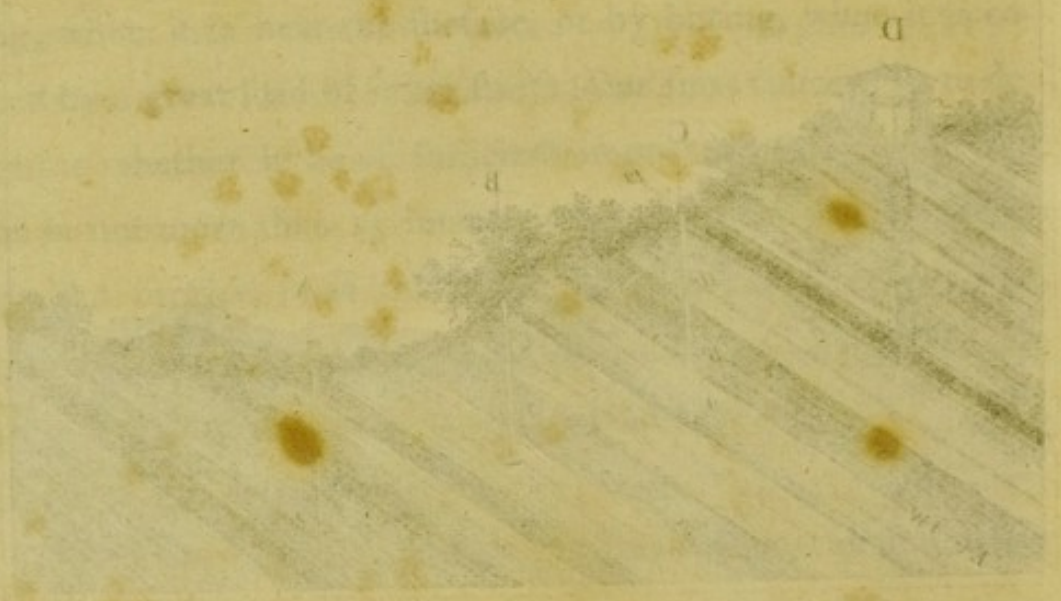
or ſandſtone, dividing it into ſtratulæ; or if it contains much pyrites or ſulphuret of iron.

2. To theſe may be added the teſt of chemical analyſis, by which we aſcertain the proportion of carbon, bitumena nd aſhes.



Plan illuſtrating the method of boring for Coal

END OF VOLUME FIRST.


D
C
B


MAP
of the
Shetland Islands
ENGRAVED FOR AN OUTLINE
of their
MINERALOGY
Unst Pk
Fetlar Pk
YELL I.
Out Skerries
Papa I.
Valey I.
Trondra
Burra I
Housie Island
Havery I.
Calsay
Quendale Bay
Scatness
Sumburgh Head
Bressay Pk
Lerwick
Scalloway
Walls
Sandsting
Aithsting
Weesdale
Whiteness
Tingwall
Dunrossness
Cunningsburgh
Sandness
Middle Rose
Thelloul
Lunna
Lunnawee
Papa Sound
Yell Sound
Colgrave Sound
Bluemull Sound
Roost of Sumburgh
Heaving to the Island of Foula

MINERALOGICAL TRAVELS

THROUGH THE

HEBRIDES, ORKNEY AND SHETLAND ISLANDS,

AND

MAINLAND OF SCOTLAND,

WITH

DISSERTATIONS UPON PEAT AND KELP.

IN TWO VOLUMES,

ILLUSTRATED WITH MAPS AND PLATES.

BY ROBERT JAMESON,

REGIUS PROFESSOR OF NATURAL HISTORY AND KEEPER OF THE MUSEUM, AND LECTURER ON MINERALOGY IN THE UNIVERSITY OF EDINBURGH, PRESIDENT OF THE WERNERIAN SOCIETY, FELLOW OF THE ROYAL SOCIETY OF EDINBURGH, AND OF THE LINNEAN SOCIETY OF LONDON, HONORARY MEMBER OF THE ROYAL IRISH ACADEMY, OF THE HONOURABLE DUBLIN SOCIETY, OF THE GEOLOGICAL SOCIETY OF LONDON, OF THE PHYSICAL AND MINERALOGICAL SOCIETIES OF JENA, *&c.*

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MINE-

MINERALOGY

OF THE

SCOTTISH ISLES.

VOLUME II.

I-COLUMB-KILL AND STAFFA.

CHAP. XVI.

Outline of the MINERALOGY *of* I-COLUMB-KILL *and* STAFFA.

I-COLUMB-KILL.

THIS iſland is mentioned by writers under the different names of Hii, Iona, and I-columb-kill; but it is now generally denominated by the inhabitants I, or I-columb-kill: the

latter name being derived from St. Columba, the tutelary ſaint of the Hebrides. It is about three miles long, and from half a mile to a mile and a half in breadth. It is low, (yet not without hills, of which Dun-ii is the higheſt,) bare and rugged, excepting in the neighbourhood of the religious houſes, where the ground is flat and cultivated, yielding about 140 l. per annum, which is nearly the rent of the whole iſland. The ſhores are in general low and rocky, yet in a few places there are pretty high cliffs.

History. The early hiſtory of this iſland is involved in the general obſcurity which veils the ancient hiſtory of Scotland; ſo that the many traditional tales concerning it, which have reached our times, are not worthy of ſerious attention. The moſt ancient written records that concern it, are not earlier than the æra of the landing of St. Columba. This remarkable man left Ireland, his native country, not, as Mr Pennant remarks, from diſcontent, but with the noble and generous intention of diſſipating the ignorance which then covered the Hebrides. He landed finally upon I, where he built religious houſes; and the iſland was ſoon afterwards preſented to him by Connal king of Scotland. Having contributed much to the diffuſion of Chriſtianity through the wilds of the Hebrides, and other parts of Scotland, he died, at the age of ſeventy-ſeven.

ven. He was certainly a man of much piety and goodneſs of heart; and his manners, altho' extremely auſtere, were well calculated for the people of the age in which he lived. For two hundred years after his death, the religious of this iſle lived quietly, and in the high eſtimation of all the country. About the year 716, the ferocious Danes, who had haraſſed every part of Scotland with their barbarous invaſions, at length diſturbed this ſeat of religion and learning; maſſacred the greater part of the monks, and drove the remainder from the iſland. Some time afterwards the whole of the Weſtern Iſlands were ſubjugated to the regular Daniſh government, when many of the monks again returned to I. From this period, however, the college of I gradually declined, until the twelfth century, when the Romiſh prieſts having got poſſeſſion of all the monaſteries, the Culdees, or ſect of St. Columba, were diſperſed, and gradually ſunk from notice, leaving behind them a high reputation for learning and virtue.

Mineralogy. At the uſual landing place, from Roſs in Mull, the ſhore is rugged, and formed of a rock which appears to be compoſed of quartz pretty intimately combined with chlorite, and hornblende. It is, however, ſubject to much variety; for it is obſerved paſſing on the one hand to hornblende

rock, and ardeſia; and on the other, into a ſiliceous talcaceous ſhiſtus *. It is traverſed with veins of the granites garbenbergenſis of Linnæus, a rock which is compoſed of quartz and mica. As we proceeded on towards the N. end of the iſland, we examined the venerable ruins of the Cathedral, and other houſes, which were formerly the reſidence of the religious of the North; "whence ſavage clans, and roving barbarians, "derived the benefits of knowledge and the bleſſings of religi-"on." The deſcription of theſe buildings, would be intereſting to the antiquary; but it is an object unconnected with my preſent purſuit; and beſides, they have been illuſtrated by the deſcriptions and drawings of Mr Pennant, and Dr Garnet. I regret much, however, that I am prevented from communicating to the public, the elegant and truly characteriſtic drawings made by my friend Mr Bell: they are the only ones I have ever ſeen that convey a complete idea of theſe remarkable ruins.

The ſtrata which we obſerved at the landing place, continue to the N. E. extremity of the iſland, when they give place to hornblende ſlate, ſienite, and hornblende rock having much the

* Mr. Mills ſays, that the rock at the landing place is laminated hornſtone. Philoſophical Tranſactions of the Royal Society of London, 1790, p. 77.

the appearance of ſerpentine. Theſe rocks alternate with each other, and are to be obſerved traverſed by baſalt and granite veins. From this to Dun-ii, the higheſt hill in the iſland, the hornblende and ſienite ſtrata, continue forming, upon ſome parts of the coaſt, cliffs of conſiderable height. We aſcended to the ſummit of this hill, which I found to be compoſed of primitive rock; and principally of hornblende ſlate. As we walked onwards, by the weſt ſide, to the ſouthern extremity of the iſland, we ſaw upon the coaſt ſeveral ſandy beaches and ſteep cliffs; and the ſtrata continued to Porta-curach, to be hornblende ſlate, and ſienite, traverſed with baſalt and granite veins. We obſerved at a diſtance, two ſhelving rocks of a green colour; which are probably of the nature of ſerpentine, or hornblende. At Porta-curach, or St. Columba's landing place, there are cliffs of conſiderable height, which are compoſed of ſtrata of hornblende rock, having much the appearance of ſerpentine, and ſienite. Theſe ſtrata are traverſed with veins of granite, and veins of quartz, (which have a light ſiſkin-green colour, owing to its admixture with hornblende,) are alſo to be obſerved. The beach is covered with numberleſs rounded fragments of marble, quartz, of an amethyſtine hue, ſiſkin-green-coloured quartz, and lapis nephriticus. We now walked acroſs this iſland, over the uſual hornblende and other rocks, to the marble quarry. This marble,

or

or what is now called dolomite, forms a great ſtratum about 40 feet wide, running N. N. W. and S. S. E. and bounded by nearly vertical ſtrata of a rock which is in ſome parts of the nature of ſhiſtoſe talc or paſſing to chlorite ſlate *. The marble as it approaches the other ſtrata, is more or leſs mixed with talc, which cauſes it to become ſcaly or fibrous, with a yellowiſh green colour; thus approaching to the nature of talcaceous ſhiſtus. I often alſo obſerved maſſes of nephrite, and of fine green talcaceous ſhiſtus, immerſed in the marble; the nephrite appears to have been formed at the ſame time with the marble, as I obſerved it diſſeminated and combined with it in a ſimilar manner as the hornblende in the ſiskin-green quartz; the talcaceous ſhiſtus, however, is diſperſed in large irregular maſſes that ſeem to have been broken off from the neighbouring ſtrata. From the marble quarry to the landing place, the ſhore is bare and rugged; and the ſtrata do not differ from thoſe we have already deſcribed. At a little diſtance from it, we obſerved ſeveral iſlands and rocks, entirely compoſed of red granite: thus rendering it probable, that this iſland was formerly joined with the granite coaſt of Roſs, in Mull.

Dr.

* Upon one ſide of the ſtratum, I obſerved a layer of felſpar; which is intermixed with quartz, paſſing to hornſtone.

Dr. Garnet, in his lately publiſhed tour through the Highlands, remarks, that the greater part of this iſland is formed of limeſtone; and that the ſtrata are all of ſecondary formation. The firſt obſervation, as far as my experience goes, is incorrect; for after having walked around a conſiderable part of the iſland, I only found marble in one place; and was informed, that it had been obſerved in another ſpot. The other obſervation is contradicted by the account I have juſt given of the ſtrata of the iſland.

STAFFA.

AS I had not an opportunity of landing upon this remarkable iſland, I am prevented from giving any deſcription of the rocks of which it is compoſed, from my own obſervations; I will, therefore, give a ſhort account of it drawn from the accounts of others; which I have confirmed and corrected by ſpecimens brought from the iſland.

The

This iſle is about one mile long, and half a mile broad, and nearly two miles in circumference. It is not very high; the higheſt part, which is that immediately above Fingal's cave, being about 114 feet above the level of the ſea. Its coaſt is ſteep, and bounded by magnificent baſaltic colonades; which are in ſeveral places broken into caves; and of theſe, the moſt remarkable is that called Fingal's cave. It is not above 25 years ſince the wonders of this little ſpot were made known to philoſophical enquirers, by Sir Joſeph Banks, who communicated his elegant drawings and deſcription, to the late Mr. Pennant. This will not appear ſurpriſing, if we conſider that thoſe, who are accuſtomed to travel frequently among the Hebrides, become ſo much accuſtomed to the appearance of baſaltic colonades, that it requires ſomething very extraordinary to excite their curioſity. Staffa, even at no great diſtance, has a more diminutive appearance, than other baſaltic rocks, which are by no means ſo magnificent; and probably, from this circumſtance, it long eſcaped the attention even of the gentlemen of this neighbourhood. The emotions excited by the view of this magnificent ſcene, are thus expreſſed by the learned Preſident of the Royal Society: "At nine o'clock, (ſays he,) after "a tedious paſſage, having had not a breath of wind, we ar-"rived, under the direction of Mr. Maclean's ſon, and Mr. "Leach. It was too dark to ſee any thing, ſo we carried our tent

" tent and baggage near the only houſe upon the iſland, and
" began to cook our ſupper, in order to be prepared for the
" earlieſt dawn, to enjoy that which, from the converſation of
" the gentlemen, we had now raiſed the higheſt expectations of.
" The impatience which every body felt to ſee the wonders we
" had heard ſo largely deſcribed, prevented our morning reſt;
" every one was up and in motion before the break of day;
" and with the firſt light arrived at the ſouth-weſt part of the
" iſland, the ſeat of the moſt remarkable pillars, where we
" no ſooner arrived, than we were ſtruck with a ſcene of mag-
" nificence which exceeded our expectations; though formed,
" as we thought, upon the moſt ſanguine foundations; the
" whole of that end of the iſland, ſupported by ranges of na-
" tural pillars, moſtly above fifty feet high, ſtanding in natural
" colonnades, according as the bays or points of land formed
" themſelves; upon a firm baſis of ſolid unformed rock, above
" theſe, the ſtratum which reaches to the ſurface or ſoil of the
" iſland, varied in thickneſs, as the iſland itſelf formed into
" hills or vallies; each hill, which hung over the columns be-
" low, forming an ample pediment; ſome of theſe above 60
" feet in thickneſs, from the baſis to the point, formed by the
" ſloping of the hill on each ſide, almoſt into the ſhape of thoſe
" uſed in architecture. Compared to this, what are the cathe-
" drals or the palaces built by men: mere models or play

" things ; imitations as diminutive as his works will always be " when compared to thoſe of nature. Where is now the boaſt " of the architect ! regularity, the only part in which he fan- " cied himſelf to exceed his miſtreſs, nature, is here found " in her poſſeſſion ; and here, it has been for ages undeſcrib- " ed. Is not this the ſchool where the art has been originally " ſtudied ; and what has been added to this by the whole Gre- " cian ſchool ? a capital to ornament the column of nature, " of which they could execute only a model ; and for that very " capital, they were obliged to a buſh of acanthus : how am- " ply does nature repay thoſe who ſtudy her wonderful works ! " With our minds full of ſuch reflections, we proceeded along " the ſhore, trading upon another Giants cauſeway ; every ſtone " being regularly formed into a certain number of ſides and " angles ; till in a ſhort time, we arrived at the mouth of a " cave, the moſt magnificent, I ſuppoſe, that has ever been " deſcribed by travellers.

" The mind can hardly form an idea more magnificent than " ſuch a ſpace, ſupported on each ſide by ranges of columns, " and roofed by the bottoms of thoſe which have been broke " off in order to form it : between the angles of which, a yel- " lowiſh ſtalagmitical matter has iſſued, and ſerves to define " the angles preciſely ; and at the ſame time, vary the colour

" with

" with a great deal of elegance; and to render it ſtill more " agreeable, the whole is lighted from without; ſo that, the " fartheſt extremity, is very plainly ſeen from without; and " the air within, being agitated by the flux and reflux of " the tides, is perfectly dry and wholeſome; free entirely " from the damp vapours, with which, in general, natural ca- " verns abound." The learned Biſhop of Linkoeping, remarks, " how ſplendid do the porticos of the ancients appear " in our eyes, from the oſtentatious magnificence of the deſ- " cription we have received of them; and with what admira- " tion are we ſeized, on ſeeing even the colonades of our mo- " dern edifices! But when we behold the cave of Fingal, for- " med by nature in the iſland of Staffa, it is no longer poſſible " to make a compariſon; and we are forced to acknowledge, " that this piece of architecture, executed by nature, far ſur- " paſſes that of the Louvre; that of St. Peter's at Rome; and " even what remains of Palmyra and Paeſtum; and all that the " genius, the taſte, and the luxury of the Greeks, were ever ca- " pable of inventing."

Such were the very ſtrong impreſſions which the columnar rocks of Staffa made on the learned gentlemen who firſt explored them; and we are not to be ſurprized, that the contemplation of ſcenery ſo new and ſtriking, ſhould have raiſed in their

minds a picture, which to other travellers may ſeem over-coloured. Although I had not an opportunity of landing on the iſland, yet from what I ſaw, and have frequently been told, I do not in the leaſt doubt that the ruins of Palmyra, or the vaſt remains of Egyptian architecture, would more powerfully intereſt the feelings, than all the wonders of Staffa. But this is mere matter of opinion; I will therefore paſs to the account of its mineralogy.

From all the accounts which have been publiſhed, and the ſpecimens which I have examined, the iſland ſeems to be principally formed of baſalt and wacken. The baſalt is generally in the form of columns, which are, 1. Triangular: of this form, there are ſpecimens in the muſeum of the Univerſity. 2. Quadrangular. 3. Pentagonal. 4. Hexagonal. 5. Heptagonal. 6. Octogonal. 7. Articulated like the Giants cauſeway or thoſe of the beautiful columns at Dunbar harbour. 8. Jointed without the convex or concave extremities. Theſe pillars generally reſt upon a baſalt tuff or breccia *, and the ſtrata of baſalt columns (as is the caſe in other parts of Scotland,) follow the more or leſs inclined direction of the tuff or breccia. The colonades are uſually covered

* Faujas' Travels, vol. 2. p. 58. 59. He there names the baſalt tuff, gravelly lava.

covered by a thick ſtratum of baſalt, which has ſometimes an irregular columnar ſhape. Mr. St. Fond alſo mentions, that he obſerved cubical zeolite, octogonal ſemitranſparent zeolite: white ſemitranſparent zeolite, in cryſtals of thirty facettes: this is probably leucit: and alſo zeolite paſſing to chalcedony.

Both Mr St Fond, and Mr Mills, inform us, that they found granite among the rolled ſtones upon the ſhore of the iſland. Theſe are either derived from the baſalt tuff, or they have been conveyed by currents from the neighbouring granite coaſt of Roſs: but the firſt ſuppoſition ſeems the moſt probable.

I-CO-

I-COLUMB-KILL.

CHAP. XVII.

Deſcription of the FOSSILS *mentioned in the preceding Chapter.*

Siſkin-green coloured QUARTZ of *I-columb-kill.*

The quartz which forms a part of the ſienite, and hornblende rock of I-columb-kill, has often a white or bluiſh colour, with the uſual luſtre, tranſparency, fracture, and hardneſs; but it is alſo liable to conſiderable variety; owing to its being more or leſs intermixed with hornblende. With a very ſmall admixture of hornblende, it acquires a greaſy luſtre; and has a hardly preceptible ſiſkin-green colour: with a greater proportion of hornblende, it has a pale ſiſkin-green colour, with

with a weak degree of luſtre and tranſparency, and a plain ſplintery, or imperfectly conchoidal fracture: and laſtly, with a ſtill greater quantity of hornblende, it has a dark ſiskin-green colour, with little tranſparency, and a coarſe ſplintery fracture.

Dark, approaching to leek-green coloured FELSPAR—*I-columb-kill.*

The felſpar of the ſienite is generally of a brick or fleſh-red colour; but is alſo of various ſhades, from pale to dark leek-green: this is owing to its being more or leſs penetrated with chlorite or hornblende.

HORNBLENDE ROCK, having the appearance of ſerpentine—*I-columb-kill.*

This rock is of a dark green colour, and is compoſed of minute cryſtals of hornblende, with a ſmall portion of quartz; which has a dark ſiſkin-green colour. Similar rocks have been obſerved in other countries: thus Humbold and Charpentier, in their diſpute with regard to the magnetic property of a ſerpentine rock, remark, that it has often a great reſemblance

blance to hornblende rock*; and Mr Kirwan in his geological Eſſays, hints, that hornblende rocks may be miſtaken for ſerpentine. The greater ſpecific gravity, and the cryſtalline texture of the hornblende rock, diſtinguiſh it from ſerpentine.

MARBLE, or DOLOMITE, *of I-columb-kill.*

Colour. Snow-white, but frequently verging to yellow, or ſiſkin-green, from the admixture of talc.

Luſtre. Hardly perceptible, and only from a few diſperſed foliae.

Fracture. Splintery, paſſing to the even; rarely granular foliated, and ſometimes imperfectly ſhiſtoſe.

Tranſparency. Tranſmits light at the edges.

Hardneſs. Yields with difficulty to the knife.

Chemical character. Diſſolves very ſlowly in acids, which is a good teſt for diſtinguiſhing it from other kinds.

Ac-

* Neuis Bergmanniſchis Journal.

According to Mr Tennant, 25 grains afford, of carbonic acid and water about 12, magneſia 4.4, lime 7.8, and 1.0 inſoluble ſubſtance.

Use as a Manure. As this marble contains a conſiderable portion of magneſian earth, it is probable that it will produce ſimilar effects, when laid on the ground, with the magneſian limeſtone examined by Mr Tennant *. I ſhall therefore mention the fact which he diſcovered; as it will be of conſequence, not only to the inhabitants of this iſle, but to farmers in general. This gentleman informs us that, in the neighbourhood of Doncaſter, two kinds of limeſtone are employed in agriculture: the one, which contains two thirds of magneſian earth, muſt be uſed ſparingly, and ſpread evenly over the ground; for, if uſed abundantly, it diminiſhes the fertility of the ſoil, and prevents vegetation for ſeveral years: the other, which is pure limeſtone, altho' laid upon the ground in great quantities, is never injurious—on the contrary, produces much fertility. Farmers ſhould therefore be careful to examine whether the limeſtone they are to employ diſſolves ſlowly in acids; as this

* Philoſophical Tranſactions of the Royal Society of London, 1799. Part 2d. p. 305.

is the character which marks the preſence of the magneſian earth.

Flexibility and Elaſticity of Dolomite.

In the Borgheſe palace at Rome, there is a ſlab of dolomite, which poſſeſes a very conſiderable degree of elaſticity and flexibility, and Mr Fleuriau de Belvue has diſcovered a nearly ſimilar ſtone at Mount St Gothard in Switzerland *. He obſerved that all the ſpecimens which poſſeſſed this property, were to be obtained only from the outſide of the ſtrata, and in the parts which had been moſt expoſed to the weather. This circumſtance led him, along with Mr Dolomieu, to ſuppoſe, that its peculiar properties were owing to the ſeparation of a part of its water, which thus weakened the adheſion, and probably altered in a ſmall degree the arrangement of the integral mollecules. He confirmed this idea, by expoſing Carrara marble, gypſum, and other inflexible ſtones to a low degree of heat, by which they acquired a conſiderable degree of elaſticity and flexibility. He found, however, that it was only thoſe marbles that had a cryſtalline grain, and contained little iron or argill, that could be made flexible and elaſtic.

As

* Journal de Phyſique, p. 2. 1792.

As the dolomite of I-columb-kill agrees in many of its properties with that from St. Gothard, it deſerves to be tried whether it will become flexible and elaſtic, by treating it as directed by Mr Fleuriau de Belvue. His proceſs is very ſimple: he puts a thin ſlab of the marble into a ſand bath, and keeps it at the temperature of 30° of Reaumeur for an hour and a half, or, if it be a pretty large ſlab, for a conſiderably longer time. He then removes it, and allows it to cool, and even to abſorb a little moiſture; and then preſſes it in all directions, ſo as to deſtroy that adherence among the particles which the fire has not affected.

NEPHRITE.

Talcum Nephriticum, Lin. & Wern. *Jade*, *Beilstein*, & *Bitterstein*, German.

Colour. Yellowiſh or iſkin-green; olive-green; and ſometimes approaching leek-green.

Fracture. Coarſe or fine ſplintery.

Tranſparency. In pretty thin pieces, it allows objects to be ſeen through it indiſtinctly, but is generally more opaque.

Hardneſs. Sometimes gives fire with ſteel. In other ſpecimens, is difficultly ſcraped with a knife.

Feels greaſy.

It is diſperſed thro' the marble, and is ſeen paſſing gradually into it; has ſometimes ſcales of mica mixed; and not unfrequently we obſerve narrow veins of aſbeſtos traverſing it. It is a curious fact, that the pieces we find upon the ſhore are often harder than thoſe which we break out of the marble.

The only uſe that is made of it, is for ornamental purpoſes; but the pieces which have been found in I-columb-kill are generally too ſmall for any fine work. In Turkey it is wrought into very elegant handles for daggers and ſcimitars; and La Metherie remarks that the many fine pieces in oriental nephrite may have been made before it acquired its preſent hardneſs, which, he ſuppoſes, was produced by expoſure to a gentle heat ‡. Some of the pieces which have been found in Iona are extremely beautiful; and there can be no doubt that, were it quarried on purpoſe, many magnificent ſpecimens might be obtained.

BA-

‡ Theorie de la Terre, tom. 2.

BASALT COLUMNS *of Staffa.*

Several years ago, Mr St. Fond analyſed this baſalt, and found it to contain, in the hundred parts—ſilex 40, argil 20, lime 12, magneſia 5, iron 21. More lately, Dr Kennedy of Edinburgh has repeated this analyſis, and found nearly ſimilar ingredients; with the difference, that he always obtained a ſmall portion of ſoda and muriatic acid. According to his trials, 100 parts contain—ſilex 48, argil 16, oxyd of iron 16, lime 9, moiſture and other volatile matter 5, ſoda about 4, and muriatic acid about 1.

COLL AND TIRIE.

CHAP. XVIII.

Outline of the MINERALOGY *of* COLL *and* TIRIE.

HAVING examined as much of the iſlands of Mull and I-columb-kill as our time would permit, we took leave of the worthy family of Torloiſk, and walked to the harbour of Quines, which is ſituated upon the north-weſt part of Mull. Here we luckily found a boat about to ſail for Coll, an opportunity which we gladly embraced; and, after a tedious paſſage of ten hours, we landed at the ſeat of Colonel Maclean, where we were moſt politely received.

COLL.

THIS iſland is about fourten miles long, and two miles broad. It is low, rugged and bleak; but in ſome places there are beautiful flats, which, during the ſummer, being cultivated, or adorned with wild flowers, form a ſtriking contraſt with the weather-beaten rocks which ſkirt them. The ſhore, upon the eaſt ſide, is generally low and rocky; on the weſt, it riſes into conſiderable cliffs, and, in many places of this ſide, great ſand-banks extend for a conſiderable way. Theſe banks are often of conſiderable height, and form groupes of ſandhills; which are ſometimes covered with the Arundo arenaria, Galium verum, &c.; but more frequently they preſent only a dreary waſte: for, during ſtorms of wind, the ſand riſes in clouds, to overwhelm and deſtroy the neighbouring country. The inhabitants have themſelves partly to blame for the continuance of this evil, by their obſtinacy in rooting up certain plants which prevent the blowing of the ſand: thus, it is a common practice to uſe the Arundo arenaria as a ſubſtitute for ropes, and the Galium verum as a yellow die; two plants which are very remarkable

markable for their power in binding the ſand. Colonel Maclean has prohibited this very pernicious practice, by ſevere penalties; which, it is hoped, will have the deſired effect.

Mineralogy. At the Loch, where is ſituated the ſeat of Col. Maclean, the iſland is low; but upon the E. and W. great ſand-banks appear. The loch is ſmall, rocky and ſhallow; ſo that, in ſtormy weather, it can afford very little ſhelter for veſſels. If we proceed along the ſouth part of the iſland, towards Loch Alin, conſiderable ſandy beaches preſent themſelves; but they are now and then interrupted by tracks of gneiſs. This gneiſs is traverſed, in ſeveral places, by great veins of granite. The granite, which fills theſe fiſſures, is eaſily diſtinguiſhable from that which is depoſited in ſtrata, by the great ſize of its conſtituent parts. Dolomieu, during his travels, often obſerved granite in veins, which, he remarks, is eaſily diſtinguiſhed from that which forms ſtrata; and Mr Beſſon alſo informs us, that the granite veins of Limouſin are diſtinguiſhed from thoſe in ſtrata by the great ſize of the felſpar and quartz. This is not, however, always the caſe; for Mr Charpentier has mentioned veins of ſmall-grained granite which he ſaw in Saxony †, and I have obſerved ſimilar appearances in the Highlands of Scotland.

† Charpentier, Mineralogiſche Geographie der Churſachsischen lande, § 261, 270.

Scotland. At Loch-Alin, Col. Maclean ſhowed us a ſmall vein of Galena, about three inches wide, traverſing the gneiſs and ſienite ſtrata; but it was ſo near the ſhore, that we had not an opportunity of tracing it but for a ſhort way. Such an appearance, however, deſerves farther inveſtigation, when we conſider, firſt, that veins of ore, altho' very trifling at the ſurface of the earth, increaſe much as they deſcend, which is the caſe with the rich mines of Freyberg and Franconia; ſecondly, that the rock, in which this vein runs, is, in other countries, extremely productive of rich ores; thus we know that the greater part of the Saxon, Bohemian and Saltzburg mines are ſituated in mountains of gneiſs. Near to this mineral appearance, I obſerved ſeveral veins of baſalt traverſing the gneiſs; and one of them ſeemed to run nearly in the ſame direction with the ſtrata: thus intimating that a rent had been formed in the ſame direction with the ſtrata, or that this baſaltic matter really forms a ſtratum which has been depoſited along with the gneiſs; of courſe, it ought to be conſidered as of primitive formation.

As we continued our journey around the iſland, I obſerved the gneiſs ſtrata interrupted by a ſmall extent of quartzy rock, which contained beautiful cryſtals of actynolite. This was again ſucceeded by ſtrata of gneiſs, which, in ſome places, form hills, that are often covered with immenſe looſe maſſes, broken

from the ſtrata by the power of the weather. Upon examining theſe maſſes, I obſerved them ſometimes reſting upon ſmaller pieces, as if they had been raiſed by the hand of art; but a more cloſe examination ſhowed us, that the ſmaller maſſes were the more ſolid parts of the gneiſs, that ſtill reſiſted the influence of the weather. This fact will explain many of the curious appearances called Rocking Stones, which antiquaries have been often pleaſed to conſider as proofs of the early knowledge of our anceſtors in powerful machinery. This gneiſs continues to the farm of Knock; but it is now and then to be obſerved alternating with micaceous ſhiſtus and hornblende ſlate, and frequently all theſe ſtrata are traverſed with baſalt veins. The hornblende, in ſome places of this track, but particularly at Griſſopool, is moſt beautifully cryſtallized; ſo that, with very little trouble, magnificent ſpecimens may be procured. At Knock, the gneiſs is much traverſed with baſalt veins, which are of various ſizes; ſome not exceeding a quarter of an inch in width, while others are more than three feet. The gneiſs here contains a very great proportion of a red-coloured felſpar; and the quartz has ſometimes a fiſkin-green colour, ſimilar to that which we obſerved in the iſland of I-columb-kill. From Knock to the northern extremity of the iſland, gneiſs, hornblende rock and micaceous ſhiſtus are the principal rocks which

which occur; and from the north point, all along the eaſt ſide, to Colonel Maclean's houſe, the ſame ſtrata continue.

In ſome places of the interior of the iſland, I obſerved conſiderable cliffs of quartz, which is either maſſive or granular, reſembling that from the iſland of Jura *; but I had not an opportunity to determine its ſituation with regard to the gneiſs, or the other primitive rocks of which the iſland is compoſed.

* Mr Fleurian de Belvue, as I have before mentioned, having found that different ſpecies of marble, by being heated, acquired a conſiderable degree of flexibility and elaſticity; alſo made a ſeries of experiments on different kinds of ſandſtone and granular quartz. He found that ſeveral of them, by being made repeatedly red-hot, and then plunged into water, acquired a remarkable degree of flexibility; and that ſome kinds of granular quartz became even as flexible as the famous elaſtic ſtone which was brought from the Brazils. The granular quartz of Coll is quite the ſame with that which Mr Belvue uſed for his experiments; and there is no doubt that, if it be tried, it will acquire the ſame curious property.

TIRIE.

THIS iſland, which is ſeparated from Coll by a narrow ſound, is about eleven miles long, and two miles and a half broad. It has many ſand-banks, like thoſe in Coll, which are alſo very deſtructive. There are a few hills, which are from two to three hundred feet high; but the greater part of the iſland is low, with interſperſed rocks, and numerous ſmall lakes. This iſland, when viewed from an eminence, appears altogether ſterile and waſte; yet the quantity of arable land among the rocks is ſaid to equal half the extent of the iſland: a proportion vaſtly greater than that of Coll. In the middle of the iſland there is a large and very beautiful plain, which contains 1200 Scotch acres, and is elevated about ſix feet only above high-water mark. During ſtormy weather, the ſea not unoften meets acroſs this plain, and is productive of bad conſequences. The inhabitants have endeavoured to avert this evil by building a defence of ſtone and earth on the one ſide, while the ſea, on the other, has raiſed a conſiderable barrier of bowlder ſtones: yet neither have been ſufficient to reſiſt the waves of the Atlantic.

This

This iſland appears to have been formerly joined to the iſland of Coll; the iſle of Guna, which lies in the ſound, being apparently part of the intermediate land, which has eſcaped deſtruction. On this account, there is but little difference in their compoſition; the greater part of Tirie being formed of ſtrata of hornblende rock, gneiſs and ſienite, which are in general very much elevated. Theſe ſtrata are, in different parts of the iſland, traverſed with veins of baſalt; and, at the ſouth-weſt part of the iſland, I obſerved a great quartz vein, interſperſed with iron pyrites, traverſing theſe ſtrata; and alſo a great vein of compact arenaceous quartz, which is intermixed with leaves of talc, cryſtals of felſpar, and a few pieces of galena. Probably this vein, upon trial, might afford lead ore in ſuch quantity as to be worthy of working. It would be of little conſequence to enter into a detail of the ſlight alterations of the ſtrata in particular parts of the iſland; I ſhall therefore terminate my few obſervations, by giving a ſhort account of the marble quarry, which has rendered this iſland ſo remarkable.

The marble quarry is ſituated immediately upon the ſea-ſhore, at a farm called Belephetrich: here the ſhore is low and rocky; but at a little diſtance there is an eminence, called the Hill of Belephetrich. The ſtrata are nearly vertical; and are compoſed of hornblende rock, and a compound of deep-red coloured

coloured felſpar and quartz, which has ſometimes cryſtals of hornblende interſperſed. The marble forms a ſtratum of very conſiderable extent; it appears alſo to be nearly vertical, and is bounded by the rocks we have juſt mentioned. It is croſſed in ſome places by ſmall veins of quartz and reddiſh-coloured hornſtone; and I obſerved a vein of granite, compoſed of felſpar and quartz, traverſing it. This ſtratum of marble has been conſidered by ſeveral travellers as a vein; but I apprehend this is a miſtake. In other countries we find marble in a ſimilar ſituation: thus Voight * informs us that it has been obſerved between hornblende ſlate and ſienite, and even that it has been found between granite in Sweden †.

Upon the oppoſite ſide of the hill of Belephetrich, there is a ſtratum of white marble, which is ſituated among the uſual rocks which compoſe the iſland. This ſtratum ſeems alſo to have been quarried, but, like the other, is long ſince given up as unprofitable.

AS

* Voight, Prack. 48. † Ibid. Briefe ueber der gebergslehre, § 12.

AS I have to deſcribe particularly only two foſſils belonging to theſe iſlands, it would be unneceſſary to throw them into a diſtinct chapter: I ſhall therefore inſert the deſcriptions in this place.

Red-coloured MARBLE—*Belephetrich.*

Colour. Pale blood-red, light fleſh-red, and reddiſh-white.

Luſtre. None, except from a number of diſperſed ſhining foliæ.

Fracture. Fine ſplintery.

Tranſparency. Tranſmits light freely at the edges.

Hardneſs. Yields pretty eaſily to the knife.

There are diſperſed through it,

1. *Hornblende.* The cryſtals are of various ſizes, from the tenth of an inch to three inches long; and they vary ſomewhat in the intenſity of the green colour. It is mixed in different pro-

proportions with the marble: ſo as to produce pale blackiſh-green, dark aſparagus-green, and a colour approaching to leek-green. Tranſparent ſea-green calcareous particles are frequently to be obſerved intermixed with the hornblende, and alſo beautiful, but very minute garnets.

2. *Mica*—Is ſometimes in pretty large plates; is of a yellow, tombac brown, or green colour; and appears paſſing to ſchiller ſpar.

White MARBLE—*Belephetrich.*

Colour. White, or very light blue.
Luſtre. Pretty conſiderable, from the foliæ.
Fracture. Granularly foliated.
Tranſparency. Tranſmits light at the edges.
Hardneſs. Yields with difficulty to the knife.

There are diſperſed through it ſcales of mica and cryſtals of hornblende. When the hornblende is minutely diffuſed, it gives the marble a green, or yellowiſh-green colour: then it has a ſplintery fracture, with little luſtre, and increaſed hardneſs. Sometimes the hornblende ſeems to be very intimately combined

combined with the marble; when it forms thoſe beautiful yellowiſh green ſpots, which have made this variety of the Tirie marble to be ſo much admired. Theſe yellow ſpots have been reckoned by ſome mineralogiſts as the ſame with the ſpargelſtein of Werner.

Corundum, or Adamantine Spar, of Tirie.

The Honourable Mr Greville, in his memoir on the adamantine ſpar, obſerves—" I had obſerved, in the ſpecimens which Mr Raſpe called Jade, or a new ſubſtance from Tirie, on the weſt coaſt of Scotland, a great reſemblance to corundum: but having then had only a curſory view of the ſubſtance, I am indebted to Mr Hatchett for the examination of a ſpecimen of it, which he had from Mr Raſpe's collection. The Tirie ſtone reſembles cryſtallized corundum of the coaſt ‡, in texture and colour: it is alſo as refractory, when examined by the blowpipe, with different fluxes. Its ſpecific gravity is 3.049; conſequently nearer the ſpecific gravity of pure corundum than the above mentioned lump 2.785, and the matrix of corundum 2.768. The Tirie ſtone will ſcratch graſs readily, but not rock cryſtal: its hardneſs, therefore, correſponds with that

‡ Coaſt of Coromandel.

of the corundum *." I believe there are ſpecimens of this corundum in the Muſeum of the Univerſity; and of theſe I ſhall probably communicate an account at the cloſe of this volume.

EIGG.

*Philoſophical Tranſactions of the Royal Society of London, 1798, p. 40.

EIGG, RUME AND CANNA.

CHAP. XIX.

Outline of the MINERALOGY *of* EIGG, RUME *and* CANNA.

HAVING thus taken a general view of the iſlands of Coll and Tirie, we left with regret the hoſpitable family of Coll, whoſe numerous and polite attentions had rendered our ſtay in this iſland ſo agreeable.

We ſailed from the bay immediately below Col. Maclean's houſe, and, after a voyage of five hours, we landed upon the iſland of Eigg, and walked to Mr Macaſgill's, who, we found, was at that time on the mainland; yet, during our ſtay in this iſland, we experienced every attention from his family.

EIGG.

THIS iſland is the property of John Macdonald, Eſq. of Clanranald, is between four and five miles long, and from two to three miles broad. It is hilly; the principally flat and cultivated piece of country being confined to the ſhore oppoſite the mountainous iſle of Rume.

Mineralogy. The harbour upon the ſouth-eaſt extremity of the iſland, where we land in coming from Coll, is formed by a ſmall iſle, called Eillean-Chaſtell, which is compoſed of baſaltic rocks. The ſhore, immediately oppoſite to this iſle, is high; and the cliffs are ſplit into pretty regular baſaltic pillars, which are of conſiderable ſize. As we proceed towards the eaſt ſide, the ſhore becomes lower; but this is only for a ſhort way, as it ſoon riſes again upon the eaſt coaſt, forming cliffs of vaſt height. Theſe ſtupendous precipices extend all along the eaſt and north part of the iſland; forming many wild and romantic ſcenes, and affording ſeveral diſtinct views of the diſpoſition of the ſtrata. The ſtrata are nearly horizontal; and are, in ſome places, ſo well expoſed, that we can obſerve their alternation

alternation from the level of the ſea to the ſummit of the cliffs. I ſhall therefore, in deſcribing them, begin with the lowermoſt ſtratum, which is,

1. *Shiſtoſe Clay.* This ſtratum is a few inches thick; and is compoſed of a dark-coloured ſhiſtoſe clay, which contains numerous well-preſerved ſhells apparently of the genus tellina.

2. *Compact Limeſtone.* This forms a thin ſtratum, lying immediately upon the ſhiſtoſe clay.

3. *Shiſtoſe Clay.* This ſtratum is about ten inches thick, and reſts upon the limeſtone.

4. *Compact blue Limeſtone, containing ſhells.* This ſtratum is about ten inches thick, and reſts upon the ſhiſtoſe clay. It acquires a yellow colour by decompoſition; ſo that it is well diſtinguiſhed from the other ſtrata, even at a diſtance.

5. *Shiſtoſe Clay.* This reſts on the limeſtone.

6. *Baſalt.* The covering of graſs prevented me from diſcovering the baſalt in immediate contact with the clay; yet, from its vicinity, it is very probable that it covers it.

7. *Fi-*

7. *Fibrous Limeſtone.* The ſtratum of baſalt is covered by a thin layer of this ſpecies of limeſtone, which has a blackiſh colour from mixed bituminous matter.

8. *Baſalt.* This covers the limeſtone.

9. *Argillaceous Sandſtone.* An immenſe ſtratum of this ſandſtone lies upon the baſalt. It is in general ſoft, but we were told that ſometimes it is very hard. This harder kind is probably got by blaſting, as the interior of ſandſtone rocks, as Charpentier * obſerves, is the hardeſt; or it may be other harder ſandſtone ſtrata alternating with the ſofter, as I have obſerved in the Orkney Iſlands and other parts of Scotland.——This ſandſtone frequently contains impreſſions of ſhells; and it alterternates with ſtrata of baſalt, which are from four inches to ſeveral feet thick. This alternation renders it very probable that the baſalt may alſo contain ſimilar animal remains; and this conjecture is rendered the more probable from ſeveral facts which have been lately diſcovered. Thus Mr Kirwan informs us that Dr Richardſon had diſcovered ſhells in the baſalt of Ballycaſtle ‡; Bruckenman has obſerved muſcle ſhells, ammonites

* Charpentier, Mineralogiſche Geographie der Churſachsischen lande, 44.

‡ Kirwan's Geological Eſſays, p. 252.

nites and corallites in the baſalt of the pretended extinct volcanoes of France †; and impreſſions of leaves have been obſerved in baſalt, as related by Lenz ‡.

10. *Baſalt in columns.* This forms a great ſtratum, which covers the argillaceous ſandſtone. The columns are varied, not only in their ſize, and in the number of their ſides, but alſo in their direction being perpendicular, horizontal, or bent, like thoſe of Staffa. The bent columns are generally ſmaller in their dimenſions than thoſe that are perpendicular or horizontal.

11. *Wacken.* This forms an immenſe ſtratum, which we obſerve reſting upon the baſalt columns. It frequently contains beautiful cryſtallizations of zeolite.

12. *Red-coloured Wacken.* This ſtratum is only a few inches thick, and it reſts upon the wacken. It is perfectly ſimilar to that which we obſerved in Mull.

13. *Baſalt.* This forms a great bed, which lies on the red-coloured wacken, or, when it is a-wanting, on the common wacken.

Theſe

† 1 Chym. Ann. 1794. § 103, &c. ‡ Lenz. 374.

Theſe ſtrata are traverſed in ſeveral places by veins of baſalt; which do not appear, in any inſtance, ſo far as I have examined, to have occaſioned any alteration in their direction or hardneſs.

Nearly at the northern extremity of the iſland, the cliffs, we have now been deſcribing, turn inwards, and run in a ſemicircular form, until they again appear upon the coaſt on the weſt ſide of the iſland. The ſemicircular track, included by theſe cliffs, is pretty flat, of conſiderable extent; and the cliffs, which bound it, are compoſed of ſtrata ſimilar to thoſe on the eaſt and north ſides of the iſland. The bottom, in ſuch places as I examined, is compoſed of ſtrata of limeſtone containing ſhells, alternating with ſhiſtoſe clay, and ſometimes reſting on baſalt or ſandſtone. Upon the ſouth ſide of this track the ſandſtone and limeſtone diſappear, and now baſalt and wacken form lofty precipices. Immediately at the bottom of theſe baſaltic rocks, upon the ſea-ſhore, I picked up ſeveral pieces of black pitchſtone, much reſembling that found in the iſlands of Arran and Mull; but I could not diſcover whether it forms veins or ſtrata. From this to within a mile of Eillean-Chaſtil, the iſland is bounded in many places by lofty precipices: and the interior is formed of irregularly-

ſhaped,

ſhaped, grey-coloured, columnar hills, and, among theſe, Scure-Eigg, which is the higheſt, has a very ſingular appearance.

In the ſea cliffs there are ſeveral conſiderable caves. They are generally ſituated in a wacken which is traverſed by baſalt veins. This wacken contains moſt elegant ſpecimens of capillary zeolite, alſo calcareous ſpar, quartz cryſtals, and chalcedony; and in ſeveral places I obſerved a red-coloured wacken ſimilar to that which is deſcribed at p. 235, vol. i. Several of theſe caves are of conſiderable extent, and are open to day; others are narrow at their entrance, but enlarge conſiderably as we go inwards.

The miniſter of this pariſh, who was ſo good as to accompany us to ſeveral parts of the iſland, led us, by a very rugged path, to a wild ſequeſtered ſpot, where there is a cave, remarkable, in the annals of this iſle, for the murder of the Macdonalds, inhabitants of Eigg, by the Macleods of Skye. As this ſtory is truly characteriſtic of the ſtate of ſociety in thoſe parts at that period, I think it will not be unintereſting to relate it ſhortly.

A party of the Macleods having landed upon the ſmall iſland of Eillan-Chaſtel, behaved ſo outrageouſly to the women who

were there tending cattle, that their friends inſtantly purſued, and put ſeveral of them to death. This ſo enraged the clan of Macleod, that they determined to take revenge, by ravaging the iſle, and putting to death the murderers of their brothers. The iſlanders, ſenſible of their weakneſs, prepared to ſhelter themſelves, upon the firſt appearance of an enemy. Soon afterwards a number of boats were ſeen approaching the iſle; when the trembling inhabitants retired, in deſpair, to this cave, their only refuge. The Macleods ſoon landed, and traverſed the whole iſland; but, as they could diſcover no human being, they concluded that the Macdonalds had made their eſcape to the mainland, or to ſome of the adjacent iſlands. Diſappointed and enraged, they were about to leave Eigg, to return to Skye, when unfortunately one of the horde obſerved the mark of footſteps on the ſnow, and thus they were enabled to diſcover the cave where the wretched inhabitants had taken refuge. Shrieks of deſpair were interrupted for a little, by a propoſal of the Macleods, that if the murderers were given up to puniſhment, the other lives ſhould be ſpared. This was only a cruel aggravation of their ſufferings, as the Macleods were the aggreſſors. Connected, as the Macdonalds were, by the deareſt ties, they determined to periſh together, rather than to give up one of their number. The Macleods, with the moſt ſavage barbarity, inſtantly

inſtantly kindled great fires at the mouth of the cave, which ſoon ſuffocated the whole of the miſerable inhabitants.

One often liſtens even to ſuch a tale, as to the deſcription of a battle, without much intereſt: but the view of the ſcene never fails to awaken a keener ſympathy—the circumſtances are brought nearer to the mind, and ſeem to be paſſing before us. We ſtood on the very ground where this tragedy was acted, and felt our ſenſibility increaſed by the ſequeſtered and dreary place in which the deed was done. But even this intereſt was faint, when compared to that we felt, when, after creeping for a conſiderable way through a low and narrow entrance, half covered with bruſhwood, we found ourſelves at laſt within a large and gloomy cave, the extent and height of which we could not diſtinguiſh; and perceived the gleams of the lights we carried reflected from the bones and ſkulls of the unhappy Macdonalds. The force with which the truth and all the circumſtances of this dreadful tale ſtruck at this moment upon our minds, and the ſtrange variety of ſenſations excited by an event ſo extraordinary, it is not eaſy to find words to expreſs.

The entrance of the cave is low and narrow, for about 12 feet. The cave itſelf extends to a height of 22 feet, the breadth 24 feet, and in length it extends inwards nearly 213 feet. The air was damp and raw. Our lights ſtruck faintly on the black

ſides of the caves, without diſpelling that deep and ſolemn gloom, which harmoniſed ſo well with its melancholy ſtory. The projecting maſſes of the rock were dimly illuminated, while the ſkulls and ſcattered bones catched a ſtrong light. Our figures, too, touched with the paley flame, ſhowed the features, or an outſtretched arm, while the parts of the body removed from the light were loſt in the gloom. Even the deep and ſonorous voice of the parſon had its effect. The whole ſcene was admirably adapted for the canvas: but it would require a very rare talent in the painter who ſhould attempt it.

A ſhort way from this cave, after walking over rocks of baſalt and wacken, I obſerved on the ſhore two veins of black pitchſtone. Theſe veins are about ten feet diſtant from each other, are from half a foot to three feet wide, and are a little bent in their courſe. They run in a ſpecies of baſalt, which contains a conſiderable portion of zeolite, and in ſome places ſmall layers of chalcedony. The pitchſtone and baſalt are ſometimes intermixed at their junction, and even pieces of the pitchſtone appear immerſed in the baſalt. But the moſt remarkable circumſtance attending this pitchſtone, is the intermixture of one of the veins with a vein of hornſtone. This appearance



PITCHSTONE *and* HORNSTONE *veins traversing* BASALT. *ISLAND EIGG.*

pearance is repreſented in the plate *, where A is the baſaltic rock in which the veins run ; B is the vein of pitchſtone, and C is the hornſtone vein. The vein of hornſtone, at D, is about two and a half feet wide ; but it varies much in this reſpect, as it ſhoots through the pitchſtone. At F, the hornſtone has incloſed a wedge-ſhaped piece of pitchſtone. At G H there are two ſtripes of hornſtone, one of them, G, containing a thin piece of pitchſtone.

Theſe appearances may be explained, by ſuppoſing, that, after the vein of pitchſtone had been formed, new rents extended both through it and the baſalt, and that theſe were afterwards filled with hornſtone. The pieces of pitchſtone incloſed in the hornſtone, appear to have been broken off the pitchſtone vein, and at the time when it was rent, and were afterwards ſurrounded by hornſtone.

Altho' pitchſtone has been diſcovered in various parts of Europe, it has not been before deſcribed as belonging to the rocks of trap formation. Haquet, indeed, mentions, that he obſerved baſalt columns converted into glaſs, among the baſalt of the Ve-

* It muſt be underſtood that the plate repreſents a horizontal ſection of the pitchſtone and hornſtone veins.

Veroneſe. This is very probably pitchſtone; yet we cannot ſay ſo with certainty, as the appearance is not deſcribed with ſufficient exactneſs. Obſidian, however, which, as we have before obſerved, is nearly allied to pitchſtone, has been lately obſerved by Humbold, ſtratified with baſalt, at the top of the peak of Teneriff.

We now aſcended from this to the Scure Eigg, which we have before obſerved to be the higheſt part of the iſland. This hill, from its peculiar ſhape, has, at a diſtance, a ſingular appearance; but as we approach nearer, it riſes much in grandeur, and at length, a ſtupendous columnar promontory burſts on our view. The whole of this promontory is perfectly mural, and extends for upwards of a mile and a half, and riſes to the height of ſeveral hundred feet. It is entirely columnar, and the columns riſe in ſucceſſive ranges until they reach the ſummit, where, from their great height, they appear diminutive. Staffa, which is the moſt magnificent aſſemblage of natural columns that has yet been diſcovered, is the only one that can bear a compariſon with Scure Eigg. Staffa is an object of the greateſt beauty and regularity; the pillars are as diſtinct as if they had been raiſed by the hand of art; yet it has not the extent or ſublimity of Scure Eigg: the one may be compar-

ed

Engd by Robert Pollard

Columnar PROMONTORY of Staffa Esqr

ed with the greateſt exertion of human power; the other is characteriſtic of the wildeſt, and moſt inimitable works of nature.

The columns are diſpoſed in different directions, being either perpendicular, curved, or horizontal. Sometimes we obſerve the horizontal pillars croſſing each other; the ſides of the horizontal columns appearing above and below the ends of thoſe horizontal columns which lie in a contrary direction. They vary conſiderably in the number of their ſides, having three, four, five, ſix, and ſeven ſides; but I did not obſerve any of them jointed. I conjectured, at firſt, from the nature of the ſtrata of which the iſland is compoſed, that theſe columns were baſalt; but a nearer examination ſhowed that they were formed of a ſpecies of porphyry, with a baſis intermediate between baſalt and pitchſtone. The ſame kind of porphyry ſeems to form many of the other hills in the interior of the iſland.

RUME.

AS the voyage from Eigg to Rume is rather dangerous, on account of the terrible ſqualls of wind which often blow from the high lands, we did not prolong our ſtay, after we had made the few obſervations which have been juſt mentioned. We therefore ſailed from the weſt ſide of the iſle of Eigg, and, after a pleaſant ſail, we landed at Kinloch, at the head of Loch Skreſert in Rume. Here we had our exertions aſſiſted by Col. Maclean's officer, and the other people of the iſland, who manifeſted every wiſh to ſerve us.

Description. This iſland, which is the property of Col. Maclean of Coll, is about eight miles long, and nearly as broad. It lies between the iſles of Eigg and Canna, and is about ſeven miles NNW, from Eigg, and four from Canna. It is altogether mountainous; in ſhort, it may be reckoned a groupe of mountains, of which, Aiſgobhall is the higheſt. Its ſhores are in general very bold and rocky, and often preſent tremendous perpendicular precipices.

Loch-

Loch-ſkreſort, which is the only harbour in the iſland, is about two miles long, and is bounded upon both ſides by hills of conſiderable height, which riſe pretty rapidly from the ſides of the loch. The ſtrata upon both ſides are of red-coloured ſandſtone. At Kinloch, the ſmall village at the head of the loch, the land is low and continues pretty much ſo, to the ſhore oppoſite to the iſland of Canna, forming a kind of valley which is bounded by lofty hills, which are more rugged upon the ſouth than the north ſide. The bottom of this valley is elevated in the middle; and here we obſerve another valley which runs quite in a contrary direction. The hills upon the north ſide of this valley are compoſed of red-coloured ſandſtone, which is elevated at an angle of 12°; and it is alſo ſtratified with baſalt, and traverſed by baſalt veins. Theſe veins are even to be obſerved burſting out upon the top of the hills; and often the baſalt, in theſe veins has a remarkable power over the compaſs: detached pieces act very powerfully. The ſandſtone by decompoſition aſſumes various tints, as red, purple, white, &c. and often it alſo decompoſes in ſlates; and theſe are frequently curved. Upon the ſhores, maſſes of onyx and ſardonyx are to be obſerved; probably coming from the ſandſtone or baſalt.

As the mountains upon the ſouth ſide of the loch are much higher than thoſe upon the north, and their ſhape and general appearance conſiderably different, we agreed to aſcend one of them, ſo that we might become acquainted with the rocks of which it is formed. Accordingly, we began to aſcend the mountain called Halival, which riſes immediately from Kinloch, but found it fatiguing not only on account of the wetneſs of the ground, but alſo from the many hollows into which we frequently tumbled, owing to their being concealed by long heather. Having reached the firſt ſhoulder of the hill, we found an extenſive platform, which is formed of baſalt and greenſtone; and the ſandſtone which had continued from the bottom of the hill, does not go higher than this. Above this platform, the appearance of the hill is much altered, the heather diſappearing, the ſide of the hill being covered with grey ſtones, and appearing to riſe by a ſucceſſion of platforms or terraces. We now clambered upwards over a wilderneſs of ſtones of greenſtone and baſalt, until we were about 60 feet from the ſummit. Our further progreſs ſeemed now to be ſtopped, as the mountain appeared to be ſurrounded by large blocks of greenſtone ſtanding in an almoſt perpendicular direction. Our guide, however, conducted us to the ſummit by a ſteep path, which was not without danger. Unluckily, a few minutes before we reached the ſummit, it was envelopped in clouds, ſo

that

that it was only as they cleared away, that the mountain of Aiſgobhall was to be obſerved towering above us; and by its terraced aſpect, announcing a ſimilarity of compoſition with that on which we were ſtanding. At ſome diſtance ſeveral other hills appeared with terrible, bare, rugged, intervening glens; and all apparently compoſed of trap-formation rocks. As we were reſting upon the ſummit, I picked up ſpecimens of a dark green-coloured cryſtalliſed pitchſtone; but I did not diſcover it *in ſitu*: near to the ſame places, I obſerved ſeveral pieces of a rock reſembling the Lydian ſtone which ſeemed to traverſe the greenſtone in the form of veins. As the clouds were now ſpreading all around, we found it neceſſary to deſcend; but we took a different rout, ſo that we might ſee as much variety of rock as poſſible. We did not, however, meet with any foſſil differing from what we had ſeen in the aſcent; and the diſpoſition of the ſtrata appeared to be the ſame, viz. greenſtone and baſalt forming the higher parts, and red ſandſtone the lower. From the ſlight examination of this mountain, and the general appearance of the others in the neighbourhood, it is probable that all the ſouth ſide of the valley is formed of ſandſtone in the lower parts, and the upper of rocks of trap formation.

I cannot omit mentioning a curious appearance which I obſerved, in examining a ravine upon the ſouth ſide of the valley,

where it was ſaid coal had been found. Immerſed in the baſalt, which forms part of theſe hills, I diſcovered pieces of limeſtone, (with interſperſed bituminous matter,) from 4 to 12 inches long, and 2 inches in diameter. In the Philoſophical Tranſactions of the Royal Society of London for 1796, we have the account of a nearly ſimilar appearance obſerved in the works of the Huddersfield canal. In perforating a hill by a ſubterraneous tunnel, the workmen met with a fault or break in the ſtrata through which they were cutting, when they found a rib of limeſtone, and a number of pyritical limeſtone balls, from one ounce to upwards of 100 lb. weight. No limeſtone had been diſcovered in that country nearer than 20 miles. In Rume, ſo far as I could learn, there is not any ſtrata of limeſtone: a circumſtance which may poſſibly render the explanation of theſe phenomena a little difficult.

As circumſtances did not allow us to ſpend more time in this iſland, we left Kinloch, and, after a rugged walk during a violent ſtorm, we reached the ſhore of the iſland oppoſite Canna. Here we found a moſt magnificent, bold, broken coaſt, formed of ſtrata of red-coloured ſandſtone, which are elevated at a conſiderable angle, and alternate with baſalt, and are alſo traverſed with numerous veins of baſalt.

Beſides

Beſides theſe appearances, I obſerved, as we were walking along the ſhore, waiting until the ſtorm ſhould allow us to croſs to Canna, vaſt ſtrata, apparently of baſalt, or wacken, lying on the ſandſtone, at the ſummit of the tremendous cliffs which here bound the iſland. I now regret extremely that the inclemency of the weather prevented me from examining theſe ſtrata; for unqueſtionably they would have proved highly intereſting, if we may judge from the ſpecimens that had tumbled from them upon the beach. The following are a few of the foſſils which I picked up on the ſhore.

1. Green, or yellowiſh-green coloured heliotrope *, which adhered to maſſes of baſalt ‡, or forming little balls immerſed in it.

2. Baſalt, containing rounded balls of green earth, along with ſimilarly-ſhaped maſſes of calcareous ſpar.

3. Baſalt,

* This heliotrope is ſometimes ſo ſoft, that it has a good deal the appearance of pitchſtone.—Is this owing to its being altered a little by the action of the weather?

‡ From the ſpecimens being a good deal decompoſed, I cannot ſay with certainty whether this is to be conſidered as a baſalt or a wacken: I at preſent rather think it is a baſalt.

3. Baſalt, containing chalcedony: and this chalcedony is frequently penetrated with the green-coloured heliotrope, forming a ſtone that ſeems to be the plaſma of the Italians.

4. Baſalt, with whitiſh, or light-brown coloured hornſtone, which has ſometimes an apple-green colour, from its being penetrated with heliotrope.

5. Maſſes of hornſtone, which contain beautiful quartz cryſtals.

6. Chalcedony in ſtalactites; and, what is remarkable, pieces of the ſtalactites are obſerved lying in, and ſurrounded by calcareous ſpar.

7. Beautiful maſſes of onyx, which are, in ſome ſpecimens, covered with a white cruſt.

The weather having now become a little more moderate, we croſſed the ſound to Canna, thro' a very tremendous ſea.

CANNA.

THIS iſland, the property of John Macdonald, Eſq. of Clanranald, is about five miles long, and two miles broad. It is low; but its ſhores are bounded by ſteep and lofty cliffs. It is remarkable for its harbour, which is reckoned one of the beſt among the Hebrides: yet it is difficult of approach in ſtormy weather, owing to the narrowneſs of the entrance, and the ſunk rocks that lie near it. This harbour is formed, upon the N. by Sand iſland, which is ſeparated from Canna by a ſtrait, which is left nearly dry at every ebbing of the tide. The iſland is low, and conſiſts of rocks of trap formation. The end, which forms the entrance of the harbour, is of baſalt tuff, having baſalt pillars reſting upon it. The oppoſite ſide of the harbour is formed by the iſland of Canna, which is here of conſiderable height, and riſing by beautiful and regular terraces. Theſe terraced appearances, which are in general pretty ſure marks of a baſalt country, do not here deceive us, as the rocks are decidedly baſaltic, and in ſeveral places are ſplit into columns.

In

In examining this iſland, we walked along the ſhore towards the W. which we found low and rocky, but bounded by conſiderable land-cliffs of columnar baſalt. This baſalt, in ſome places, reſts upon baſalt tuff; but, farther on, I obſerved the tuff expoſed without any covering—the baſalt, if it had ever been ſuper-impoſed, being waſhed away; and, near to the place, the baſalt pillars are ſeen wore down by the action of the ſea, the ends ſtanding up under the water like a regular pavement. At a place called Tarbet, the cliffs on the ſhore aſſume a bold form: they there riſe to a great height, and are immediately waſhed by the ſea, or, in other places where there is an accumulation of debris, the further action of the waves is prevented. The ſuperior ſtratum of theſe cliffs is columnar baſalt. The pillars vary very much, not only in ſize, but alſo in the number of ſides; and frequently they are to be ſeen bent, when their length and breadth is leſs than the upright ones. Immediately below the ſtratum of baſalt, there is a ſtratum of wacken, which contains calcareous ſpar, elegant capillary zeolite, quartz cryſtals, blackiſh-coloured cryſtals, whoſe nature I am ignorant of, and, more rarely, cryſtals of leucit, or Veſuvian garnet. To this ſucceeds another ſtratum of baſalt; and below it, a ſtratum of wacken; and ſo on, alternately, to the bottom of the cliffs.

Having

Having walked for a conſiderable way along a narrow path in the face of theſe cliffs, the violent wind and rain forced us to ſcramble to the ſummit, as it was impoſſible to walk longer in this track, without the riſk of being precipitated into the ſea, or among the rocks. We now croſſed the iſland to a place called Dun-eudain, where coal had been formerly wrought: unluckily the cliff had fallen down, ſo that I had not an opportunity of ſeeing it. We were told, by the people who had worked it, that it was a ſtratum from 6 to 8 eight inches thick, and was incloſed in whin rock (baſalt or wacken). Its ſituation, upon the face of a high cliff, was given as the reaſon why the working was ſtopped: this is a circumſtance, however, of little detriment; for, if the coal ſtratum had been of conſiderable extent, many economical expedients might have been uſed to raiſe the coal. From this, in going around the other parts of the iſland, the cliffs become lower; but they ſoon riſe again, and continue of great height nearly to the harbour of Canna. In many places of theſe cliffs the ſtrata are well expoſed: thus, upon the eaſt ſide, near to Compaſs-Hill, the uppermoſt ſtratum is baſalt, with a ſlight tendency to the columnar form; below this, is a ſtratum of baſalt tuff; this is again ſucceeded by baſalt; and ſo on, alternately, to the bottom of the cliffs. The ſhore is covered with a vaſt collection of debris from the cliffs; and, in ſome places,

it even ſeems to form a kind of alluvial breccia, in which vaſt maſſes of columnar baſalt are immerſed.

Compaſs-Hill, which we have already mentioned, is ſituated at the top of the cliffs we have been juſt deſcribing; and appears, at its ſummit, to be formed of a ſpecies of baſalt, which, by decompoſition, acquires the power of affecting the compaſs: hence this eminence has received its name. Other rocks in the iſland, however, are much more powerful in this reſpect: thus the baſalt at the outer point of the harbour affects the compaſs at the diſtance of between 25 and 30 feet.

Near to this hill, but immediately upon the ſhore, there is an iſolated rock, called Humbla, which is intereſting to the antiquarian, as there is upon its ſummit the ruin of a ſmall caſtle, where, it is ſaid, an old jealous highland chieftain, even long ago, vainly endeavoured to confine a handſome wife. At a little diſtance, there is another rock, where baſalt tuff lies on baſalt; and, in the tuff, I obſerved ſeveral pieces of wood ſlightly bituminated. In one place I ſaw a piece of wood about two feet long, but only a few inches thick: thus intimating that it had acquired its ſhape either by the preſſure of the ſuperincumbent rocks, or by the contraction of the argillaceous

ceous earth of the baſalt *. In proof of this latter opinion, which ſeems the moſt probable, I may obſerve, that the carbonated wood found in limeſtone, or among coal, is never obſerved to be flattened.

As the appearance of wood, thus ſlightly altered, in a rock of trap formation, is intereſting for geology, I will now ſhortly mention a few ſimilar appearances which have been obſerved in other parts of the world. At Stackhouſe, in Weſterwald, there are ſtrata of carbonized wood, which alternate with wacken and clay †. Mr Eſmark obſerved a vein, at the depth of 200 fathoms, entirely filled with carbonized wood ‡. Werner mentions veins of wacken, at Bautzen, that contain pieces of bituminated wood ‖. Near Rennes, a whole cheſnut tree was obſerved lying horizontally among ſhiſtus; of which the bark was converted into pyrites, the ſap into jet, but the center was wood ſlightly altered, being nearly in the ſtate of char-

* Kirwan's Geological Eſſays, p. 46.

† 1 Berl. Beob. 52, 56. Kirwan's Geological Eſſays, 311.

‡ Neues Bergmanniſches Journal.

‖ Werner Neue Theorie von der Entſtehung der Gange.

coal *. Mr Pennant informs us that wood is found incloſed in the ſolid rock in different parts of Iceland, and, like that of Canna, is very much flattened: what is remarkable, pieces of the wood are often found ſo little altered, and of ſuch a ſize, as to be eaſily planed, and made into middle-ſized tables ‡.

EIGG,

* Journal de Phyſique, Mai, 1786.

‡ Introduction to Arctic-Zoology, p lx.

EIGG, RUME AND CANNA.

CHAP. XX.

Deſcription of the FOSSILS *mentioned in the preceding Chapter.*

Columnar PORPHYRY of *Scure-Eigg.*

This rock has, diſperſed thro' it, numerous cryſtals of yellowiſh or white-coloured cryſtals of felſpar; and the baſis preſents the following characters:

Colour. Black.

Luſtre. Little glancing, or rather glimmering.

Fracture. Even, approaching more or leſs to the conchoidal.

Tranſparency. None.

Hardneſs. Gives a few ſparks with ſteel; but ſometimes yields alſo with great difficulty to the knife.

It decompoſes into a greyiſh-white powder.

Fuſibility.

Fuſibility. At 29° it had acquired a grey or white colour, and was converted into a kind of enamel.

This change by action of the heat, conjoined with the external characters, confirm me in the belief that it is intermediate between pitchſtone and baſalt.

PITCHSTONE—*Eigg.*

Colour. Deep black, or bluiſh-black.

Luſtre. Pitchy, ſtrong glancing.

Fracture. Uneven; or, even, with a greater or leſs tendency to the conchoidal; and ſometimes ſhiſtoſe.

Tranſparency. None.

Hardneſs. Scarcely gives fire with ſteel.

Fuſibility. Formed a black cellular maſs at 47°, and at 52° was more compact.

There are, interſperſed, a few cryſtals of felſpar, and thin layers of a yellow-coloured ſubſtance.

HORN-

HORNSTONE, which traverſes the Pitchſtone—*Eigg.*

Colour. Pale greeniſh-grey.

Luſtre. None.

Fracture. Even, or fine ſplintery.

Tranſparency. Hardly perceptible at the edges.

Hardneſs. Gives fire pretty plentifully with ſteel.

There is, diſperſed thro' it, calcareous ſpar and chalcedony. The chalcedony is of a bluiſh-white, or light-yellow colour; and is ſimilar to that which I have mentioned in the preceding chapter, as being contained in the baſalt. It is ſometimes cellular; and theſe cells are lined with quartz cryſtals, and filled with a nearly liquid bitumen.

BASALT, in which the Pitchſtone Veins are ſituated—*Eigg.*

Luſtre. Little glancing, from a number of minute cryſtals of hornblende which are diſperſed through it.

Fracture. Uneven.

Hardneſs.

Hardneſs. Yields with ſome difficulty to the knife; and leaves a grey trace.

By decompoſition it acquires an iron-grey colour.

GREENSTONE—*Rume.*

It is compoſed of cryſtals of hornblende and felſpar; and, intermixed, there are beautiful tranſparent graſs-green coloured cryſtals, which reſiſt decompoſition, while the felſpar and hornblende are reduced to an iron-brown or greyiſh powder. It has a very great ſpecific gravity.

Cryſtallized PITCHSTONE—*Top of Halival, Rume.*

It is of an olive, or dark leek-green colour; and has the uſual luſtre, tranſparency and hardneſs. The cryſtals are immerſed in a rock formed of felſpar, with a few ſcales of tombac-brown coloured mica. They are from the tenth to the half of an inch long; which is much greater than the cryſtallized pitchſtone of Bohemia. I could not diſcover the form of the cryſtals, on account of their being much broken; yet I have no doubt that it

is

is a cryſtallized pitchſtone. As this is a very rare foſſil, having been diſcovered only in another part of Europe, it is well deſerving the attention of thoſe who viſit Rume.

CHALCEDONY—*Rume.*

This chalcedony is of a bluiſh-grey, or browniſh colour, or even of a milk-white colour, thus approaching to the nature of ſemiopal; and has the uſual luſtre, tranſparency and hardneſs. It is frequently accompanied by calcareous ſpar, hornſtone, and cryſtalliſed quartz. It is alſo ſtalactitical; and, what is curious, we ſometimes obſerve fragments of the ſtalactites incloſed in the calcareous ſpar *. It is frequently penetrated with

* The explanation of the formation of ſiliceous or chalcedonic ſtalactites has been conſidered a difficult problem in geology, and no doubt there is ſome truth in the opinion. Upon reading with a view of collecting facts on this ſubject, I met with one which deſerves to be generally known, as it will help to explain ſeveral of the remarkable forms that the ſtalactitical chalcedony aſſumes. Baron Trebra, whilſt in the deepeſt mines at Kromnitz in Hungary, paid particular attention to the appearance of the ſiliceous ſtalactites, and obſerved that thoſe newly formed,

heliotrope, or bloodſtone; when it has characters exactly reſembling the plaſma of the Italians.

PLASMA ?—*Rume.*

Colour. Dark apple-green.

Luſtre. Glimmering.

Tranſparency. Sometimes allows the light to paſs thro' pretty freely.

Fracture. Even, with a tendency to the flat conchoidal.

Hardneſs. Does not give fire with ſteel ſo readily as chalcedony.

This ſtone was formerly conſidered as a ſpecies of chalcedony; but Werner has lately deſcribed it as a diſtinct genus. Abbé

formed, or forming, in place of breaking, as is the caſe with the calcareous, were flexible, and this in a very great degree ‡.

‡ Mineralien cabinet gesammelt und beschrieben von dem Verfaſſer der Erfahrungen von innern der gebirge.

Abbé Eſthner conſiders it as an intimate combination of calcedony and talcerde. This may be the caſe with the ſpecimens he examined; for I have little doubt that chalcedony may, in one inſtance, be penetrated with heliotrope, and, in the other, with talcerde, yet the reſulting foſſils may be difficultly diſtinguiſhable by their external characters.

Dark apple-green coloured HORNSTONE—*Rume.*

Luſtre. None.

Fracture. Coarſe ſplintery.

Tranſparency. Allows a little light to paſs at the edges.

Hardneſs. Gives ſparks very plentifully with ſteel.

It has browniſh-coloured ſpots diſperſed thro' it. This appears to be hornſtone penetrated with heliotrope; and the ſuppoſition is rendered more probable, from the diſperſed brown-coloured ſpots, which are characteriſtic of the preſence of heliotrope.

HELIOTROPE, or, ORIENTAL JASPAR—*Rume.*

CHALCEDONIUS HELIOTROPIUS, Lin. *XANTHUS*, Walker.

Colour. Dark graſs-green, or yellowiſh green; and marked with ſpherical ſpots of an iron-brown, or light olive-green colour.

Luſtre. Glimmering, with a weak waxy luſtre.

Tranſparency. Very little at the edges.

Hardneſs. Gives ſparks plentifully with ſteel, but not ſo much as flint.

The red, olive-green, or iron-brown coloured ſpots and veins are merely accidental, as the ſame ſtone is to be found without them. It is conſidered by Emmerling as an intimate of green earth and chalcedony; and this is countenanced by its ſituation in Rume, as both green earth and chalcedony are found accompanying it. A foſſil of this name is deſcribed by Pliny, at the 10th chapter of the 37th book of his natural hiſtory; but its properties are ſo different from the ſtone with which we are acquainted, that we muſt, for the preſent, conſider it as different. It is to be hoped that the intelligent and well-informed Mr. Hawkins, who has travelled over ſo much of the Eaſt, where

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it is ſaid the heliotrope of Pliny is found, will clear up this difficulty.

BASALT TUFF—*Canna.*

This rock is compoſed of rounded maſſes of baſalt, wacken mandelſtein, and argillaceous ſandſtone, connected by a baſaltic baſis. Very conſiderable looſe maſſes of ſandſtone are to be obſerved in different parts of the iſland; and ſeem to be derived from this breccia or baſalt tuff: as I did not obſerve any fixed rock of ſandſtone in the whole iſland.

SKYE.

SKYE.

CHAP. XXI.

Outline of the MINERALOGY *of* SKYE.

HAVING ſpent two days in examining what was curious in Canna, we ſailed for the iſland of Skye, and, after a tedious paſſage, we landed at Rue-dunan, which is about 12 miles from the harbour of Canna.

The iſland of Skye is about 70 miles long; but it varies much in breadth, owing to the number of lochs or arms of the ſea with which it is interſected. Cambden imagines that it is the eaſtern Æbudæ of Ptolemy*, while others reckon it the Dumna.

Its

* Ptolem. Geograph. lib. viii.

Its preſent name is of Norwegian origin, being derived from *Ski*, a miſt; and from the clouds that almoſt perpetually envelope the lofty mountains, it has been ſtyled *Ealand-ſkianach*, or the cloudy iſland †. It lies between the mainland of Scotland, and the Long-iſland; it is, upon the weſt ſide, many miles from the Long-iſland; but on the eaſt, it is ſeparated from the mainland in ſome places by a ſound not half a mile broad. The ſhores are rocky, and the cliffs in many places are of great height. It is very mountainous upon the SW. where the Cullin mountains riſe to a great height, and afford many ſcenes of the greateſt ſublimity. To the north of theſe mountains, the iſland is formed of comparatively low hills, which continue to within a few miles of the extremity, when they are ſucceeded by a plain, which forms part of the pariſh of Kilmuir. South from theſe mountains, is the low, narrow, pariſh of Sleat, which forms a peninſula, that is reckoned the moſt productive part of the iſland.

Caves. There are conſiderable caves that occur in different parts of the iſland; one at Camesketel, on the ſouth ſide, is fam'd for having afforded ſhelter to the unfortunate Prince Charles when he was eſcaping from Scotland after the battle of

† Dr M'Pherſon, in Pennant's Tour.

of Culloden. There are alſo, in ſeveral places, grand caſcades; one in particular, upon the eaſt ſide of the iſland, is reckoned little inferior to the fine fall at Fyers, which is between Fort Auguſtus and Inverneſs.

Lochs. This iſland appears, at ſome former period, to have been very much expoſed to violent convulſions, which have broke up the land, and formed the many lochs which traverſe it. The moſt conſiderable of theſe lochs are Snizort, Follart, and Bracadale.

Mineralogy. Rue-dunan, where we landed, after leaving Canna, is ſituated at the bottom of the Cullin mountains, and at the head of loch Brittle. The mountains riſe here, with the utmoſt grandeur; but the continual covering of clouds, prevented me from inveſtigating them with ſo much accuracy as I wiſhed. I found, that the ſides of the loch, and the lower part of theſe mountains, were compoſed of baſalt; but the ſuperior parts, appeared to be wholly of ſienite and hornblende rock, traverſed by baſalt veins. The faces of the mountains were bare, ſteep, and rugged, and were much traverſed by open fiſſures. In ſome places, I obſerved the brows of the hills covered with hornblende rock, which, by its brown colour, had

had much the appearance of the ſerpentine rocks in the iſland of Unſt in Shetland.

Having taken a ſlight view of theſe mountains, we intended to proceed to Talyſker, as being a centrical ſpot for the inveſtigation which we propoſed of the coaſt of Skye, from Ruedunan to Dunvegan-head; but, in this, we were diſappointed, as the worthy Col. M'Leod of Talyſker, to whoſe attention we were recommended, died on the very day on which we landed upon the iſland. We were now glad to take ſhelter in the firſt houſe we came to, and luckily, we met with an obliging man, the ſhepherd to a gentleman in the army; he lodged us comfortably in his maſter's almoſt waſte manſion-houſe; but we ſoon wearied of this retirement, and ſet out for Grule, at the head of loch Eynort, where, we were informed, the miniſter of the pariſh reſided. The path led us through a hilly country, which, as far as I examined, appeared to be compoſed of baſalt and wacken; and both contained fibrous, and variouſly cryſtalliſed zeolite. At Grule, we waited upon Mr Macleod, the miniſter, to whom we were entire ſtrangers, yet he gave us a moſt kind reception, and the next day accompanied us near to the valley of Talysker; but we found no variety of rocks, the whole being compoſed of baſalt or wacken; at little Breeze hill, which is near to the vale of Talysker, there is a pretty

colonade of baſalt pillars, which, Mr Pennant, in his voyage to the Hebrides, erroneouſly mentions as the moſt northern groupe of columns in Scotland. As the weather was very ſtormy, we remained with our good hoſt for three days, but on the fourth, our anxiety to proceed on our journey, overcame every obſtacle; and we left, with regret, Mr Macleod's hoſpitable cottage. Upon gaining the upper part of the glen, the rain and miſt increaſed, and prevented us from having a view of many parts of the country. We continued our journey among baſaltic hills, until we found ourſelves on the ſide of Loch Harpart, an arm of the ſea, which is of conſiderable extent, and bounded upon both ſides by low baſaltic hills. From this we walked on to Loch Bracadale, another arm of the ſea, in which we obſerved ſeveral ſmall iſlands, which were all apparently baſaltic; as is alſo the caſe with the neighbouring country. As the ſtorm had ſomewhat abated, the remainder of our walk to Dunvegan, the bleak ſeat of General M'Leod, was not ſo diſagreeable: we, however, obſerved no variety of ſtrata, as the the ſame baſaltic rock ſtill predominated; but at a diſtance we remarked ſeveral truncated hills of conſiderable height; and two of them, called Macleod's Tables, are ſaid to have a conſiderable reſemblance to Table Mountain at the Cape of Good Hope.——At Dunvegan there is a loch of conſiderable extent, which is bounded on both ſides by low hills, apparently

compoſed

compoſed of baſalt and wacken; and there are diſperſed thro' it ſeveral ſmall iſlands, which, from their terraced appearance, ſeem alſo baſaltic. We were informed that coal had been worked near Dunvegan, but the ſtratum was ſo ſmall that it was ſoon given up. Pieces of wood have been alſo found in the rocks upon the ſide of the loch; probably in a breccia reſembling that of the rock at the iſland of Canna.

Although I had no opportunity of examining the rocks upon the ſhore which extends from Rue-dunan to Dunvegan head; yet, from the baſaltic nature of the country near it, and the general appearance of the coaſt, as ſeen from the iſland of Canna, I have little heſitation in ſaying, that the general rocks will be found baſalt and wacken. It is probable, however, that this extent of country may contain many curious ſporadic foſſils; and veins or ſtrata of pitchſtone may alſo be obſerved.

We now walked to Kingſburgh, by the end of Loch-Bay and Loch-Griſorniſh, through immenſe tracks of peat. The neighbouring hills are low; but the rocks upon the ſides, and at the mouth of the lochs, are often of great height, and very rugged and broken. I ſaw no variety of foſſils; the whole country, ſo far as the peat and heather would allow me to examine, being of baſalt and wacken.

We remained at Kingſburgh for ſome days, waiting the return of Mr Campbell, who had gone upon a fiſhing expedition; but in the meantime I examined the neighbouring country. It proved to be little intereſting, as it was entirely formed of ſtrata of baſalt and wacken, which contained beautiful fibrous and cryſtalliſed zeolite, and both kinds of ſtrata were frequently traverſed by baſalt veins. The old houſe, in which Mr Campbell at this time lodged, is remarkable for having afforded ſhelter to Prince Charles, when purſued by the king's troops; and the ſhore is noted in hiſtory as the place where King James V. landed when he was making the tour of his kingdom. Mr Campbell having returned, we got the neceſſary inſtructions for our route to the north part of the iſland, for which we ſet off next day. After leaving Kingſburgh, we walked for a mile or two along the ſide of Loch-Snizort, through a baſalt country, until we reached the mill which is ſituated upon a ſtream of water at the head of Loch-Uig. A conſiderable way above this mill there is a pretty large caſcade, formed by the water which collects from the neighbouring baſaltic hills; and near it we obſerved appearances of coal. The firſt was upon the ſide of the ſtream in the face of a ſteep rock: the coal was only a few inches thick, and covered by a ſtratum of baſalt at leaſt 30 feet high. Immediately at the ſide of the caſcade there is another ſmall ſtratum of coal, a few inches thick, and lying in

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the baſalt. Theſe ſeams, or ſtrata, however, are ſo ill-ſituated, and ſo trifling, as to be unworthy of any conſideration in an economical point of view. Near to the caſcade there is a conſiderable ſtratum of wacken, which is covered by baſalt, and traverſed by baſaltic veins: it contains nodules and ſtratulæ of ſteatites, or ſoap-rock.

After croſſing this ſtream, we came to a good road, which led us to the top of a baſalt hill; and by continuing our walk for a quarter of an hour longer, we came in ſight of the low, flat part of the iſland, to which we deſcended by a winding road. This flat is much expoſed on all ſides, excepting on the ſouth, where it is defended by the lofty cliffs, which are the termination of the hilly grounds of Skye, and alſo form the boundary between this part of the pariſh of Kilmuir and the other parts of Skye. It appears very certain that this flat, at ſome diſtant period, was of an equal height with the adjacent mountains; but probably the violent agitations which took place at the Deluge, or ſome very remote period, may have either ſweeped away the land which is here a-wanting, or violent earthquakes may have ſunk it nearly to its preſent level. It could not have been carried away by the ſlow action of the ſea, as there are no marks of the ſea having lately covered it; nor can

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we ſuppoſe that the combined meteoric influences could, in any length of time, have produced this appearance.

The moſt prevalent rock of this flat is baſalt; but upon the ſhore I obſerved ſome variety of ſtrata, of which I ſhall now give a ſhort account. Upon the ſhore, near to the houſe of Mr Martin, the miniſter of the pariſh, there are cliffs of moderate height, where the lowermoſt ſtratum is baſalt: above this is a ſtratum of blue ſhiſtoſe clay; then a ſtratum of bluiſh-coloured limeſtone, a foot and a half wide; and above this is another ſtratum of blue ſhiſtoſe clay. At ſome little diſtance from this, I obſerved ſtrata of compact blue limeſtone, which are from 8 to 14 inches thick, alternating with layers of black-coloured ſhiſtoſe clay, and both are traverſed by baſalt veins. To the weſtward of this the ſtrata are arranged in the following manner—

1. Lowermoſt ſtratum, compoſed of baſalt.
2. Blue-coloured ſhiſtoſe clay.
3. Argillaceous ſandſtone.
4. Blue-coloured ſhiſtoſe clay.
5. This rock differs from the ſhiſtoſe clay, in wanting the ſhiſtoſe fracture, and being ſo hard as not to be touched by the knife.

6. Blue

6. Blue ſhiſtoſe clay. This rock is ſometimes very compact, and approaches to the nature of Lydian ſtone.
7. Sandſtone.
8. Shiſtoſe clay.
9. Baſalt, which forms the upper ſtratum.

Theſe ſtrata are in general very thin, being from 4 to 12 or 14 inches thick; but the uppermoſt ſtratum, the baſalt, is of vaſtly greater thickneſs.

We now walked along the coaſt towards Duntulme Caſtle, but obſerved no variety of ſtrata beſides what we have now mentioned: the gradual breaking-down of the rocks formed, however, a ſtriking object. In ſome places, the ground on the top of the high cliffs was to be obſerved rent for ſeveral hundred feet, only waiting the effects of froſt to ſeparate maſſes of vaſt magnitude. Many ſuch maſſes were ſeen near to the ſhore; and it was pleaſing to obſerve how nature, by the breaking-down of theſe maſſes, and covering them with vegetation, has formed many ſmall, green hills, which gradually become uſeful to man, and hide the rude and broken appearance of the country. Some hundred yards from Duntulme Caſtle, I obſerved a ſtratum of ſhelly limeſtone, about 6 feet thick, reſting upon a thin layer of ſhiſtoſe clay, which again lies upon a ſandſtone.

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It is remarkable that this limeſtone contains pieces of wood ſlightly carbonated, being in a far leſs altered ſtate than the wood found in the baſalt tuff of the rock at Canna. At a little diſtance from theſe, but nearer to Duntulme, I obſerved three ſingular patches of Lydian ſtone, which, from their black colour and glimmering luſtre, are, at a diſtance, much like black pitchſtone. Theſe maſſes, which are the remains of a ſtratum that has been broke away by the ſea, lie upon blue-coloured limeſtone, and appear to be covered with ſandſtone: but I am not quite certain as to this latter fact. Theſe ſtrata are traverſed by two baſaltic veins, which croſs each other, in ſuch a manner, that the Lydian ſtone, at firſt ſight, ſeems incloſed in a baſaltic hollow. At Duntulme, formerly the ſeat of the Macdonalds, the cliffs, upon which the ruins of the caſtle are perched, are of conſiderable height, and ſeem to conſiſt principally of baſalt. Mr Pennant remarks that in theſe cliffs there are numerous ſmall compreſſed ammonitæ *. It is to be regretted that he has not mentioned, whether it was really the baſalt in which they were immerſed, or rather a ſtratum of limeſtone: the latter, to me, ſeems more probable.

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* Pennant's Tour in Scotland, and Voyage to the Hebrides, p. 304.

As we proceed towards the north point of the iſland, the coaſt becomes high and rocky: the cliffs are ſeen to have been torn aſunder, and great maſſes project in terrific grandeur from their tops. Upon the moſt northern point, the rocks are precipitous, and of great height. In one part they are particularly grand: we were upon the ſummit, and the burning of the kelp below enveloped their baſe in murky darkneſs, while the waves, broken into irregular points, were indiſtinctly ſeen laſhed into foam. From this, looking northwards, the point of the Lewis retires beautifully into a low track of land; and, towards the eaſt, the mainland melts into the horizon, and at laſt is diſtinguiſhed only by the fleecy clouds that are attracted by it. Such an appearance muſt be grateful to the ſailor, when his eye has been long fatigued with the weary ſameneſs of the ocean, before land is perceptible, it is known by the appearance of the clouds on the horizon.

We now walked through a conſiderable extent of country to Loch Staffin, which is ſituated upon the eaſt coaſt of the iſland; but in this track I obſerved no other rocks beſides baſalt and wacken, which are in ſome places traverſed by baſaltic veins. At Loch Staffin, the country on the ſhore is low; but on one ſide there is a ſmall hill, which, at a diſtance, has a very reddened and burnt appearance, ſo that it may with all pro-

priety pass for a *Scottish* volcano: but a nearer examination discloses its structure, which is an alternation of basalt and common wacken, with red-coloured wacken. The quantity of this red wacken is very great; indeed more so than I have observed in any other part of the Hebrides. At some distance from the shore we observed a range of hills, which rise from the low part of Kilmuir parish, and, we were told, extend to Portree. These hills, which appear entirely basaltic, are here much broken; and the separated masses are to be seen gradually mouldering down, and at length covered with vegetation. If we examine this breaking-down of the land with more attention, we shall find a beautiful progression. First, we observe immense masses, which, by their vicinity to the cliffs, and their peaked form, indicate that they have been lately rent from the mountain. At some distance, other masses are to be seen, where the sharp, peaked form is worn away, and now they have a flat and rounded form, and are partly surrounded by debris. Still nearer the sea, the masses disappear under the covering of debris; and now vegetation makes its appearance, which increases more as we come to the flatter parts of the country. At a little distance from Loch-Staffin we observed a beautiful freshwater lake, called Shiant, or The Sacred Lake. Its banks are covered with natural wood, and it is filled by numerous springs; so that its water is cool, clear, and refreshing. It has

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not eſcaped the particular regard of the inhabitants, who formerly frequented it in great numbers, as it was reckoned ſacred, and capable of healing all diſeaſes. From this loch we walked for a ſhort way through corn fields, and then along a dreary moor, which was bounded, upon one ſide, by the range of hills which extend to Portree, and, upon the other, by the ocean, and the diſtant mountains of the mainland of Scotland. The ſilence of the ſcene was broken only by ſounds which rendered it more diſmal—the mournful whiſtle of the plover, or the wild notes of the curlew; while the ſullen roar of the ocean came at intervals upon the ear, as it heaved its mighty ſurges on the ſhore. The day, which was for ſome time extremely delightful, began to lour, the wind aroſe, and we ſaw the clouds gathering upon the neighbouring mountains. To avoid the coming ſtorm, we haſtened to paſs the muir, that we might reach the path which leads acroſs the mountains. After a journey of ſeveral hours, we came to the bottom of the mountains: they were enveloped in clouds, and the rain was falling in torrents. Fatigued by a long march, and with our clothes wet and clinging about us, we had ſtill the ſteep aſcent of the mountains, which divide the northern part of the iſland, before us. We began to aſcend, and perſevered in climbing againſt the blaſt: the long heather, and the wetneſs of the ground, encreaſed our toil; but at laſt we gained a conſiderable plain.

Sometimes we were involved in impenetrable mists; but we could look back, at intervals, upon the plain country we had left, still partially illumined by the sun, and smiling faintly through the veil that surrounded us. As we continued to ascend, the thickness of the mist was terrible. Our guide began to talk seriously of his doubts and fears; assuring us that frequently people, going in search of cattle among the mountains, were overtaken by these mists, and forced to sit quietly down, and wait for the morning. The situation forcibly impressed us with the truth of what he related; and we entered with a lively sympathy into the anxiety and despair, and vain struggles, of those who are left thus to wander alone. While we went musing on our situation, and indulging in imaginary distresses, our guide pointed to the cairn of a poor shepherd who had perished in the snow. It was the very scene that Thomson must have painted,

> Where many hills ascend, of unknown, joyless brow,
> And many scenes of horrid prospect rise.

We could fancy we saw the unhappy man, with desperate effort, hurrying through the waste,

> From hill to dale still more and more astray,
> Impatient—through the drifted heaps,
> Stung with the thoughts of home: the thoughts of home

Burst

Burſt on his nerves, and call their vigour forth
In many a vain attempt——till down he ſinks
Beneath the ſhelter of the ſhapeleſs waſte,
Thinking o'er all the bitterneſs of death.

Having contemplated the unhappy fate of this poor ſhepherd, we paid the tribute of a ſtone to his cairn, and paſſed on. We found a narrow ſheep-track, by which we ſcrambled upwards, but the torrents of water which were daſhing upon all ſides, rendered the aſcent very fatiguing, and ſometimes dangerous. At length we reached the ſummit, from which we were glad to deſcend quickly towards the low country. About half way down the mountain, the clouds appeared clearer, the rain was leſs violent, and ſuddenly, as by enchantment, we burſt from clouds, and ſaw the country ſmiling below us. When we deſcended from the mountain the ſun was ſetting; the evening was placid and ſerene; all the landſcape was "mellowed by the gradual duſky veil." We now walked onwards when our fatigues were forgotten in the pleaſures of the hoſpitable family of Kingſburgh.

This tract of country over which we had paſſed, appeared to be entirely compoſed of baſalt and wacken. We now paſſed a few days at Kingſburgh, and then left with much regret a family,

a family, to whoſe extreme kindneſs and hoſpitality, we had been ſo much indebted, during our ſtay in this part of the iſland.

Mr Campbell, who was going to the ſouth part of Skye, accompanied us to Portree. The hills in this direction are not of great height; but as we approach Portree, they become higher, and upon the ſummit of one of them there is ſaid to be the *crater of a volcano*, where probably there may be ſtill ſufficient heat to revive the drooping ſpirits of ſome forlorn fire philoſopher as he wanders through this cold, bleak country. The ſtrata are either baſalt or wacken; and the latter often contains a very great quantity of zeolite, indeed ſometimes it forms nearly one half of the ſtone.

Portree is a harbour of conſiderable extent, and capable of admitting veſſels of ſome burden; it is beſides very ſafe, as it is well defended by the iſland of Raſa, from which it is only about three miles diſtant. Here there is a conſiderable thorough fare; and as it is the principal market place in the iſland, of courſe there is an inn. There are in the Highlands, as in other countries, places where ſtrangers find bad accommodation; but certainly the inn of Portree has ſeldom been equalled for dirtineſs: a traveller from among the Hottentots might

might well recogniſe the *Kraal*, although ſo far removed from its cuſtomary ſituation. Upon the north ſide of the harbour, there are rocky cliffs, which increaſe in height from the inn to the entrance of the harbour, where they are very bold and ſtriking. Near to the inn, the cliffs are formed of a reddiſh coloured argillaceous rock, which is much of the nature of ſandſtone, and contains pieces of baſalt, and is alſo traverſed by baſaltic veins; but the higher cliffs preſent a ſandſtone which contains numerous petrefactions, and alternates with baſalt. This alternation of ſandſtone probably continues all along the ſhore to the muir near Loch Stafling. Upon the ſouth ſide of the harbour I obſerved a ſtratum of coal, from one to two feet wide, reſting on baſalt, and covered by a ſimilar maſs from 16 to 20 feet high. In the coal I ſaw ſeveral pieces of carbonated wood, which could not poſſibly be diſtinguiſhed from pieces of common carboniſed fir. This does not ſeem to be a common appearance, for Emmerling only relates two inſtances, the one obſerved by Dr Reuſs, the other by Mr Flurl. As we approach the mouth of the harbour on this oppoſite ſide, the cliffs riſe to a great height, and are compoſed of ſandſtone and baſalt, which alternate; and the baſalt, from its being the leaſt deſtructible, ſeemed always to form the higher and more expoſed parts. The ſandſtone at a diſtance has the appearance of a breccia compoſed of great rounded maſſes,

maſſes, but upon a nearer examination, I was ſurpriſed to find it in large oval or globular ſhaped maſſes, as is the caſe with many kinds of baſalt, and ſome kinds of granite.

This appears alſo to be a rare phenomenon in other countries, as I find it only mentioned by Dr Reuſs, who obſerved globular ſandſtone in the Bunzlauer circle in Bohemia*. Having procured a boat, we ſailed along the coaſt to Kaimiſkianeveg, where we were told that coal had been diſcovered. The coaſt all the way is apparently ſandſtone and baſalt, being a continuation of the ſtrata from the ſouth ſide of Portree harbour. Having landed, I obſerved in a cliff, about 40 feet above the level of the ſea, a ſtratum of coal, covered by baſalt, but unluckily the whole cliff was ſo concealed with vegetation, that neither the extent nor direction of the coal could be diſcovered. Nearly at the bottom of this cliff I obſerved a great ſtratum of the common argillaceous ſandſtone, and part of it was globular, like that at the harbour of Portree. From this towards Sconſer the cliffs are in general lower, but the ſandſtone is not now to be ſeen, baſaltic cliffs, as far as I examined, appearing to bound the coaſt. I cannot omit mentioning another appearance of coal, which I examined upon the coaſt oppoſite

* Reuſs mineralogiſche geographie von Boehmen. B. 2. 45.

oppoſite to Clachan in the iſland of Raſay. It is a ſeam of coal about two inches wide, and viſible for about 30 feet, but it is waved in its courſe. The upper and lower ſides are bounded by ſhiſtoſe clay. Above this clay there is a thin ſtratum of Lydian ſtone, and this is again covered by great cliffs of baſalt. From this the baſaltic rock continues nearly to Sconſer, where the high mountains connected with the Cullin groupe, now make their appearance immediately on the ſhore. Above the poſt-houſe of Sconſer, riſes the high hill of Glamoſcard, which we aſcended in order to have a view of the Cullin mountains from this ſide of the iſland. The ſhore and lower part of the mountain is formed of red coloured argillaceous ſandſtone: to this ſucceeds a more compact and nearly ſiliceous ſandſtone, but it continues only for a ſhort way, for as the mountain becomes ſteeper, we find it formed of great ſtrata of porphyry and wacken, and both are traverſed by baſalt veins. Theſe ſtrata continue to the ſummit of the hill, which has a burnt or reddiſh brown colour, owing to the cover of decompoſed porphyry. The neighbouring mountains, as ſeen from this elevation, ſeem to riſe to a great height, and are ſeparated from each other by extenſive vallies, which have a ſtriking appearance, owing to the red colour of the bounding mountains. In deſcending, we were obliged to take the lea-ſide of the mountain on account of the violent wind; this was a fortu-

nate accident, for while walking in this direction, I obſerved numerous fragments of yellowiſh, and green coloured pitchſtone. This was to me an intereſting fact, as I had never before obſerved pitchſtone among porphyritic rocks: I therefore examined all around very carefully, in order to diſcover if poſſible whether it was diſpoſed in ſtrata or veins. I was not ſo fortunate, however, as to determine this point, on account of the great covering of debris; yet I am inclined to ſuſpect that it is diſpoſed either in very thin ſtrata, or in veins, as the quantity of debris ſeemed too ſmall, for ſuppoſing that great ſtrata exiſted near this ſpot. As the determination of the geognoſtic relations of this foſſil, is an object of much conſequence, I would earneſtly recommend a careful examination of this mountain to future travellers. To do this at ſufficient leiſure, it will be convenient to ſpend ſome days at Sconſer, and from this to examine Glamaſcard, and the neighbouring mountains, where moſt certainly they will be able to diſcover the relative poſition of the pitchſtone to the other rocks. To aſſiſt in this inveſtigation, I may mention that pitchſtone has been found among ſimilar rocks in different parts of Europe; thus in Miſnia, great ſtrata of pitchſtone, are obſerved alternating with porphyry *. Eſmark, a well informed pupil of Mr Werner, deſcribes

* Emmerling Mineralogie.

deſcribes it as alternating with porphyry in Hungary ‡; and Voight found it at the foot of Schneekops in the foreſt of Thuringia, among rocks of porphyry, but he does not mention whether it was in ſtrata or veins.

From Sconſer to Broadford we ſailed along the ſhore thro' the ſound formed by the iſlands of Raſay and Scalpa, which was bounded on one ſide by lofty magnificent mountains. Theſe hills, as far as the weather would permit me to examine, appeared to be compoſed of porphyry; and upon the ſhore, in place of the baſalt and ſandſtone, was formed a compound of felſpar and quartz, or what may be called granitel, which pears to reſt on limeſtone, and is traverſed by baſalt veins. At Broadford, the ſhore is very low, and continues ſo to the Kyles of Skye; the country is pretty flat, affording an agreeable ſcene after ſo long wandering among mountainous ruggedneſs. From Broadford to Cory, the country is low, but is bounded upon both ſides by hills, thus forming an irregular valley, which extends to Loch Slepin, upon the oppoſite ſide of the iſland. The low part of the valley, appeared to be principally compoſed of the above-mentioned granitel; which, as is the caſe with the other, ſometimes contains a little chlorite; and in other inſtances, ſeems paſſing to porphyry. Upon one ſide, there is a

‡ Newes Bergmaniſches journal.

range of blue limeſtone hills, which riſe from the ſhore at Broadford, and continue increaſing in height to Suwardel, which is the higheſt part; whence they run in an irregular manner towards Loch Slepin. This limeſtone, which is of a blue colour, is in many places traverſed by baſalt veins, which are often of great ſize, and run in different directions. Upon the oppoſite ſide of the valley, Ben-na-callich and the neighbouring mountains, form a tremendouſly ſublime boundary. As our time would not allow us to examine all theſe mountains, we agreed to aſcend Ben-na-callich; we did this the more readily, as we knew from Mr Pennant, that from its ſummit, there was a vaſt diſplay of mountainous ſcenery. After leaving the houſe of Cory, on our way up the mountain, the firſt object which attracted our attention, was a fine white calcareous marle, which forms a bed of conſiderable thickneſs. Upon examining particularly, I obſerved mixed with it, maſſes of white and grey marble; and theſe were ſeen in all the ſtages of decompoſition, until they formed a ſubſtance not diſtinguiſhable from the marle. This fact renders it probable, that the whole bed is formed by the debris which has been waſhed from the neighbouring marble ſtrata. As we continued our aſcent, the mountains became more ſteep, and we obſerved the crop of blue and white coloured marble, which formed a ſtriking contraſt with the brown burnt-like

aſpect

aſpect of the heath. As I could not at this place diſcover how theſe marble ſtrata were diſpoſed, I deſcended into one of the numerous ravines which furrow the ſide of the mountain, where we judged it probable that their poſition might be determined. The bottom of the ravine was formed of white marble; but upon the ſides, I obſerved rocks different from any which had been ſeen in the other parts of the iſland; but unluckily, they were ſo diſcompoſed and covered with debris, that I could neither determine their ſituation with regard to the marble, nor their particular nature. I therefore continued my examination along the ravine, until I diſcovered the marble covered with a ſtratum of hornblende rock, which had much the appearance of baſalt: and higher up the mountain, in another ravine, it appeared nearly in contact with a granitel ſimilar to that which forms the bottom of the valley; but I could not determine whether there was any interpoſed hornblende rock. Beſides this hornblende rock, I alſo obſerved maſſes of greenſtone, and a porphyritic rock, which has a baſis of quartz penetrated with hornblende, and immerſed in it a few cryſtals of felſpar. This part of the mountain ſeems alſo to contain either ſtrata or veins of dark nearly leek-green-coloured pitchſtone: as I picked up ſeveral fragments that were ſcattered among the heath—As we continued aſcending, the marble diſappeared, and alſo the heather; the mountain ſide being now covered

with

with looſe ſtones, which rendered our further progreſs difficult and tedious. This debris is formed by the breaking down of the granitel which forms the hill to its ſummit; it is different in appearance from that of true granite, baſalt, or granulated quartz; and although it cannot be characteriſed in writing, yet, an attentive examiner, is much ſtruck with the peculiarity of its appearance. Amongſt the debris, I obſerved maſſes of greenſtone; but had not an opportunity of determining, whether it formed ſtrata or veins. After ſcrambling over this debris, which covers ſo conſiderable a part of the mountain, we came to a green ſpot; from whence, the aſcent is eaſier. We now haſtened with eager ſtep towards the ſummit, and ſoon reached the cairn, which is upon the moſt elevated part of the mountain. Here, our moſt ſanguine expectations were more than realized, every faculty for a while ſeemed arreſted, until we could burſt into an exclamation on the vaſtneſs of the ſcene, and on the mighty and eternal power of him who framed ſo great a work. Before us, were many great vallies bounded by lofty mountains, whoſe ſteep ſides were red, owing to the powerful influence of the elements, and furrowed by the many torrents which collect during the dreadful ſtorms that often reign in theſe wilds. At a greater diſtance, the dark, lurid and terrible ſummits of the Cullin mountains retiring in majeſty among the clouds; thus dimly ſeen, adding much

VIEW from BEINN NA CAILLICH in SKYE.

Engraved by R. Scott Tudor

much to the ſublimity of the ſcene. To the north, we obſerved below us the low part of the iſland, with the iſles of Rona, Raſay, Scalpa, and Pladda: towards the eaſt and ſouth, the rugged mountains of the mainland appeared ſtretching in all the grandeur of Alpine wildneſs to the point of Ardnamurchan; and nearer, the iſles of Eigg and Rume added to the variety of this intereſting proſpect.—We ſtood long enraptured with the wonderful ſcene; but the darkening of the ſky admoniſhed us to ſhorten our ſtay, and haſten again to the valley. The clouds were now ſeen driving through the glens, and covering the mountains with a dark veil; ſoon all was loſt in grand confuſion; what a few minutes before was clear and diſtinct, was now a troubled ſcene of tremendous mountainous peaks, ſhooting above the dark clouds, and reddened valleys dimly ſeen through the driving miſt and rain. We took the lea ſide of the mountain, and ſoon reached the houſe of Cory *.

As the weather continued ſtormy, we could not accompliſh our intention of examining the mineralogy of the country about Loch Slepin, a circumſtance which I regretted very much, as

* Upon the ſummit of Ben-na-callich, I picked up ſeveral pieces of porphyry, reſembling that which forms the hill above Glamoſcard.

as in all probability, it would have proved very intereſting. We therefore left the kind and hoſpitable family of Coryhattican, to take a view of Sleat, which is the moſt ſouthern pariſh in the iſland. Having reached Broadford, we walked through a dreary muir, to a ſmall bay called Loch-in-daal, which is nearly oppoſite to the wild and romantic arm of the ſea, called Loch-Huron. In this tract, we walked for ſeveral miles over a blue-coloured limeſtone, which by the action of the weather ſplits into thin rhomboidal-ſhaped maſſes, like the ſandſtone we obſerved near the Cock of Arran. To this ſucceeds a red-coloured argillaceous ſandſtone, which extends nearly to Loch-in-daal, when it is ſucceeded by an argillaceous breccia. This rock, however, continues only for a ſhort way, when diſtinct primitive rocks, as gneiſs, talcaceous ſhiſtus, and hornblende ſlate, are to be obſerved alternating with each other. The face of the country is now much altered in its appearance, the hills are low, and in place of brown heather, are covered with graſs, and beautiful little tufts of natural wood, with interſperſed caſcades, increaſe much the beauty of the ſcenery. As we proceed onwards, the country increaſed much in beauty; and at Armidale, the ſeat of Lord Macdonald, where we terminated our journey through this iſland, there is a ſweetly retired houſe and grounds, but in extremely bad order. As far as I could judge from a ſhort excurſion which I made

made, ſouth from this place, the ſtrata appear to be primitive to the extremity of the iſland; and theſe are principally talcaceous ſhiſtus, hornblende ſlate, and ſometimes chlorite ſlate, and all traverſed by baſalt veins. The hornblende has ſometimes interſperſed cryſtals of actynolite.

RASAY, RONA AND SCALPA.

CHAP. XXII.

Outline of the MINERALOGY *of* RASAY, RONA, *and* SCALPA.

RASAY.

THIS iſland, which is the property of James Macleod, Eſq. is about 15 miles long, and three miles broad: it is ſeparated from the iſland of Skye by a ſound about three miles over: it is low towards both extremities, but riſes to a conſiderable height in the middle, forming the hill of Dun-can. The ſhores are in general rocky, and in ſome places the cliffs riſe to a conſiderable height; but there are no caves of any conſiderable magnitude, nor is there a harbour in the whole iſland.

Min-

Mineralogy. The ſhore below Clachan, the pleaſant ſeat of the hoſpitable Mr Macleod, is formed of white-coloured argillaceous ſandſtone, diſpoſed in horizontal ſtrata; but as we walk towards Sweniſh, we meet with argillaceous porphyry. At Sweniſh point the porphyry appears to lie on ſandſtone, and has, in many places, an iron-brown colour, owing to the decompoſition of the iron pyrites which it contains. As we proceed towards the ſouth part of the iſland, the porphyry ſtill continues; but nearly oppoſite to Sconſer, in the iſland of Skye, I obſerved, on the ſhore, blue-coloured limeſtone cropping through the debris, and it even continues to ſome height in the neighbouring grounds. At Rue-clachan, the moſt ſouthern part of the iſland, the porphyry diſappears, a ſandſtone breccia taking its place. In this breccia, beſides the fragments of quartz, I obſerved ſmall ſtratulæ of red ſandſtone, and maſſes of a very beautiful porphyry, with a blue-coloured baſis. From this, along a conſiderable extent of the eaſt coaſt of the iſland, the cliffs are low; but, nearly oppoſite the iſland of Scalpa, they riſe to a conſiderable height, and continue ſo to Brokel Caſtle. The prevailing ſtrata in theſe cliffs are ſandſtone and breccia, which alternate. The ſandſtone has frequently a calcareous baſis, and contains numerous impreſſions of ſhells, as pectines, &c.; and ſome ſpecimens of the pectines which we obſerved were from 6 to 8 inches

long, and 4 or 5 broad. The ſandſtone, alſo, not unoften contains pieces of bituminated wood. Having reached the cliffs which are nearly below the hill of Dun-can, we aſcended by a narrow path, and ſoon arrived at the top. I obſerved no intereſting variety of rock: the ſtrata, near the ſummit, being ſandſtone, which was in ſome places very hard; and upon the ſummit there were rocks of baſalt, which had a conſiderable effect upon the compaſs. The view from this ſpot is very extenſive; but what intereſted us moſt, was, the appearance of the north end of the iſland, and the iſle of Rona, which, from their rugged, grey, ſteril aſpect, and their riſing into low, irregular hills like Coll and Tirie, ſeemed to announce a ſimilarity of compoſition. We now deſcended from this towards Brokel Caſtle, and in our courſe met with much red-coloured argillaceous ſandſtone, and in ſeveral places great maſſes of breccia. This caſtle is built upon a great rock of breccia, and is the moſt pictureſque and ſtriking ruin that we had obſerved in any of the Hebrides. A few yards from the caſtle, and immediately on the ſea-ſhore, the ſecondary ſtrata are terminated, when gneiſs and hornblende-rock begin. At a little diſtance from where the ſandſtone diſappears, I was ſo lucky as to obſerve a ſtratum of breccia, compoſed of fragments of gneiſs, hornblende-rock, and quartz, lying on the gneiſs: thus ſhowing the junction of the primary with the ſecondary ſtrata. The ſtrata of gneiſs

gneiſs continue to the northern extremity of the iſland, ſometimes alternating with hornblende ſlate, and traverſed by baſalt veins: thus confirming the conjecture we had made on the top of Dun-can, that the north part of the iſland is of a ſimilar compoſition with the iſlands of Coll and Tirie. The end of the iſland is ſeparated from the ſmall iſland of Rona by a narrow ſtrait, in which lies the iſle of Mattea, which is compoſed of ſimilar rocks with this part of Raſay. As we return along the weſt ſide, the ſame kinds of rock ſtill continue; but, near to the iſland of Fladda, I obſerved a ſmall portion of ſecondary rock ſkirting the primary. As the appearances preſented by the junction of the different ſtrata, particularly that of the primary with the ſecondary, are highly deſerving of attention, I landed upon the ſhore of Raſay, in the ſound of Fladda, to examine the ſecondary ſtrata I have juſt mentioned. Theſe ſtrata do not extend for more than 30 or 40 feet in all directions. The uppermoſt ſtratum is an argillite, or ſheifer-thon; and, below, is a ſpecies of breccia, containing fragments of hornblende ſlate, gneiſs, quartz, and hornſtone; and from under this ſtratum riſes the gneiſs, which forms this part of the iſland. Theſe ſecondary ſtrata appear formerly to have been connected with thoſe in the iſland of Fladda, as it is entirely compoſed of ſecondary ſtrata of argillite and red ſandſtone; and, in a more extended view,

Fladda

Eladda appears to have formed a part of the ſtrata which formerly joined with the ſandſtone cliffs upon the ſhore of Skye. After leaving this junction, the coaſt continues formed of the uſual gneiſs, &c. until we come to Loch-Arniſh, where I obſerved great ſtrata of breccia covering the gneiſs. Nothing curious again occurred, until we landed upon that part of the iſland, which is, I think, about due W. from the caſtle: here the gneiſs is covered with breccia, and the breccia is covered with red-coloured argillaceous ſandſtone ſimilar to that obſerved near Brokel Caſtle. From theſe obſervations, it appears that the primitive rock occupies that part of the iſland which is included in the ſpace marked A, in the map.

The red ſandſtone, which I have now mentioned, is elevated at an angle of 45°, and dips to the W. and continues for ſome miles, forming low ſhelving ſhores, or high cliffs; and as it riſes into the interior of the iſland, the extenſive, bare, expoſed ſurface of the red ſandſtone has a ſtriking appearance. As we proceed along the ſhore, we find it ſucceeded by white-coloured ſandſtone; but this continues but for a ſhort way: as, nearly oppoſite to Portree harbour, felſpar-porphyry makes its appearance, forming low cliffs upon the ſhore, or riſing upwards to within 30 or 40 feet of the ſummit of Dun-can, thus forming the weſt ſide, as the ſandſtone does the eaſt. It continues

alſo

alſo to form the rocks upon the ſhore, and the hills, until we come within half a mile of Clachan, where baſalt rocks begin, and continue nearly to Mr Macleod's houſe. This baſalt does not riſe to any conſiderable height, and the porphyry is to be ſeen riſing from under it; but I was not ſo fortunate as to obſerve their junction.

The whole of the porphyry is evidently of ſecondary formation, as it does not extend beyond the line A, which I have before mentioned as the boundary between the primary and ſecondary ſtrata. It ſeems to form the baſis of the ſouth part of the iſland; and it is probably covered by the ſandſtone and baſalt, or they may alternate with each other. A diſpoſition of ſtrata, pretty nearly ſimilar, has been obſerved in other parts: thus, Kohler, in the Miner's Kalendar for 1790, obſerves, that ſandſtone and porphyry are ſometimes connected together, and it is then of ſecondary formation; and, in the iſland of Arran, we have already obſerved porphyry reſting upon ſandſtone.

RONA.

THIS iſland, which is alſo the property of James Macleod, Eſq. of Raſay, is about four miles long, and ſeparated from Raſay, as I have before mentioned, by a narrow channel. It is bare and rugged, and riſes into irregular hills, like thoſe in the north part of Raſay: the ſhores are rocky and dangerous, and there is no harbour.

Mineralogy. The ſtrata, in general, do not differ much from thoſe that form the north end of Raſay; being an alternation of gneiſs, micaceous ſhiſtus, and hornblende-rock. Many granite veins are to be obſerved traverſing theſe ſtrata in different directions, and they are from one foot to ten feet wide. They are to be diſtinguiſhed at a conſiderable diſtance; not only by their running in a croſs direction to the ſtrata, but alſo, by reaſon of the great ſize of the cryſtals of felſpar, which are ſometimes 12 inches long. The only other appearance of conſequence, which I had an opportunity of examining, was at

Tuhumas

Tuhumas, or Blue-Bay: here there is a maſs of rock, which is compoſed of chalcedony, hornſtone, and quartz, from 12 to 15 feet wide, and extending for a long way, and bounded on both ſides by gneiſs. I regret that I had not ſufficient leiſure to determine with certainty whether it forms a ſtratum or a vein: the determination of this point, however, is well deſerving the attention of mineralogiſts who may viſit this iſland.

SCALPA.

THIS ſmall iſland, which is the property of Lord Macdonald, is about 2½ miles long, and 1 mile broad: it is hilly, and the ſhores are low.

Mineralogy. At Mr Macdonald's houſe, the ſhore is low, and is formed of blackiſh-coloured argillaceous ſandſtone, which contains numerous impreſſions of ſhells and zoophytes. This ſandſtone, with an alternation of limeſtone, continues to the northern extremity of the iſland: here, however, a red-coloured ſandſtone, alternating with common ſandſtone-brec-

cia, makes its appearance, and continues around the whole eaſt and ſouth ſides of the iſland, until we again come to Mr Macdonald's. The higher parts of the iſland are entirely compoſed of a granitel ſimilar to that of Ben-na-cailigh; but I could not determine its ſituation with regard to the ſandſtone: it is probable, that the ſandſtone covers it.

SKYE, RASAY AND RONA.

CHAP. XXIII.

Deſcription of the FOSSILS *mentioned in the preceding Chapters.*

SIENITE—*Cullin Mountains, above Rue-dunan.*

The ſienite of theſe mountains, like that of the iſland of Arran, is ſmall-grained, and extremely compact, and alſo varies much in the proportion of its conſtituent parts. I ſhall not now give any more particular deſcription, as it would be pretty nearly a repetition of what I mentioned when deſcribing that of Arran; and have only to mention, that we frequently meet with beautiful neſts of glaſſy actynolite diſperſed through it.

WACKEN—*Uig Mill Water.*

This has the common character of wacken; but it has, interſperſed, balls of calcareous ſpar, zeolite, and ſoap-rock, both in balls and irregular pieces.

The SOAP-ROCK, or STEATITES, has the following characters—

Colour. White, greeniſh white, dark green, and ſometimes brown and blue.

Luſtre. None.

Tranſparency. Allows light to paſs freely through the edges, but is alſo ſometimes nearly opaque.

Fracture. Fine ſplintery.

Hardneſs. Scrapes eaſily with the nail.

Trace—upon paper, is glimmering, and takes a poliſh with the nail; and feels greaſy.

The white kind is marked by dendritical figures, and is the ſame with the chalk of Briancon, and, intermixed with it, are frequently beautiful white fibrous zeolites. It is uſed in Corn-

wall

wall for the making of porcelain; and were it found in conſiderable quantity in Skye, might alſo be of conſiderable value.

At a meeting of the Electoral Academy of the Uſeful Sciences at Erfurt, C. A. M. Baron Von Dalberg read a paper on ſteatites, in which he ſhewed, that, when cut into figures, and then burnt in a cloſe veſſel, it acquires a hardneſs that will reſiſt the file. He alſo related a ſeries of experiments he had made, on the method of giving a durable dye to hardened ſteatites; by which it appears, that it may be made to imitate the moſt eſteemed and beautiful kinds of ſtone. In the ſpecimens laid before the Society, the hardened ſteatites had taken a very remarkable degree of poliſh, and the heads that were cut on it were very beautiful.

LYDIAN STONE, *which covers the Coal, in Skye, oppoſite to Clachan, in Raſay.*

Colour. Black.

Luſtre. Faintly glimmering.

Tranſparency. None.

Hardneſs. Gives fire very plentifully with ſteel.

Fracture. Uneven, with a tendency to the conchoidal.

This

This ſtone is deſcribed by Pliny, who mentions that it is found in great plenty in Lydia, in the leſſer Aſia. It was much uſed by the antients as a touchſtone for trying the purity of gold or ſilver. It is now known, however, that any ſtone, which has a black colour, and a ſufficient degree of hardneſs, will anſwer equally well.

SHISTOSE CLAY, *which covers the Lydian Stone.*

Colour. Black.

Luſtre and Tranſparency. None.

Fracture. Even; in the groſs, ſlaty.

Hardneſs. Yields with difficulty to the knife.

Streak. Dark-brown.

PORPHYRY—*Hill of Glamoſcard, Skye.*

This porphyry has, in ſome inſtances, a baſe of hornſtone; in others, has more the appearance of indurated clay. It has cryſtals of white and red felſpar, and alſo quartz, diſperſed thro' it. By decompoſition, it becomes white, and ſometimes brown.

PITCH-

PITCHSTONE—*Hill of Glamoſcard, Skye.*

Colour. Dark reſin-brown.

Luſtre. Reſiny, and nearly ſtrong glancing.

Tranſparency. Tranſmits light at the edges; but, in thin pieces, it is ſemi-tranſparent, and has a fine amber colour.

Fracture. Uneven, and conchoidal.

Hardneſs. Does not yield to the knife, and gives a few ſparks with ſteel.

Interſperſed there are a few cryſtals, which appear to be felſpar.

Blackiſh-green PITCHSTONE—*Hill of Glamoſcard, Skye.*

Colour. Light blackiſh-green.

Luſtre. Waxy.

Tranſparency. None.

Fracture. Uneven, with a number of rounded, diſtinct concretions: in the groſs, it is frequently ſhiſtoſe.

Hardneſs. Gives fire very difficultly with ſteel.

Has, diſperſed, a few cryſtals of white felſpar.

In

In ſome ſpecimens this Pitchſtone has the following characters—

Colour. Pretty dark blackiſh-green.
Luſtre. None, or extremely little.
Tranſparency. None.
Fracture. Even, with a tendency to conchoidal.
Hardneſs. Gives fire plentifully with ſteel.

It is alternated with layers of a whitiſh-coloured ſubſtance which reſembles hornſtone, and a few cryſtals of felſpar are diſperſed through it. This ſeems to be one of the links of a gradation to hornſtone, or ſome ſimilar rock.

WACKEN, *which alternates with the Porphyry, upon the Hill of Glamoſcard, Skye.*

Colour. Light greeniſh-grey.
Luſtre and Tranſparency. None.
Hardneſs. Yields rather with difficulty to the knife.
Streak. Light grey.
Smell. Strong earthy.

It

It contains frequently yellowiſh-green coloured cryſtals, probably actynolite, and ſometimes reddiſh cryſtals of felſpar.

GRANITEL.

Saxum Morensi, Lin. *Granites Simplex*, Gmelin. *Halb Granit*, Germanor.

This rock, which forms the upper part of Ben-na-cailich, in Skye, is compoſed of white-coloured felſpar, and quartz; and, intermixed, there are a few dark-green points, which appear to be chlorite. Iron pyrites is ſometimes obſerved; and this, by decompoſition, gives a reddiſh tinge to the mountains.

MARBLE—*Cory, Skye.*

1ſt Species.

Colour. White, and veined with aſh-grey.

Luſtre. None.

Tranſparency. Tranſmits light at the edges.

Fracture. Even, fine ſplintery.

Hardneſs. Yields with ſome difficulty to the knife.

It is very heavy; and, by expoſure to the air, it waſhes down into a powder, and forms calcareous marle.

2d Species.

Colour. Aſh-grey.

Luſtre. Has a ſlight degree of luſtre, from a number of very minute foliæ.

Tranſparency. Tranſmits very little light at the edges.

Fracture. Coarſe ſplintery.

Hardneſs. Yields pretty eaſily to the knife.

It feels very heavy; and is variegated by beautiful citron-yellow coloured ſtripes, which traverſe it in different directions. Theſe yellow ſtripes ſeem to be owing to an intimate combination of chlorite, or hornblende, with the marble.

3d Spe-

3d SPECIES.

Colour. Snow-white.

Luſtre. None; or extremely little, from very minute foliæ.

Tranſparency. Tranſmits light at the edges.

Fracture. Even, or very minutely granularly foliated.

Hardneſs. Yields pretty eaſily to the knife.

Feels very heavy. Sometimes it has a brecciated appearance, from its containing maſſes of marble of a harder texture. By the action of the weather, it decompoſes, and forms a marl.

4th SPECIES.

Colour. Pure white, mixed with bluiſh grey.

Luſtre. Pretty conſiderable, from the number of foliæ.

Tranſparency. Allows light to paſs at the edges.

Fracture. Granularly foliated.

Hardneſs. Yields pretty eaſily to the knife.

This ſpecies differs from the fine marble of Carrara, only in the ſlight admixture of the bluiſh-grey colour.

FELSPAR PORPHYRY—*Raſay.*

This porphyry has a baſis which is compoſed of minute cryſtals or grains of felſpar and quartz, with generally a few ſpecks of hornblende or chlorite; and in this baſis there appear pretty large cryſtals of reddiſh or white-coloured felſpar, and ſometimes cryſtals of quartz. Often it is merely a compound of cryſtals of felſpar and quartz, forming a ſtone like that of Benna-cailich in Skye. This porphyry differs from the ſienite-porphyry of Werner, in containing a greater proportion of felſpar, and comparatively little hornblende. Eſmark * informs us, that the Schemnitz and Cremnitz mining-fields, in Hungary, are ſituated in ſienite-porphyry; and alſo, that he obſerved it alternating and paſſing into clay-porphyry. This latter fact ſhows us that ſimilar alternations and gradations may be diſcovered in Raſay; as I remarked clay-porphyry, in ſeveral parts of the iſland, intermixed with the felſpar-porphyry.

Indigo-

* Neues Bergmanniſches Journal, bande 1, 2.

Indigo-blue coloured HORNSTONE PORPHYRY—*Raſay.*

Colour. Pretty dark indigo-blue (hoch indig blau).

Luſtre and Tranſparency. None.

Fracture. Even, with a tendency to the conchoidal.

Hardneſs. Strikes fire very plentifully with ſteel.

Smell. Faint earthy.

It has, diſperſed through it, yellowiſh-coloured cryſtals of felſpar, and alſo quartz of the ſame colour, which is ſometimes in the form of ſix-ſided pyramids. This beautiful ſpecies of porphyry ſeems to be intermediate between clay and hornſtone-porphyry, but, by reaſon of its hardneſs, it is more of the nature of hornſtone.

CHALCEDONY—*Rona.*

Colour. Grey, brown, or greeniſh.

Luſtre. Glimmering, with a greaſy luſtre.

Tranſparency. Allows light to paſs eaſily through it.

Fracture.

Fracture. Compact; ſometimes paſſing to the ſplintery.

Hardneſs. Gives fire with ſteel more plentifully than flint.

It is ſometimes intermixed with the gneiſs, in which it lies; and very thin ſtripes of a yellow and white-coloured ſubſtance alternate with it: ſo that, at firſt ſight, ſuch ſpecimens are not unlike petrified wood.

CHALCEDONY, penetrated with Hornblende—*Rona.*

Colour. Siſkin-green, of various ſhades; and ſometimes dark leek, or mountain green.

Luſtre. None, or hardly perceptible glimmering.

Tranſparency. It has more or leſs tranſparency, according to the intenſity of the green colour. If the colour is very pale, the tranſparency does not differ from common chalcedony; but as the colour approaches to dark leek-green, it becomes leſs tranſparent, until it is quite opaque.

Fracture. Compact, even, and ſometimes ſplintery.

Hardneſs. Is much the ſame with chalcedony, excepting when much hornblende is combined, when it is ſomewhat ſofter, and has a greater ſpecific gravity.

QUARTZ

QUARTZ—*Rona.*

Sometimes the quartz has a beautiful green colour, owing to diffuſed hornblende; and frequently the nearly-tranſparent quartz is variegated with beautiful ſpots and ſtripes of a ſiſkin-green colour: thus forming a beautiful foſſil. It is alſo to be obſerved of a red colour; and, being mixed with the common quartz, it is not unlike a granitel.

ON

ON PEAT.

CHAP. XXIV.

Obſervations on PEAT.

AS this ſubſtance is mentioned in all the Syſtems of Mineralogy, and as it occurs in great quantity in the Iſlands which I have juſt deſcribed, I do not think it neceſſary to apologiſe for the publication of the following obſervations and experiments. I propoſed, in a former work *, to continue my inveſtigations with regard to this ſubſtance, and had begun a new ſeries of experiments, when the Highland Society, by offering a prize of 50 guineas for the beſt account of Peat, induced me to wait the publication of theſe prize eſſays, which will, no

* Outline of the Mineralogy of the Shetland Iſlands.

no doubt, contain many new obſervations and experiments. If, however, the experiments, communicated in theſe memoirs, be different from what I had begun, I will certainly continue the plan I had laid down.

This curious and uſeful ſubſtance has been long known as an article of fuel to the inhabitants of the North of Europe, and uſed as ſuch, in thoſe regions where no coal has been found, to defend the inhabitants from the rigors of a frozen climate. The learned Torfœus informs us, that its uſe was firſt made known to the inhabitants of the Orkney and Shetland iſlands, by one Einar, a Norwegian, who, from that circumſtance, was named Torf Einar. It ſoon after this came into very general uſe, and is now the only fuel of many parts, not only of the iſlands and Highlands of Scotland, but of other nations in the North.

In deſcribing the general appearance of a peat moor, we may conceive an almoſt entire flat of ſeveral miles extent, of a brown colour, here and there marked with tufts of heather, which have taken root, owing to the more complete decompoſition of the ſurface peat; no tree or ſhrub is to be ſeen; not a ſpot of graſs to relieve the eye, in wandering over this dreary ſcene. A nearer examination diſcovers a wet ſpungy ſur-

face, paſſable only in the drieſt ſeaſons, or when all nature is locked in froſt. The ſurface is frequently covered with a ſlimy black-coloured ſubſtance, which is the peat earth, ſo mixed with water, as to render the moſs only paſſable by leaping from one tuft of heather to another. Sometimes, however, the ſurface of peat moſſes has a different aſpect, owing to the greater abundance of heath and other vegetables, as the ſchœni, ſcirpi, eriophora, &c. but this is principally the caſe with ſome kinds of what are called Muirlands, which contain but little peat, being nearly compoſed of the interwoven fibres of the roots of living vegetables.

Many different ſpecies of peat might be deſcribed, but ſuch an inveſtigation is not ſuited to my preſent purpoſe; I ſhall therefore content myſelf with mentioning the ſubſtance in a general way. Quick moſs (as it is called) is a ſubſtance of a more or leſs brown colour, forms a kneadable compound, and when good, cuts freely and clean with the ſpade; but when it reſiſts the ſpade, by a degree of elaſticity, it is found to be leſs compact when dried, and is of an inferior quality. The beſt kinds burn with a clear bright flame, leaving light coloured aſhes; but the more indifferent kinds, in burning, often emit a diſagreeable ſmell, and leave a heavy red-coloured kind of aſhes. In digging the peat we obſerve that, when firſt taken from

from the pit, it almoſt immediately changes its colour, and in time becomes more or leſs of a deep brown or black colour; and the peat matter becomes much altered, being incapable of forming a kneadable paſte with water. When dry and reduced to powder, as it is often by the action of the weather, it forms a blackiſh-coloured powdery matter, capable of ſupporting vegetation, when calcareous earth is added. Peat earth is very retentive of moiſture, which circumſtance affords us a ſatisfactory explanation of the floating iſlands, obſerved in many places of Holland, as Friſe, Breme, Groningue, Oldenburg, &c. Theſe are cauſed by the peat earth or turf, retaining ſo great a proportion of water as to float immenſe maſſes of it, which are driven about upon the ſurface of lakes, or are floated upon the land itſelf. This is ſo well known in Holland, that tracts of moſs, of great extent, are ſecured by means of chains, &c.

Peat is found in various ſituations, often in vallies or plains, where it forms very extenſive deep beds, from three to forty feet deep, as thoſe in Aberdeenſhire; it alſo occurs upon the ſides of mountains, but even there it is generally in a horizontal ſituation. The tops of mountains, upwards of two thouſand feet high, in the Highlands of Scotland, are covered with peat of an excellent kind. In Germany, it is alſo found at

very great heights; thus the Blogſberg, a high mountain in Lower Saxony, and the Brohen, the higheſt mountain in the Hartz, are covered to their ſummit with peat. It is alſo found in ſituations nearly upon a level with the ſea; thus the great moſs of Cree in Galloway, lies cloſe upon the ſea, on a bed of clay, little higher than flood-mark at ſpring tides; Locker-moſs, hard by Dumfries, about ten miles in length, is only a few feet above high water mark; in the iſland of Lewis, one of the Hebrides, there is an extenſive plain, about thirty miles long, covered with peat moſs, having its ſurface very little elevated above that of the ſea. In other places, as in Holland, a kind of peat is obtained by dragging mud from the bottom of canals, and moulding it into the form of bricks; this ſpecies is alſo often taken up upon the flukes of anchors, on the coaſt of Holland, and is ſometimes caſt aſhore in ſtormy weather, which has led ſome ſpeculators to imagine that it is of marine origin. In the harbour of Oban in Argyleſhire, one part of the bottom appears to be formed of quick moſs, which affords no ſure anchorage. The depth of the ſea is there about twenty fathoms *.

Sometimes peat is to be obſerved alternating in thin ſtrata with ſand or clay: of this, I have obſerved inſtances in the Orkney

* Anderſon's Treatiſe upon Peat Moſs.

Orkney iſlands; and in the ſecond volume of the Journal des Mines, I find ſimilar appearances noticed in France.

It appears to be peculiar to cold climates, which is one of the innumerable inſtances of the wiſdom of nature in providing the inhabitants of a cold country, with a material ſo neceſſary for their comfort, and even their exiſtence. Dr Anderſon, in his Treatiſe upon Peat, remarks, that it is not confined to cold climates, as he had ſpecimens of real peat ſent from the iſland of Sumatra. It is not improbable that a ſubſtance reſembling peat in ſome of its properties, may be found in the warmeſt countries, when we reflect that decayed vegetable matters, in a certain ſtage of their decompoſition, have an appearance ſo like peat, that they want only compreſſion to form a ſimilar ſubſtance. On this account, it is not ſurpriſing, that ſomething of this kind ſhould occur in the warmer regions; but great maſſes of matter like our peat, can hardly exiſt in the Tropical regions. This obſervation is rendered more probable from the following remarks: In Scotland, it is obſerved, that the peat, at the bottom of a mountain, is more decompoſed than at its top, and the wood of moſſes is more freſh upon the higher part of a mountain than at its lower. It is alſo remarked, that the peat of the South of England is more decompoſed than that of the North of Scotland;

land; and the peat of France has more of the coaly appearance, than that of England. In France alſo, Mr Arthur Young remarks *, that the peat is never found in the low lands, but under cover of vaſt ſize; and it is only in the higher regions, where the climate is more temperate, that it is to be obſerved upon the ſurface. All theſe facts ſhow us, in a ſatisfactory manner, that as we advance towards the warmer climates, the vegetable matter is more and more decompoſed, until we arrive at the Tropical regions, where, in all animal and vegetable matters, putrefaction proceeds ſo rapidly, as to prevent the formation of any body of this ſubſtance.

It will not be foreign to my preſent purpoſe, to mention, in a curſory manner, the moſt remarkable undecompoſed vegetable matters, which have been obſerved in our peat moſſes, or bogs; particularly as writers have endeavoured to draw concluſions, with regard to the time and mode of formation of peat, from the appearances which theſe bodies preſent.

1. Fir or Pine. This tree more frequently occurs, than any other; it is found of various ſizes, ſome having been dug about one hundred feet long, perfectly ſtrait, with branches growing in

* Travels through France.

in a circular form; as is the caſe with the pine tribe. It is remarkable, that in ſuch ſituations the wood has often loſt its latitudinal adhefion, which renders it ſoft; but that the longitudinal fibres are ſtrong and tough, ſo that they are ſplit, and twiſted, to form halters for cattle, as in Aberdeenſhire.

2. Oak. In all the low moſſes, in Scotland, this tree is the principal one which is to be obſerved, and is generally found wanting the bark, which ſhews that the wood had been long dead before it had been enveloped in the moſs. In draining Hartfell level, in Yorkſhire, oak trees were found, not leſs than 100 feet long. They were black as ebony, in excellent preſervation, and ſome of them ſold, in the middle of the laſt century for 15l. a tree. One of them, which is particularly deſcribed, was about one hundred and twenty feet long, twelve in diameter, at one end, and ſix at the other; and 20l. was offered for it. Beckman alſo informs us, that wood which has long lain under water becomes black, and looks as if charred; it however loſes none of its toughneſs or compactneſs; and many trees, dug up in Holland from the turf earth, are employed there for ſhip-building. * Dr Anderſon remarks, that he never ſaw a piece of oak taken from a peat moſs,

* Beckman, 6 vol. New Tranſactions of the Royal Society of Gottingen.

moſs, which could be uſed in workmanſhip, like the ſtakes which were lately taken from the Thames, and ſaid to have been placed there by Julius Cæſar; from this he concludes that moſs does not preſerve wood ſo long as water. This, however, is contradicted from the facts obſerved at Hartfell level, and that mentioned by Beckman.

3. Birch. This tree alſo frequently occurs in our peat moſſes, but its wood is not ſo reſinous as that of the fir, nor has it the hardneſs of the oak; on theſe accounts it is ſeldom found in a ſtate of good preſervation; the bark is generally the moſt entire, which may depend upon the great quantity of reſin which it contains, which enables it to reſiſt the all powerful hand of time.

The alder, yew, willow, aſh, and ſeveral other trees, have been dug out of our moſſes; but any detailed account of theſe would lead me to a great deal of unneceſſary deſcription: I may here mention, however, that, beſides trunks and branches of trees, we alſo ſometimes diſcover their more delicate parts in a ſtate of preſervation: thus, the leaves have been obſerved well preſerved. Seeds, which have a remarkable power in reſiſting the influence of the weather, have been found in peat moſſes; thus we have inſtances of fir cones and hazel nuts; the

the kernel of this laſt was deſtroyed, and the ſhell, which is very indeſtructible, was freſh.

Beſides trees and herbaceous plants, another tribe deſerve to be particularly noticed, which are the muſci. Theſe plants are fond of moiſture, and, with a ſufficiency of room to ſpread upon, and a cold climate, grow very faſt and luxuriantly. Of theſe the moſt remarkable is the ſphagnum paluſtre of Linnæus, which is found in great abundance in all peat diſtricts, particularly in thoſe places where the ſoft white peat abounds; this peat is found ſeveral feet deep, and is nothing but a collection of the ſphagnum, which we can obſerve more or leſs decompoſed as we go downwards; at laſt its texture diſappears, its colour changes, and it cannot be diſtinguiſhed from the common brown peat.

I have in my poſſeſſion ſpecimens of a ſubſtance, which was found in the peat moſſes of the Highlands; it anſwers to the Bergfet of the Germans, the Mineral Tallow of Mr Kirwan.

Deſcription. Colour, white; has nearly the reſemblance of tallow, feels greaſy, and ſtains paper as tallow does; flames with much ſmoke, leaving a pretty light coaly matter. It is brittle like tallow, but its ſpecific gravity is conſiderably leſs.

A ſubſtance ſimilar to this was found ſome years ago by peaſants on the coaſt of Finland, afterwards in one of the Swediſh lakes; and, more lately, Dr Babington informs us that it is found in great quantities in New Holland. Some have imagined that it is tallow which has been accidentally depoſited along with the peat, and, by long expoſure to the influence of the vegetable juices, may have been altered. This cannot be the caſe, as we are utterly unacquainted with any ſuch changes; and beſides, the circumſtance of its being found in great quantity in New Holland, leads us to ſuppoſe that it is not accidental. The editor of the Bibliotheque Britannique ſuppoſes that it is a ſubſtance ſimilar to the fatty matter into which the muſcular fibre is converted, when long expoſed in particular ſituations.

A great number of extraneous ſubſtances have alſo been found in peat moſſes, ſometimes at conſiderable depths; from their appearance, declaring, in certain characters, the great antiquity of ſuch moſſes. Many curious inſtances of this kind might be mentioned; one in particular deſerves to be noticed. In digging a moſs at Axholm, in Lincolnſhire, the body of a woman was found pretty freſh, her hair was unaltered, her nails were rounded, and her ſkin was tanned, ſoft and pliable; ſhe had antique ſandals upon her feet, which renders it proba-

ble

ble that ſhe was of the Roman æra. Another curious inſtance occurred in Shetland; in digging a peat moſs, the body of a man was found well preſerved, which, it was ſuppoſed, could not have been in the moſs leſs than eighty years. In the Iriſh moſſes the horns of the mooſe deer have been found; in our own, the head and horns of the urus occur. Dr Walker has in his poſſeſſion a drawing of the head and horns of a deer, found in a peat moſs, of a ſpecies now no longer found in Britain. Other ſubſtances occur in moſſes; thus, fragments of very ancient dreſs, and many inſtruments of human induſtry have, at different times, been diſcovered.

Analysis of the Peat of Glen-Cloy, Island of Arran.

Character.

It is of a blackiſh brown colour, pretty much intermixed with undecompoſed vegetable matter, which renders it rather looſe in its texture.

Solution in Water. *

1. I took one thouſand grains of powdered peat, boiled it repeatedly with diſtilled water, until no more could be diſſolved, then dried, weighed, and found eight hundred grains remaining.

The

* Lord Dundonald remarks, † that "the ſulphuric acid, when concentrated, acts in a ſimilar manner to that of alkaline ſubſtances, in the reſolution or deſtruction of animal and vegetable ſubſtances, diſengaging from them certain gaſſes, and forming therewith certain ſaponaceous and ſaline compounds. Theſe ſolutions or extracts are of a reddiſh-brown colour, ſimilar to that produced by the action of alkaline ſalts on oxygenated peat. On the principles already ſtated, the vitriolic acid may be uſed beneficially to decompoſe, and bring into action the inſoluble matter accumulated in ſoils, by the combination of the phoſphoric and foreline acids, with calcareous matter." The action of the ſulphuric acid upon vegetable ſubſtances engaged my attention five years ago, and in a paper read to the Royal Medical Society of Edinburgh, I endeavoured to ſhew (what has been ſince done more ſatisfactorily by Vauquelin and Fourcroy) that acetous acid is formed; that a portion of carbonaceous matter, deprived of hydrogen, remains in ſolution, and that carbon is ſeparated. It is certain that alkalies exert no ſuch influence upon vegetable

† A Treatiſe of the connection of Agriculture with Chemiſtry, 4to, by the Earl of Dundonald.

The ſolution had a deep brown colour, with a ſlightly bitter taſte; tinged litmus paper; and, by expoſure to the air for ſome time, part was precipitated in an inſoluble ſtate.

2. By paſſing the oxygenated muriatic acid through this ſolution, a precipitation of a dark-browniſh matter immediately takes place, ſimilar to what we obſerve by paſſing this acid through other vegetable infuſions.

3. Cauſtic

vegetable ſubſtances; in the preſent inſtance, they only diſſolve a portion of brown dehydrogenated matter, without cauſing any alteration in the proportion of the conſtituent parts. Their action upon animal ſubſtances, however, is more nearly allied: Vauquelin found, that ammonia was formed by the action of this acid; and I have reaſon for ſuſpecting that a ſimilar change is produced by the agency of potaſh or ſoda upon the muſcular fibre. A ſeries of experiments, which my father was lately engaged in, at the deſire of the honourable Board of Truſtees, led me to make this obſervation. We found that the muſcular fibre of fiſh, formed a brown-coloured ſolution, by treating it with the cauſtic potaſh or ſoda: during the ſolution, a ſmall quantity of ammonia was formed, but in a far greater proportion, when tallow is added and the boiling continued. During this extrication of ammonia, a blackiſh-coloured matter falls to the bottom, which is not acted upon by alkalies; in ſhort, it appears to be the carbonaceous matter of the muſcular fibre. This change appears to be a nearly complete decompoſition of the muſcular fibre, its hydrogen and azote forming the ammonia, whilſt the carbonaceous matter is left behind, forming the inſoluble matter. Vide Nicholſon's Journal.

3. Cauſtic ammonia, or carbonat of potaſh, did not cauſe any precipitation in the ſpace of twelve hours.

4. Pruſſian alkali did not afford any traces of the combinations of iron, copper, or zinc.

5. Lime water formed a copious brown-coloured precipitate.

6. Muriat of barytes, nitrat of ſilver, ſulphat of iron, ſulphat of copper, cauſed conſiderable precipitations; but nitrat of ammonia, muriat of ſoda, muriat of ammonia, did not produce any change.

The ſolution, being evaporated, left a blackiſh-brown coloured reſiduum, which had no peculiar ſmell. It preſents the following characters:—

a. Not ſoluble in ſpirit of wine, except by a boiling heat.

b. Difficultly ſoluble in water, without the aſſiſtance of heat.

c. Soluble

c. Soluble in cauſtic ſoda, at the common temperature, or when heated.

d. Soluble in cauſtic ammonia, in the ſame manner.

7. A quantity of the reſidue being put into a retort, connected with a pneumatic apparatus, a gradually-increaſing heat was applied, when the following appearances were obſerved. At firſt, water paſſed over, quite colourleſs; after ſome time, it was tinged brown; and towards the end of the operation, when no more brown liquor came over, carbonic acid, and carbonated hydrogen, paſſed in conſiderable quantity. No oil or ſaline matter could be detected, and not the leaſt traces of ammonia could be perceived. The carbonaceous reſidue was of a blackiſh-brown colour; inſoluble either in hot or cold water, but eaſily ſoluble in a weak ſolution of cauſtic ſoda.

The eaſe with which this carbonaceous matter is diſſolved in weak ſolutions of alkali ſhows, that it contains a conſiderable portion of hydrogen; (at leaſt this is the explanation given by modern chemiſtry:) for I find it impoſſible to diſſolve any perceptible quantity of charcoal with ſuch ſolutions.

8. The reſidue, by burning, affords a grey-coloured aſh; which I examined, in order to aſcertain the nature of the ſaline

line matters. It did not afford ſulphat of potaſh or ſoda, phoſphat of lime, or phoſphat of iron; only *ſulphat of magneſia*, and *oxyd of iron*.

To the eight hundred grains, which I found inſoluble in water, I added a ſolution of cauſtic ſoda, which acquired a brown tinge at the common temperature; but, when heated, a very deep-brown coloured ſolution was formed. After repeated digeſtion with the alkali, I was able to diſſolve four hundred grains: the remainder was undecompoſed vegetable matter, which was quite inſoluble in the alkali I uſed.

I next added muriatic acid to this alkaline ſolution; the diſſolved matter was precipitated of a brown colour, and did not appear to be altered by its combination with the alkali: for it was ſtill ſoluble in cauſtic ſoda and ammonia, inſoluble in water by boiling, but ſoluble in ſpirit of wine. When burnt, a brown-coloured aſh is left, which afforded ſulphat of lime and oxyd of iron; but in no inſtance did I find phoſphat of iron, or phoſphat of lime.

Properties

Properties of the Acid contained in Peat.

In relating the characters of the aqueous ſolution, I obſerved that it tinged litmus paper red. This ſhows the preſence of an acid, which I found to poſſeſs the following characters :—

1. It is not cryſtallizable, but may be obtained by evaporation, in the form of thin cruſts.

2. Taſte, ſlightly acid.

3. Forms compounds with lime, barytes, and ſoda; which I have not particularly examined. The compound of lime and this acid is difficulty ſoluble in water; which diſtinguiſhes it, on the one hand, from the Gallic acid, as it forms a very ſoluble compound with lime; on the other, from the oxalic, which forms an inſoluble ſalt with lime *.

* Lord Dundonald affirms, that peat contains the oxalic and phoſphoric acids, which, according to his explanation, are of great uſe in ſeveral of the operations of nature: thus, when lime is added to peat, it is imagined that an oxalat of lime is formed; which, by the addition of ſulphuric acid, is decompoſed, and a gypſum formed;

4. Decompoſes the acetite and nitrat of lead.

5. With ſulphat of copper, a copious brown-coloured precipitate is formed, having a beautiful green ſupernatant liquor.

6. With ſulphat of iron, it forms a brown precipitate, and a nearly colourleſs ſupernatant liquor.

7. Nitrat of copper changes the ſolution to a beautiful green, without cauſing any precipitation. In this it alſo differs from the oxalic acid, which cauſes a copious precipitation.

8. Muriat and nitrat of barytes are decompoſed by it.

9. With a ſolution of ſulphat of indigo, it forms a beautiful green colour: in this it alſo differs from the oxalic acid, which does not produce any change of colour.

This

formed; while the oxalic acid enters into new combinations, uſeful in promoting the growth of plants. We have already ſhown, however, that this acid of peat is very different from the oxalic; but, allowing it to be the ſame, it is contrary to well known chemical affinity, to ſuppoſe, that the ſulphuric acid can decompoſe the oxalat of lime. In the experiments I have made, none of the combinations of phoſphoric acid appeared.

This acid appears to be the ſame with the ſuberique acid, lately diſcovered by Buillion La Grange, and which he imagines to be a compound of carbon, hydrogen and oxygen.

Diſtillation of Peat.

A quantity of this peat was carefully diſtilled, when a deep yellowiſh-brown coloured liquor was obtained: it had a ſtrong empyreumatic ſmell, and, by expoſure to the air, it acquired a conſiderable conſiſtence. I did not examine particularly this liquor: I only found that, by the addition of quicklime, much ammonia was ſeparated. Giroud, in the firſt volume of the Journal des Mines, mentions pretty fully the properties of this liquor. He finds that it is an ammoniacal ſoap; which, from the many experiments he made, he thinks, may become of conſiderable uſe: thus, the ammoniacal ſoap, being decompoſed by ſea ſalt, would form a cheap muriat of ammoniac, and the oily matter, by proper management, may anſwer for ſome purpoſes in the arts.

Carbonization of Peat.

The late improvements in agriculture have pointed out a method of converting much of the peat, which is ſo abundantly ſpread over the Highlands, into a good and productive ſoil: yet ſtill there is a great deal of it loſt, not only in theſe operations, but alſo from its being ſituated where the labours of the farmer would be employed with little advantage. From theſe circumſtances, it is certainly deſerving of attention, to endeavour to diſcover ſome means of employing this waſte vegetable matter; and thus to raiſe new ſources of induſtry in parts of the country where there are now only extenſive and dreary waſtes, without an inhabitant. As the want of common coal and charcoal, in moſt parts of the Highlands, appears to have been the cauſe why many promiſing mineral appearances have been abandoned; I think that it is not improbable that charcoal, from peat, may, if carefully prepared, be uſed with common charcoal, or even by itſelf, in the working of ores. This is not an opinion founded upon mere ſpeculation, for it has been actually put in practice in different parts of Europe: thus Baron Dietrich informs us that it is uſed in the Hartz for the ſmelting of iron ores. As the ſucceſsful proſecution of this practice would be of much conſequence to the Highlands of Scotland,

Scotland, I think it of importance to ſtate ſhortly the different methods that have been followed to obtain a good charcoal from peat.

Two methods have been followed in theſe trials: the one, by expoſing the peat to a ſmothering heat, as is practiſed in the making of charcoal from wood; the other, by expoſing it to heat in cloſe veſſels or furnaces, and thus ſubjecting it to a kind of diſtillation.

So long ago as 1631, Lamberville † ſeems to have uſed the firſt proceſs; but his attempts were not ultimately ſucceſsful, as his charcoal was too friable; conſequently, of no uſe in the forge, and other ſimilar operations. In the Hartz, Dietrich obſerved that they carboniſed the peat in large cylindrical iron veſſels: but this was found to be too expenſive; beſides, the volatile matter, ſeparated from the peat, was ſaid greatly to injure the veſſels. At Villeroi, in France, peat was carboniſed by burning it in a furnace not unlike the common lime-kilns of this country: this method, like the other, was alſo found to be unprofitable. Theſe different methods, as Ribacourt † remarks, are very objectionable; as they do not allow the watery, oily, volatile and

† Journal des Mines, vol. 1.

and ſaline matters of the peat to ſeparate, without, at the ſame time, conſuming a portion of the carbonaceous matter, which cauſes a great diminution of the peat: beſides this inconvenience, the peat is always irregularly burnt; one portion being in the ſtate of charcoal, the other, with a conſiderable portion of the watery and other matters, not ſeparated.

The ſecond proceſs, which is the ſubjecting the peat to a kind of diſtillation, ſeems from all the trials which have been made to be the moſt promiſing. Pfeiffer, in a work entitled, Hiſtoire de Charbon de terre et de la tourbe, &c. publiſhed in 1777, deſcribes a furnace, in which he diſtilled peat, and obtained a ſolid charcoal. Thorin, in 1791, obtained a recompence from the French government for a method of carbonizing peat in an improved iron furnace, by which he obtained a firm and uſeful charcoal. This method, however, was ſoon found to be unprofitable, on account of the great waſte of the iron veſſels by the fire, and the action of the volatile matters of the peat on them. More lately, Blavier ‡ has publiſhed an account of a furnace, which is conſtructed of ſtone, and at little expence, and is ſaid to anſwer excellently for the carbonization of peat; and, beſides, it has this advantage, that all the volatile,

‡ Journal des Mines, vol. x.

volatile, oily, and alkaline, matters are eaſily collected. I at one time intended to give drawings of this furnace, but I am confident that the importance of this ſubject will lead the authors for the prize queſtion, to make this the object of experimental enquiry. From this ſhort account which I have given we have reaſon to ſuppoſe, that by the adoption of a furnace ſomewhat ſimilar to that of Blavier, peat, at little expence, may be carbonized with advantage in the moſt remote corner of the Highlands.

Before leaving this ſubject, I will ſhortly mention the various trials that have been made with charcoal of peat, with a view of determining the difference between it and that obtained from wood. Sage* found that the charcoal of peat gave a ſtronger and longer continued heat than the charcoal of wood; and, further, that the charcoal of wood gives only a third of the heat of that of peat. Two furnaces of equal ſize, and in every other reſpect alike, were employed to melt a quantity of ſilver, when it was found that it required a greater quantity of charcoal of wood than that of peat to bring it into fuſion. An experiment was alſo made in the great way at Paris to aſcertain the utility of peat charcoal in the boiling of liquids,

* Journal de Phyſique, 1786.

quids, when it was here alſo found to have great advantages over that of wood. †

In metallurgic operations peat has been by ſome conſidered as very pernicious, while others find it not leſs uſeful than charcoal from wood. Dr Lind, in the Edinburgh Phyſical Eſſays, remarks, " that there exiſts in peat an inflammable ſubſtance, " which produces upon metals the ſame effect as ſulphur, ren- " dering them brittle. Another inconvenience which I have " had the misfortune to experience is this, that a ſtrong heat " converts the charcoal of peat into a glaſſy ſubſtance, which " collects along the ſides of the furnace, obſtructs it, ſtops up " the paſſage by which the melted metal ſhould run, and hin- " ders it from collecting in the lower part of the furnace." This obſervation, which ſeems very unfavourable for the employment of the charcoal of peat in the ſmelting of ores, probably deſerves little credit; or if it be true, it only ſhews us that it is neceſſary that the nature of the peat ſhould be known before it is employed, for, by its admixture with various extraneous matters, it may poſſibly become pernicious. That it is innoxious and uſeful, Dietrich has proved; and even Lamberville, in 1626, aſſures us that it was ſucceſsfully uſed in the

† Journal des Mines, vol. 1.

the working of iron. More lately, experiments were made at Paris, when even the temper of ſteel was not in the leaſt hurt by it. *

Soap from Peat.

I endeavoured in various ways to make a ſoap from peat, but always found that it gave a brown colour to the cloth. *See Nicholſon's Journal, Vol. III.*

Theory of the Formation of Peat.

The frequent occurrence of peat in many countries has naturally attracted the attention of philoſophers, who have endeavoured to diſcover the mode of its formation. One claſs of obſervers have contented themſelves by endeavouring to ſhow that it is of vegetable origin, and have only differed as to the probability of wood, or moſs alone, or jointly, having formed it; others again, having admitted its vegetable origin, differ only in the explanation of the means which nature uſes

* Journal des Mines, vol. x.

in the preſervation of the vegetable remains. Laſtly, it has been conjectured, that it is a *live vegetable*, *ſui generis*; and an elegant poet having admitted its vegetable origin, has ſuppoſed ſome changes it undergoes by elutriation, &c.

There can be no queſtion of the vegetable origin of this ſubſtance: any other opinion is but vain and frivolous: and, it is alſo inconſiſtent with fact, to aſſert, that either wood or moſs ſingly are the only ſubſtances that form peat; for we know that in moſt caſes they both contribute to its formation. In conſidering the peculiar ſtate of preſervation of the vegetable matter in peat, it is very generally believed that fallen wood, when it begins to putrify, produces an extract of the nature of tan, which preſerves the moſs that grows up among the trees, and converts it into peat. This opinion is founded upon the known action of aſtringent ſubſtances in preſerving animal ſubſtances from decay; it will therefore be neceſſary to examine this proceſs, to diſcover if it will help us to explain the phenomena of peat. It is but lately that we have had any probable explanation of the tanning proceſs; and we are indebted to an excellent chemiſt, Seguin, for ſome intereſting experiments and obſervations upon this ſubject.* He informs us,

* Journal of the Polytechnic School of France.

us, that oak bark, &c. contains two ſubſtances, the tanning principle, which has a great affinity for gluten, and the gallic acid, which has a powerful attraction for oxygen. When a ſolution of bark is applied to ſkins, he ſuppoſes that the gallic acid abſtracts oxygen from the muſcular fibre and reduces it to the ſtate of gluten, when it immediately combines with the tanning principle, forming a compound, which is the cauſe of the indeſtructibility of leather. We have already ſhewn that peat does not contain the gallic acid; but, allowing that it does, it is impoſſible to conceive ſuch an action to take place with regard to vegetable matters, particularly in peat, which I have found from experiment to contain no tanning principle. It will therefore be neceſſary to inveſtigate the influence of vegetable acids, &c. upon vegetable matters, before any probable opinion of this kind can be formed.

The ſingularity of the appearance which peat preſents, has led Dr Anderſon to conclude, that it is a *live vegetable, ſui generis*. This he imagines to be very ſatisfactorily proved, from the ſuppoſed impoſſibility of decaying vegetables poſſeſſing properties ſimilar to peat. He remarks, " That in vegetables, " which have once fallen into a ſtate of putreſcency, their in- " flammability decreaſes in proportion as that putreſcency " augments; and that their chemical qualities ſuffer an alter-

" tion proportioned to the ſame circumſtance. But by the " hypotheſis of every perſon who ſuppoſes that ſphagnum is " the original conſtituent matter of moſs, it is always under- " ſtood that the foggy peat, by their hypotheſis, is the ſphag- " num ſtill ſo little decayed, as not yet to have become per- " fect moſs; and, that in proceſs of time, it gradually be- " comes more and more perfect moſs, as it gradually becomes " more thoroughly putrid, till at laſt, it loſes even the appear- " ance of ſphagnum, and becomes hard, and perfect peat; " that is to ſay, in other words, as it becomes more putrid, it " becomes more inflammable, which is directly the reverſe of " the well known progreſs of nature in every other caſe." It is upon this and ſome ſimilar arguments, that the Doctor rejects the opinion of moſs being a collection of decaying vegetable matters. But to theſe we may ſhortly anſwer, that decaying vegetables only loſe their power of burning, with the deſtruction of their carbonaceous matter; but this we know requires a very long ſeries of years, and when the vegetable matters are in a moiſt ſituation, as is the caſe with peat, ſuch a decompoſition may be prevented for hundreds of years.

The laſt theoretical opinion with regard to peat, which I ſhall mention, is contained in a note of Dr Darwin's beautiful poem, the Botanic Garden. He there gives us a truly ſtrange account

account of the changes which peat moſs undergoes by elutriation, fermentation, and the conſequent heat. As this is little elſe than a *dream*, it might be paſſed over; but it is detailed in the form of matter of fact, and therefore requires to be noticed. He remarks, "That moraſſes, in great length of time, undergo a variety of changes; firſt by elutriation, and afterwards by fermentation, and the conſequent heat. By water perpetually oozing through them, the moſt ſoluble parts are waſhed away, as the eſſential ſalts; theſe, together with the ſalts from animal recrements, are carried down the rivers into the ſea, where all of them ſeem to decompoſe each other, except the marine ſalt. Hence the aſhes of peat contain no alkali; and are not uſed in the countries where peat is uſed as the fuel of the lower orders, for the purpoſe of waſhing linen. The ſecond thing which is always ſeen oozing from moraſſes, is iron in ſolution, which produces chalybeate ſprings, from whence depoſitions of ochre and variety of iron ores. The third elutriation ſeems to conſiſt of vegetable acid, which, by means unknown, is converted into all the other acids. 1ſt, Into marine and nitrous acids; 2d, into vitriolic acid, which is found in ſome moraſſes ſo plentifully, as to preſerve the bodies of animals from putrefaction, which have been buried in them; and this acid, carried away by rains and dews, and meeting with calcareous earth, produces gypſum or alabaſter,

with

with clay it produces alum, and, deprived of its vital air, produces ſulphur. 3d, Fluor acid, which being waſhed away, and meeting with calcareous earth, produces fluor or cubic ſpar. 4th, The ſiliceous acid, which ſeems to have been diſſeminated in great quantity, either by ſolution in water, or by ſolution in air, and appears to have produced the ſand in the ſea, uniting with calcareous earth previouſly diſſolved in that element, from which have been afterwards formed ſome of the gritſtone rocks, by means of a ſiliceous or calcareous cement. By its union with calcareous earth in the moraſs, other ſtrata of ſiliceous ſand have been produced; and by the mixture of this earth with clay and lime aroſe the beds of marl." After this follow ſome whimſical notions about the formation of coal, which are connected with ſome ſuppoſed changes produced by fermentation and heat. We ſhall now, in as few words as poſſible, examine the truth of the ſuppoſed change by elutriation, which is all that intereſts us at preſent. As to the firſt poſition, that the ſalts are carried to the ſea and decompoſe each other, we have no manner of probability, far leſs proof. The third ſtage of elutriation, where a vegetable acid makes its appearance, ſhould have been confirmed by experiment; its ſuppoſed converſion into marine and nitrous acids is perfectly chimerical. I have not found ſulphuric acid in peat, nor does Dr Darwin inform us that he had detected it;

it; therefore any reaſoning founded on its action muſt be ideal.* The exiſtence of the fluor acid in moraſſes, and the ſpeculations about the ſiliceous acid, are all conjectures as odd and improbable as could be contrived.

Having now mentioned the principal opinions with regard to the formation of peat; and having ſtated ſuch objections as occurred to me; I will now endeavour to aſcertain, upon chemical principles, the peculiar ſtate of the vegetable matter when in the form of peat. In viewing the various phenomena of decaying vegetables, two diſtinct ſtages may be obſerved—

* "The common vitriolic acid, I believe, has never been found in nature, free from all combination, though it may unite with ſome bodies beyond the point of ſaturation. It is true, Mr Baltaſſari ſays, he found ſome dry concentrated vitriolic acid adhering to ſelenite, in a grotto in Monte Zaccolina, near Sienna; but this has been fully diſproved by the ſubſequent obſervations of Mr Murray, in the 7th volume of the Memoirs of Stockholm, and of Mr Dolomieu, in his Notes upon Bergmann de Prod. Volcan. page 88." *Kirwan's Mineralogy, Vol. II. p.* 2.

More lately, however, in the eighth volume of the Bibliotheque Britannique, we are informed, that, upon examining a water from Savoy, it was found to contain a conſiderable quantity of uncombined ſulphuric acid.

ſerved—the acetous and putrefactive fermentations. Theſe proceſſes are much modified by circumſtances; depending upon the degree of heat, moiſture, the preſence of air, and the greater or longer continuance of the action of theſe agents. The putrefactive fermentation is the one which here claims our chief notice; for, attention to the appearances it preſents will enable us to judge better of the ſtate of vegetable matter in peat.

In the putrefactive proceſs, if the heat be conſiderable, the deſtruction of the vegetable matter is ſoon accompliſhed: the whole is diſſipated in the form of carbonic acid, carbonated hydrogen, and ſometimes ammonia; a ſmall portion of charcoal and aſhes being left behind *. A more moderate degree of

* It is plain, that, in general, wherever carbonic acid and carbonated hydrogen gaſſes are formed, both earthy and ſaline matters will be left behind; for carbon, which enters into the compoſition of theſe gaſſes, contains neither earthy nor ſaline matters. This being admitted, we can account for the preſence of ſaline matters in plants, without any great ſtretch of hypotheſis. It has been diſcovered by Lampadius, profeſſor of chemiſtry at Friburg, that charcoal decompoſes water at the common temperature; and as all ſoils contain carbonaceous matter, it is plain, that, during the formation of theſe gaſſes by the action of the ſun's rays, a quantity of ſaline matter will be left in the ſoil for the uſe of vegetables.

of heat, with moiſture, allows the matters to decompoſe more ſlowly, and to preſent the vegetable matter in ſeveral other intermediate ſtages, ſuch as we obſerve with regard to peat when more or leſs decompoſed. A very great proportion of moiſture has a powerful influence in retarding this proceſs: thus, the trees, which are found at the bottom of moſſes, are freſher than thoſe at the top, owing to the bottom containing a greater quantity of water; and the ſtakes, lately taken out of the Thames, are another remarkable inſtance of this.

From theſe circumſtances, it is plain, that peat is a vegetable ſubſtance, which has undergone in part, and is ſtill undergoing, the changes which have been juſt mentioned; and many facts lead me to conclude, that the common peat, or quick moſs, is the vegetable matter, deprived of a conſiderable portion of its hydrogen. Not only the circumſtances attending the ſituation and appearance of peat, but alſo other facts, render this opinion probable.

1. Sulphuric acid being added ſlowly to oils, and triturated, they gradually become brown, when the oil is rendered ſoluble in water and ſpirit of wine; but, if the acid be added in too great quantity, a black inſoluble matter is formed.

2. If oleum animale be expoſed to the action of oxygenous gaſs, water is formed, and carbon precipitated.

In this laſt experiment, we perceive, that the ſeparation of hydrogen cauſes the precipitation of carbon: and, in the experiment with the ſulphuric acid, we obſerve, that, in proportion as the hydrogen is diſſipated, the carbonaceous baſis becomes more or leſs ſoluble in water; and when the whole of the hydrogen diſappears, a true carbon is left behind. In the ſame manner, with regard to peat, the woody, or other vegetable matters, are ſlowly deprived of a portion of their hydrogen, become brown, and ſomewhat ſoluble in water and ſpirit of wine; thus forming a kind of bituminous matter *. By a further decompoſition, more hydrogen is ſeparated, when the vegetable matter becomes inſoluble in water, but ſtill ſoluble in alkali; laſtly, nearly the whole of the hydrogen is ſeparated, when a black ſubſtance is left, what is called Peat Earth. This laſt, by expoſure to the air, combines with a portion of oxygen, forming ſuberique acid; and appears to be what Lord Dundonald calls Oxygenated Peat.

If

* Vide Mr Hatchett's excellent paper on Bituminous Subſtances, inſerted in the 4th volume of the Linnæan Tranſactions.

If this explanation be thought to have probability in its favour, we may explain ſome other facts in a pretty ſatisfactory manner. Thus the great Captain Cook remarks, that the coaſt of Tierra del Fuego is covered with peat-moſs, and the water which runs from it has a brown turbid appearance. At one time, he was obliged to water upon this dreary ſpot, and could obtain no other water but that from the peat moſs, which made him very ſuſpicious of its good qualities, ſo that at firſt it was but ſparingly uſed. Having ſoon got into the warmer regions of the Pacific Ocean, he found that this water depoſited a ſmall ſediment, became pellucid, and was the moſt wholeſome and freeſt from putrefaction of any he had on board. It is probable that the infuſion of peat acted, in this caſe, in a ſimilar manner with charcoal, (from which it differs but little,) by abſtracting the putreſcent matter. Another curious fact is mentioned by Dr. Plott—that intermittent fevers never occur in the neighbourhood of peat-moſſes. This appears to be owing either to the ſlower decompoſition of the organiſed matter in peat-moſſes than in fens, by which a ſmaller portion of noxious gaſs is formed; or to the abſorption of theſe gaſſes by the peat matter approaching to the ſtate of charcoal. This laſt explanation is rendered the more probable from a well-known fact, that in church-yards, where a great number of dead bodies are buried, no bad ſmell is to be perceived; evi-

dently owing to the abſorption of the noxious gaſſes, by the carbonaceous matter of the ſoil.

Improvement of Moss Land.

The method of improving peat moſs, by means of calcareous earth, is certainly one of the moſt uſeful diſcoveries of the preſent day, and will, no doubt, form an important era in the annals of agriculture. Not long ſince, peat lands were only conſidered as uſeful on account of the fuel which they afforded. The caſe is now widely altered: the moſs grounds are eagerly ſought after: and, in the weſt of Scotland, this method of improvement is carried on with great ſpirit, and is repaying the judicious manager very amply. To give a detailed account of the methods which are followed, (and that is the only one that can properly be given,) would require a volume; and, after all, would be little more than a repetition of what is already known. I ſhall therefore content myſelf with endeavouring to apply the preceding experiments, to explain the mode of action of the calcareous earth.

We have already obſerved that peat contains the ſuberique acid, or one nearly allied to it, which appears to be formed in greater quantity the longer the peat is expoſed to the action of the

the air; thus aſſiſting in retarding the decompoſition of the peat, of courſe preventing its being uſeful in vegetation. Marle, ſhells and limeſtone are uſeful, in a triple capacity: in the firſt place, by removing the acid, the vegetable matter is allowed to decompoſe more rapidly; ſecondly, the combination of this acid with the lime, forms a compound, which may aſſiſt in vegetation; and, laſtly, this acid having a ſtronger attraction for lime than the carbonic, will diſengage it in conſiderable quantity, when it will aſſiſt vegetation.

I ſhall conclude, with remarking, that there is a conſiderable prejudice in favour of quicklime: if the explanation now given have any plauſibility, it is plain that carbonat will anſwer as well, if not better, in the improvement of moſs lands.

FROM

FROM BERNERA TO THE FRITH OF FORTH.

CHAP. XXV.

Journey from BERNERA, *by Fort-Auguſtus, Garvimore, Dalwhynnie, Dalnacardoch, Blair in Athol, Dunkeld, and Perth, to the Frith of* FORTH.

HAVING viſited all the iſlands that lie immediately along the weſt coaſt of Scotland, from the Craig of Ailſa to the iſland of Skye; we agreed to defer, till another ſeaſon, our expedition to the chain of iſlands that lie farther to the weſtward. We therefore left Armidale, in the iſland of Skye, and ſailed up the ſound to Elean-reach, which is ſituated upon the mainland of Scotland. Here we landed, after a pleaſant paſſage of three hours. The ſcenery, upon both ſides of the ſound, was grand, and particularly about Loch-Houron. Though the mountains are peculiarly rugged and ſterile, yet this ruggedneſs

neſs was ſoftened in the diſtance; and the airy tints of their ſummits, with the deep ſhadows on their baſe, marking ſtrongly their vallies and furrowed ſides, formed a beautiful mountain ſcene. As we paſſed the mouth of Loch-Houron, the day was ſerene; and the placid waters beautifully reflected the mountain ſkreens, which ſucceſſively burſt forth, and retired as we ſailed along. The houſe of Mr Macleod is a ſheltered retreat, almoſt hid among trees: it lies on the ſea-ſhore, on the ſide of a grand amphitheatre of rocks, which opens to the ſound of Skye. As our ſtay here was very ſhort, I can ſay little with regard to its mineralogy; yet, from what I ſaw, I have little doubt that, upon attentive examination, many intereſting appearances might be diſcovered. The rocks are entirely of primitive formation, and are compoſed of micaceous ſhiſtus, gneiſs and hornblende-rock, and are traverſed by great veins of granite. In ſeveral places, I obſerved great maſſes of lapis ollaris, which contained beautiful ſpecimens of green actynolite, and green hornblende. We remained all night at this place, and in the morning ſet out on our journey homewards. We walked along the ſhore for about 2 miles to Bernera, where there are the remains of barracks that were built in this ſequeſtered ſpot after the troubles in 1745. The rocks in this direction are ſtill of the ſame nature with thoſe at Elean-reach, but principally of gneiſs. From this we entered into Glen-elg, which

which is an extenſive valley bounded on both ſides by great mountains. The lower part is cultivated, and vegetation is even obſerved covering the tops of the hills. The prevailing rock is micaceous ſhiſtus, but gneiſs is ſometimes to be obſerved in the higher parts; and both kinds of ſtrata are traverſed by granite veins. In our walk towards the upper part of the glen, I picked up ſeveral ſpecimens of tremolit, which adhered to maſſes of quartz, and ſeemed to be derived from the ſtrata or veins in the neighbouring mountains. Having reached nearly to the upper part of this glen, we aſcended, by a broken military road, to the top of a hill, which ſeems to be principally compoſed of ſienite. From this elevated point, we had a grand view of mountain ſcenery; vallies beautifully retiring, in miſty colours, among ſkreens of mountains, lightened with catching gleams: below us, appeared a pretty extenſive loch, apparently ſurrounded by lofty mountains. We now deſcended to the ſide of the loch, by many windings down a very rugged and ſteep road, when we obſerved that the loch communicated with the ſea, and its ſides were adorned with gentlemen's ſeats. Although the ſcene was ſtill beautiful, yet our ideas altered ſtrangely, when, inſtead of the calm and cultivated retreat on the banks of an inland lake, we found an oozy bank, covered with ſlime and ſea-weed, left by the retiring tide. The ſame ſienite rock continues to the ſide of the loch;

and

and from this to Ratachan Inn, which is ſituated at the upper part of the loch, the country is low, preſenting ſtrata of micaceous ſhiſtus.

As we were obliged to remain here the reſt of the day, we examined ſlightly the hills in the vicinity. They riſe to a a great height, are bare and rugged toward their ſummits, and, ſo far as my examination went, appeared to be compoſed of micaceous ſhiſtus, which ſometimes paſſes into gneiſs, and is traverſed by veins of granite.

We left the inn next morning before ſun-riſe, as we had to perform a long and dreary journey of nearly forty miles before the evening. Immediately after leaving the inn, we entered, by a narrow, abrupt paſs, into Glen-Sheill. Tremendous mountains roſe on each ſide, but, farther diſtant, all was dark and indiſtinct: it was but twilight; the obſcurity thus thrown over the ſcene was peculiarly impreſſive. Before us, towards the head of the glen, the clouds were cleared away as the day advanced, and the opening, the modeſt, mellow tints of the morning cheared us with the proſpect of a charming day for a journey through a country ſo dreary and wild. We were ſoon grievouſly diſappointed: the clouds were ſeen rapidly covering the mountains; the ravines, ſituated near the ſum-

mits, appeared white, from the water ruſhing over their rugged bottom; and ſoon the whole glen was obſcured, and the rain poured down with great violence. We continued our diſagreeable journey, which had but little diverſity: only, now and then, a partial diſperſion of the clouds allowed us to obſerve many grand, peaked mountains, riſing to a tremendous height, far beyond the boundaries of the glen. At length, having reached far up the glen, we came to a narrow paſs, where the waters were collected from the neighbouring mountains. They were precipitated over rude fragments of the rocks; and, ſwollen and pent up in a narrow channel, ruſhed impetuouſly forth until they gained the level bottom of the glen, where the river flowed "calm, ſluggiſh, ſilent." Such ſcenes are the greateſt ornament of the Scottiſh glens—where the ſtream, collected from the rude mountains, glides thro' the moſſy wilds, and deſcends, by ſucceſſive falls, thro' the rocks, ſhadowed by the overhanging woods, till gathering ſtrength, "it boils, and wheels, and foams, and thunders thro." Indeed, in the courſe of this glen, we ſaw all the various beauties which a river diſplays in a wild and mountainous country. The tumultuous noiſe of the waters was reverberated from the neighbouring mountains, and continued to be heard long after we had loſt ſight of them. The road was now nearly impaſſable, torrents croſſing it every few yards; which, in ſome places, were ſo rapid

and

and deep, as to endanger our lives in croſſing them: our guide having ſtumbled, with great difficulty ſaved himſelf. Having forded theſe torrents, we at length advanced into a more open part of the glen, where the road was better: here the ſtorm began to abate; the clouds gradually roſe; and in a few hours the ſun again beamed upon us. When we looked back to the mountainous ſcene of Glen-Sheill, ſtill obſcured by dark clouds, it formed a ſtriking contraſt with the ſcene before us.

We now travelled, by a broken and winding road, to the ſide of a loch called Clouny, which is of conſiderable extent, and bounded on both ſides by lofty mountains. On their lower parts, theſe mountains are ſkirted by natural wood. We walked along the ſide of this loch, to its farther extremity, which brought us nearly to the entrance of Glen-Moriſon. This glen is conſiderably different, in appearance, from Glen-Sheill: the hills which bound it are lower, and have much of the round-backed ſhape. We deſcended into this glen, and walked ſeveral miles, when we reached a dirty black houſe, called Unach Inn.

The country through which we had paſſed in coming from Ratachan inn, will afford much inſtruction to future travellers; but as my journey was rapid and attended with every

inconvenience, I can give but little information as to its peculiar nature. The mountains of Glenſheill appear to be compoſed of micaceous ſhiſtus, which is ſometimes alternated with hornblende ſlate, and veins of granite appear traverſing theſe ſtrata in various places. At Loch Clouny, however, the micaceous ſhiſtus diſappears, when great hills of red granite are to be obſerved; and this rock ſeems to bound both ſides of the loch, as is well marked, not only by the red colour of the debris along its banks, but alſo by the appearance of the broad flat faces, ſimilar to what we obſerve in the great granite glen Roſa in the iſland of Arran. This granite continues for about a mile, when the micaceous ſhiſtus again makes its appearance; and near the junction of the granite and micaceous ſtrata, great veins of granite are to be obſerved traverſing the micaceous ſhiſtus, and ſeveral of the veins ſeem to iſſue from the granite itſelf. The greater part of theſe granite veins, however, have a different appearance from that of the great body of ſtratified granite, its conſtituent parts being of a great ſize. The micaceous ſhiſtus continues to Unach inn, but it is in ſeveral places alternated with hornblende-rock, and traverſed by granite veins.

As the appearance of the granite veins ſhooting from the granitical ſtrata into the micaceous ſhiſtus, &c. has been conſidered

conſidered by the late Dr Hutton as a proof of the poſterior origin of granite to the ſtrata which cover it; I think it neceſſary now to conſider the plauſibility of an opinion ſo contrary to that of the beſt informed geologiſts.

Dr Hutton maintains, "that all the ſolid ſtrata of the earth have been conſolidated by means of ſubterranean heat; ſoftening the hard materials of theſe bodies; and that in many places theſe conſolidated ſtrata have been invaded by huge maſſes of fluid matter ſimilar to lava, but for the moſt part perfectly diſtinguiſhable from it †." Granite he conſiders as a body which has been transfuſed in a fluid ſtate from the ſubterranean regions, and made to break and invade the ſtrata in the manner of baſalt. His evidence for this opinion is as follows: He obſerved in the bed of the river Tilt, near to Blair in Athol, that the granite and ſhiſtus were much intermixed at their junction; and in the ſhire of Galloway and the iſland of Arran, veins of granite ſeemed to iſſue from the ſtrata of granite and traverſe the ſhiſtus; from this he concluded, as all veins are of a poſterior origin to the ſtrata which they traverſe, that the veins of granite which traverſe the ſhiſtus, being continuous with the granite, make the whole after formation

† Philoſophical Tranſactions of the Royal Society of Edinburgh, Vol. III.

mation to the ſhiſtus. Many objections occur to this hypotheſis, and I ſhall now mention a few of them.

1*ſt*, If granite had flowed from below, how does it happen that after it had burſt through the ſtrata of micaceous ſhiſtus, &c. it did not overflow the neighbouring country? If this hypotheſis were true, Mont Blanc could never have exiſted.

2*d*, If the granite had been forced up with the violence which Dr Hutton ſuppoſes, we ſhould expect that the ſtrata of micaceous ſhiſtus, or other ſtrata that cover granite, ſhould be invariably diſturbed and broken in every direction, but more particularly at their junction. This is by no means the caſe; Sauſſure, Charpentier, and others, have examined vaſt tracts of granite country without obſerving ſuch appearances; and in Scotland I have examined great tracts of granite, but the appearances deſcribed by Dr Hutton occurred rarely.

3*d*, If all kinds of granite have been ejected from below, and if all veins of granite communicate with a central maſs of granite, how ſhall we explain the appearance of granite veins in countries where no ſtrata of granite have been obſerved? nay, where theſe veins have been traced from their beginning to their

their termination in the ſhiſtus, a ſufficient proof that they are not connected with any granite underneath?

4th, The general obſervation that the granite which runs in veins has a character different from that found in ſtrata, intimates ſtrongly that it has been found at a different period from the granite in ſtrata.

Theſe objections bear much againſt Dr Hutton's opinion, and may probably appear, in a conſiderable degree, to diſprove it. I ſhall not ſtop here, however, but ſhall now mention a fact, which to me ſeems to remove in a conſiderable degree the doubts with reſpect to the connection of the granite with the other ſtrata. The obſervations of Werner, Charpentier, Sauſſure, Reuſs, and other geologiſts of the higheſt character, have demonſtrated that granite, when it is covered by ſtrata of gneiſs, gradually acquires a ſhiſtoſe fracture, and at length is not to be diſtinguiſhed from it; the gneiſs, when covered by micaceous ſhiſtus, gradually paſſes into it by the loſs of its felſpar; and laſtly, when ardeſia, or primitive argillaceous ſhiſtus covers the micaceous ſhiſtus, a diſtinct gradation is to be obſerved by the diſappearance of the quartz, and the encreaſe of the argillaceous ingredient. Here then we have a demonſtration that theſe different ſtrata have been formed in

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the ſame manner, and nearly at the ſame time; therefore any ſpeculations which refer to one of theſe kinds of ſtrata are equally applicable to the others; conſequently the hypotheſis of Dr Hutton is to be conſidered as unſatisfactory. The tranſition of theſe ſtrata into each other is not an appearance confined to one country; it has attracted the notice of geologiſts in all parts of the globe, and has been univerſally conſidered as a proof of the identity of the formation of theſe different ſtrata. The appearance of the veins of granite ſhooting from the ſtrata of granite into the ſhiſtus, may be explained in the ſame manner as common veins. Granite ſtrata are frequently traverſed by veins of granite, and theſe veins, although in general of a different grain from the rock through which they run, yet, in ſome inſtances, it is with great difficulty that we can diſtinguiſh them from the ſtratified rock. Now, as it is nearly demonſtrated that granite, gneiſs, micaceous ſhiſtus, and ardeſia, are of the ſame formation, it is not at all improbable that rents would as readily extend through the gneiſs and granite, as through the gneiſs and micaceous ſhiſtus; and that theſe rents would be afterwards filled up with granite ſimilar to that of the ſtrata, and thus form the appearance of the granite invading the ſhiſtus. The maſſes of granite encloſed in the ſhiſtus, and of ſhiſtus encloſed in the granite which are obſerved

where

where the granite and ſhiſtus meet together have been explained in another part of the work.

I cannot leave this ſubject without mentioning that Dr Hutton aſſerts that granite is not ſtratified, and conſequently that this is a proof that it has been formed at a different time and in a different manner from the other ſtrata which cover it; and he applies the ſame reaſoning to porphyry and baſalt, which he ſays are not ſtratified. It is now well proved, however, as I have mentioned in a former part of the work, that granite is diſpoſed in ſtrata; and no one, I think, can doubt that porphyry and baſalt occur in ſtrata in many parts of the world. Indeed theſe are very common appearances. The ingenious Sir James Hall, a ſupporter of the Huttonian theory, remarks, that the mineral kingdom is divided into ſtratified and unſtratified bodies, the latter comprehending granite, porphyry, and baſalt *; but he underſtands by ſtratification, the ſlaty fracture of the ſtone. He is here in an error, as we have great mountains of ſhiſtoſe porphyry †;

* Edinburgh Philoſophical Tranſactions, Vol. III.

† Although porphyry, in general, does preſent a uniform and compact ſtructure, yet, when it is quarried, it riſes in large flat maſſes, or when broke by a hammer, it yields more eaſily in one direction than another; conſequently it has the ſhiſtoſe ſtructure, but in a leſs perfect degree than micaceous ſhiſtus or ardeſia.

and ſhiſtoſe baſalt ‖ and granite, have been frequently obſerved.

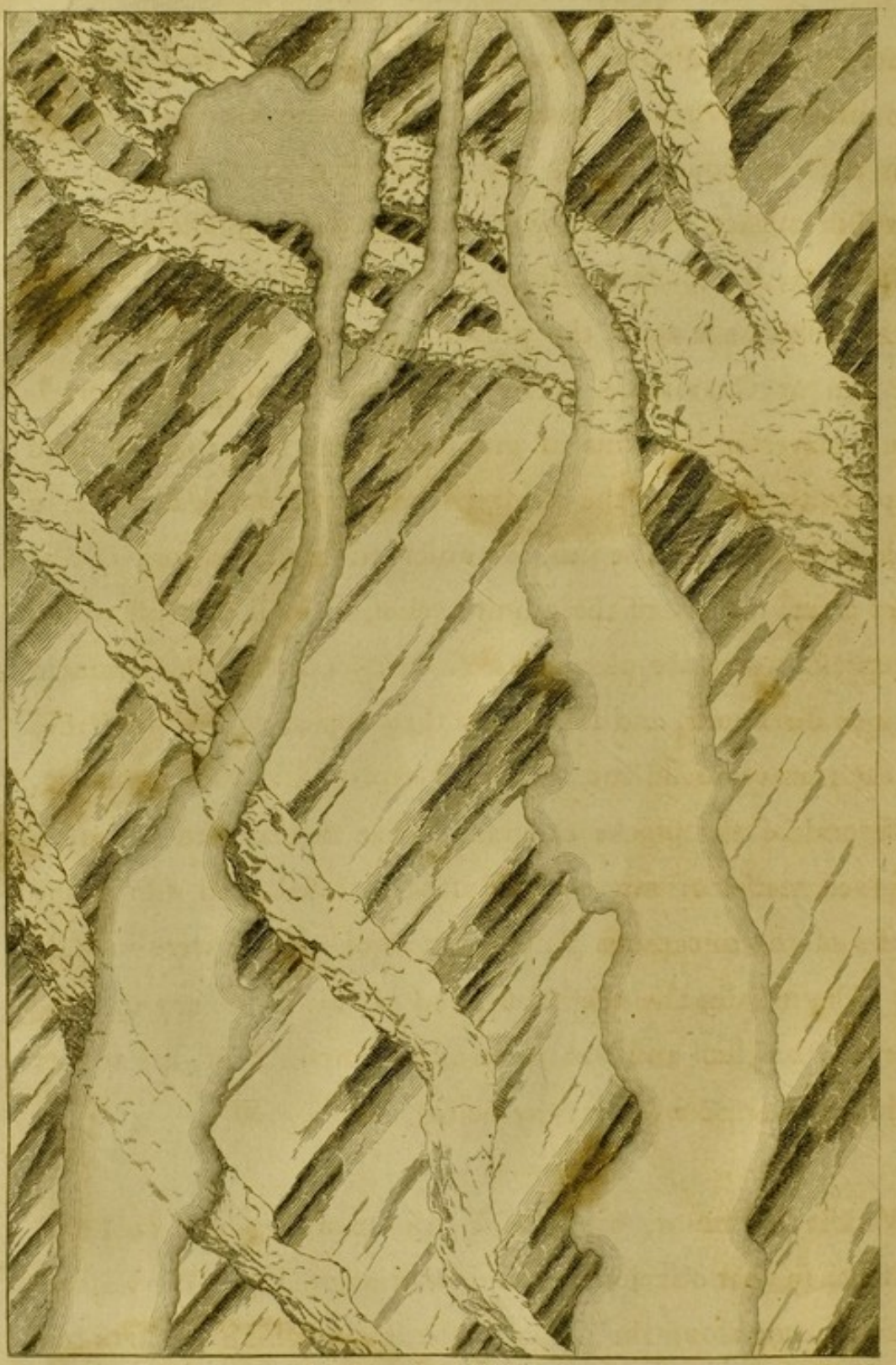
Having reſted a little at Unach inn, we ſet out for Fort Auguſtus. The road was firſt up a ſteep hill, which is compoſed of micaceous ſhiſtus alternating with hornblende ſlate, and traverſed by granite veins. Having reached the top of the hill, we had a good view of Glen-Morriſon nearly to its further extremity, bounded on both ſides by grey hills, all apparently of a ſimilar compoſition with that on which we were ſtanding. We now walked pleaſantly along for ſeveral miles through a muirland, when we came to a hill upon one ſide of the

‖ Reuſs obſerved, near to Teplitz, the top of a hill compoſed of baſaltic columns; under theſe he obſerved baſalt in very thin tables; and, lower down, the baſalt was obſerved paſſing completely into ſhiſtoſe porphyry. He alſo obſerved the ſhiſtoſe baſalt forming a vein, which traverſes common ſandſtone. Reuſs Mineralogiſche Geographie von Boehmen.—And Charpentier has obſerved granite decidedly ſhiſtoſe, and even where it had not externally the ſhiſtoſe texture, he found that it always broke in a certain direction, and when raiſed from the quarries, that it riſes in great flat blocks; but it is only in a particular direction that theſe maſſes could be raiſed. At Aberdeen, where there are immenſe granite quarries, the workmen have the daily experience that the granite riſes more eaſily in one direction than another, and alſo that in dreſſing it, their work is much haſtened by breaking the ſtone in a particular direction.

the valley, in which Fort Auguſtus is ſituated. Below appeared the Fort, which has more the appearance of a manſion-houſe than a place of ſtrength, but is charmingly ſituated upon the extremity of Loch Neſs; and at a diſtance the great mountain of Ben-Nevis, the Mont Blanc of Scotland, was ſeen half wrapped in the clouds, which almoſt perpetually encircle its lofty ſummit. We now deſcended by a winding road over ſtrata of micaceous ſhiſtus, traverſed by granite veins, and in a little time reached a comfortable inn, which was the more agreeable after our long walk from Ratachan inn.

Having reſted all night, we ſet out in the morning for Garvimore, preferring it to the route by Fort-William. The road continues for a conſiderable way to be very ſteep. It leads over a hill, which is compoſed of micaceous ſhiſtus, and is probably traverſed by granite veins, as I remarked upon places of the road great maſſes of granite, that ſeem to have come from the neighbouring rocks. Having reached the ſummit, we walked for ſeveral miles among heathy mountains, compoſed principally of micaceous ſhiſtus, until we came to the foot of the mountain called Coriariach. We aſcended it by a long, winding, tedious road of ſix miles: it was extremely dreary and deſolate; not a human being, not a bird was to be ſeen; and the long bleached poles that are erected along the road to

direct the traveller during the ſnow had a ſingular appearance. From the ſummit, we had a very magnificent ſpectacle of the tremendous peaked mountains extending along the weſt coaſt of Scotland. This hill, and the neighbouring one, as far as I could judge, are entirely of primitive rock, and appear to be principally formed of different ſpecies of micaceous ſhiſtus. I obſerved upon the road maſſes of quartz of a nearly black colour, thus approaching in external character to the obſidian. Reuſs, in his mineralogical hiſtory of Bohemia, informs us, that he found ſpecimens of obſidian paſſing into quartz, and that he has in his poſſeſſion a cryſtal, where the one half is obſidian, and the other quartz. Theſe appearances obſerved by Reuſs, as alſo the black quartz of Coriaraich, are probably no real gradation to obſidian, but merely quartz coloured deeply with iron or inflammable matter; the trial of its fuſibility will help to determine this point. I alſo obſerved upon the top of the mountain fragments of compact felſpar, which muſt either form veins traverſing the ſtrata, or alternate in the manner of ſtrata; the latter ſuppoſition is the more probable. We now deſcended by a very zigzag and ſteep road, to the bottom of the mountain, when we entered into Glen-Drummond, through which runs the river Spey, having its origin in the neighbouring mountains. Many ſmall heather-covered hills were ſcattered below the lofty precipices; and, upon examination



GRANITE VEINS TRAVERSING MICACEOUS SHISTUS GLEN DRUMMOND BADENOCH

ination, appeared to be formed of the debris waſhed from the mountains. We now continued our dreary journey through this deſolate country. As we approached to Garvimore the ſtrata of micaceous ſhiſtus were ſucceeded by conſiderable hills of granite, but theſe continue only for a little way, when micaceous ſhiſtus is again the prevailing rock, and continues to the inn at Garvimore. The micaceous ſhiſtus, however, is much traverſed by veins of granite, which are from an inch to 12 feet wide. At the bridge which croſſes the Spey, at a little diſtance from the inn, we obſerved in the bottom of the river a fine diſplay of the granite veins, a ſmall part of which is repreſented in the plate. Theſe veins traverſe the ſtrata in various directions, and ſometimes they appear to incloſe maſſes of the micaceous ſhiſtus, as is well expreſſed in the engraving. In ſeveral of the blocks of granite that lie ſcattered about, I obſerved maſſes of micaceous ſhiſtus incloſed, and alſo in the maſſes of the micaceous ſhiſtus, pieces of granite were included. The hills in the neighbourhood of this houſe are of conſiderable height, and are generally compoſed of micaceous ſhiſtus, traverſed with granite veins.

We left Garvimore by ſun-riſe; the morning was cool and pleaſant, ſo that our journey was very agreeable. We walked for ſome time along the banks of the Spey, which are here included

cluded between great banks of boulder ſtones, that have been carried from the upper part of the glen. We ſoon left the banks of the river, and journeyed along by the foot of the hills that form the ſide of the valley; theſe hills are in general heath-clad, but often alſo preſent broken, rough, gray, ſurfaces, announcing them to be compoſed of micaceous ſhiſtus. This ſhiſtus appears in ſome places to be traverſed by granite veins, as I obſerved upon the road maſſes of a granite, whoſe conſtituent parts are of great ſize, ſimilar to that which is only to be found in veins. In ſome of the granite maſſes I obſerved pieces of micaceous ſhiſtus incloſed, ſimilar to the appearance of the bridge near Garvimore. Having walked near to the further extremity of Glen-Drummond, we expected that we were near to Dalwhiny, the next ſtage, but to our mortification, we found that we had taken a wrong road, being near to Pitmain on the Inverneſs road; we were therefore obliged to walk back for about 12 miles, and did not reach Dalwhiny until the afternoon. The ſtrata in this direction are ſtill primitive, and compoſed of micaceous ſhiſtus; and, in the beds of the rivulets, I often remarked it traverſed by granite veins.

Having refreſhed ourſelves after the long and circuitous walk from Garvimore, we ſet out for Dalnacardoch, as we wiſhed to reach it before the cloſe of the evening. The road

was

was good, and led through a valley bounded on both ſides by lofty heath-clad hills, which are in general of micaceous ſhiſtus. Their ſhape is lumpiſh, with ſteep ſides; and the ſtrata are only to be ſeen where the rains have worn deep ravines, owing to the thick covering of heath. At a turn of the road, where we met with the river Carie, the ſtrata are well expoſed, but are ſtill of micaceous ſhiſtus: but, upon the road, I remarked large maſſes of green hornblende, which approaches to actynolite; alſo, ſienite, which is compoſed of white felſpar, quartz, and hornblende: but I had not any leiſure to determine their ſituation with regard to the other ſtrata, as night was faſt approaching, and we were happy to reach Dalnacardoch after our tireſome journey.

As the weather ſtill continued extremely pleaſing, we ſet out early in the morning for Blair in Athol, which is the next ſtage to Dalnacardoch. The road continued for ſeveral miles thro' a dreary country, ſimilar to that which we had paſſed the preceding days, and the ſtrata were not much different; micaceous ſhiſtus, in ſome places alternating with blue-coloured granularly-foliated limeſtone, being the prevalent rock. A few hundred yards before we enter into a birch wood that ſtretches near to Blair in Athol, I obſerved a large ſtratum of felſpar porphyry? inclined at an angle of 45°, and reſting on, and covered by,

ſtrata

ſtrata of micaceous ſhiſtus, which have a ſimilar elevation. The ſtratum of porphyry, where I obſerved it, is from 12 to 15 feet wide, and is to be obſerved riſing to the tops of the hills on both ſides of the river; and, even at a diſtance, is eaſily diſtinguiſhable from the micaceous ſhiſtus, by its colour, and the peculiar manner in which it decompoſes. As we approach to Blair, the banks of the river become lower; and in ſeveral places I obſerved porphyry, but it was ſometimes difficult to determine whether it formed ſtrata or veins. The mountains now recede, and range themſelves on each ſide of the delightful valley which extends to Dunkeld: the banks of the river are ſkirted by natural wood, and to this immediately ſucceed lofty woods, that extend even to the ſummit of the hills. The country now increaſes in beauty every ſtep; and we are led, by a delightful road, thro' a rich diverſity of wood, to Blair, where there is a ſummer ſeat belonging to the Duke of Athol. The rapid change, from the brown, barren heaths of Dalnacardoch, to the richly-cultivated valley of Blair, is very ſtriking to the traveller; and it is farther pleaſing, from the probability that the other valleys, thro' which he has paſſed, may, one day, like the valley of Blair, attract admiration.

Having reſted a little, we took the charming road which leads to Dunkeld, through a valley that is not to be exceeded

for

for the richneſs, or the variety and beauty of its ſcenery. The hills, which form the ſides of the valley, are not of great height; and are, in general, formed of micaceous ſhiſtus, which has ſometimes interſperſed cryſtals of hornblende; yet there are alſo other rocks. Thus, a porphyry, ſimilar to that which we have before obſerved between Dalnacardoch and Blair in Athol, appears to form a conſiderable hill among the micaceous ſhiſtus; but I regret that I had not leiſure to examine their relative poſition. I alſo obſerved maſſes of ſienite upon different parts of the road, and calcareous micaceous ſhiſtus. The micaceous ſhiſtus is ſometimes to be obſerved paſſing into talcaceous ſhiſtus; and not unfrequently I obſerved cryſtals of hornblende ſhooting thro' it. At Dunkeld, the hills are of conſiderable height, and afford a conſiderable variety of rock; but I ſhall not at preſent ſtop to mention them particularly. I may only remark in general, that I found micaceous ſhiſtus; this is to be obſerved paſſing, by various ſteps, to chlorite ſhiſtus; and, laſtly, the chlorite ſhiſtus is to be traced into ardeſia. I alſo obſerved much quartz penetrated with the chlorite, in various proportions; and frequently I remarked a granular quartzy rock, which has a baſis of chlorite. *

* As the country from Dunkeld to Dunbarton is frequently viſited by ſtrangers, I will in this note mention a few facts with reſpect to the general nature of the

We ſet out early in the morning for Perth; and on the road, at a little diſtance from Dunkeld, I examined a pretty extenſive quarry of roof ſlate, (ardeſia tegularis,) which is intermixed with chlorite, and beautiful ſpecimens of micaceous iron ore. I ob-

the rocks in that route. From Dunkeld to Taymouth the road is ſkirted by lofty mountains of micaceous ſhiſtus; and near to Taymouth there are quarries of talcaceous ſhiſtus, or lapis ollaris, which alſo afford fine ſpecimens of aſbeſtus. The rocks in the immediate vicinity of Taymouth are of micaceous ſhiſtus, but Mr Hatchett, with whom I made this journey, pointed out to me chlorite ſhiſtus paſſing into micaceous ſhiſtus, and the chlorite ſhiſtus approaching to lapis ollaris, and even making a paſſage into it. The micaceous ſhiſtus has frequently intermixed with it little rounded maſſes, having at firſt the appearance of garnets, but when cut with the kniſe, appear to be rounded pieces of the micaceous ſhiſtus. In the mountain we alſo picked up fragments of clay porphyry, but had not an opportunity of determining its ſituation with regard to the other rocks. From Taymouth along the banks of Loch Tay, the principal rock is micaceous ſhiſtus; and from the delightful retreat of Killin to the dreary and bleak Tyndrum we meet micaceous ſhiſtus, which is in ſome places ſtratified with limeſtone. At Tyndrum the mineralogiſt will be amuſed in examining the remains of the old lead mine. The next ſtages to Dalmally and Inveraray lead through a mountainous country compoſed of micaceous ſhiſtus, chlorite, &c. At Inveraray, there are quarries of lapis ollaris, and a conſiderable ſtratum of hornſtone porphyry, and this porphyry is covered by a ſtratum of marble. From Inveraray to Carindow, the rocks are principally of micaceous ſhiſtus. At Carindow there is a beautiful kind of ſienite, containing pretty conſiderable cryſtals of hornblende, and pink-coloured cryſtals of felſpar. From Carindow to Ar-

rochar,

I obſerved a breccia covering the micaceous ſhiſtus, thus announcing the termination of the primary ſtrata; which we found to be the caſe. As the country now became much lower, its general appearance was quite changed; and to the ſtrata of breccia, argillaceous ſandſtone ſucceeded.

I now took leave of the Highlands, where I had ſpent three months very actively; and have only to regret, that my little experience, and want of knowledge, in many important parts of mineralogy, may have cauſed me to over-

 look

rochar, through the wild Glen Croe, the mountains are principally of micaceous ſhiſtus. From Arrochar to Luſs, which leads along the charming banks of Loch Lomond, micaceous ſhiſtus is the principal rock that occurs. Ben-Lomond, the higheſt mountain that riſes from the ſide of the Loch, is compoſed of micaceous ſhiſtus on its lower part, but, towards the ſummit it is compoſed of gneiſs. At Luſs, there is a quarry of ardeſia or primitive argillaceous ſhiſtus; here Mr Hatchett pointed out to me the diſtinct gradation from indurated chlorite to chlorite ſlate, and from chlorite ſlate to ardeſia. Maſſes of porphyry are to be ſeen in different places; and a rock, which is compoſed of rounded fragments of quartz, cemented by a baſis of chlorite, lies ſcattered near to the quarry of ardeſia. From Luſs to Dunbarton, we have not only a complete change in the appearance of the country, but alſo of the ſtrata, as the primitive rocks near to Luſs are ſoon ſucceeded by the ſecondary ſandſtone, limeſtone, baſalt, &c. which extend towards Dunbarton.

look intereſting appearances, or to deſcribe thoſe, which I did obſerve, but imperfectly, and probably, in ſome inſtances, without ſufficient accuracy. But, if after travellers ſhall experience as much pleaſure in their journey as I did, they will have cauſe to think their time uſefully employed.

The ſecondary ſtrata, which are principally ſandſtone and baſalt, continue to the flouriſhing and pleaſant town of Perth. In the neighbourhood of the town, is the hill of Kinnoul, which is remarkable for the charming proſpect from its ſummit, and the numerous beautiful pebbles of onxy, ſardonyx, &c. which are found in a baſis of indurated wacken.

From this, by Kinroſs, to North Queensferry, the country is entirely formed of ſecondary ſtrata, as, ſandſtone, limeſtone, baſalt, wacken, and greenſtone; and in ſeveral places, as at Inverkeithing and St. David's, there are ſtrata of coal, which are worked to a great extent.

A particular deſcription of all this tract of country, from Dunkeld to the Frith of Forth, with an account of the coal mines,

mines, would form a work that would afford much inſtruction and entertainment. The intelligent mineralogiſt would here have an opportunity of giving a minute deſcription of an extenſive Scottiſh coal-field, which would be an acquiſition of much value to geology.

[*I am happy to have it in my power to communicate to the public the following obſervations upon the mineralogy of the country between Fort-Auguſtus and Inverneſs, which were politely communicated to me by Lord Webb Seymour and Profeſſor Playfair. In ſtrict order, they ſhould have been inſerted in a preceding part of this chapter, but the ſheet happened unluckily to be printed off before I was favoured with them.*]

THE road, ſoon after it leaves the Fort, aſcends, on the ſouth ſide of the lake (Loch-Neſs), into an elevated, mooriſh tract, and continues on this high level for many miles.

For the firſt five or ſix miles, the rock is all micaceous ſhiſtus, with a conſiderable admixture of quartz.

Riſing

Riſing from this high level, there are ſeveral hills, along the ſides of which the road paſſes: the valleys between are tolerably wooded. There are alſo a great many ſmall lakes.

From about the point where the level begins to deſcend toward the eaſt, the micaceous ſhiſtus ends, and a granitic ſandſtone begins, which continues for a mile or two.

The river Fyers riſes on the right; and where the road firſt comes on the banks of it, you ſee micaceous ſhiſtus again, with a large dyke or vein of granite interſecting it.

We ſoon after come to granitelle, in great maſſes, ſome of it containing minute veins of much indurated ſteatites.

This kind of rock continues till near the uppermoſt of the two falls.

The high plain, in which we had been travelling all this while, is intereſting, not only from its being on a level ſo much above other plains, but becauſe the hills, that have their baſe in it, are of conſiderable beauty, as well as wildneſs, with valleys between them, abounding in paſturage, and interſperſed with wood.

The

The Fyers runs, in the middle of the great valley, with much rapidity; the ground declines faſt toward the E.; the bed of the torrent rocky, and the banks wild.

The vale of Fyers opens into a meadow between fine granite rocks, before you come to the firſt fall, which is above a little bridge.

At this fall, the rocks are all of granite. The whole ſcene ſtriking and grand.

Below the bridge, which is cloſe to the fall, you ſee marks of the wearing and ſcooping out of the granite rocks, 30 or 40 feet above the preſent level of the river.

About a mile farther down, is the great fall, by which the river deſcends at once to the level of the lake. This fall has been often deſcribed: it could ſcarcely be ſeen in a more favourable ſtate than it was by us. The rock is ſtill granite.

From the General's Hut, a mile eaſtward of the fall, the rock is granite; but is ſoon, on proceeding eaſtward, ſucceeded by a pudding ſtone, containing large rounded blocks of

of reddiſh quartz and of granite ſhiſtus, united by a cement of ſandſtone.

This pudding-ſtone begins at the firſt torrent beyond the inn, which runs in a very deep channel, and expoſes a fine ſection of the rock.

This pudding-ſtone accompanied us to near the end of the lake, when day-light forſook us, and prevented us from ſeeing diſtinctly the ſteps by which the highland country ſoftens down into the plain.

The ſtones that we picked up on the road continued, however, to be primitive, all the way to Inverneſs. At Inverneſs, the ſame continues; and the freeſtone uſed in building is brought from quarries on the ſea-ſhore not far from Elgin.

[*It*

[*It is now ſeveral years ſince I wrote the following account of the* SHETLAND ISLANDS. *Since that time, I have been almoſt continually and actively employed in mineralogical purſuits; aud have learned, at leaſt, how very deficient this outline muſt appear. That knowledge of the ſubject, which enables a man to examine the mineralogy of a country with accuracy, is not merely the knowledge of foſſils as ſpecimens in a cabinet: it is to be gained only by an actual and very careful ſurvey of different countries. This, I hope, will be my apology. I have republiſhed this account, though imperfect, becauſe theſe iſlands are remote, difficult of acceſs, and intereſting both to the geologiſt and the mineralogiſt.*]

SHETLAND ISLANDS.

CHAP. XXVI.

Outline of the MINERALOGY *of the* SHETLAND ISLANDS. *General Obſervations. Mineralogy of the* MAINLAND, FOULA, PAPA-STOUR, VEMENTRY, MUCKLE-RHOE, UNST, FETLAR, YELL, *and* WHALSEY.

THE Shetland Iſlands lie N. E. from Orkney, between lat. 59° and 61°. The neareſt are diſtant, from Buchan-neſs, 46 leagues; 16 or 18 leagues N. from the iſland of Sanda, one of the Orkney Iſlands; 6 or 7 leagues N. E. from the Fair Iſland; 58 leagues E. from the Faroe Iſlands, and nearly the ſame diſtance N. W. from the Lewis.

Theſe iſlands are very numerous, but few of them are of any conſiderable magnitude: thirty-three are ſaid to be inhabited, of which the largeſt is called the Mainland.

On

On a general view of theſe iſlands, a wonderful ſcene of rugged, bleak and barren rocks, preſents itſelf. No tree, nor ſhrub, relieves the eye, in wandering over the dreary waſte. Sometimes, however, a few ſcanty portions of cultivated ground catch the eye of the traveller, exciting emotions of pleaſure, and forming a ſtriking contraſt with the barren heath-covered mountains which ſkirt them. The weſtern part preſents many ſcenes, wild and ſteril as can well be conceived; where grey rocks, riſing from the midſt of marſhes or pools, and ſhores bounded by awful ſea-beat precipices, ſuggeſt to the mind ideas of deſolation and danger.

The coaſts are in general rugged and precipitous. Frequently the ſcenes are truly ſublime: vaſt rocks, of various heights, dreadfully rugged and broken, oppoſe their rude fronts to all the fury of a tempeſtuous ocean; which in ſome places has formed great detached pillars, in others has excavated grand natural arches and caverns, that mock all human magnificence.

The eaſt ſide of the Mainland (it is alſo the caſe in the other larger iſlands) is comparatively low; but the weſt is remarkably lofty, rugged and broken. Many of the mountains are ſenſibly more ſteep on the weſt, than on the eaſt ſide. This

geological fact was long ago discovered by Dr Walker. It first occurred to him in the hills in the vicinity of Edinburgh; but he also found it to hold true in the Lomonds, and in all the other hills in the Highlands of Scotland. We also know that the west coasts of Scotland and of England have a gradual slope towards the east; and the course of all the great rivers, as the Spey, Tay, Tyne, Trent, and Thames, is from east to west. Upon examining other countries, the same phenomenon presents itself. Thus, the west coasts of Norway are precipitous, high and rocky. In the interior of Norway, the Lapland Alps present a precipitous west side, and the east shelves away, forming extensive plains. It is also very remarkable in the continent of America; where several of the largest rivers, as St. Laurence, La Plata and the Amazons run nearly from east to west.

Another observation may be made with regard to the hills—that they all run in the longest direction of the islands. This is a general fact, to be observed all over the globe. Thus, the mountains in Britain run from N. to S.; the Scandinavian mountains follow the same direction; as also the great ridges of the Norwegian and Swedish Alps. In America, the long-extended chain of the Andes runs from N. to S. which is the greatest length of the continent.

The

The hills in Shetland have ſeldom the ſtrikingly rugged aſpect of the iſland of Arran. They are greatly lower, and not ſo much worn by rains and torrents: the principal ſcenery of Shetland being produced by the action of the waves upon ſea-coaſt.

The hills are generally round-backed, running in ridges: ſome approach to the conical ſhape, and are detached. None are remarkably high: the higheſt, which is Ronas Hill, is only about 1500 feet above the level of the ſea.

To make general remarks upon the climate of a country, requires a long and careful ſeries of obſervations, with a multiplicity of apparatus, which few have an opportunity of obtaining: and although a good deal may be done by means of careful obſervation with the thermometer and barometer, the proper uſe of theſe requires no common ſhare of ſkill. To the exertions of the celebrated Mr Kirwan of Dublin, we are indebted for a great deal upon this ſubject. With the liberality which characteriſes a great mind, he has, at much expence, diſtributed meteorological inſtruments thro' Ireland; and we are now beginning to ſee the good effects of his endeavours. In this diſtant quarter of the globe, no accurate regiſter of the weather has been kept; ſo that all I can do, will be, to make

a few

a few general obſervations, which apply pretty generally to all the northern iſles of Britain.

The weather is extremely variable, there being a great deal of rain, and thick fogs, which occaſion the loſs of many veſſels on theſe terrible ſhores. During the winter, there are conſiderable falls of ſnow, which lies, however, but a ſhort time, on account of the vicinity of the ſea. The froſts, which are ſeldom ſevere, and never long, produce little inconvenience: were they to continue for any conſiderable time, this ſituation, already ſufficiently dreary, would be comfortleſs indeed. The thermometer has been obſerved 20° below the freezing point, but this continued for a very ſhort time; a thaw ſoon followed, with hail, and violent gales of wind. Frequently, during the winter, dreadful ſtorms prevail, particularly from the W. accompanied with thunder and lightning: an appearance ſeldom obſerved at that ſeaſon in other parts of Britain.

Many inſtances might be mentioned, of the fatal effects, and extreme violence of the ſtorms, which frequently happen among theſe iſlands; but I ſhall only mention one, which is ſtill freſh in the memory of many.

During

During the three firſt days of January 1784, it blew a violent gale, and continued with increaſing violence until eight o'clock in the evening of the third day. The ſtorm was ſo furious, that the ſea broke over headlands 120 feet high; and, at one place, a ſtone, computed at 12 tons weight, which lay ninety feet from the ſea, was raiſed out of its place, and thrown two fathoms farther from the ſhore. Many veſſels were wrecked, and vaſt quantities of fiſh thrown upon the ſhore. In the iſland of Mouſa, I obſerved many great maſſes of ſandſtone, which had been torn off by the violence of the ſtorm, and thrown far inland.

The aurora borealis, or what is uſually called ſtreamers, illuminates the ſky with uncommon brilliancy, and helps greatly to alleviate the gloom of the long winter nights.

MAINLAND.

THIS is by far the largeſt of the Shetland Iſlands, being about ſeventy miles long, and from twenty to half a mile broad.

The

The cliffs around the whole iſland are very rugged, but more ſo on the weſt than on the eaſt ſide; and the bays or voes, iſlands and rocks, are alſo more numerous on the weſt than on the eaſt coaſt.

There are few mountains of any conſiderable height, being generally from a thouſand to fifteen hundred feet high. Few of them are unconnected; but they generally run from N. to S. in the form of chains, having round-backed ſummits, approaching more or leſs to the conical form. Several conſiderable ridges can be traced along the whole of their courſe; and of theſe the moſt remarkable are the following:

1. *Cliff Hills.* This range commences oppoſite to the iſland of St. Ranens, where it is of conſiderable height, and runs by Scalloway to Deal-Voe, and from that to the ſea, where it becomes gradually lower.

2. A range, which has no particular name, riſes from Weſt-ſhore, and runs, with little variation in height, S. W. and N. E. to Lunneſting, terminating on the ſea-ſhore.

3. A range riſes upon the eaſt ſide of Weeſdale-Voe from Buneneſs,

Buneneſs, and runs from 16 to 18 miles, terminating on the ſouth ſide of Deal-Voe, in the pariſh of Delting.

4. The higheſt range riſes from the weſt ſide of Weeſdale-Voe from Ruſtaneſs, and terminates at Friſkineſs in Delting.

The Mainland is divided into ſeveral pariſhes, ſome of them of conſiderable extent: the pariſh of Lerwick, which gives name to the principal village in the iſland, is the ſmalleſt. This village contains about 2000 inhabitants, and is built upon the ſhore of Braſſay Sound, which is near the middle of the iſland. The houſes in general are but indifferent; here and there, however, there are ſome commodious dwellings: and they are built of ſandſtone and ſandſtone breccia, forming one ſtreet, which is terminated by Fort-Charlotte. This fort was built during the time of Oliver Cromwell, and was for a long time in a ſtate of ruin, until lately that it has been repaired at great expence, and garriſoned by a corps under the command of a captain.

Braſſay Sound, which is the harbour of Lerwick, is one of the moſt extenſive and ſafe harbours in the Britiſh dominions; and has its name, and is formed in part by the iſland of Braſſay. This iſland is about 5 miles long, and between 2 and 3 broad, but very irregular in its ſhape. It is high and rugged

on the S. and E. where it is much expoſed to the action of the ſea; but it is comparatively low on the W. and N. where it forms part of the ſound. The higheſt hill, which is called the Ord of Braſſay, forms, towards the ſea, frightful precipices, ſeveral hundred feet high; all compoſed of ſandſtone, ſandſtone flag and breccia: and the whole iſland is compoſed of the ſame materials. A great maſs has been ſeparated from the eaſt ſide by the violent action of the ſea, and forms what is called the iſle of Noſs, remarkable for its tremendous cliffs and holm, where the natives encounter many dangers in fowling. This famous holm * is ſeparated about 34 fathoms from the iſle, and is perfectly mural on all ſides, ſo as to preſent a moſt terrific aſpect when viewed from below. Inacceſſible as it appears, it has not prevented the daring iſlanders from gaining its ſummit, which exploit was performed many years ago, by a fearleſs fowler, who, having climbed to the top, drove ſtakes into the ground, and ropes being thrown around them from the oppoſite ſide, were faſtened to correſponding ſtakes upon the bank of the iſland; a machine of wood, which they call

* Mr Pennant, in the elegant introduction to his Arctic Zoology, has given a drawing of Low's, which expreſſes the appearance of the holm very indifferently. The holm is ſaid, by Mr Pennant, to be 480 feet in height: this is certainly too high.

call a *cradle*, was then faſtened upon the ropes, ſo that it could be pulled backwards and forwards: and in this way they go in queſt of the numberleſs ſea-fowl that inhabit theſe cliffs. The fowler who firſt planted the ſtakes, fluſhed with his ſucceſs, would not take advantage of the cradle, but, braving every aid, attempted to deſcend, and was daſhed to pieces upon the rocks below. The iſland and the holm do not differ from Braſſay in their compoſition; being formed of ſandſtone, ſandſtone flag, and breccia: but the ſandſtone is of various colours, a conſiderable extent of the cliffs being of a reddiſh hue.

The oppoſite ſide of the ſound, where Lerwick is ſituated, is compoſed of the ſame ſandſtone and breccia which we obſerve at Braſſay. The fort, already mentioned, forming one extremity of the town, is built upon a rock of breccia; which ſoon gives place to a horizontal ſtratum of ſandſtone, running to the oppoſite extremity of the town, called the Nab. The hills in the neighbourhood are not high, and are compoſed of ſandſtone and breccia. This ſandſtone is the ſame we obſerve in all the other parts of the iſland. The breccia is compoſed of fragments of red granite, micaceous ſhiſtus, quartz, felſpar, and green mica: the fragments are either rounded or angular; of various ſizes, from that of a grain, to maſſes of ſeveral hundred weight. The ſubſtramen, or baſis,

is hardly diſcernible, excepting in large maſſes, when a paſte is formed by the ſmaller fragments. I alſo obſerved, in general, that, where the fragments are large, the ſtrata are diſtinguiſhed with difficulty, and are horizontal; but as the particles become ſmaller, the ſtrata are more diſtinct and inclined.

The coaſt, from Lerwick to Quarf, is compoſed of ſandſtone: in ſome places, however, there are great rocks of breccia, which have a very ſingular appearance, owing to the immenſe ſize of the concretions.

On this part of the coaſt there are ſeveral extenſive caves. We rowed a conſiderable way into one of them, then landed, and walked to its farther extremity. At the entrance, it is a natural arch, which becomes gradually lower until it is loſt in darkneſs, where nothing is to be heard but the dropping of water from the damp, black roofs, and now and then the ſilence is diſturbed by the ſnorting of ſeals, or the flutter of the pelicani or columbæ. But the moſt beautiful part of theſe rocky ſcenes, is the wonderful tranſparency of the water, which diſcloſes, to our view, rocks of various fantaſtic forms, covered with the beautiful millepora rubra, and adorned with fuci of a great variety of colours. Theſe fuci, when moved by the gentle

tle motion of the water, diſcover numerous ſpecies of ſpongiæ, actiniæ and echini, of the moſt exquiſite colours, altogether forming an admirable ſubmarine picture.

At Quarf, the iſland is only about two miles broad, forming the iſthmus which connects the ſouthern pariſhes with the mainland. It forms a kind of valley, which is bounded on both ſides by mountains of conſiderable height, compoſed of micaceous ſhiſtus. Here, there is a ſmall fiſhing ſtation, from which boats go to the *Haafe*, or fiſhing ground, in ſearch of tuſk and ling.

The land from this again becomes broader, forming one ſide of Æthvoe, and is compoſed of ſandſtone, and breccia; in ſeveral places, however, there are conſiderable ſtrata of limeſtone, which is worked for building and manuring the ground. This voe is a large open bay, having the flat and cliffs of Coningſburgh on the north and weſt, with Sandlodge, and Mouſa on the ſouth. The cliffs of Coningſburgh, which form part of the range of hills that riſe oppoſite to St. Ranens, are compoſed of micaceous ſhiſtus; and in ſeveral places it is to be obſerved, with the common argillaceous ſandſtone covering it.

Among

Among the ſtrata of micaceous ſhiſtus, I obſerved beautiful ſpecimens of cryſtalliſed ſienite.

Having paſſed theſe cliffs, we come to Sandlodge, one of the ſeats of the ancient and moſt hoſpitable family of Bruce of Sumburgh. It is ſituated upon the ſea ſhore; having a pretty extenſive flat near it. At a little diſtance from the ſhore, in the ſandſtone, which is here ſtill continued, there is a vein of copper pyrites, or ſulphuret of copper, which was worked for ſome time, by a party of miners, from Wales, with very flattering proſpects; but the vein gradually decreaſed in width, until it was not above an inch broad, when it was thought proper to leave it †. On the oppoſite ſide of the houſe, there is another large vein of iron ore, above ſix feet wide, having a very ſcorified aſpect. This was alſo worked for ſome time, but the great expence, and the ſmall proportion of copper obtained, ſoon made it to be given up. The ſandſtone continues from this, all around to the bay of Sandwick, here and there interſected with calcareous ſpar, and much impregnated with oxyd of iron. Betwixt Sandlodge and Sandwick bay, lies the ſmall iſland of Mouſa, or Queen iſland, about

† I am happy to learn, that theſe mineral appearances have again attracted the attention of ſome Welſh miners, and they are now buſy raiſing the ore.

which is about a mile and a half long, and upwards of a quarter of a mile broad. It is rather low, compoſed entirely of ſandſtone, and ſandſtone flag, with ſeveral ſtrata of limeſtone, which run in the ſandſtone from eaſt to weſt.

The whole coaſt from Sandwick to Sumburgh head, the moſt ſouthern point of the iſland, is almoſt entirely compoſed of ſandſtone, and breccia, lying upon the mountains of gneiſs and micaceous ſhiſtus, which run through this part of the iſland; there are alſo in ſeveral places conſiderable ſtrata of limeſtone. From Sumburgh head, which is entirely compoſed of ſandſtone, we have an extenſive and beautiful view of a great part of the Mainland, iſland of Braſſay, and ſtupendous Noſs; on the one hand the far diſtant Fair iſle riſes gently in the horiſon, and on the other the ſecluded Fula forms a tremendous object. Below us we have a direful example of the blowing of looſe ſand, or what is called the *Sand Flood*; for an eſtate which belongs to Sinclair of Brue is now rendered a forlorn waſte, which, before this calamity, was one of the moſt productive parts of the iſland. I could not learn the cauſe of this diſaſter, but it was probably owing to the tearing up ſome of the plants which are known to prevent the blowing of ſand. This practice cannot be too ſeverely reprobated, when it is known that the conſequences are ſo pernicious; thus, in many of the Weſ-

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tern Iſlands Dr. Walker has obſerved, that if the ſmalleſt aperture be made in the ſand, the flood inſtantly commences; and we know that, in Suffolk, a quantity of ſand, which at firſt only covered about ten acres, has now ſpread itſelf, and covers ſeveral thouſand. The ſowing of plants, which grow in looſe ſand, is the only remedy which can be recommended to ſtop the baneful progreſs of thoſe floods. Of theſe ſeveral have been recommended; but the moſt efficacious, are the Galium luteum, Elymus arenarius, Triticum junceum, and Arundo arenaria; this laſt the Dutch plant with great benefit. From Sumburgh head acroſs the large open Quendal bay, little is to be ſeen, except a few rocks of an extremely coarſe breccia, of the common kind. At the next head-land, Fitful head, the primary mountains make their appearance, without any covering of the ſecondary breccia or ſandſtone, which diſappears at one ſide of Quendal bay, and is not to be obſerved again until we come to Sandneſs hill on the north weſt part of the iſland. This immenſe head-land is almoſt entirely compoſed of a lead-coloured micaceous ſhiſtus, of which the greater part is mica, in very minute ſcales; and in the fiſſures of the rock I obſerved ſeveral ſmall portions of micaceous iron ore. The micaceous ſhiſtus is here to be obſerved paſſing to chlorite ſhiſtus, and intermixed with the talcite of Mr Kirwan, and conſiderable quantities of quartz. Below this at Garthneſs, there is a large

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vein of ſulphuret of iron, about ſeven feet thick, running in a ſtone intermediate between micaceous ſhiſtus and chlorite ſhiſtus. It lies expoſed to the day for twenty or thirty feet, and was worked for ſome time, but was alſo given up.

The coaſt from this all along the weſt ſide by Bigtoun to Scalloway, including Colſa iſle, and the iſland of Saint Ranens, is compoſed of granite, micaceous ſhiſtus, chlorite ſhiſtus, talcite of Mr Kirwan and quartz.

The iſland of Saint Ranens is ſmall, very rugged, and connected with the Mainland by a bank of decompoſed micaceous ſhiſtus. Captain Preſton, in his chart of the Shetland Iſlands, has placed this bank at one end of the iſland, in place of the middle. The coaſt from this to Cliff Sound is very rugged, owing to its expoſure to the Atlantic Ocean; but in the Sound the land is defended by the iſlands of Houſe, Burra, and Trondray, and is neither rugged nor very abrupt.

The iſland of Houſe is about three miles long, narrow and flat, compoſed of micaceous ſhiſtus, granite and quartz. Near to the north end I obſerved a vein of granite two or three feet wide, running in the micaceous ſhiſtus; the granite had the

uſual appearance, and where in contact with the ſtratified matter was not at all altered in hardneſs.

The iſland of Burra, which is ſeparated from the iſland of Houſe by a ſmall ſound, is alſo more rugged on the weſt, where it is much expoſed to the action of the ſea, and is compoſed of granite, micaceous ſhiſtus and quartz.

The coaſt and hills from Scalloway by Uſtneſs Voe, Stromneſs Voe to Weeſdale Voe, are compoſed of the uſual alpine rocks. At Weeſdale Voe there is a great ſtratum of limeſtone, which can be traced for ſeveral miles running in the micaceous ſhiſtus. All the hills in the neighbourhood are compoſed of micaceous ſhiſtus, talcite and gneiſs; this laſt by decompoſition forms a clay-like maſs, which the inhabitants uſe for fullers earth. A great ſection of the gneiſs is to be ſeen amongſt theſe hills, in various ſtages of decompoſition *. From Weeſdale through Æthſting and Sandſting, the alpine rocks continue,

* The late Mr Wedgewood, upon analyzing an earthy ſubſtance from Sidney Cove, New Holland, was led from ſeveral circumſtances to conclude, that it contained a new earth which he called Sydneia. Lately, however, Mr Hatchet, in a paper read to the Royal Society of London, has demonſtrated, in a moſt

tinue, forming in many places conſiderable hills, and upon the ſea-ſhore immenſe precipices of red granite. The ſcenery upon this coaſt is awfully grand; a great extent of coaſt, dreadfully rugged and broken, preſents to our view vaſt detached pillars, and numberleſs magnificent arches, through which the tides ruſh with inconceivable fury, and the whole being tinged with a reddiſh hue, produces a grand effect, when contraſted with the lurid appearance of a ſtormy ſky.

The next pariſh, which is named Walls, I had but little opportunity of examining, ſo that I can ſay nothing with certainty of its compoſition. In the neighbouring pariſh of Sandneſs, the ſandſtone again makes its appearance at Sandneſs hill, which is of conſiderable height. From this the coaſt becomes gradually lower, and is in many places peculiarly ſterile and iron-like; the land again riſes in height, and ſo on alternately all around the iſland, forming many conſiderable voes, with very magnificent pieces of ſcenery, particularly the Doreholm off the pariſh of North Maving, which is a vaſt detached rock, perforated by a great natural arch, very ſimilar

moſt ſatisfactory manner, that this ſuppoſed earth is a compound of ſilex, argil, and oxyd of iron; and he ſuppoſes that it is derived from a decompoſed granite, or gneiſs, ſimilar to what has been mentioned above.

to ſome of thoſe obſerved by Captain Cook among the South-Sea Iſlands. The immenſe rocks, the Oſſa, Skerries, and Ramna Stalks, preſent a moſt tremendous appearance in ſtormy weather: but to particularize the many rocky ſcenes that occur around this iſland, would be foreign to my preſent purpoſe. I ſhall therefore conclude this ſketch, by remarking, that the rocks (ſo far as I have examined) are either granite, gneiſs, micaceous ſhiſtus, chlorite ſhiſtus, limeſtone, or ſandſtone; but I did not obſerve this laſt in any quantity till we came to the eaſt coaſt.

FOULA*.

THIS iſland is about three miles along, and half a mile broad, ſituated in the Atlantic Ocean, about twenty-four miles from Main-

* As the Orkney Iſlands are viſible from the heights of Foula in clear weather, there can be little doubt of its being the Ultima Thule of Tacitus: that of Pythias the Marſeillian, who was contemporary with Ariſtotle, is thought, by Mr Pennant †, to be Iceland, while Dr Foſter ‡ is decidedly of opinion that it is ſome part of the Shetland Iſlands.

† Arctic Zoology, vol. i. p. lvii. ‡ Voyage to the North, p. 15, 30.

Mainland; holding the ſame ſituation with regard to Shetland, which St. Kilda does to the Hebrides. It contains but little level ground, being chiefly formed of three hills, of a nearly conical ſhape; the higheſt of theſe is between 800 and 900 feet in height. Here there is but one landing-place, and in bad weather it cannot be approached. The eaſt ſide, which is much lower than the weſt is compoſed of granite, micaceous ſhiſtus, and quartz. The micaceous ſhiſtus covers the granite; but in ſome places the ſea has waſhed it away, and left the granite expoſed, which is of a red colour, and is frequently traverſed with conſiderable veins of quartz. The micaceous ſhiſtus alſo contains neſts of green actynolite, and garnets are often diſperſed thro' it. The ſouth, weſt, and north ſides of the iſland are compoſed of ſandſtone, and ſandſtone flag, of the ſame ſpecies with that we have obſerved in the other parts of Shetland. Upon the weſt ſide there are moſt hideous precipices, inhabited by numberleſs ſea-fowl, which the people run incredible riſks in catching.

The account which Pontopiddan has given of the fowlers in Norway, is realiſed, and even exceeded by the inhabitants of this ſecluded ſpot. It is not many years ſince it was a common obſervation, that few died a natural death, being either drowned or daſhed to pieces among theſe terrible precipices: now

now they are more cautious, and comparatively few are deſtroyed.

PAPA-STOUR.

THIS iſland is of a very irregular ſhape, about a mile long, and half a mile broad, lying in the mouth of St. Magnus Bay, at a little diſtance from the ſhore of Mainland. It is low, but one of the moſt fertile of the Shetland Iſlands; and it has ſeveral tolerable harbours, of which Hamna Voe is the beſt: but the entry is difficult, on account of a great ridge of rocks, which runs acroſs the entrance. At Houſe Voe, which is the uſual landing-place in coming from Mainland, ſandſtone, ſandſtone flag and breccia form one ſide of the voe, which is low, and not rugged. In going round the iſland toward the next harbour, called Olis Voe, the ſandſtone diſappears, when a foſſil, nearly ſimilar to wacken, preſents itſelf, forming cliffs of conſiderable height, without any marks of ſtratification; and it continues with little interruption all around the iſland, until it meets with the ſandſtone ſtrata on the oppoſite ſide. From this, it appears, that theſe two genera of rock form the greater

greater part of the iſland. Several other foſſils, however, are to be obſerved, either in ſtrata below the wacken, in veins, or ſporadic. Thus, upon the north ſide of the iſland, the wacken lies upon a kind of breccia, much reſembling that of the Calton Hill, near Edinburgh. It is alſo traverſed by veins of different kinds, which run in different directions, and vary conſiderably in their magnitude. The following are thoſe which I obſerved. 1. Veins of greenſtone and baſalt: the baſalt ſometimes contains ſmall cryſtals of fluor ſpar. The appearance of fluat of lime in baſaltic rocks is rare; the only ſimilar inſtance I am acquainted with, is detailed in the 6th volume of the Journal des Mines, where it is mentioned that grains of fluor ſpar had been obſerved in a baſaltic rock. 2. Veins of ſemi-indurated ſteatites, which often contain hollow nodules of chalcedony and jaſper, which are lined with cryſtals of quartz. 3. Veins of red ſinople, which are intermixed with chalcedony and quartz.

I cannot diſmiſs this ſhort account, without mentioning, that various ſpecies of pumice are to be gathered in ſeveral of the voes of this iſland, and ſome of the pieces are of very conſiderable ſize. Similar kinds of pumice are got near the Giant's Cauſeway, in Ireland, and upon the ſhores of the Weſtern Iſlands, which volcaniſts have reckoned a very ſatisfactory proof

proof of their chimera. An examination of the rocks would ſoon ſatisfy any one but a volcaniſt that theſe were adventitious matters. Accordingly, their origin is now plainly traced from the famous iſland of Iceland; and this is rendered the more probable, when we conſider, that many light ſubſtances are floated, from the Weſt India Iſlands, upon the ſhores of the Shetland and Weſtern Iſlands.

VEMENTRY.

THIS iſland is ſituated in St. Magnus Bay, at a conſiderable diſtance from Papa-ſtour. It is much interſected by the ſea, and riſes high in the middle, forming what is called the Wart of Vementry, upon the top of which there are the remains of a burgh. From this hill, we have a view of the whole iſland, and the adjacent coaſt of Mainland; than which nothing can be a more dreary proſpect.

From the ſhort time I was upon this iſland, I can only ſay, in general, that it appeared to be compoſed of granite, diffe-

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rent kinds of micaceous ſhiſtus, and a beautiful ſpecies of hornſtone porphyry, which I obſerved in various ſtages of decompoſition; in ſome ſpecimens the feltſpar appeared to be decompoſed firſt, in others the hornſtone.

MUCKLE-RHOE.

THIS iſland is about twenty-four miles in circumference, the eaſt and ſouth ſides are low, owing to their being defended from the violent action of the ſea by the Mainland, but the weſt ſide is very rugged and broken. From the little opportunity I had of examining it, I can only ſay that a conſiderable part appeared to be compoſed of granite. Another iſland in the ſame bay, called Papa Little, appears to be compoſed of granite and micaceous ſhiſtus, of various kinds.

UNST.

THIS is the moſt northern of the Shetland iſlands; it is about eight miles long, and from two to two and a half miles broad. Its form is that of a lengthened ſquare; the ſea coaſt is as uſual very rugged, and the iſland is hilly; the higheſt hill which is named Valley-field, is about ſeven hundred feet. There are two excellent harbours, Balta and Uyea Sound, which are often of the greateſt ſervice in ſheltering veſſels that paſs to and from the Greenland ſeas; but the firſt is generally preferred as being more convenient and ſafe. Balta Sound is a pretty deep inlet, formed into an excellent harbour by the iſland of Balta that lies acroſs its entrance, thus forming two paſſages; one from the north is rocky and only fit for ſmall veſſels, but the other from the ſouth will allow large ſhips to enter.

The hills upon the north ſide of this ſound are of conſiderable height, compoſed of ſerpentine, but preſent an extremely bleak and barren aſpect, owing to the iron-brown covering, which it acquires by the action of the weather. The ſerpentine is of a green colour, is frequently traverſed with ſmall veins of

of iron ore, and often aſſumes a fibrous appearance, forming what Wallerius calls talcite; a ſtone very different however from the talcite of Mr Kirwan. It alſo contains lamellar actynolite, labrador hornblende, tremolite, and veins of ſhiſtoſe talc traverſe it.

This ſerpentine continues to form the hills and cliffs, until we arrive at the beautiful bay of Norwick, when a ſingular ſtriated micaceous ſhiſtus takes it place, forming one ſide of the bay; this alſo conſtitutes a great part of the coaſt until a ſpecies of gneiſs (remarkable for the large ſize of its cryſtals of feltſpar) makes its appearance, the micaceous ſhiſtus which covered it being waſhed away. Near to this place an immenſe maſs has been ſeparated from the land, forming a great hollow called Saxes Kettle, from the ſea ruſhing through a narrow aperture at the bottom, which cauſes it to boil up with great violence. *

* Here the Shetland Giant Saxe uſed to boil his prey, and terrify the affrighted natives; but more ſurpriſing than this is a famous well at a little diſtance, where the inhabitants ſay their anceſtors uſed to get boiled or roaſted fiſh, in proportion to the depth they went. This is a fact truly Plutonic, well deſerving the attention of world makers.—*Brand's Hiſtory of the Orkney and Shetland Iſlands.*

The land from this runs out to form what is called the point of Lambaneſs, equally ſteep, but not ſo high as the ſides of the bay, and from this to the Sha, the moſt northern point of the iſland, and of his Majeſty's dominions, the gneiſs continues, and does not diſappear until we approach to the deep bay of Bura-firth, where the land becomes higher, forming lofty cliffs of micaceous ſhiſtus. At the bottom of this bay the land is low, preſenting beautiful rocks of undulated micaceous ſhiſtus †; but after croſſing the bay we find the land riſe gradually, forming the lofty cliffs of Hermoneſs, which are compoſed of ſimilar rocks. At the bottom of theſe cliffs there are immenſe caves excavated by the ſea, into which a boat can row many hundred feet in calm weather; the entrance is ſaid to be ornamented with regular octogonal pillars, but what their nature is I could not determine, as the ſurf prevented me from approaching. Is it probable that they are formed of gneiſs? for there is no other foſſil near but micaceous ſhiſtus. From this the whole weſt coaſt is very lofty and rugged, compoſed of micaceous ſhiſtus, and this laſt often contains extremely beautiful regularly cryſtallized garnets of great

† This ſpecies is entirely compoſed of mica without any admixture of quartz, which Karſten in his catalogue of the Leſkean cabinet reckons a rare production.

great ſize. As we approach the ſouth weſt extremity, the land becomes lower, and towards Belmont, the ſeat of Thomas Mouat, Eſq. of Garth, ſtrata of ardeſia, or primitive argillaceous ſhiſtus, are to be obſerved in the neighbourhood of the micaceous ſhiſtus. The ſerpentine now again makes its appearance, and forms in ſeveral places conſiderable hills, which have as uſual a barren and bleak aſpect. On the ſea ſhore, between Uyea Sound and the caſtle of Mounis, there are ſtrata of ſandſtone; and from this to Balta Sound the hills and ſhores are low, formed of micaceous ſhiſtus with a compound rock of green hornblende and quartz, and in ſome places we obſerve rocks of a compact feltſpar with hornblende.

FETLAR.

THIS iſland is about four miles long, and three and a half broad, of an irregular ſhape, owing to its being much expoſed to the action of the ſea. Its mineral productions are not very different from thoſe in Unſt; indeed it is probable that at one time they were joined. There are no harbours of any conſequence; the bay of Treſta is one of the largeſt, but is not ſafe

in

in ſtormy weather. One ſide of this bay is compoſed of micaceous ſhiſtus, quartz, in which large cryſtals of ſhorl are to be obſerved, with ſtrata of alpine or primary limeſtone. On the oppoſite ſide of the bay there are appearances of plumbago; in one place particularly there is a vein of a matter reſembling an impure plumbago, which is between two and three feet wide, running to all appearance in micaceous ſhiſtus. This latter foſſil forms the coaſt for a conſiderable way. It however diſappears, when immenſe cliffs of ſerpentine are to be obſerved, which often afford beautiful maſſes of rock cryſtal, alſo fine ſpecimens of aſbeſtus and amianthus. The ſerpentine, having formed a conſiderable extent of cliffs, diſappears, when a curious ſpecies of micaceous ſhiſtus preſents itſelf, compoſed of rounded maſſes of quartz, of conſiderable ſize, connected by means of mica, thus forming a rock not unlike to breccia. This rock, however, is only to be conſidered as a ſpecies of micaceous ſhiſtus, where the quartzy maſſes are of a greater ſize than uſual. Similar appearances, but not ſo ſtriking, have been obſerved in other countries: thus the great road which traverſes Moravia, is made, in the environs of Mark-Stannern, with a ſpecies of gneiſs, which has diſſeminated globules of quartz, about half an inch in diameter †. This curious

† Journal des Mines, No. 23. p. 69.; from Trebra's catalogue of foſſils.

rious rock forms a conſiderable extent of cliffs; but at Strandburgh, a micaceous ſhiſtus, which ſeems paſſing to ardeſia, takes its place. This micaceous ſhiſtus alſo forms a conſiderable extent of coaſt, which is low, preſenting a moſt ſplendid appearance when the ſun ſhines, his rays being reflected from the micaceous rock as from immenſe mirrors. As the coaſt riſes, the ſerpentine again makes its appearance, having the uſual brown, iron-like aſpect, and forming lofty cliffs upon the ſhore; but theſe continue only for a ſhort way, when the micaceous ſhiſtus is again to be obſerved, and continues forming low cliffs to the houſe of Urie. From this, round to the bay of Treſta, the coaſt is lofty and precipitous, formed of micaceous ſhiſtus; but at one place there are immenſe cliffs of gneiſs, which, by decompoſition, form a matter ſimilar to that obſerved at Weeſdale Voe, which is here alſo uſed as fullers earth.

YELL.

THIS iſland is about 4 miles from Mainland, is about 16 long, and 8 broad, and is, next to Mainland, the largeſt in Shetland.

Shetland. There are ſeveral harbours, but none of them large or commodious. It is in general pretty hilly, very much covered with peat moſſes: this, with its tremendous broken coaſts, renders the iſland wild and gloomy. The hills, as far as I could determine, are compoſed of granite, micaceous ſhiſtus, and quartz. On the weſt ſide, which is extremely broken and rugged, there are ſeveral veins of granite, about 5 or 6 feet wide, that run in the micaceous ſhiſtus. They are ſometimes much curved, but generally run at an angle of about 70°. The granite is compoſed of quartz, felſpar, and mica; but all theſe are larger than in the granite which is found in ſtrata.

In ſeveral places I obſerved bitumen, ſticking upon ſtones, or floating in ſmall ſpring wells.

WHALSEY.

THIS iſland is about 6 miles long, and 4 broad, and is 3 miles diſtant from Mainland. The ſhores are low on both ſides, and,

as

as far as I could obſerve, compoſed of micaceous ſhiſtus and granite. The higheſt hill is the Wart, which I found to be compoſed of micaceous ſhiſtus to the top.

At a conſiderable diſtance lie the Grief and Out-Skerries; dreary and deſolate rocks, inhabited by a few fiſhermen, and compoſed of the ſame materials as Whalſey.

CHAP. XXVII.

Deſcription of the FOSSILS *mentioned in the preceding Chapter.*

CIANITE.

SAPPARE, Kirwan. *BLAUER TALC*, *GLIMMER*, *SCHORL*, Germanor.

Colour. White, finely tinged with azure blue. The detached cryſtals reflect a ſilver-white light.

Cryſtallization. Is cryſtallized in the form of compreſſed priſms, more or leſs ſeamed acroſs. Preſents two narrow, and ſlightly ſtreaked, and two broad and ſmooth ſides. The cryſtals are frequently diſpoſed in a radiated form.

Croſs Fracture. Striated, and deſtitute of luſtre.

Longi-

Longitudinal Fracture. Foliated, with a luſtre like that of cryſtals, or metals not much poliſhed.

Hardneſs. When ſtruck parallel to its length, yields difficultly to the knife; when perpendicular to its length, gives fire with ſteel: ſcratches glaſs.

Specific Gravity. 3.618.

Becomes electric by friction, and this electricity is negative.

Another ſpecies of this beautiful foſſil was diſcovered many years ago at Botrephny in Banffſhire, and it has ſince been diſcovered in various parts of Europe. Mr Werner thinks that it is nearly allied to the indurated talc, and that it makes an intermediate foſſil between talc and hornblende.

WACKEN—*Papa-Stour.*

Colour. Brick-red of various ſhades, alſo dark-brown.

Luſtre and Tranſparency. None.

Fracture. Smooth, earthy; but, when compact, it has a tendency to the fine ſplintery.

Fuſibility. Melted at 120° of Wedgewood.

It frequently contains felſpar, forming a ſpecies of porphyry; ſometimes it is intermixed with green earth: it often alſo is cellular, and the cells are encruſted with dark-brown chalcedony, covered with cryſtallized quartz; and nodules of onyx and ſardonyx are ſometimes found in it.

Common SERPENTINE *.

Colour. Blackiſh green.
Luſtre. None, or faint glimmering.
Tranſparency. A little at the edges.
Fracture. Sometimes fine, ſometimes coarſe ſplintery.
Hardneſs. Yields with difficulty to the knife.

This foſſil is uſed in many countries for the building of ovens, as it reſiſts the action of the fire very much; and, when powdered and burnt along with potter's clay, it can be made into

* Werner has lately divided the Serpentine into two kinds, the Common and Noble Serpentine: the laſt mentioned has a conchoidal fracture, with a greater degree of luſtre and tranſparency, and has generally a finer green colour than the firſt.

into light, ſolid veſſels, which take a fine glazing, and reſiſt the fire very well. In Italy it is uſed for the fineſt buildings. What the Italians call the Verde antico, is the noble ſerpentine mixed with marble or granular limeſtone.

Lamellar ACTYNOLITE—Kirwan.

This correſponds with the ſpecimen I examined in the Leſkean cabinet at Dublin, from which Mr Kirwan's deſcription is taken. It appears to be an intermediate foſſil between actynolite, or ſtrahlſtein, and hornblende.

Common TREMOLIT.

Asbestinite, Kirwan.

Colour. Pale green.

Luſtre. Silky.

Tranſparency. A little at the edges.

Fracture. Broad ſtriated, the ſtriæ frequently diverging as from a centre. Its fracture alſo preſents diſtinct concretions, and it is from theſe that the ſtriæ appear to diverge.

Hardneſs. Yields eaſily to the knife.

By decompoſition it acquires an iron-brown colour.

Mr

Mr Kirwan found that this ſpecies melted into a green glaſs at 150° Wedgewood; and Klaproth has lately found, that, in a coal crucible, it gives a greyiſh-white, opaque ſlag, with the loſs of 0.05; and in a clay crucible a compact greeniſh-white ſlag is formed. He finds that two parts contain,

Silex, - -	0.65
Lime, - -	0.18
Magneſia, - -	0.103
Carbonic acid and water	0.065
Oxyd of iron - -	0.005

The phoſphoreſcence of the tremolit is very remarkable, and it has been found that the degree of effect is inverſely as their hardneſs: thus the ſoft ſilky ſpecies gives a more vivid and red light, with a leſs degree of friction, than the harder kind. The phoſphoreſcence can even be produced by means of a feather.

SCHILLER SPAR, or *LABRADOR HORNBLENDE.*

This beautiful foſſil is found in the ſerpentine rocks of the iſland of Unſt. It was firſt diſcovered on the coaſt of Labrador;

dor; afterwards in Germany; and ſince in Cornwall, by Mr Hatchett. It is conſidered to be nearly allied to mica and talc; indeed it paſſes, on the one hand, into green mica, and, on the other, the yellow varieties paſs into common talc.

MICA

Is found in ſeveral of the Shetland Iſlands; and ſometimes the plates are of conſiderable ſize; but they are not ſo large as thoſe that I have ſeen brought from Ruſſia. A conſiderable quantity of mica is uſed in the Ruſſian navy, for the making of lanterns and cabin windows. It is preferred to glaſs, from its not breaking by the diſcharge of cannon. It has a conſiderable inconvenience, however, that it ſoon loſes its tranſparency by the action of the air and ſea-water.

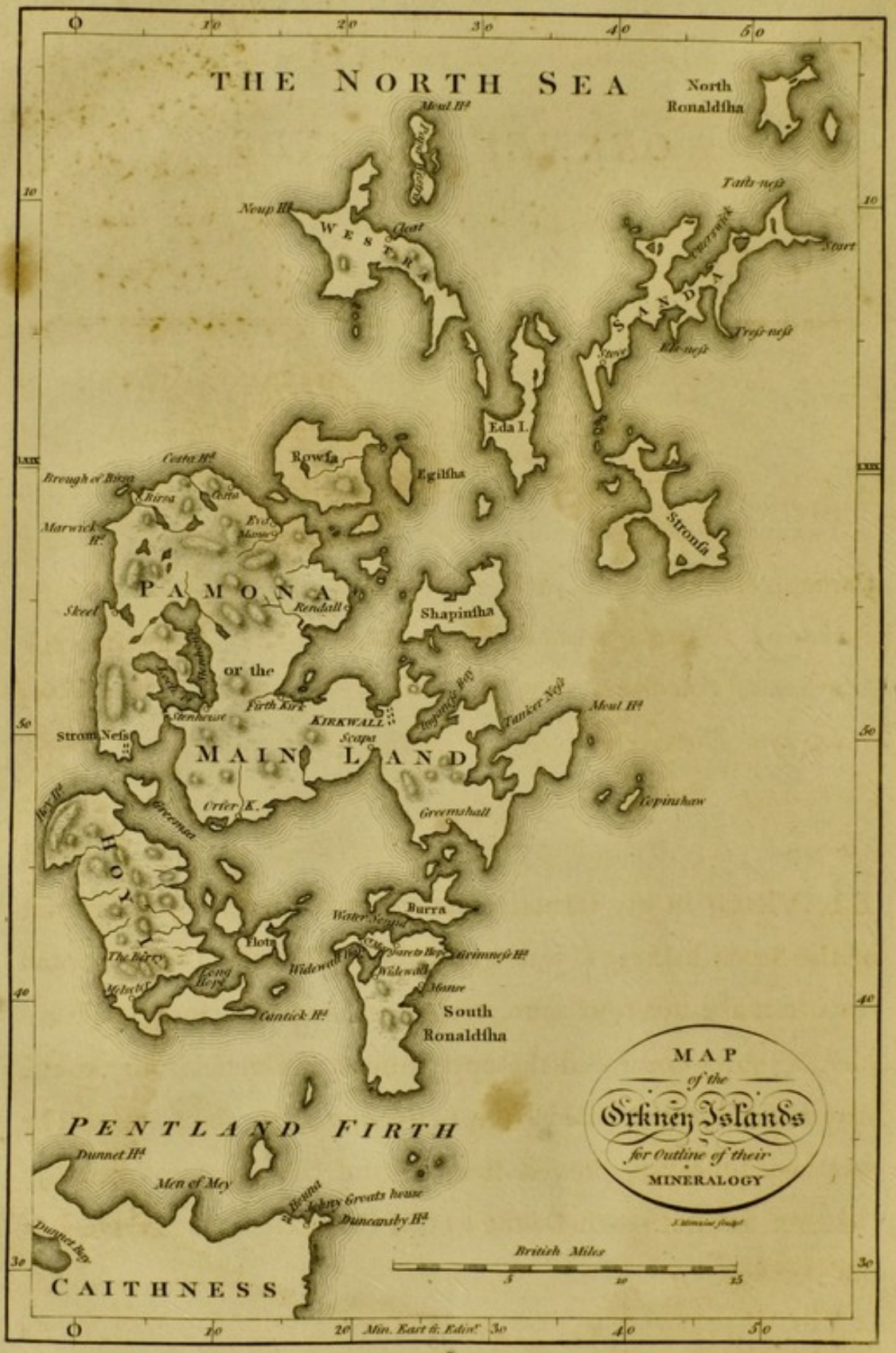
As there are ſeveral foſſils that have a very near reſemblance to mica in their external appearance, I will here ſhortly ſtate the characters by which they may be readily diſtinguiſhed, as ſtated by the Abbé Huay *.

Mica

* Journal des Mines.

Mica is diſtinguiſhed from talc, by its communicating, by rubbing, the reſinous electricity to wax, while talc communicates the vitreous; and farther, mica has not the unctuoſity of talc. It is diſtinguiſhed from cyanite, by its ſoftneſs; the cyanite being vaſtly harder. It may be confounded with ſulphure of molybdæna; but the ſulphure of molybdæna ſoils paper, while mica does not: the ſame diſtinction with regard to carbure of iron. It is diſtinguiſhed from the green cryſtallized uranite, by its pliability, the uranite being very fragile: the blow-pipe alſo affords a good diſtinction, the mica being converted into enamel, while the uranite is changed into a black ſcoria. The greyiſh-black mica may be confounded with the micaceous iron ore, or eiſenman; but the latter is friable, and adheres to the fingers, often acts on the magnet, and melts into a black ſcoria.

ORK-


THE NORTH SEA
North Ronaldsha
Moul Hd
Neup Hd
WESTRAY
West
Tafts-ness
Start
Noust
SANDAY
Start
Ebe-ness
Troso-ness
Eda I.
Rowsa
Egilsha
Costa Hd
Brough of Birsa
Birsa
Osha
Marwick Hd
Eyre Manse
PAMONA
Skeel
Rendall
Shapintha
or the
Firth Kirk
KIRKWALL
Stenhouse
Strom Ness
Scapa
MAIN LAND
Inganess Bay
Tankerness
Moul Hd
Copinshaw
Greemshall
Orfer K.
Hoy Hd
HOY
Water Sound
Burra
Flota
The Burry
Widewall Bay
Widewall
Manse
Grimness Hd
South Ronaldsha
Cantick Hd
PENTLAND FIRTH
Dunnet Hd
Men of Mey
Duncansby Hd
Dunnet Bay
CAITHNESS
MAP
of the
Orkney Islands
for Outline of their
MINERALOGY
British Miles
Min. East & Edinr.

ORKNEY ISLANDS.

CHAP. XXVIII.

Outline of the MINERALOGY *of the* ORKNEY ISLANDS; *comprehending* FLOTTA, SOUTH RONALDSHA, BURRA, POMONA, SHAPINSHA, STRONSA, SANDA, EDDA, WESTRA, EGLISHA, ROUSA, *and* HOY.

HAVING, in my former journeys, traverſed the greater part of the Scottiſh Iſles, I was anxious to viſit the Orkneys, and thus to make my tour more complete; and therefore, laſt ſummer, 1799, I embraced the opportunity of a veſſel going to the iſland of Hoy, and ſailed from Leith upon the 9th of June. The weather, however, proved ſtormy, and the wind contrary, ſo that we did not reach Orkney until the 20th, heartily tired of our voyage.

As ſoon as the veſſel anchored, we landed upon the iſland of Hoy, immediately below the houſe of Mr Bremner, the miniſter of the pariſh, who received us very kindly. Having breakfaſted, Mr Bremner was ſo good as to accompany us to the Berryhead, which is one of the moſt tremendous rocky precipices in Orkney. The walk was at firſt pretty eaſy; but as we came higher up the hill, it was fatiguing. Having reached to the ſummit of a high hill, we had ſtill to aſcend a conſiderable height, which brought us to the Berryhead. Here, indeed, a moſt ſublime ſcene burſt upon our view. Below us, and extending along the weſt coaſt of the iſland for ſeveral miles, were tremendous precipices of red-coloured ſandſtone, which roſe to a great height. We crept towards the edge of the precipice, and beheld with terror a perpendicular deſcent of more than 1000 feet deep. When our attention could be withdrawn from the ſight of theſe vaſt precipices, a ſcene of a different kind preſented itſelf to our view. The ſky was clear; the ſea calm, and ſtill as a lake; and the whole extent of the ſea, and Pentland Frith, from Cape Wrath to Duncanſbay Head, was before us: the wild mountains of Sutherland and Caithneſs, of an etherial blue, added to the grandeur of the ſcene, retiring from the eye till at length they ſeemed to be blended with the ocean. We returned to the manſe, well pleaſed with our excurſion;

excurſion; but found no variety of rock, ſandſtone being the only rock we obſerved.

We remained at Mr Bremner's all night, and took a boat next day for the iſland of South Ronaldſha; but, in our way, examined the ſmall iſland of

FLOTTA.

THIS iſle is of little extent, low, but in ſeveral places there are cliffs upon the ſea-ſhore which are of conſiderable height. It is entirely compoſed of ſandſtone and ſandſtone flag; nor is it remarkable, excepting for its former celebrity, being the reſidence of the hiſtoriographer appointed by the crown of Norway to collect information with regard to the north of Scotland. Theſe narrations formed a work called Codex Flotticenſis; to which Torfæus is indebted for much of his hiſtory of the northern parts of Scotland.

We croſſed from this iſle to the iſland of

SOUTH RONALDSHA.

THIS iſland is about ſeven miles long, and one and a half broad. It is low, excepting upon the ſhores, where there are tremendous precipices, which have proved fatal to many an unfortunate mariner. The whole iſland is compoſed of ſandſtone, ſandſtone flag, and in ſome places ſhiſtoſe clay is to be ſeen. It appears, like all the other Orkney Iſles, to have been formerly joined to Caithneſs, as the ſtrata are ſimilar. Mr Watſon, the miniſter of the pariſh, told me, that the ſandſtone, in different parts of the iſland, has been dug, in expectation of finding good veins of lead ore (galena), but always without ſucceſs. This is very probable, for Emmerling informs us that ſandſtone is very unfavourable to ores *. (Mineralogie, B. 3. S. 119.) In one part of the iſland we obſerved a ſtratum of ſhell marl lying under the peat, and in differents parts of the iſland we obſerved bog-iron ore.

As

* It is ſaid, however, that the mountain Verſopatal, in Mexico, is compoſed of ſandſtone, which is traverſed by numerous veins, in which gold is found; Gerhard mentions ſimilar rocks.

As the weather was boiſterous, we remained in this iſland ſeveral days; at length the wind ſubſided, when we were enabled to croſs to the iſland of

BURRA.

THIS iſland is of little extent, low, and compoſed of ſimilar argillaceous ſandſtone with that of Ronaldſha; and in one place I obſerved ſtrata of ſhiſtoſe clay alternating with it. The ſhiſtoſe clay is of a black colour, and has frequently interſperſed bitumen; and veins of calcareous ſpar are to be obſerved traverſing it. This is a favourable appearance for coal, and deſerves to be tried.

As this iſland afforded nothing particularly intereſting, we croſſed to the Mainland, or what is called the iſland of

POMONA.

POMONA.

THIS iſland is about 22 miles long, and in ſome places about 20 broad. It is in general low; the hill of Wideford, near to Kirkwall, and thoſe in the pariſh of Orphir, being the higheſt in the iſland. The ſhores in ſome parts of the iſland are pretty high, yet in general they are low. There are two good harbours: the one at the principal town, called Kirkwall; the other upon the oppoſite ſide of the iſland, at Stromneſs.

The mineralogy of this iſland is by no means intereſting; the whole of the iſland, excepting a ſmall portion near to Stromneſs, being entirely compoſed of ſandſtone, ſandſtone flag, ſhiſtoſe clay, and in one place limeſtone and baſalt make their appearance. The ſtrata are generally horizontal, and are of various breadths; and the ſandſtone and ſhiſtoſe clay alternate with each other. As it would be of little conſequence to trace my ſteps in the walk which I made around this iſland, I ſhall mention only the peculiarities of the different rocks.

1. *Sand-*

1. *Sandſtone.* This rock is of various colours, grey, red, or whitiſh; has generally an argillaceous cement: yet, in particular kinds, this is but in ſmall quantity. It is frequently ſhiſtoſe, forming ſandſtone flag. It is uſed for building in all parts of the iſland; and in ſome places, as at Skail, where it is very hard, being a ſiliceous ſandſtone, it is cut for mill-ſtones, and is ſaid to anſwer the purpoſe very well. A ſtratum of ſiliceous ſandſtone, ſimilar to that at Skail, I obſerved among the ſoft ſandſtone ſtratà near to Scapa; and I have not the leaſt doubt, if well quarried, that it would anſwer equally well for mill-ſtones *. Sometimes maſſes of iron pyrites, of a globular or irregular form, are diſperſed through it; and of this

* Different kinds of rock are uſed in Scotland for the making of mill-ſtones. Thus, in ſome places, as in the iſland of Raſay, I found porphyry uſed for mill-ſtones; and in Shetland, a compact ſpecies of micaceous ſhiſtus, is uſed for the ſame purpoſe. It has been a great deſideratum to diſcover in Great Britain, a mill-ſtone equal to the French bur; indeed it is of ſuch inportance, that, the Society for the Improvement of Arts and Manufactures, at London, have offered a reward of 100 guineas, to him who ſhall diſcover a ſimilar rock in Great Britain. As this rock may not be generally known, I think it proper here to mention that it is a cellular hornſtone, and is found in vertical ſtrata, according to Wallerius. As this famous ſtone is of a porous nature, and very hard; it is very probable that theſe properties muſt reſide in all good millſtones.—See Townſon's Tracts, paper on Mill-ſtones.

this we have an example in the ſandſtone rocks upon the ſhore between Scapa and Orphir kirk. Trials have been made in the ſouth part of the iſland with a view to find lead, but without ſucceſs. At Yeſtneby, near to Skail, I obſerved veins of barytes traverſing the ſandſtone; and, intermixed with this barytes, there was calcareous ſpar, iron pyrites and galena. At Skail, the ſandſtone, by the action of the weather, ſplits into many ſingular forms, ſimilar to the ſandſtone I have deſcribed in the iſland of Arran.

2. *Shiſtoſe Clay.* This rock has a black colour; is always intermixed with mica; and paſſes, on the one hand, into ſandſtone ſlate, and, on the other, into clay, where the ſhiſtoſe character is more difficultly diſtinguiſhable. It acquires, by the action of the weather, an iron-brown covering; ſo that the rocks, at a diſtance, have much the appearance of the weathered ſerpentine rock in the iſlands of Unſt and Fetlar, in the Shetland iſlands. In ſome places, as near to Stromneſs, I obſerved a red-coloured clay, which ſeemed to be clearly derived from the decompoſing ſhiſtoſe clay. It is quarried to a conſiderable extent in different parts of the iſland, particularly near to Stromneſs, and the ſlates are uſed for roofing houſes; but they are vaſtly inferior, in every reſpect, to the ardeſia which is raiſed at Ballyhuliſh and Eaſdale.——Upon the ſea-ſhore, near

to

to Brinnigar manſe, which is about a mile from Stromneſs, in a kind of rock intermediate between ſhiſtoſe and indurated clay, there are many pieces of galena diſperſed. Several years ago, a party of miners examined this appearance, and, having judged it probable that lead would be found in abundance, continued working for ſome time, but at length deſiſted, having, as they ſay, found it not worthy of farther labour. Near to the manſe of Brinnigar, I obſerved maſſes of Lydian ſtone immerſed in the ſhiſtoſe clay: in the Lydian ſtone there were ſeveral cavities filled with bitumen.

3. *Limeſtone.* At Yeſkneby there is a conſiderable ſtratum of black-coloured limeſtone, which alternates with a rock intermediate between ſandſtone flag and ſhiſtoſe clay. It is much impregnated with bitumen, forming what is called ſtinkſtein; and in ſeveral places I obſerved maſſes of bitumen diſperſed through it.

4. *Baſalt.* At Yeſkneby is the only baſaltic rock which I obſerved in the whole iſland. It forms veins, which traverſe the common argillaceous ſandſtone. The cryſtals of hornblende, which are contained in it, are larger than uſual in ſuch rocks, being more than an inch long, and half an inch broad. I ſometimes obſerved ſmall cavities filled with bitumen.

The rocks of ſandſtone, ſhiſtoſe clay, &c. which I have juſt deſcribed, form the whole iſland, excepting an extent of a few miles around Stromneſs, which is of primary ſtrata. Theſe ſtrata are, granite, gneiſs, micaceous ſhiſtus, and hornblende rock; and all are traverſed by veins of great-grained granite. The granite ſeems to form the central part, and is covered by gneiſs, micaceous ſhiſtus and hornblende ſlate. At the mill water of Cairſton, which is not far from Stromneſs, I obſerved the junction of the primary with the ſecondary ſtrata. The micaceous ſhiſtus is covered by a breccia which is compoſed of fragments of granite and quartz, cemented by a baſis of ſmaller particles of the ſame rocks; and, in the breccia, I obſerved pieces of galena immerſed. This breccia is to be obſerved, in ſome places, covered by the ſhiſtoſe clay. From ſome appearances in the neighbourhood of Brinnigar, it is not very improbable that the ſhiſtoſe clay may lie upon the primary rock, without any interpoſed ſtratum of breccia?

Having ſeen every thing that was worthy of notice, we croſſed to the iſland of

SHA-

SHAPINSHA.

THIS iſland is about 7 miles long, and 5 broad. The ſhores around the whole iſland are in general low.

The ſtrata do not differ from thoſe of Pomona; being principally compoſed of ſandſtone, ſandſtone flag, ſhiſtoſe clay, limeſtone, and baſalt. The limeſtone is covered by a very hard, nearly ſiliceous ſandſtone, and it is alſo traverſed by veins of the ſame ſandſtone. The baſalt, which is only to be obſerved at the ſouthern extremity of the iſland, ſeems to be covered with ſandſtone. In the ſandſtone iſles of Copinſha, which lie at the ſouthern extremity of the Mainland, or Pomona, I alſo obſerved a baſalt, or rather wacken, traverſed by veins of horn-ſtone, and covered by a very hard ſandſtone: theſe, with the baſalt veins at Yeſkneby, are the only appearances of baſalt which I have obſerved in the Orkney Iſlands.

As this iſland afforded nothing intereſting, we ſailed for the iſland of

STRONSA.

THIS iſland is about ſix miles and a half long, and ſix miles broad. It is low, but upon ſeveral parts of the coaſt there are cliffs of conſiderable height. The rocks are entirely of ſandſtone and ſandſtone flag; which latter ſometimes paſſes to ſhiſtoſe clay.

Having ſpent two days in traverſing this iſland, we croſſed to the iſland of

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SANDA.

THIS iſland is about 12 miles long, and in ſome places nearly 3 miles broad. Upon the weſtern extremity there are hills about 300 feet high, but all the other parts of the iſland are low and flat. Large ſhoals extend a great way from the coaſt, which is one of the cauſes of ſo many veſſels being wrecked upon this iſland.

The

The mineralogy, like that of all the other iſlands, is very uninteresting; it being, as far as I examined it, compoſed entirely of ſandſtone and ſhiſtoſe clay; excepting a rock of ſandſtone breccia, which I obſerved at a place called Hecla-bor: hence the rock has been conſidered as volcanic.

Having ſpent ſeveral days in traverſing this iſland, we croſſed to

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EDDA.

THIS iſland is about 7 miles long, and in ſome places about 2 miles broad. It is hilly, and, like Sanda, entirely compoſed of ſandſtone, which is of a red colour.

We croſſed from this to the iſland of

WESTRAY,

and landed at the hoſpitable manſion of Mr Stewart of Brough. This iſland is about 9 miles long, and 6 broad. It riſes, in ſome places, to a conſiderable height; and upon the north-weſt part of the ſea-coaſt there is very magnificent rocky ſcenery. It is entirely compoſed of ſandſtone and ſandſtone flag; ſo that to a mineralogiſt it affords no variety.

PAPA-WESTRAY.

ABOUT two miles north from Weſtray, is the ſmall, but pleaſant iſle of Papa-Weſtray. It is about three miles and a half long, and about a mile broad. It is principally compoſed of ſandſtone, ſandſtone flag, ſhiſtoſe clay, and in ſome places I obſerved fragments of breccia.

We now croſſed, by a dangerous ferry, nine miles in breadth, called Weſtra Frith, to the ſmall iſland of

EGLI-

EGLISHAY,

where we were very kindly received by Capt. Baike. It is about two miles and a half long, and one broad; and is entirely compoſed of ſandſtone and ſandſtone flag, and in ſome places the ſtrata ſeemed to be very much elevated.

As the weather was ſtormy, we could not leave this iſle for ſeveral days: it having become more moderate, we croſſed to the iſland of

RONSAY.

THIS iſland is about four miles long, and three broad, and, excepting Hoy, is the moſt hilly of the Orkney Iſlands. The coaſt, in ſome places, is of great height, and preſents many ſublime rocky ſcenes. It affords no variety of foſſils, being, like the other iſlands, entirely compoſed of ſandſtone and ſandſtone flag; which laſt ſometimes paſſes to ſhiſtoſe clay.

Having

Having traverſed the whole of this iſland, we croſſed again to Pomona, and walked by Stromneſs, and again croſſed to the iſland of

H O Y.

THIS iſland is about 12 miles long, and 5 broad; is the moſt mountainous of all the Orkney Iſlands; and its ſhores, as I have already remarked, riſe, in many places, to a moſt terrific height. This iſland is remarkable for its excellent harbour, called the Long-Hope, where great fleets can rendezvous, and in complete ſafety.

This iſland is entirely compoſed of ſandſtone, ſandſtone flag, ſhiſtoſe clay, and in many places I obſerved a rock of wacken. The ſtrata are generally horizontal, and ſometimes they alternate. The ſandſtone has been dug, in various places, in ſearch of iron ore; and the attempts ſeem to have been attended with ſome ſucceſs, as rich hematitical iron ore was obtained. I am of opinion, however, that, in the trials which have been made

made near to Melſetter, upon the eſtate of Major Moodie, the proper bed of ore has not been fairly diſcovered; and that which has been obtained, is merely an admixture of ſandſtone and ore. In other countries, this admixture, of the ore and the ſtratified matter, has been taken for the true bed, and much unneceſſary expence incurred, which might have been avoided by digging in a proper direction, ſo as to meet with the bed of ore. The ſhiſtoſe clay, where it alternates with the ſandſtone, has ſometimes that ſhining appearance which is characteriſtic of the ſpecies found above, or in the vicinity of, coal ſtrata: a circumſtance which is to be conſidered as favourable for the diſcovery of coal in the lower parts of this iſland.

The wacken, which I have mentioned, is upon the ſeaſhore, at a little diſtance from Melſetter. It has, intermixed with it, calcareous ſpar, either in little veins or nodules: pieces of ſilicious ſandſtone are found in it, and even veins of a ſimilar ſandſtone traverſe it.

We now took leave of Major Moodie, and ſailed down the harbour of Long Hope to the iſland of Ronaldſha, where we ſpent a few days very agreeably with Mr Watſon, waiting favourable weather to croſs the Pentland Frith.

ON KELP.

CHAP. XXIX.

Obſervations on KELP.

AS this ſubſtance is of the greateſt importance to the Orkney Iſlands, I hope the following obſervations will not be conſidered as out of place.

This uſeful material does not appear to have been known as a manufacture in Britain, until ſome time after the beginning of the preſent century; owing to the backward ſtate of the ſoap and glaſs manufactures, which, particularly in Scotland, have not been carried on with ſpirit above thirty years. It will not then ſurpriſe us, when we learn, that its firſt introduction

duction was about the year 1730, into the iſland of Uiſt, by a Highland gentleman, of the name of M'Leod, who brought the art from Ireland, where it had been carried on many years before. The method he followed was a bad one, as he was ſatisfied by merely reducing the ſea-ware, or fuci, to aſhes. This practice was ſoon diſcontinued, and the method of fuſion was adopted. This manufacture ſoon found its way into all the other iſlands; for we find it forming an article of trade in Shetland, ſoon after its introduction into the Hebrides. The quantity of kelp, at firſt made, was trifling; but the great increaſe, and the rapid progreſs, of the manufactures depending on it, ſoon raiſed the price and increaſed the quantity: the following being, as far as I can collect, pretty nearly the price of kelp from the year 1740 to the preſent time.

From 1740 to 1760,	average price about		2l. 5s. a ton.
1760 to 1770	-	-	4l. 4s. a ton.
1770 to 1780	-	-	5l. os. a ton.
1780 to 1790	-	-	6l. os. a ton.

Since the year 1791, its value has greatly increaſed, and has now riſen to a greater height than was ever known before, owing to the war, which has prevented the importation of the

uſual quantity of barilla, and has thus raiſed kelp to the enormous price of 11l. a ton *.

In Shetland, from 250 to 300 tons are made annually, but this quantity bears ſo ſmall a proportion to the extent of the lands, as not to have affected the rent in an equal degree to that of Orkney; where, within theſe ſeven years paſt, ſmall farms of about 40l. yearly rent, have riſen to 300l. a year.

In Shetland, the coſt of manufacturing is from 2l. to 2l. 10s. a ton; but in the weſt Highlands, the price of labour is greatly lower, being from 1l. to 1l. 10s. a ton. The method of manufacturing, though rude, is ſufficiently ſimple. The different ſpecies of fuci, particularly the veſiculoſus, ſerratus, and nodoſus, are cut from the rocks in the months of May, June, and July, and ſpread out and dried ſo as to enable them to burn more eaſily. In drying the ware, they are very cautious to prevent any fermentation from taking place, or to ſuffer it to be expoſed to rain; as kelp, made from ſuch damaged ware, is neceſſarily of a very inferior quality.

The

* Even this price might be ſtill further increaſed in a very conſiderable degree, if proper methods of manufacturing the kelp were followed.

The ware being well dried, a ſmall quantity is kindled in a pit dug in the ſand, or upon a piece of ground which is ſurrounded with looſe ſtones, ſo as to form what is called a kiln. They continue adding freſh quantities, until the pit or kiln is nearly filled, when the whole is frequently ſtirred towards the evening, when it gets into a ſemifluid ſtate; it is allowed to cool, and afterwards taken out of the pit ready for the market. This method of burning the ware, is liable to many inconveniences. Of theſe, the following are not the leaſt conſiderable: 1. As the ſides of the kiln become heated, conſiderable maſſes of ſtone ſplit off, and are mixed with the melted matter, which reduces the value of the kelp very much. 2. From the heat not being ſufficiently confined, the ware is always very imperfectly burnt. 3. By the fuſion being made upon the ground, a very conſiderable portion of ſiliceous earth is mixed with the melting materials; and this earth uniting with the alkali, renders a portion of it uſeleſs; becauſe, though it increaſes the weight of the kelp, it deteriorates its quality.

Theſe facts engaged the attention of my father ſome years ago, who endeavoured, by a ſeries of experiments, to aſcertain the value of kelp burnt in this rude way, and that made in furnaces. He erected ſeveral different kinds of furnaces, in which he burnt the ware, and afterwards examined the kelps; which

were

were very ſolid; free of foreign earthy ſubſtances of maſſes of carbonaceous matter; and contained a greater quantity of alkali than common kelp—A recapitulation of all theſe experiments would be inconſiſtent with the intended brevity of this publication. I ſhall, therefore, only mention what he conceived to be the beſt form of a furnace.

It conſiſts of one fire-place, covered with an arch, which communicates with four reverberating cavities, into which the ware is to be thrown. This fire-place, with a ſmall quantity of fuel, produced a kelp of greater ſtrength than any he had examined during his long practice; and, upon calculation, it was found that the expence of furnaces and fuel, was greatly more than repaid by the increaſed value of the kelp.

I find, that a ſpecial committee of the Highland Society, aſſiſted by the late celebrated Dr. Black, had examined theſe furnaces, and reported to the Society their approbation of them. They alſo mention ſeveral other particulars, which are of importance to be more generally known.

" Mr Jameſon further ſtated, that the expence of theſe kilns would be of moderate amount; that of the ſingle 7l. or 8l. and of the four united, (which is the one I have deſcribed), about

about 30l, with the addition of a ſmall ſum for a ſhade or cover, to protect the article when made, from the weather; but that ſuch an expence would be repaid by the additional quantity of good kelp, produced from the ſea weed, burnt into 10 tons; which the kilns would produce in a very ſhort time, the ſingle one burning one ton, and the quadruple four tons a day †."

Merchants, in their examination of kelps, are poſſeſſed of a few rules, which they generally follow, in determining their relative value; theſe are, taſte, ſmell, colour, and compactneſs. Theſe will give us a very vague idea of their value; and it requires no foreſight to perceive, that truſting to external characters, in ſo heterogeneous a maſs as kelp, muſt often lead the unwary buyer into a diſagreeable predicament, in purchaſing as good, what upon actual trial he finds of comparatively little value. Theſe remarks are not idle conjectures; for I have often ſeen them verified, to the no ſmall detriment of the manufacturer, and have as often regretted that ſo little attention ſhould be paid to the aſcertaining the proportion of alkali, &c.

Mr Kirwan of Dublin, whoſe active induſtry is now well known to all Europe, is the firſt who has engaged ſeriouſly in this

† Tranſactions of the Highland Society, Vol. I. p. xxiv, xxv.

this inveſtigation; and the reſults of his labours are detailed in the 3d vol. of the Tranſactions of the Royal Iriſh Academy.

Having favourable opportunities, through the good ſervices of ſome of my friends, of procuring kelps and barillas, I aſcertained the proportion of pure alkali in each of them: in ſome by the teſt of ſulphat of argill, which is employed by Mr Kirwan; in others, by uſing an acid of known ſtrength, the method recommended by Dr. Black.

Table of the Proportion of ALKALI *contained in different kinds of* BARILLA *and* KELP.

		In the 100lb.
Barilla and	Alicant—good	23½.
	Teneriff—bad -	8 lb. 7 oz. 120 gr.
Kelp from	Norway indifferent	2 lb. 11 oz.
	Shetland—indifferent	2 lb. 6 oz.
	Lewis—indifferent	2 lb. 11 oz.
	Ibid—indifferent	2 lb. 6 oz.
	Weſt Highlands—much damaged - -	1-3d of lb.

Arran

Arran - - -	3½ lb.
Iſla—good - -	4 lb.
Mull—good - -	4½ lb.
Morven—good -	4½ lb.
Iſland Skye—good -	5 lb.
Leith ſhores - -	4 lb.

In judging of the value of kelp, it is not ſufficient that we have aſcertained the proportion of ſoda; ſeveral other circumſtances muſt be attended to. In the firſt place, in judging of the value of a cargo, we muſt carefully examine its general appearance, which comprehends the ſize of the maſſes, the greater or leſs quantity of mixed ſtony matter, the degree of compactneſs, the proportion of diffuſed charcoal, the cauſticity, its wetneſs or dryneſs, &c. We then take pieces as different as poſſible from each other, and as expreſſive of the character of the whole as we can, pound them, and take any intermediate quantity, as an ounce, and aſcertain the proportion of ſoda, which being done, will afford us as juſt an idea of its value, as from the nature of circumſtances we can obtain.

Chemical Analyſis of Fuci.

Our knowledge of the ſaline and earthy matters contained in fuci, is as yet very limited, which is to be regretted, when we conſider the utility and importance of ſuch an inveſtigation. Bouvier, in the Annales des Chymie for 1791, has given us an analyſis of what he names Fucus Helmenthorcoton. From his experiments, it appears, that no uncombined alkali is preſent, and that the principal ſaline compound is muriat of ſoda, (common ſalt.)

Vauquelin has found ſoda ready formed in ſome maritime plants. The plants which give moſt alkali by combuſtion, are not thoſe that grow under the ſea-water as fuci, but thoſe that grow upon the land near to the ſhore, as ſalſola kali, ſoda, ſativa. The ſalſola ſativa is the ſpecies which is cultivated in Spain for the making of barilla, and the exportation of the ſeeds is puniſhed by death.

Cultivation of Fuci.

The cultivation of fuci upon ſhores, is now become an object of ſome conſequence, not only from their value, as affording kelp, but alſo on account of their ſucceſsful uſe as a manure.

nure. It has, therefore, been recommended to place ſtones upon the ſhores, which, in many places can be done at ſmall expence; and theſe in two years, become covered with fuci, in ſuch a ſtate, as to admit of cutting. Various kinds of ſtones have been tried, as baſalt, ſandſtone, and limeſtone; this laſt is by many reckoned the beſt, and, next to it, baſalt.

FROM HUNA TO THE FRITH OF FORTH.

CHAP. XXX.

Journey from HUNA, *upon the ſhore of the Pentland Frith, by Wick, Berrydale, Dornoch, Tain, Cromarty, Fort-George, Nairn, Forres, Elgin, Loſſiemouth, Cullen, Portſoy, Banff, Aberdeen, Stonehaven, Dundee, to the Frith of* FORTH.

ALTHO' it required nearly ſix weeks to traverſe the Orkney Iſlands, and that journey proved the moſt unintereſting I had ever made; yet I had the pleaſing reflection of having examined a country, the mineralogy of which was before unknown, and of having now finiſhed my journey thro' the greater part of the Scottiſh Iſles. But I cannot leave them, without acknowledging, in the warmeſt manner, my ſenſe of the

the hoſpitality of the inhabitants : a kindneſs the more agreeable, that it ſeemed, on their part, to look for no return, and to proceed from feelings ſo conſonant and natural, that they had forgot that it was unuſual, and confined to thoſe remote highlands, where the better feelings of the heart more freely expand themſelves.

The weather being favourable, Mr Watſon accompanied us to the ferry, which is at a place called Burwick, ſituated upon the ſouth-weſt end of the iſland of South Ronaldſha. We bade him adieu, and left with regret a friend to whoſe kind attentions we had been ſo much indebted. Altho' the boat was excellent, we did not embark without ſome dread, from the recollection of the many terrible accidents which have happened in croſſing the frith. Luckily the weather proved fine; ſo that we landed at Huna, upon the coaſt of Caithneſs, after a paſſage of about two hours and a half. In croſſing, we came cloſe to the ſmall, low iſland of Stroma, which appears to be compoſed of ſandſtone and ſandſtone flag: indeed we were informed that a great number of flags are annually quarried in this iſland, and carried to the coaſt of Caithneſs. At Huna, the ſhore is low, and is compoſed of coarſe argillaceous ſandſtone; and the coaſt and country, from Duncanſbay Head to Dunnet Head, are evidently formed of ſimilar rocks. As the poſtman was juſt ſetting out for Wick, which is the firſt town we meet with

in

in going ſouthward, we embraced the opportunity of having him as a guide. The country continues low and flat, only in a few places varied by conſiderable hills; and cultivation ſeems very ſparing. Near to Kies Caſtle we encountered a tedious ſandy beach, over which we walked; and in ſeveral places we obſerved that the peat had been dug from under the ſand. At the extremity of this beach, we paſſed a formal tower, a ſeat of Sir Benjamin Dunbar; and further on, towards the Noſs Head, the caſtles of Guernigo and Sinclair were ſeen perched upon lofty ſea-cliffs; and ſoon afterwards we came to the ſmall borough town of Wick. The country, thro' which we had paſſed, is compoſed of ſandſtone and ſandſtone flag; but, in many places, I obſerved maſſes of breccia, compoſed of fragments of red granite, micaceous ſhiſtus, and quartz, cemented by an arenaceous baſis: but I could not diſcover how it is connected with the other ſtrata of the county.

Wick is the chief county town in Caithneſs; is of little extent; and lies upon the north-eaſt ſide of what is called Wick river. The ſtrata, upon both ſides of the river, and in the neighbourhood of the town, are compoſed of ſandſtone flag, which is diſpoſed in ſtrata nearly horizontal; and, in the bed of the river, I alſo obſerved great maſſes of the breccia juſt mentioned.

We left Wick in the morning for the houſe of Berridale. We continued our journey for ſeveral miles thro' a heath-covered country, pretty level, but brown and bleak, with little cultivation, and no variety of ſtrata; ſandſtone and ſandſtone flag being the only rocks. At Poakmaſt the country is more hilly; and now and then the great mountains, the Paps of Caithneſs, and the lofty Morven, appeared at a conſiderable diſtance, forming a ſtriking contraſt with the low, mean-looking country thro' which we were paſſing. From Poakmaſt to Dunbeath we had ſtill the ſame bleak ſcene; and this tedious uniformity was only varied by the appearance of old, ruinous caſtles, perched upon the rocky cliffs on the ſea-ſhore, or recluſe gentlemen's ſeats ſituated amid brown deſert heaths.

After paſſing Dunbeath, we continued walking for about four miles, along the ſea-ſhore, thro' a heath-covered country, when we came upon the ſide of a valley beautifully covered with natural wood; and we obſerved, ſituated in its bottom, the neat inn of Berridale, for which travellers have to thank the generoſity of Sir John Sinclair. As we deſcended, by a winding road, to the houſe, the valley became more recluſe: the diſtant mountains being hid by the ſides of the valley, and a bridge thrown acroſs a water which runs over a broken channel overhung with natural wood, added much to its beauty.

This

This is indeed a ſcene that might be admired under a milder climate. The ſtrata, from Dunbeath to this valley, are formed of ſandſtone, ſandſtone flag, and a blue ſpecies of ſecondary ardeſia: the higher grounds appear to be entirely of primitive rocks.

As the weather was delightful, we did not proceed on our journey homewards, but next morning we agreed to aſcend the mountains in the neighbourhood, ſo that we might obtain ſome information as to the ſtructure and compoſition of the high parts of the country. After breakfaſt, we took a winding and pretty ſteep road upon the ſouth ſide of the valley, which led thro' the natural wood, and ſoon reached the ſummit of the valley. From this, we had a fine view of Morven, Scuraben, and the neighbouring mountains; yet we were ſeparated from them by a long, dreary peat muir. Having croſſed the muir, which was very fatiguing, (owing to its broken ſurface,) we at length reached the bottom of Scuraben. We here found a tolerable tract, which led us a conſiderable way up the mountain. At the termination of this tract, we turned weſtward, and walked over a wilderneſs of ſtones, and thro' a thick fog, to the ſummit of the mountain of Scuraben. The thick miſt entirely prevented us from ſeeing the neighbouring country; and we were forced to deſcend into a hollow

upon

upon the lea ſide of the mountain, to ſhelter ourſelves from the piercing cold and drizzling rain. We laid ourſelves down behind a great maſs of rock, anxiouſly waiting for the diſperſion of the fog; and, being much fatigued, fell aſleep, but awaked ſoon afterwards, cold and wet, and ſtill involved in a thick miſt. As our ſituation was now by no means agreeable, we quitted the hollow in which we had taken ſhelter, and deſcended by the north-weſt ſide of the mountain, and, after a long walk, we were happy again to reach the ſweet retreat of Berridale.

From the obſervations which I made upon the ſummit of the hill, and in the aſcent, the following appears to be the nature of the ſtrata. The lower part of the country is common argillaceous ſandſtone, and ſand ſandſtone flag; but, as we aſcend, the next rock is an arenaceous breccia, which has, immerſed in it, fragments, of various ſizes and ſhapes, of red granite, micaceous ſhiſtus, and quartz; and to this ſucceeds a rock of quartz, which reaches to the ſummit of the mountain. This quartz is ſometimes ſo intermixed with the mica, as to form micaceous ſhiſtus; and very often it has a brecciated appearance. Morven, with the other neighbouring mountains, from their white colour, appear to be compoſed of a ſimilar quartzy rock. It would be an object well worthy the attention of the mineralo-

giſt, to examine the junction of this quartzy rock with the ſandſtone ſtrata, and alſo to determine with accuracy the angle of elevation, &c. of theſe ſtrata.

Having reſted after the fatigues of our journey to Scuraben, we left Berridale early in the morning. The weather was charming; and the perfume of the wild flowers, which was diffuſed all around, rendered the beginning of our journey very agreeable. We aſcended firſt by a ſteep, winding road, which was covered with maſſes of ſandſtone breccia; and conſiderable blocks of granite and micaceous ſhiſtus lay ſcattered upon the road. From this, to the valley which is formed upon one ſide of the Ord of Caithneſs, the ſame ſtrata continues: that is, upon the ſea-ſhore, red argillaceous ſandſtone; and, farther up, ſandſtone breccia, which contains fragments of granite, micaceous ſhiſtus, and quartz, immerſed in an arenaceous baſis; and to this ſucceed the primitive ſtrata. As we deſcended into this valley, we obſerved the road covered with great maſſes of granite; and the hills above (which are heath-covered) appeared alſo to be formed of granite.

We now aſcended from this valley by the ſteep mountain called the Ord of Caithneſs, and, after a fatiguing walk, we reached the narrow paſs which forms the entrance into Sutherlandſhire

landſhire from the north. Before, were the diſtant mountains of Roſs and Inverneſs ſhires; but, below, was the ſea-coaſt of Sutherland, which had a ſingular appearance: the cultivated ground forming a low and nearly level bank, which is ſkirted by dark mountains of a conſiderable height. The paſs itſelf was bounded upon one ſide by a ſteep mountain of granite †; on the other, was a frightful precipice hanging into the ſea, and compoſed of a ſpecies of breccia, which, as far as my ſhort time would allow me to determine, ſeems to lie upon the granite. We now deſcended, by a winding road, to the bank we have juſt mentioned, and walked along it to a village called Helmſdale, where unluckily we could get little to ſatisfy our craving hunger. This village, or kraal, is ſituated in a valley of conſiderable magnitude, and is bounded on both ſides by mountains of granite. We now croſſed the water of Helmſdale, and walked along the ſhore, by the ſide of the bank which is continued from Helmſdale, to a dirty hut, which paſſes for an inn, and is called Wilk Houſe. This bank is compoſed of ſtrata of red and white-coloured ſandſtone; but upon the ſhore, at a little diſtance from this ſandſtone, there are low, ſhelving rocks, of an argillaceous breccia, which is compoſed of fragments of ſandſtone and quartz immerſed in an argillaceous breccia. Theſe ſecondary ſtrata are bounded by higher mountains, which are primitive, and probably of granite.

† This granite is compact, and compoſed of felſpar and quartz.

After leaving Wilk houſe, the bank, which had accompanied us from the Ord of Caithneſs, was now ſucceeded by flat ground; but our general courſe was thro' ſandy beaches: and this, with the great heat of the day, rendered our journey very fatiguing. As we approached near to Dunrobin Caſtle, the fine ſeat of the Counteſs of Sutherland, the country becomes wooded; and at length we obſerved the caſtle riſing with much dignity among the fine wood with which it is ſo richly ornamented. Soon afterwards, we reached the kirk of Golſpie. Having reſted a little, we continued our journey over a flat ſandy tract of country, which is bounded by high primitive mountains. About three miles from Golſpie, we came to a river, and were here detained for nearly an hour until the obſtinate boatmen would ferry us acroſs; and then walked among ſand banks, and over heath muirs, to Dornoch, where we arrived in the evening, completely fatigued, after a walk of nearly 20 hours. I was a good deal ſurpriſed to meet with many pieces of pumice ſtone among the ſand banks between Golſpie and Dornoch: theſe have aſſuredly been driven on ſhore from the ſea, as I have already mentioned to be the caſe with regard to the pumice found upon the ſhores of the Shetland Iſlands.

Dornoch is an old, deſolate-looking town, only remarkable for the ruins of its cathedral.

We

We left Dornoch in the morning, for the village of Tain. The road to the ferry, which is upon the north ſide of the frith of Dornoch, is thro' a low, level, and pleaſant country. It is in many places well cultivated, and ornamented with wood, that extends to a conſiderable height upon ſome of the hills bounding the low country. The ſtrata of the lower parts are of red ſandſtone; and I obſerved many fragments of micaceous ſhiſtus, and granite, which have been waſhed from the neighbouring mountains. We now croſſed the ferry, which is about three quarters of a mile broad. In our paſſage, looking downwards, we had a pretty extenſive view of the low ſandy country on both ſides of the frith; a proſpect not unlike the views we have on many of the low ſhores on the Engliſh coaſt. The view upwards was of a very different kind: it was the wild and rugged mountains of Roſs-ſhire, which in ſome places appeared white with ſnow, in others richly covered with wood. The road from this to Tain led firſt thro' a ſweet flat adorned with broom; then along a road bounded by trees; and the ſcene was again varied, before we reached the town, by a diſagreeable tract of heathy and ſandy ground. The ſtrata, in this tract, appeared to be principally red-coloured argillaceous ſandſtone: but, as we approached the town of Tain, I obſerved conſiderable maſſes of granitic porphyry, gneiſs, micaceous ſhiſtus, and hornblende ſhiſtus. Whether all theſe

rocks

rocks form ſtrata in the neighbouring hills, or are only maſſes derived from a breccia which I obſerved lying upon different parts of the road, I had not an opportunity of determining.

After dinner, we walked to the ferry of Cromarty. The road led thro' a pretty flat country, and the ſtrata ſeemed to be entirely of red-coloured argillaceous ſandſtone; and, in ſeveral places, I obſerved great maſſes of breccia, which is formed of fragments of granite, gneiſs, micaceous ſhiſtus, hornblende rock, and quartz. We now croſſed a ferry, of about one mile and a half broad, to the town of Cromarty. This is a neat highland town, and is much beautified by the fine grounds and handſome ſeat of the Earls of Cromarty. The prevailing ſtrata in the neighbourhood of this town, and what forms both ſides of the entrance of the Cromarty frith, is a red-coloured argillaceous ſandſtone.

We left Cromarty early in the morning, for Fort-George. The country is, all the way, pretty flat. We could not obſerve the ſtrata, owing to the covering of heath, until we came near to Fortroſe; but in ſeveral places I obſerved maſſes of granite, gneiſs, micaceous ſhiſtus, hornblende rock, and alſo maſſes of arenaceous breccia. As we deſcended to Fortroſe, ſtrata of arenaceous breccia made its appearance; and the coaſt

of

of the Murray frith, from Fortroſe to the entrance of the Cromarty frith, ſeemed to be compoſed of red-coloured argillaceous ſandſtone, with ſtrata of arenaceous breccia. We now walked down to the ferry-place, and croſſed the frith, which is about two miles broad, to Fort-George. This fort, the moſt complete piece of fortification in Great Britain, is ſituated upon a low point of land which juts acroſs the Murray frith, and is built of red and white-coloured argillaceous ſandſtone. From it, we have a fine view of the frith, which expands beyond the fort, and is bounded by lofty hills; and this proſpect is terminated by the capital of the highlands, the pictureſque town of Inverneſs, with great mountains riſing on both ſides of it.

If we look at the map, we ſhall obſerve that Scotland is deeply indented both on its eaſt and weſt ſide. In the eaſt, the ſpacious Murray frith interſects the country as far up as Inverneſs; while, upon the weſt ſide, Linnhe Loch reaches to Fort-William. A great valley, about 60 miles long, extends between theſe arms of the ſea: it is bounded by lofty mountains; and its bottom is covered, excepting for about 17 miles, with deep lakes. The land between the lakes is level, and compoſed entirely of alluvial ſtrata, excepting ſome rocks to the ſouth-weſt of Fort-Auguſtus†. It has been propoſed to connect the lakes by a canal,

† Tranſactions of the Highland Society, vol. i.

a canal, and thus to ſave the tedious and dangerous paſſage by the Pentland frith; and, as the ground is level and ſoft, the expence would not be very great. This plan has much plauſibility; yet it would be more likely to meet with attention, if the mineralogy of the great glen was carefully examined. It is not improbable that promiſing appearances of ore may be diſcovered; and theſe, if worked with ſpirit, would employ many hands, and render a canal of vaſtly more importance. The few ſatisfactory mineralogical obſervations which have been made on this glen, have not been made with a view of diſcovering veins or beds of ore; ſo that we are, as yet, entirely ignorant of the mineral treaſures which it may contain.

We left Fort-George. The road led thro' a low, heathy country. On one hand was a ſandy flat, partly overgrown with heath, which ſeemed to have been formely covered by the ſea: on the other was a heathy country, and at a diſtance hills. I obſerved, upon the road, maſſes of granite, micaceous ſhiſtus, quartz, and ſandſtone. The ſandſtone ſtrata, which I obſerved cropping near to Nairn, ſeem to form the level part of the country; but the hilly part, from its general appearance, and the maſſes of micaceous ſhiſtus which are ſcattered about, ſeem to be of primitive rock.

We

We dined at Nairn, and ſet out for Forres. At a little diſtance from the town, we obſerved great ſand hills, and a terrible ſandy coaſt ſtretching towards the ocean. This ſcene was very ſtriking: the whole ſky was covered with dark clouds; yet the whiteneſs of the ſand cauſed the light to be ſo ſtrongly reflected, particularly from the hills, that they appeared as if the ſun was ſhining upon them. We ſtopt to examine them, and found that they were compoſed of fine white ſand, which does not lie in beds, but is irregularly heaped: a circumſtance ſufficiently concluſive that theſe accumulations have been produced by the blowing of the ſand. The whole of the neighbouring country is much covered with ſand, and ſome great eſtates have been almoſt deſtroyed by this ſand flood. We now continued our journey; and as we retired from the ſand hills, their appearance became the more ſtriking, as every object was clothed in a ſable hue, while their bright ſurfaces at length ſhone like luminous points upon the horizon. The road continues for a conſiderable way through a bleak country, but as we approach to the pleaſant town of Forres it aſſumes a rich and lovely aſpect. The ſtrata, all the way, are decidedly ſecondary, being of ſandſtone and baſalt; but the rocks in the higher parts of the country are probably of primitive rock, as is intimated by the fragments of granite and micaceous ſhiſtus which lie ſcattered about.

Forres is a neat, well-built town, pleaſantly ſituated between two little hills; but we could not enjoy the pleaſure of examining it more at leiſure, as the evening was at a cloſe: and we were forced to proceed to Elgin, a diſtance of 12 miles. At a little diſtance from Forres, we examined, in the twilight, the famous pillar mentioned by Mr Pennant; and then continued our journey to Elgin in the dark. In the middle of the night, we croſſed the blaſted heath on which the weird ſiſters met Macbeth in the day of his ſucceſs, and ſtopt him with their prophetic greeting. The ſolitary hour of the night, the melancholy noiſe of the wind ruſhing acroſs the heath, the glimmering of the Will-o'-the-wiſp, excited in us that ſtrange feeling of ſuperſtitious alarm of which every man muſt at ſome time or other have been conſcious.

Although much fatigued with our long journey from Cromarty to Elgin, we roſe up early in the morning, and examined the magnificent ruins of Elgin cathedral.

We now continued our journey from Elgin towards Loſſiemouth, which is ſituated upon the ſea-coaſt. The country, for a ſhort way, was very pleaſing; but having reached an eminence above the town, we deſcended into a flat, indifferently-cultivated country. As we approached Loſſiemouth, the

the whole of the country appeared to be formed of bowlder ſtones; and, near to the town, great banks, evidently left by the retiring of the ſea, make their appearance. Theſe bowlder ſtones are of granite, granitic porphyry, micaceous ſhiſtus, quartz, limeſtone, and arenaceous breccia. At Loſſiemouth, which is a trifling village, I obſerved ſtrata of red-coloured argillaceous ſandſtone; but no other rock was to be obſerved in the neighbourhood. We now walked along the ſhore for a conſiderable way, ſtill over bowlder ſtones; we then changed our courſe, and continued walking for ſeveral miles upon the road to Fochabers, when we found the country to improve very much in beauty. As this route did not ſeem very intereſting, we again traverſed the country until we came nearly to the mouth of the river Spey, which we croſſed in a ſmall boat. Here we walked along a beach of bowlder ſtones, which was without any covering of heath, and was extremely fatiguing. Having reached its farther extremity, we walked, by a better road, to the fiſhing town of Buckie. Upon ſeveral parts of the ſhore, I obſerved the red-coloured argillaceous ſandſtone; and at Buckie the ſtrata became nearly vertical. At this place, as far as I had leiſure to determine, the ſecondary ſandſtone, which we had traced along the ſhore all the way from the Pentland frith, diſappeared, the ſea-coaſt being formed of primary ſtrata. We now left the coaſt, and aſcended for a lit-

tle, when we came upon a level, which continues for a conſiderable way either bare or heath-covered, and at a little diſtance is bounded by mountains of conſiderable height. As we approach to Cullen, the country becomes well cultivated; and we paſs, to this ſweet village, thro' very fine and rich plantations. It was almoſt dark before we reached Cullen, ſo that we probably paſſed richly-wooded ſcenes. The ſtrata, all the way from Buckie, are entirely primitive, and are principally micaceous ſhiſtus, traverſed by quartz veins. In ſome places I obſerved maſſes of granite: but I had not time to determine its poſition with regard to the other rocks.

In the morning, we left with regret the delightfully-ſituated village of Cullen, and took the road which leads to Portſoy. A little way from the town, the country loſes much of its beauty, and the wood gradually diſappears. About two miles from Cullen, we forſook the road, and walked towards the ſhore, to view the old caſtle, once the ſeat of Lord Oliphant. The caſtle is built upon the ſummit of a cliff about 80 feet high, which projects into the ſea; and its ruins ſhew that formerly it muſt have been a place of conſiderable ſtrength. The times are now happily changed. In place of the fortreſs perched upon the almoſt inacceſſible ſea-cliff, the ſeats of our chieftains are now placed in the moſt enchanting ſituations, and adorned with all the

the richneſs and luxurious variety of nature and art combined. It is a character which ſtrongly marks the barbariſm of former times, and the preſent happy change of manners and government. The rock, upon which this caſtle is ſituated, is compoſed of talcaceous ſhiſtus, which is diſpoſed in ſtrata that are nearly vertical, and is more or leſs intermixed with quartz. I alſo obſerved a great ſtratum of compact quartz, which is in ſome places between 16 and 17 feet wide. What is curious, this ſtratum has, in ſome places, the character of granular quartz; and it is often ſo intermixed with talc, as to form a ſpecies of talcaceous ſhiſtus. The ſtrata of talcaceous ſhiſtus, upon one ſide of the ſtratum of quartz, are much twiſted, while on the other they are perfectly regular.

We now continued journeying along by the ſea-ſhore, that we might have a better opportunity of diſcovering any intereſting appearances which were to be obſerved. The cliffs continue to Sandſide to be compoſed of nearly vertical ſtrata of talcaceous and micaceous ſhiſtus; but, upon the ſouth ſide of Sandſide, I obſerved a conſiderable ſtratum of ſteel-grey, foliated limeſtone, which lies upon an ardeſia, or primitive argillaceous ſhiſtus, and this ardeſia appears to be covered by a breccia. As the ſea covered the greater part of this rock of breccia, I could not determine with certainty its poſition with regard to the

the limeſtone. After paſſing this ſtratum of limeſtone, which, we were informed, runs a conſiderable way into the country, we came to an immenſe maſs of breccia, which ſeemed to be quite inſulated: it is not improbable, however, that, before the ſea had waſhed away the talcaceous ſhiſtus, the breccia would have been obſerved covering it. We ſtill continued our journey along the ſhore, until we came within a quarter of a mile of Portſoy; and, in that extent, I obſerved ſtrata of talcaceous, micaceous and hornblende ſhiſtus alternating with each other. We now walked to the town, which we found to be irregular and dirty.

As the rocks upon the ſea-ſhore, near to this town, are very intereſting, we agreed to ſtay a day or two, and examine them particularly. I was the more anxious to do this, as they have long attracted the attention of mineralogiſts; but their particular geognoſtic characters have never been detailed in any publication. After having examined theſe rocks, the following is the reſult of the obſervations which I made.

About a quarter of a mile from Portſoy, at the place to which I had traced the ſtrata in coming into the town, the talcaceous ſhiſtus appeared, in vertical ſtrata; and, nearly at the ſame place, I obſerved a ſtratum of white marble, which is marked

marked E, in the plan at the end of this volume. It is about 12 feet wide, and runs S. W. and N. E. which is in the ſame direction with the bounding ſtrata *. It appears to have been worked for ornamental purpoſes, as I obſerved ſeveral blocks upon the beach which ſeem to have been ſawed. To this ſtratum ſucceeds a vertical ſtratum of micaceous ſhiſtus †, marked F, which is compact, and of a blackiſh colour where in contact with the marble, but of a green colour where it is in contact with the next ſtratum, which is ſerpentine ‡. The ſtratum of ſerpentine, marked G, which ſucceeds to the talcaceous ſhiſtus, is of great width, and, like the other ſtrata,

* This marble is white, or clouded with ſteel-gray, but it is much mixed with ſcales of talc.

† The talcaceous ſhiſtus, which alternates with theſe ſtrata, has ſometimes ſo much the appearance of compact micaceous ſhiſtus, that it cannot be diſtinguiſhed from it; and as it approaches the marble, it is to be obſerved mixed with it, and paſſing into it.

‡ This ſerpentine is of various ſhades of olive and blackiſh green. Its fracture, which is either uneven, coarſe ſplintery, or even fine ſplintery, preſents canary-green ſcales. It is intermixed with various foſſils, as aſbeſtus, indurated ſteatites, talcite of Wallerius, calcaceous ſpar, and iron pyrites.

ſtrata, is nearly vertical, and runs in a ſimilar direction. It runs out into the ſea like a great wall; and this, with its green colour, gives it a ſingular aſpect. This ſtratum is bounded by a ſtratum of talcaceous ſhiſtus, H, which is almoſt entirely compoſed of quartz, where it is in contact with the ſerpentine; but as it approaches the next ſtratum which is marble, it has more of the talcaceous character, and is alſo traverſed by veins of quartz. The ſtratum of marble, I, is from 15 to 20 feet wide; is alſo vertical; but is of a bad quality, and will not ſerve for any ornamental purpoſe. It has, immerſed in it, pieces of quartz and talcaceous ſhiſtus. To this ſtratum ſucceeds a thin ſtratum of quartz; and this again is bounded by a thin ſtratum of talcaceous ſhiſtus, K. Both theſe ſtrata are only a few feet wide; and are ſucceeded by a ſtratum of marble, L, nearly of the ſame width with the former ſtratum, I. To this marble ſucceeds a great ſtratum of ſerpentine, M, which is of the ſame nature with the ſtratum we have before deſcribed. This ſtratum is bounded by hornblende rock *, N, which forms the rocks that ſurround the harbour of Portſoy, and continues beyond it towards a bay, the name of which I do not recollect.

* The hornblende rock is generally ſhiſtoſe, and has ſometimes ſcales of brown mica intermixed with it.

collect *. It is traverſed in ſeveral places by veins of granite, which run in different directions, and vary in breadth from one to eight or nine feet. At a little diſtance from the ſide of the bay I have juſt mentioned, another ſtratum of ſerpentine, marked O, makes its appearance; and to it again ſucceeds the hornblende rock, P, which is traverſed by veins of granite †.

We now walked along the ſhore by the bottom of this bay; and, upon its oppoſite ſide, in place of the hornblende rock, there are rugged cliffs of micaceous ſhiſtus, which is in ſome places alternated with quartz, and in others traverſed by conſiderable granite veins. The micaceous ſhiſtus ſometimes contains garnets; and the granite, which is great-grained, frequently contains cryſtals of ſhorl and mica, and ſometimes it has the appearance that is called pierre graphique.

* The ſerpentine, as it approaches the hornblende rock, becomes gradually intermixed with it, and at laſt is not to be diſtinguiſhed from it.

† Betwixt Portſoy harbour and the bay, I obſerved marble; but I could not determine how it lay with reſpect to the other rocks; ſo that I have not repreſented it in the plan.

Such appears to me the diſpoſition and nature of the ſtrata upon the ſhore at Portſoy *.

As the geognoſtic characters of the ſerpentine, at this place, are intereſting, I ſhall here mention, for the information of my readers, a few facts, which ſhew that pretty nearly ſimilar appearances have been obſerved in other countries. Zobtenberg, in lower Sileſia, conſiſts entirely of ſerpentine, in which ſome hornblende is found, and its ſtrata are nearly vertical †. In the Miner's Kalendar for 1790, Kohler informs us, that ſerpentine and primitive limeſtone (marble) are nearly allied in their geognoſtic characters, and that ſometimes they are diſpoſed in ſtrata which alternate. We are alſo informed that ſerpentine reſts upon gneiſs, and even alternates with it ‡, and alſo with quartzy talcaceous ſhiſtus ‖.

The

* Some travellers are of opinion that the ſerpentine and marble form great veins, rather than vertical ſtrata.

† 4 Berl. Beobacht. 353.

‡ Charpentier Mineralogiſche Geographie von Churſachsichen Lande.

‖ N. Nord. Beytrage. 149.

The appearance of the veins of granite traverſing hornblende rock and micaceous ſhiſtus, is by no means uncommon in Scotland; and in other countries ſimilar appearances have been very often obſerved. The pierre graphique has been obſerved, in Siberia, to form the ſides of veins where the topaz is found *; but at Sebnitz it is diſpoſed in beds with the common granite †; and, in the Uralian mountains, Herman obſerved it mixed with the common granite ‡. Patrin, who found it in Siberia with the topaz, conjectures that it may generally be conſidered as indicative of the preſence of theſe gems.

Having thus examined the ſtrata upon the ſhore, I walked into the country for about two miles; but could obſerve no trace of the ſerpentine, or marble, or talcaceous ſhiſtus, but in ſeveral places I obſerved the hornblende rock. I aſcended a hill a few hundred feet high; upon the ſide of it were maſſes of hornblende rock and gneiſs ſcattered about, but towards the ſummit it was entirely compoſed of ſhiſtoſe quartz. This

* J. de Phyſique. Ann. 1791.

† N. Bergmanniſhes Journal, B. 2. 443.

‡ Herman Mineralogiſche Beſchreibung des Uralaiſchen Geburges. B. 1. ſ. 144.

is a rare rock in Scotland; nor has it been obſerved but in a very few places upon the continent.

We now left Portſoy, and continued our journey by a good road which leads thro' the country towards the town of Banff. At the bridge of Boyne, I obſerved a ſtratum of foliated limeſtone incloſed in the micaceous ſhiſtus, which is continued to this from Portſoy. We here obſerved a beautiful wooded dell, with a ſmall river running thro' it, extending below the bridge, and we were told that it continued to the ſea-ſhore. As it is in theſe places that good ſections of the ſtrata are often to be obſerved, we forſook the high road, and walked thro' it. At a little diſtance from the entrance, I again obſerved the limeſtone cropping thro' the ſtrata of micaceous ſhiſtus; and, farther down, our attention was arreſted by the extenſive ruins of the caſtle of Boyne, which is ſituated upon one ſide of the dell, and richly ſurrounded with wood. We continued our walk, and ſoon reached the opening of the dell, upon the ſea-ſhore, where we obſerved conſiderable quarries of the primitive limeſtone. From this to Banff, we walked along the ſea-ſhore, which is low and rocky; and the ſtrata, as far as I recollect, are principally compoſed of micaceous ſhiſtus, which paſſes, on one hand, to ardeſia, and, on the other, to talcaceous ſhiſtus,

and

and ſometimes it is to be obſerved alternating with hornblende rock ‡.

Banff is pleaſantly ſituated upon the ſide of a hill, which declines towards the ſea-ſhore. It has a harbour, which is protected by a good pier. The whole town has a neat appearance; and the buſtle of induſtry formed a ſtriking contraſt with the other towns we had paſſed thro'.

We intended to have continued our journey along the coaſt towards Peterhead; but, the weather being fine, we were deſirous to reach Aberdeen, ſo that I might examine the granite, and its connection with the other ſtrata. We therefore changed our route, and took the road to Turreff, which we reached befor the cloſe of the evening. The ſtrata are, all the way, of primary formation, and principally of micaceous ſhiſtus and ardeſia.

Having reſted all night at Turreff, we left it early in the morning; but unluckily a thick fog was ſpread all around, and

‡ I have to regret the loſs, both of the notes, and of the ſpecimens which illuſtrate this part of my journey; ſo that what I here write is from memory.

and ſoon the rain began to pour upon us, and continued without intermiſſion the whole day. We reached Aberdeen in the afternoon, drenched with rain, and much fatigued with our journey. The ſtrata are, all the way, of primary formation, and ſimilar to thoſe I obſerved between Banff and Turreff.

We remained here ſeveral days, expecting the weather to moderate, ſo that I might have an opportunity of examining the ſtructure and nature of the ſtrata for five or ſix miles around the city, and thus to acquire a knowledge of the poſition and different appearances of the granite. In the meantime, I examined the granite which is in the neighbourhood of the town, and obſerved, in the bed of the river Don, that it is covered by micaceous ſhiſtus, and that it ſeemed to be diſpoſed in great ſtrata, or beds. It has very often cryſtals of hornblende intermixed with the felſpar and quartz.

As the weather ſtill continued ſtormy, we were obliged to defer the examination of this country until another ſeaſon. Having taken leave of our friends, to whoſe kind attention we had been ſo much indebted during our ſtay at Aberdeen, we ſet out for the banks of the Forth.

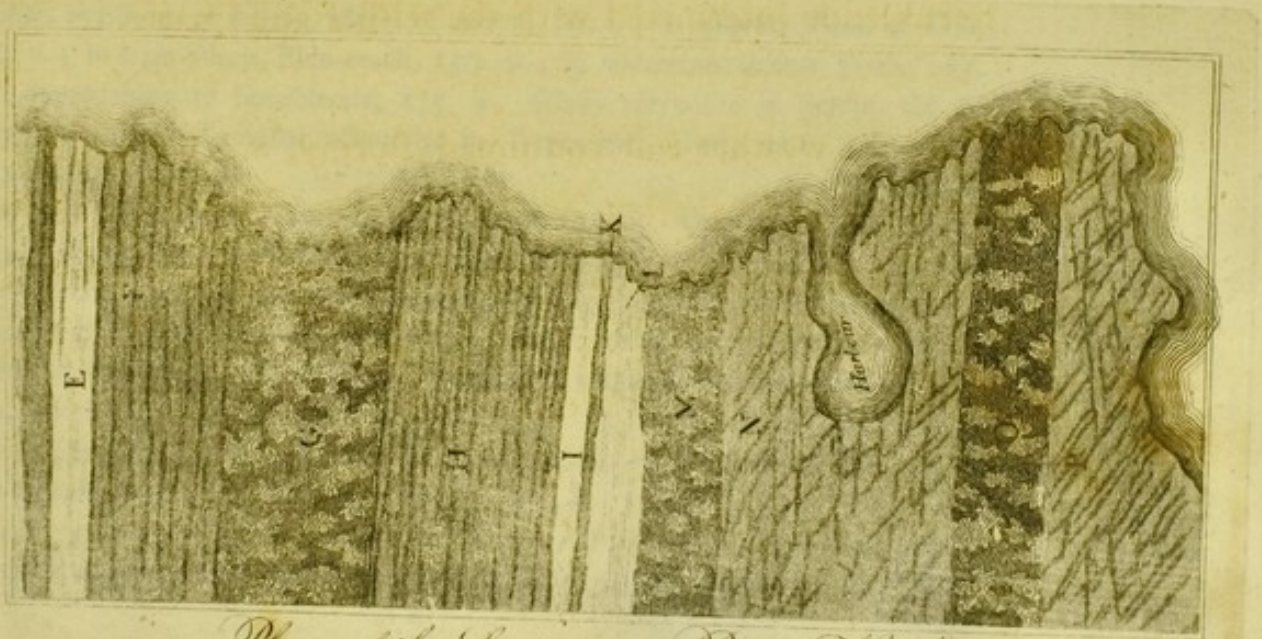
The primary ſtrata of micaceous ſhiſtus continues for two

or

or three miles after leaving the town; when it is ſucceeded by red-coloured argillaceous ſandſtone, and ſandſtone breccia.

At Stonehaven, which is about 14 miles from Aberdeen, we obſerved the ruins of the caſtle of Dunotter, ſituated upon a rock of breccia.

From this, by Montroſe, Dundee, through a fine country called the Carſe of Gowrie, to Perth; and from that, by Cupar in Fife, to the banks of the Forth; the whole ſtrata are of ſecondary formation, and belong either to the tranſition or ſtratified rocks.



Plan of the Strata near Portsoy Harbour.

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