scarcely be recognised, were it not for the presence of limestone with its characteristic fossils. Of the beds of trap there are four, one of them about 200 feet thick ; and that they are true beds which have been poured out over the bottom of an ancient sea is proved, not only by their regular interstratification among aqueous deposits, and by the earthy texture and amygdaloidal structure of their upper parts, but by the quantity of trap fragments included in the conglomerates which alternate with them. The lower part of one of these beds of conglomerates is, by the admixture of these fragments, converted into a kind of tufa. One of the beds of trap forms the bottom of the carboniferous series, and rests on the edges of hard shales and thin bedded limestones, filled with Silurian fossils. The edges of the Silurian rocks are slightly altered at the point of contact.

These rocks being on the margin of the great line of ancient disturbed strata, which extend from Cape St. George along the southern edge of the Pictou coal trough, have been subjected to more than one igneous convulsion. A few miles further along the shore, the same beds of conglomerate and sandstone, with interstratified amygdaloid, are seen in a vertical position, with their sandstones changed into quartz rock and jasper. This is, apparently, in consequence of the eruption of the crystalline greenstone and other igneous rocks which appear in their neighbourhood, and we are thus informed that the igneous action along the above-named anticlinal line, which continued to the close of the carboniferous period, was exerted also at the commencement of that period, and no doubt influenced the deposition of its strata in a manner as yet very imperfectly understood.

2. *GEOLOGICAL FEATURES of the Country round the MINES of the TAURUS in the Pashalic of DIARBEKR described from Observations made in the Year 1843.* By WARINGTON W. SMYTH, Esq., B.A., F.G.S.

IN that part of Asiatic Turkey, where the provinces of Anatolia, Armenia, Kurdistan, and Mesopotamia unite, the chain of the Taurus is bounded on the one side by the Euphrates and on the other by the Tigris, and this district, being now out of the way of the main roads of commerce, has until within a few years been almost entirely neglected.

The interest, however, attached to these regions in the present precarious state of the Ottoman empire, and the difficulty of obtaining information concerning them, will excuse the imperfect condition of the sketch now offered of the geographical and geological configuration of the country ; but I have to regret that my absence during some years from England prevented my being ac-

quainted with the valuable information to be obtained from the published routes of Messrs. Brant and Ainsworth.*

The line of road which I took enabled me to complete the section of the country in a direct line from the Euphrates to the town of Sivas, and a stay of some weeks put it in my power to obtain some interesting details concerning the important mines of copper at Arghaneh Maden, and of silver at Kebban Maden, as well as others more or less neglected, which lie in various parts of Armenia and the N.E. of Asia Minor.

The great mountain chain called the Taurus by the ancients, runs from the province of Cilicia (now *Adana*) in a north-easterly direction, and often forms large irregular elevated groups; on the eastern side of the Euphrates it spreads in various directions around the great lake of Van, and merges into the high land of northern Kurdistan and the volcanic plateaux of Armenia. At the point where the Euphrates cuts through the Taurus the chain appears to consist of one main ridge, and this afterwards branches off into elevated tracts of very irregular form, one portion extending eastward from the river, and another commencing considerably to the west of it and stretching away towards the north.†

The division of the Taurus with which we have to deal, is separated into two parts by the valley of Kharput, the waters of which flow to the north-east and join the eastern Euphrates. The first of these two portions, in which the river Tigris takes its rise, contains the most elevated points, varying from 6000 to 8000 feet above the sea, and then, proceeding towards the north-east, it joins another range called the Darkush Dagħ (Niphates) some of whose peaks are estimated at from 8000 to 10,000 feet high.

The second portion from Kharput to the Euphrates does not attain an elevation of more than 5000 feet, and on the north sinks gradually towards the valley of the Murad Tchai.

The eastern or main ridge, whose breadth between Arghaneh and Kharput may be estimated at nearly 50 English miles, presents us with a series of limestones and marly slates belonging to the cretaceous period, and resembling the formations of various countries bordering on the Mediterranean.

The higher portions generally consist of calcareous strata, abounding in nummulites; whilst the marls, which for the most part occupy a lower position, are highly metamorphic, being changed in colour and frequently hardened to the consistency of siliceous slate. Below both, although sometimes occurring in dykes high up the mountain sides, appear rocks of diallage and actinolite in great variety.

To the west of Kharput, the mountains exhibit a different cha-

* See "Journal of Royal Geographical Society" for 1841.

† The lesser ridge of the Karajah Dagħ (Masius) which strikes off from hence to the south-east, should not be considered, as it is represented on the maps, as a branch of the Taurus, being almost wholly unconnected with the greater range, and composed of rocks not seen again nearer than forty miles to the westward.

racter. Their chief mass is composed of limestones and slates of an older period; the limestones of a darker colour than that around Arghaneh; the slate chiefly talcose, and connected with the mica-slates and other primary rocks, described by Russegger as forming the nucleus of the Taurus in the district of Adana. The eruptive rocks, occurring in juxtaposition with these, are syenite, diallage rock, basalt, similar to that of the plateau of Diarbekr, and lastly, at Kebban Maden, a felspar-porphry.

Such are the rocks presented in this transverse section of the chain, and the determining of their boundaries is much assisted by the nature of the ground; for the Taurus is, in this part, so totally bare, that it seldom happens that its geological features are obscured by trees, grass, or even vegetable earth. That forests, however, have once existed, and that at no very distant period, is evident from the oak brushwood which is occasionally met with; though the inhabitants, in order to supply the furnaces, cut away with unsparing vigour the shoots as fast as they spring up.

The city of Diarbekr is built on an extensive plain, covered with rough fragments of basalt, resting upon more compact masses of the same rock; and through these the river Tigris has cut for itself a valley about a hundred feet in depth. On the south of the city, the hills of the Karajah Dag exhibit varieties of the same rock, which is sometimes amygdaloidal, sometimes scoriaceous. These hills often rise up in strongly marked cones, which bear exactly the type of the ancient secondary cones of Etna; and are covered by various accumulations, and in some cases overgrown with trees. On the south-west, this igneous formation extends beyond the town of Siverek, a distance of sixty miles from the Tigris; and in approaching the mountains to the north-west, we find the same series continued for twenty miles. At Arghaneh the southern outposts of the Taurus present their most remarkable features. The celebrated Armenian monastery of this name is built on the summit of a calcareous mountain, which attains a height of 2000 feet above the plain, or 4000 feet above the sea, and is conspicuous from a great distance, owing to its two sharp peaks. Hence we find the place designated in some old maps as *Arx bicornis*. The chief component rock of this and the neighbouring elevations, on the north and east, is a compact light coloured limestone, generally abounding in nummulites, and sometimes exhibiting fragments of pecten and ostrea. Against its flanks, on the east and west, rest beds of porphyritic conglomerate, of which the rolled fragments consist chiefly of greenstones with imbedded large crystals of hornblende. The stratification of the limestone is not very distinct at this spot; but, on the road to the north-west, the beds become remarkable, being exhibited in long denuded parallel lines, generally tilted from the southward. The limestone is accompanied by slates of a highly metamorphic character: they are black, grey, ferruginous, or green in colour; and from beneath them there appears a greenstone porphyry, which,

in some parts having its hornblende replaced by diallage, or its felspar paste by a magnesian one, passes gradually into diallage rock and serpentine, and rises in dykes, or is laid bare in the bottom of deep valleys, at several points between this and a Koord village about five miles to the north-east.

The elevated peninsula formed by the Tigris, which is crossed by the road to Arghaneh Maden, is composed almost entirely of ophiolite, or of a variety of serpentine and diallage rock. These are seen immediately on the western side of the river, which is here crossed by a stone bridge. The colour of the rocks is commonly bottle green; but hardly a square yard of it is homogeneous, so frequent are the changes in the material. The cracks and fissures are filled with precious serpentine, with asbestos, and other minerals, chiefly of silicates of magnesia. The greater portion of the rock, however, is characterised by interspersed foliated crystals of diallage, sometimes as large as the palm of the hand, which reflects so brightly the sun's rays as to be generally taken by the natives for a species of silver. About a mile further to the

north, at the opening of a valley which runs up from the Tigris in the direction of Maden, are found some very singular conical mounds and hills, which render probable the eruptive origin of the serpentines. Their summits are formed by a crest of tilted strata of limestone or shale, supported by a mass of serpentine or diallage rock, which has been much decomposed by exposure, and is even sometimes so much worn that the cap of harder stone projects from its base, as if nicely balanced upon it by art.

On the road to the mines, are passed strata of finely laminated shales, which are, here and there, interrupted by dykes or masses of diallage rock, and frequently become allied to jasper.

The serpentine is laid bare at Arghaneh Maden, in the valley of

MINING DISTRICT OF ARGHANEH-MADEN.

The dotted parts in this diagram represent diallage rock, the crossed lines an irregular mass of sulphuret of iron and copper in which the mines are situated, and the remainder of the marks, limestones, and metamorphic slates of various periods.

the Tigris, and in the ravine formed by a rivulet which pours in its tribute close below the town. The rock is generally full of diallage, and contains the other magnesian minerals before described. From its being intersected in all directions by fissures

and joints of separation, it is not applicable to the purposes of building. Between the rivulet and the Tigris, or to the north of the main portion of the town, the serpentine does not rise high above the level of the valley, but, at a few feet above it, is capped by slates and marls, partly crumbling and partly jaspery; the former being of a dark grey colour, and the latter having a brownish red tint.

The steep south side of the ravine is of a different character. In contact with the serpentine appears a ferruginous breccia, consisting of angular fragments of ochreous marls and sandstone, and, more rarely, pieces of porphyry, cemented together by hydrous oxide of iron, and forming a bed of considerable thickness. This is used as a building material, being easily worked, and tolerably durable, but its dull rusty appearance, combined with the total absence of herbage and the strangely coloured sterile slopes of the surrounding mountains, give the place a character of unequalled dreariness.

Higher on the mountain there rise up, from beneath beds of marl, rugged masses of diallage rock, and these extend in the form of a powerful dyke over the shoulder of the height towards the south. In the portions where it is friable this dyke is deeply furrowed by the rains and the tracks of the animals, which are constantly passing and repassing with charcoal for the furnaces. Its position in this form and at this elevation is important, as tending to prove that the limestone was not deposited upon it, as might have been argued, from seeing the diallage rock constantly laid bare in the deep valleys, where the superincumbent limestones and marls have been removed. On the summit of the mountain, to the west of the town, marls and limestone are again found; and the limestone incloses numerous nodules of serpentine projecting from the weathered face of the rock, and thus exhibiting a greater degree of hardness.

It is to its copper mines that Arghaneh Maden owes all its importance. The breccia before mentioned appears to constitute the outer wall of the cupriferous mass. This mass, though it continues in depth to the level of the waters of the Tigris, has not hitherto been opened anywhere except on the surface of the mountain above the town.

It appears to be but one huge lump of ore, consisting of the double sulphurets of copper and iron, planted amid the serpentine, or perhaps between it and the marls. In the mines which I entered, not the slightest character of a vein or bed was to be seen, but floor, and roof, and walls consisted entirely of solid pyrites, diversified only by stalactitic coatings of blue and green vitriol. This extended to a depth of 10 or 12 fathoms; but the additional 20 or 30 feet which had been excavated, were filled with water, which had for upwards of a year kept the works almost at a standstill. It is only by waiting patiently until the month of July or August, that access is gained to the lower parts of the mine. The accumulated rains of the winter and spring at that time gradually

find their way out through crevices into the valley below, and leave the mines dry for a few weeks.

The shafts, which belong to different individuals, are scattered irregularly over a part of the mountain, which is almost level, and is about fifty fathoms in diameter; and since in all of these shafts the same appearances are presented, we may be justified in considering the ore as forming rather an insulated mass, than as belonging either to a bed or lode.

The pyrites varies so much in quality, that a large proportion is left untouched by the miners, not repaying them for working; the generality of ore contains from 10 to 12 per cent of copper, whilst the better sorts rise to 20 or 24 per cent; and occasionally a little vitreous copper, or pure sulphuret occurs, when the per centage is much higher. The boundary of this mass of ore is hitherto unexplored, but judging, as before, from the area occupied by the mine entrances, it cannot be less than fifty fathoms in diameter; and since the ore is again met with, and even of better quality, in an adit now driving from the valley of the Tigris, it appears that it continues also thus far in depth, perhaps 50 or 60 fathoms.

The workings are conducted on a miserable plan, adopted indeed in all the Turkish mines, but which will soon bring the present undertaking to an end, and entail difficulty on future enterprise. A shaft is sunk from the surface at an angle of 45° with the horizon; and it is secured, somewhat insufficiently, by timbering, and provided with rough wooden steps for ingress and egress. As soon as a good portion of the ore is thus reached, the miners work off in different directions, digging out in the most irregular manner only that which pays them best, and leaving the rest to stand or break down as accident shall determine.

The road to Kharput or Palu ascends steeply, to the west of Maden, across a ridge through which the Tigris rushes, in a narrow glen many hundred feet below. The first part of the acclivity, after leaving the diallage rocks, is composed of very thin marly slates, easily separating into rhomboidal fragments. Then follow various amygdaloidal rocks, exhibiting spicular crystals of felspar in a paste, composed partly of felspar, and partly of carbonate of lime,—a continuation, in short, of the metamorphic rocks which generally accompany the near approach of the serpentines to the secondary limestones and shales. The crest of the mountain is composed of powerful banks of limestone, tilted towards the north-east, to which succeeds, about a hundred feet lower down, serving as a base to the rugged cliffs presented by the stratified rocks, the hornblende-porphry which we before had in conjunction with the serpentines. After this steep descent, the road ascends by a very gentle rise the course of a stream to the west, in a valley bounded sometimes by mountains whose lower parts are porphyritic, and sometimes by limestone hills inclining to the north-west. It then crosses a water-shed, and, after passing a third isolated khan, enters a perfectly level plain of about six miles in length and two in breadth, through which the

main feeder of the Tigris flows from some peaks on the south-west. Judging from the quantity of snow which still lay there in the month of June, the elevation of these peaks must be considerable. After ascending from this plain, a narrow and low ridge of limestone strata, inclining to the north-east, separates the waters of the Tigris from those of the Euphrates. On its western side is a lake, the direction of which is nearly east and west, its length being ten or twelve miles, and its breadth three or four; and this lake is said to give off its surplus water to the Euphrates. In the valley, at its eastern end, through which flows a small tributary stream, occur numerous instances of diallage rock, in which the foliated crystals are remarkably large and beautiful. The ascent westwards is again over porphyry and greenstone. The summits of the high ridge we then cross are formed principally of limestone, and the descent to the broad valley which lies on its other side, offers steep slopes, on which are exposed, at intervals only, rocks of actinolitic porphyry and diallage, which appear to be intimately connected with each other.

This fertile valley, through which a stream takes its course to the Murad Tchai, near the town of Palu, is entirely covered by alluvial soil; and being carefully irrigated by the inhabitants of its numerous villages, presents a great contrast to the sterility of the mountains. Its height above the sea, from the observations of Ainsworth and Brant, is about 2500 feet. The hills which project into it towards the town of Kharput consist mainly of marls and sands, much decomposed and deeply furrowed by rains.

At Kharput, a fine natural section is presented to the steep face of rocks opposed to the east. This lower portion is composed of a greenstone porphyry, disintegrated and rounded by the action of the weather, whilst the upper part consists of thick massive strata of compact limestone, having an inclination to the north-west, of about 30° , and split by numerous fissures at right angles to the plane of inclination. The contact of the two rocks may easily be observed; but the limestone appears to have undergone no change, whilst the porphyry has become so friable that it is generally eaten away by the air and rain to a depth of several feet below the bed of limestone.

To the west of Kharput, the country assumes a very broken aspect, and exhibits confused groups of lower elevations, extending towards the valley of the Murad Tchai, beyond which is now seen a magnificent range of mountains, the Dujik Dagħ, running about east by north, and west by south, and in the month of June still capped with snow. The hills nearest to Kharput consist of limestone and shale, but about three miles to the north-west appears a grey syenite, with large and well-formed crystals of black hornblende, yielding very readily to the action of the atmosphere. The mounds thus composed open out into a plain which is divided into natural terraces, and which in its geological features presents a repetition of the plateau of Diarbekr on a small scale, the whole surface being strewn with blocks of basalt of every size, which are so

numerous as to render the road very difficult for the horses, and make it necessary for the inhabitants to form huge piles of stones in preparing a small piece of ground for cultivation; though the quality of the black soil, then sparingly occurring, is good enough to repay them for their labour. The low ridge which bounds this plain on the west consists of a grey limestone, associated with thin marls, the strata inclining to the south-east; and on its opposite side, where the road winds among some narrow gullies previous to entering among higher mountains, syenite, diallage rock, and hornblende porphyry are found in close connection with each other.

About eighteen miles west-north-west from Kharput, a group of limestone mountains fills up all the space intervening between this point and the Euphrates to the north and west; and through these a deeply-cut valley runs to the north-west, extending for six or eight miles to the Euphrates, where, for some distance around the point of confluence, are worked the silver mines of Kebban Maden.

MINING DISTRICT OF KEBBAN MADEN.

The dotted parts indicate the presence of felspar porphyry, the small crosses metalliferous threads and nodules; two of the hills are capped with limestone, chiefly of the cretaceous period, and the rest of the diagram represents older limestones and talcose slates.

The mountains around the silver mines exhibit, in general, bare surfaces of grey compact limestone, or of argillaceous and chloritic slates, both of which appear to be without fossils. On both sides of the valley in which the town is situated, rise sharp peaks of a hard felspathic porphyry, containing large crystals of pink common felspar, and sometimes exhibiting a slaty texture, with the crystallised parts so ill defined, that where it occurs in contact with the clay slates, it is difficult to assign to each its proper boundary. This eruptive rock also makes its appearance more frequently in the bottom of the neighbouring valleys; as, for instance, below the furnaces, and at the lower parts of the slopes which border the Euphrates. A sharp ridge of the same rock runs along the back of the east side of the town, and there forms bold precipices facing the river which flows almost beneath. A little further to the north, the porphyry is interrupted by a band of ochreous matter, which, probably before the formation of the

valley of Kebban, communicated with a similar patch on the opposite side, forming a lode or dyke. The surfaces of the hills, as well here as on the opposite side of the Euphrates, are covered with innumerable rubbish heaps, formed in attempts to open mines which have rarely been pushed more than two or three feet into the ground. The mines at present worked (which are three in number) lie beyond the ridge on the west of the town, and are even more miserably directed than those of Arghaneh. The adit mouths are driven through shale and limestone, which, here and there, shows on the surface small strings and lumps of galena; but so irregular and dirty are the works, that little can be seen underground to inform us how the ore occurs. The lower mine exhibited some rich portions of nearly pure argentiferous sulphuret of lead, but it nowhere had the appearance of occurring in veins, and I could not hear of crystallisations or druses. In the upper mine, a large quantity of soft iron ochre, a sort of gossan mingled with threads of gypsum, is excavated as ore, being found to contain, like the galena, from an ounce to an ounce and a half of silver in 100 lbs.

The miners told me that near the junction of two species of rock, whether limestone or shale, or of one of these with porphyry, they find the ore more plentifully disseminated than elsewhere.

Dressing or preparing the ores is not understood, so that all which is not rich enough to go at once to the furnace is wasted.

Between the Euphrates, at Kebban Maden, and the Kizil Irmak, or Halys, at Siwas, extends a broken and neglected high land, in which the traveller meets with no habitations, except in villages fifteen or twenty miles apart, and these are inhabited by koords of a somewhat lawless character.

On leaving the felspar porphyry which is found in peaks, or below the sedimentary rocks at Kebban, a high land of limestone and shales is reached. This high land extends up the course of the Western Euphrates, above Eghin, and towards Kamak, where the limestone forms the sides of a magnificent gorge through which the river flows. Superimposed on the older grey limestone, occur beds of a white calcareous rock of softer character, which mineralogically has a strong resemblance to the *calcaire grossier*, or *Grobkalk* of the Vienna basin, and contains the shells of oysters. About twelve miles from Kebban, the almost level country is strewn with basalt blocks, like those of the plateau of Diarbekr, which continue beyond the village of Ergavan. An hour's distance from hence, a long valley running up towards the north-east, exhibits porphyries frequently trachytic in character, and containing hornblende crystals in a felspar paste; and also banks of a conglomerate, containing fragments of the same porphyry. Then, after passing the water shed, about ten miles before reaching Hakim Khan, rise on the right hand precipitous heights of compact limestone in beds inclining to the west; and in some places porphyry comes up from beneath them. The country on the south-west, towards the Euphrates, is composed of low undulations of sand and marls.

Around Hakim Khan are crumbling marls, in vertical or highly inclined positions, running N. E. and S. W. ; above which rise a few remarkable peaks of bare white limestone.

Towards Hassan Tchelebi, on the road side for six miles, diorites and serpentine rocks appear, the heights above which, often wooded, and said to be tenanted by wild goats and deer, are of limestone. These calcareous strata, having a moderate inclination to the westward, continue visible as far as the village last mentioned.

From Hassan Tchelebi, for about twenty miles, the rocks are hidden by vegetable mould and grass ; though fragments of porphyry, limestones, and marls are found.

From Alajah Khan, for a distance of four or five miles, diallage rocks, often much discoloured by iron, are found ; and after this appears limestone, tilted towards the west, then for some distance before reaching Kangal, and from thence as far as Delikli Tash, the slopes are covered with thin grass.

The chain of the Anti-Taurus (Itschitchehi Dag), attaining an elevation of 5800 feet, runs in a very marked line from W. S. W. to E. N. E. The limestones of which the higher part is formed, rest on serpentine ; which appears to have coloured and hardened the beds of shale, near the surface of contact. Immediately on the west, towards which side the beds incline, granular gypsum appears in beds of considerable thickness on both sides of the road ; and on this lies salt, the presence of which is betrayed by a lake, whose waters evaporate in summer. Eighteen miles from Delikli Tash is found a quartzose sandstone in strata from 2 to 6 feet thick, inclining gently towards the west, and between this and the deeply cut valley of the Kizil Irmak (Halys), that rock continues without interruption.

The preceding observations collected in the course of a single traverse are not a sufficient foundation on which to base general conclusions as to the constancy of the order in which the rocks occur ; but since the mere enumeration of the rocks in geographical order is, in general, but a dry repetition, and, for want of comparison with some known scale, is not easily kept in mind, it may be of advantage to conclude with a sketch of the probable order of the formations above mentioned, which may serve as a guide to future travellers in these districts.

The oldest stratified rocks of the series are unquestionably the limestones and chloritic slates of Kebban Maden, which appear to be in connection with the mica slate, forming the nucleus of the Taurus at Adanah : they overlies a felspar porphyry, which seems to have pierced them in dykes, and near the contact affords ores of argentiferous lead.

The second deposit may be the quartzose sandstone which occurs between the range of Anti-Taurus and Siwas ; and this deposit, no doubt, belongs to the system observed by Hamilton near Eregli *, to the south of Kaisariyeh, towards the head of the

* These saliferous deposits are probably more recent than the Scaglia Limestones. W. J. H.

river Melas, and mentioned by him as stretching across from Galatia to Cappadocia. In both places, it is a hard red grit, associated with strata of gypsum, and with red and grey marls; and, in the first case, also with salt.

The grey limestone of Arghaneh, Kharpur, and the Anti-Taurus, must be referred to the vast calcareous deposit, which, cotemporary with our green sand, occupies an enormous extent of country in Italy, Dalmatia, Albania, Greece, and Syria, on the one hand; and in South France, Spain, the Balearic islands, Sardinia and Sicily on the other, a zone in fact which, from what we find of it again in Egypt and Algiers, appears to encircle the whole Mediterranean. In the Taurus, as in many of those countries, it has been upheaved and pierced by serpentine and diallage rock; and these are the circumstances which in the country I have endeavoured to describe, as well as in the Maremme of Tuscany, at Monte Castelli, Rocca Tederighi, Monte Catini, &c., are associated with the presence of the sulphuret of iron and of the sulphuret and other ores of copper. The lower beds of this limestone, often described under the name of scaglia, are not yet very definitely referred to their place in the geological scale; since they differ much among each other, and are often poor in characteristic fossils; but the upper portion, with its nummulites and the marls associated with it, retains more nearly the same type throughout.

The date of the eruption of the serpentines, which are associated with the cretaceous beds, has been referred by most observers to the tertiary epoch; nor would it appear that those of the Taurus are an exception, since their occurrence in dykes near Arghaneh proves their outburst to have been subsequent to the deposition of the limestones.

I should be inclined to refer to the tertiary period also those limestones which occur on the summit of the mountain west of Arghaneh Maden, and contain imbedded fragments of serpentine; and also those which cap the mountains near the junction of the Murad and Frat; but the line of distinction, from the difficulty of procuring fossils, is not easily drawn. It is however very possible that a more accurate examination may show them to be secondary, and thus prove the outburst of the serpentines to be of remoter date than is generally supposed; or, what is more likely, to have happened not all at once, but at several successive periods.

To the deposition of these calcareous strata have succeeded the further elevation of the chain, and the formation of the existing valleys; phenomena probably contemporaneous with and due to the same cause as those which produced the protrusion of the igneous rock occupying several large tracts in the district under consideration. A further study would doubtless prove these rocks to be connected with the vast series of volcanic rocks, of the same general character, which extend at intervals from the Katake kaumene of Asia Minor to the Taurus, and thence to Mesopotamia on the one hand, and through the north of Syria to Galilee on the other. The protrusion of these rocks is one of the principal agents to which the present configuration of this important tract of country is due.