⁵ Mr. Osborne White is also of the opinion that the excavation of the Goring Gap was begun in long pre-Glacial times.

⁶ T. I. Pocock, *The Geology of the Country around Oxford*, Mem. Geol. Surv. England and Wales, 1908, pp. vi, 142.

⁷ H. J. Osborne White, "On the Origin of the High-level Gravel with Triassic Debris adjoining the Valley of the Upper Thames": Proc. Geol. Assoc., vol. xv, pp. 157-74, pl. vii, 1899. The view that the clay with flints on the Buckinghamshire hills is of glacial origin has been maintained by Sherlock & Noble (Quart. Journ. Geol. Soc., vol. lxxviii, pp. 199-212, pls. xii-xiv, 1912). In the discussion on this paper the authors' views were generally rejected.

⁸ A. E. Salter, "Pebble and other Gravels in Southern England": Proc. Geol. Assoc., vol. xv, pp. 264-86, 1899.

II.—NOTES ON THE PETROLOGY OF A PORTION OF THE NORTH KALGOORLIE FIELD.

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(PLATES VI AND VII.)

(Concluded from the March Number, p. 114.)

FROM the foregoing analyses there is little doubt that the rock is a hornblende-quartz-keratophyre. The term porphyrite, however, has been adopted in the mapping for convenience. It is worthy of note that a very similar rock, though greenish in colour, has been already described from Kanowna by the writer.¹ In the latter, silica amounted to more than 71 per cent, while soda reached 7.85 per cent; potash was again absent.

12237, G.M.L. 4458 E., Hyman North.²

The rock is finer in texture than the preceding one, but has no remains of hornblende phenocrysts, and the ground-mass is of very fine grain, and is intermixed with fine flakes of muscovite. A few of the felspar phenocrysts are cracked. There are a few aggregates of a yellow chlorite, some brown-red grains and dust of iron-ore. The 'matrix' of 12331B, G.M.L. 4458 E., Hyman North, is similar to 12237, though the former shows unmistakable evidence of shearing action, not only in the parallel orientation of sericite fibres and the presence of brownish-yellow flakes or spots of chlorite, but also in a 'lined' or 'grated' appearance in section, due beyond doubt to the sliding of one portion of the mass over another.

12316 (about $5\frac{1}{2}$ chains north-west of south corner of G.M.L. 4161 E.) is very similar in section to the previous specimens, but the felspar both in the phenocrysts and in the ground-mass is almost all altered to sericitic aggregates, amongst which the quartz plates are easily visible.

12368, 120 ft. level G.M.L. 4406 E., Hyman, is distinctly porphyritic with ferruginous outlines of former hornblende.

¹ Bulletin No. 47 G.S.W.A., Petrological Notes, p. 71.

² M.C. = a weathered brownish rock. S. = minerals: felspar, quartz, chlorite, sericite, and iron-ore.

Rock-sections, Kalgoorlie.

To illustrate Mr. Farquharson's paper (see March Number, p. 113).

In No. 11106, square, columnar, and other shapes of a turbid, indistinctly twinned felspar, together with irregular patches of calcite, appear in a ground-mass that consists of small square and lath-shaped felspars, minute granules apparently of quartz, numerous round grains of pyrites, and small scales of green chlorite. The felspar, both of the phenocrysts and of the ground-mass, is more or less kaolinized, so that determination of the species is difficult. It is highly probable, however, that the rock is another variety of the porphyrite with felspar phenocrysts.

10433 closely resembles 12331A and 12368. There are large kaolinized phenocrysts of twinned albite in various forms in a ground-mass of small felspar squares and laths, without any 'flow' structure, and small interstitial plates of quartz. There are also large green chloritic aggregates without definite shape enclosing talcose fibres, and usually brown from iron oxide. These, no doubt, represent the hornblende phenocrysts noticeable in some other sections. One or two large plates of clear quartz are visible in places, and there are occasional patches of brown-stained carbonate.

12321 differs from the above only in having a larger development of granular calcite and a tendency towards felted structure in the laths of the ground-mass. A considerable amount of sericitic mica also is distributed over the slide.

In 12232 large deep-green chloritized hornblende columns and prisms make their appearance, often stained, however, by iron oxide. They are disposed in a fine-grained ground-mass which consists of more or less twinned felspar laths, and which closely resembles the ground-mass of 12376. Felspar phenocrysts are not observable in this slide.

2937 and 10434. These are blackish rocks with white, somewhat lenticular spots of a white carbonate, which, as it gives an effervescence with cold dilute H Cl, though a feeble one, is at least in part of calcite. In section green chloritic patches and granular carbonate in rounded and columnar forms, as well as in small grains, stand out of a ground-mass of minute lath-shaped and small short columnar crystals of a twinned and turbid felspar. The carbonate areas appear in places mixed with chlorite and quartz, some, mainly chlorite, have almost exactly the form of cross-sections and elongated forms of hornblende crystals (see especially 2937). It is possible, also, that some of the forms, though they show no remains of twinning, represent original felspar phenocrysts. Numerous small black grains of magnetite are scattered through the mass.

The rocks are difficult to place, but the character of the phenocrysts and the nature of the ground-mass have led to their being classed as hornblende porphyrites. A slight tendency to the drawing out of the white spots in a parallel direction is observable in the hand-specimen, a fact presupposing some shearing action on the rock-mass.

12311 is a hard reddish rock with a few dark-green specks. In section there are numerous square and columnar phenocrysts more or less decomposed with the production of kaolin and sericite. These stand out of a ground-mass consisting of a few felspar forms, granular

quartz, granular patches of an iron-stained carbonate, some grains of magnetite, and a few patches of green scaly chlorite. One or two larger plates of quartz are to be observed, but phenocrysts of the mineral are conspicuously absent. The species of felspar present was indeterminable owing to the alteration the mineral has undergone.

The rock may be either a quartz-porphry, with quartz wanting among the phenocrysts, or an altered specimen of keratophyre.

(b) *The Non-Porphyrific Type.*

12231. In hand-specimens, the same in appearance as the other brown specimens. In section the rock is seen to be devoid of felspar phenocrysts, and to consist of a plexus of trimmed laths of felspar, among which quartz is very hard to identify. In the ground-mass are several long, thin, acicular as well as rectangular crystals, yellow in colour, which are doubtless chloritized remains of hornblende forms. Here and there are pieces of tourmaline without definite shape, with a dichroism from deep green to pale violet or lavender.

12233 is in a hand-specimen a light-grey, compact, fine-grained rock with a brown crust. The section is composed entirely of irregularly outlined laths of felspar of considerable size, some interstitial quartz, and some aggregates and scattered scales of greenish pleochroic chlorite with grains and squares of magnetite. Phenocrysts are absent, though some of the laths attain unusual size (Pl. VII, Fig. 3). Twinning is pronounced, and measurements of extinction angles indicate albite or oligoclase-albite. The irregular nature of the outline of the laths is a noteworthy feature.

B. ROCKS OF GABBROID OR DOLEMITIC ORIGIN.

The rocks of this group are either light-grey with green spots and rather hard, e.g. 12324, or dark-green, soft, and with minute quartz crystals, e.g. 12379. As stated previously, the distinctive characters of the group are few, but generally there are clear outlines of long columnar twinned felspars, and in two specimens at least, 12324 and 12322, a kind of coarse ophitic structure.

12324. Minerals observed: hornblende, felspar, quartz, zoisite, epidote, chlorite, apatite, iron-ore.

The section consists of large ragged plates and flakes, of a pale, almost colourless hornblende that is sometimes partially chloritized, disposed amongst numerous completely turbid rectangular and columnar crystals of felspar, with idiomorphic outline. The turbidity is seen with high powers to be due to a granular mass of zoisite, epidote, and occasionally clear quartz, and is consequently to be attributed to saussuritization. Between the felspar crystals there is frequently some clear interstitial quartz that is, without doubt, original. Long needles of apatite occasionally make their appearance, and besides forms of leucoxene there are grains of ilmenite surrounded by that mineral.

The idiomorphic nature of the felspars and the platy character of the hornblende suggest a sub-ophitic structure. The rock is an amphibolized and partially saussuritized quartz dolerite.

12322 differs from 12324 only in a greater development of felspar forms, and a smaller development of the ferro-magnesian and quartz.

The feldspars are also more turbid, and in them epidote is not so prevalent. Leucoxene is rare.

12370 is a rock of the soft green type.

Minerals observed: chlorite, quartz, calcite, feldspar, magnetite, apatite, epidote.

Long, thin columnar crystals of feldspar, partially or wholly altered to carbonate and green chlorite, with usually a green border of chloritic scales all round the crystals, are the most prominent feature of the slide. The feldspar appears to be andesine. Between these forms are clear areas of quartz with chlorite inclusions; some of the quartz appears originally interstitial, but most is doubtless secondary. There are numerous apparent intergrowths of calcite or chlorite and quartz forming a micropegmatite, and though the calcite and chlorite may be due to decomposition of feldspar the structure in this case is more probably of secondary origin. On the other hand, a few small areas of micropegmatite in which the feldspar is only kaolinized are regarded as original. There are a few needles of apatite, numerous grains of magnetite, and some small plates of epidote.

Though the alterations to which this specimen and 12324 have been subjected are quite different, the structure of the rocks is somewhat similar. There is even in 12370 a suggestion of ophitic structure. The rock is of doubtful origin, but is classed as originally a quartz dolerite.

12377 and 12379 are of very similar type to the preceding, but though they are undoubtedly originally the same rock their structure is more indefinite. 12377, in particular, approaches 12322 in structure, and it would seem that the difference between the two is due only to a difference in the type of alteration each has undergone.

2108 is more closely grained and has a larger amount of chloritic scales. The feldspar columns are very large, and the mineral is now represented largely by calcite, chlorite, and epidote, but in places by quartz and chlorite, or quartz and calcite.

In 12378 there has been a much more complete mineral and structural alteration. There are few signs of idiomorphic feldspars: the structure is distinctly granular, and the slide consists of a mixture of chlorite, calcite, quartz, epidote, and iron-ore. Yellowish epidote is particularly abundant in small platy aggregates. In part of the section the constituents are arranged parallel, as if the rock had been sheared since its decomposition. One large columnar crystal with perfect longitudinal cleavage, straight extinction, very low birefringence, and a biaxial figure has been referred to zoisite.

12310 is a dark-green carbonated chloritic rock. Under the microscope, it appears at first sight to consist of a basis of almost isotropic chlorite in which are grains and crystals of a carbonate, small plates and grains of nearly colourless epidote, and some dark-grey or brown areas with the appearance of leucoxene. Closer study, however, shows that the chloritic basis contains remains of small columnar, almost lath-shaped crystals of twinned feldspar. Since there appear to be no idiomorphs of any size the whole rock seems to be composed chiefly of the laths, and the suspicion arises that it is but

a much chloritized form of the non-phenocrystal porphyrite. The grey, or brown areas are resolvable under high powers into aggregates of minute brown-yellow rutile prisms and needles, so that these areas no doubt represent original ilmenite, or less probably biotite.

The structure of the rock is rather indefinite. It resembles that of the fine-grained ophitic dolerites, but also that of the non-phenocrystal porphyrites. The rock is difficult to place, but has been put provisionally amongst those of doleritic affinities.

12387 is a greyish-green rock with veinlets of quartz, with much carbonate, and with a somewhat sheared structure. The mineral constituents are chlorite, quartz, carbonate, and apparently some kaolinic material. In places forms are visible which by ordinary light resemble large decomposed zoned plagioclase crystals, but which by polarized light appear as mixtures of quartz and carbonate. Prisms and grains of brown-yellow rutile are scattered all over the slide, as also are small plates of clear quartz.

The rock shows no structure. It appears more allied to the diorites than to any other group.

12303. A weathered, dirty red and green rock of rather coarse texture. Minerals observed: epidote, chlorite, quartz, magnetite, apatite, and some rounded areas rendered rusty-red by ferric oxide.

There is a total absence of structure. The slide is a mineral mass in which the commonest mineral is a yellow and greenish-yellow epidote in plates and platy aggregates. With the latter are partially chloritized fibrous and strongly pleochroic collections of greenish hornblende forms, while in many places are patches of greenish chlorite. Quartz occurs in large clear cracked plates; there is much magnetite, and there are occasional apatite needles. In one place a turbid form resembling a columnar felspar is visible. The rock was with little doubt formerly an amphibolite.

Epidioritic Rocks.

Both 2950 and 11001 are specimens too much decomposed to call for description. They appear, however, to be composed of fibrous, sheafy, and divergent aggregates of a pale hornblende which has subsequently been partially altered to chlorite. They are both without normal igneous structure, and are, in consequence, set down as weathered epidiorites.

C. THE TALC-CHLORITE ROCKS OF MORE INDEFINITE ORIGIN.

The rocks of this group are those composed largely of talc and chlorite, but of which the origin is doubtful. They vary in colour from red to dense black, but are commonly green. They are all soft.

3391. A blackish-green rock, with few recognizable minerals. Seen in section it consists of numerous fine fibres of a colourless mineral with low refractive index and high double refraction. Some radial extinction in sheaf-like aggregates is also to be observed. Grains of magnetite are frequent, as are patches of granular carbonate. Though in hand specimens the rock is serpentinous in character,

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Rock-sections, Kalgoorlie.

To illustrate Mr. Farquharson's paper (see April Number, pp. 150 and 155).

in section its characters more closely agree with those of a talc-chlorite rock. An analysis made in the Survey Laboratory gave the following results :—

	Per cent.		Per cent.
Si O ₂	47.44	<i>Brought forward</i>	91.70
Al ₂ O ₃	6.65	Na ₂ O	.33
Fe ₂ O ₃	.76	K ₂ O	<i>nil</i>
Fe O	6.78	H ₂ O +	5.68
Mg O	26.68	H ₂ O -	.78
Ca O	3.39	C O ₂	2.06
	<hr/> 91.70	Total	<hr/> 100.55

From the relatively high percentage of alumina and ferrous oxide, it would appear that chlorite is present in fair amount. On the other hand, as potash is absent there is no sericite. The silica percentage is in the neighbourhood of that of the various epidiorites and amphibolites, and, though not much reliance can be placed on this as a criterion, it is probably that the rock has been derived from some such original.

7006 is almost identical with 3391.

12240 is grey in colour and more or less granular, and with a soapy feel. In section it is composed of a mass of minute scales and rods of a yellowish-green mineral with rather high birefringence and noticeable pleochroism, amongst which there seem to be other very minute needles of a paler colour. Idiomorphic crystals of reddish dusty carbonate are not uncommon. There are occasional fragments of quartz, and a few small pieces apparently of feldspar. An analysis of the rock made in the Survey Laboratory gave the following results :—

	Per cent.		Per cent.
Si O ₂	35.90	<i>Brought forward</i>	57.90
H ₂ O +	4.71	Mg O	15.69
C O ₂	9.22	Fe O	4.12
K ₂ O	2.00	Fe ₂ O ₃	7.04
Na ₂ O	.26	Al ₂ O ₃	13.48
Ca O	5.81	H ₂ O -	1.84
	<hr/> 57.90	Total	<hr/> 100.07

It will be seen that the silica percentage is very low; the C O₂ percentage is high, and the percentage of alumina is also comparatively high. The presence of potash with a high percentage of alumina suggests the occurrence either of feldspar or of sericite. The presence of the former is demonstrably present, but the identification of the latter cannot be made with accuracy. From the analysis and the optical characters, the rock would appear to be a talc-chlorite-sericite rock with carbonate crystals, and to be derived from an amphibolite or some closely related type.

12372, G.M.L. 4320 E. "Ivy"; consists of fine scales of talc, decomposed chlorite, and granular carbonate; it closely resembles 3391.

1947 (Old Thunderbolt lease, now G.M.L. 1121 E. Devon Consols Consolidated) is another dark-green chlorite rock, which consists of lenticular areas of talc and carbonate streaked out in parallel

directions, and surrounded by almost isotropic green chlorite. Crystals of carbonate are also visible, and there are occasional small plates of quartz. Brown-yellow rutile is rather common in grains and prisms.

12315 (shaft about 80 ft. S.E. of S. corner of G.M.L. 4161 E.) is a reddish rock with small plates of quartz, areas of greenish chlorite, many small brilliantly polarizing flakes that have been referred to talc, and numerous brown-red dusty aggregates and crystals. As the latter show in places distinct rhombic forms, they are, in all probability, forms of ferriferous carbonate that have been oxidized. Veinlets of quartz penetrate the rock.

12366 (dump 11 ch. N.N.W. of N. corner G.M.L. 4337 E.) is a soft greyish-green rock with a reddish tinge. There are again ferriferous carbonate crystals, and remains of small twinned, columnar, or lath-shaped crystals of feldspar. The rock is of doubtful origin. It may be either a chloritized or somewhat carbonated form of the keratophyre, or it may be of amphibolite origin.

11083, "Tabby Cat" (Gibson), is a talc-chlorite rock with crystals of a carbonate. There are pleochroic halos round brown and black crystals of ilmenite in chlorite.

D. ROCKS OF DOUBTFUL ORIGIN.

1. *The Fuchsite Rocks.*

These specimens are more or less identical in appearance with those already described by the writer from other localities,¹ with the exception of 12317, which is a pale-green quartz rock with green micaceous scales in strings on the surface; they are all heavily carbonated, partly siliceous, with white quartz, and to a greater or less extent pyritic. The fuchsite occurs in films and scaly aggregates all over the rocks. Most noteworthy, however, as tending to throw some light on the mode of origin of the rocks, is the occurrence in 10439 of a development of tourmaline needles, associated with a fresh feldspar and large idiomorphic crystals of a carbonate. The nature of the feldspar has not been definitely established, but from measurements already made it appears to be albite. The significance of the occurrence of tourmaline has already been pointed out. The origin of the chromium oxide that has given rise to the fuchsite is still, however, to be accounted for. Attempts have already been made to explain its origin in definite terms, but one great difficulty has been that for various reasons no field evidence of its occurrence of any service can be obtained. The same difficulty has been met with in the area under consideration. The specimens were obtained from dumps of shafts to which access is no longer possible. The chromium must, however, be regarded either as original in the rock or as introduced by circulating lateral or ascending solutions to which the carbonates, the silica, and indirectly the tourmaline are due.

¹ Bulletin No. 43, G.S.W.A.: Observations on some Rocks from Ingliston, Extended Mine, Meekatharra. Also Bull. No. 47, G.S.W.A., Petrological Notes, p. 92.

It is known that the water of hot springs does contain not only CO_2 in solution but also small amounts of Cr_2O_3 . Traces of chromium are contained, for instance, in the deposits of hot springs at Carlsbad.¹ On the other hand, there are in these fuchsite rocks small grains of a black or brown colour, often surrounded by the micaceous mineral, which may be chromite or picotite. At present, however, no definite views as to its origin can be put forward. It must be noted that in the cases previously described no tourmaline has been identified in association with these rocks, so that its development may be subsequent to the formation of the carbonate.

10439. A green and white, partly siliceous, carbonate rock with tourmaline, pyrite, and feldspar.

The characters presented by the rock are essentially the same as those of similar rocks already described. Briefly, the section consists of a granular mass of carbonate, quartz, sericite, and fuchsite, and brown and black grains surrounded by green mica. There are small aggregates of rutile needles, some in the carbonates. Apparently a marginal peculiarity is a mixture of quartz, fairly fresh feldspar, and numerous long prisms of a tourmaline with dichroism from almost colourless to brownish-green. In places the mineral is found to be apparently enclosed both in the carbonate crystals and in the feldspar. (Plate VII, Fig. 4.)

11028. A dark greyish-green rock with strings of pyrites, veinlets of a whitish carbonate, and with a rather faint green tinge. In section, besides the ordinary granular mixture, there are fragmentary plates of a partially granulitized clear feldspar that appears to be albite. It is in places more or less sericitized.

12257 is similar to 11028, but more heavily carbonated, and shows several veinlets of quartz with some cryptocrystalline areas of very low birefringence.

In 12256, which is a light-grey carbonate rock with greenish spots, there are much granular carbonate, small plates of quartz, and long columnar striated feldspars that have been partially replaced by sericite and carbonate. There are also laths of altered feldspar and a large number of opaque, squarish, and rounded granules that appear whitish or yellowish by reflected light. It was impossible to identify the feldspar, but the appearance of the rock is such as to suggest the possibility of its having been the keratophyre. The small green spots in the hand-specimen are very difficult to pick up owing to their small size and the presence of sericite. It seems unlikely, however, that they are inclusions.

12317. Appears in section to be made up of quartz plates of various size rendered dusty by minute fibres of sericite and small bluish-green patches presumably of fuchsite.

2. *Rocks possibly of Plutonic Origin.*

11096. M.C. A weathered grey-green rock with numerous grains of pyrites and occasional long thin columnar and pale greenish feldspars visible.

¹ Beck, *The Nature of Ore-deposits*, vol. ii, p. 426.

Minerals observed: quartz, feldspar, pyrite, magnetite, granular calcite, chlorite, a micaceous mineral (muscovite).

There are long broad columnar crystals of a feldspar showing either only Carlsbad twinning or none at all; other crystals, tabular as well as columnar, show broad albite lamellation and symmetrical extinction angles as high as 14° , 15° . The former are doubtless orthoclase, the latter andesine or a basic oligoclase. Quartz is abundant in a few plates that are almost idiomorphic, but mostly in shapeless areas. Intergrowths of feldspar and quartz are very frequent, and of large extent, the feldspar being either micacized or kaolinized. In some places tabular feldspars appear like islands in a sea of clear quartz; in others the feldspar of an intergrowth is optically continuous with a tabular crystal. Instances are to be seen where feldspar crystals have been broken across, and in these the cracks have all become filled with clear quartz.

Granular patches of calcite and magnetite and also of chlorite, with crystal outlines, may represent an original ferro-magnesian. Flakes of a colourless micaceous mineral occur sporadically and have been referred to muscovite. Pyrites is common in the rock in grains of various size. There is no distinct porphyritic structure.

The rock is difficult to name; it resembles some hornblende granites and quartz diorites, but, though no ground-mass is noticeable, it more closely approaches in character a granite porphyry. The great amount of clear quartz and the infilling of cracks in the feldspars by this mineral suggests a partial metasomatic replacement of some of the feldspar by quartz.

2918 is a grey rock with dark-grey spots in a lighter rock mass, and with veins of pyrites. In section are visible large shapeless plates of clear quartz, some leucoxene areas, and much granular pyrites in a granular mass of carbonate, quartz, muscovite, and sericite. There are remains of platy feldspars now sericitized, and occasionally what appear to have been intergrowths of quartz and feldspar, the latter sericitized.

No noticeable rock structure now remains, so that it is impossible to come to any conclusion as to the nature of the original rock.

5. CONCLUSIONS.

Briefly, the main points which emerge from a consideration of the area dealt with in this paper are these. The earliest rocks and those that form the greater portion of the area are greenstones which comprise masses of doleritic or gabbroid type, others of amphibolite without doubt derived by extreme dynamic metamorphic action from the former, and talc-chlorite rocks which probably represent the extreme phase of chemical and dynamic alteration both of the dolerite and of the amphibolite. The movements which contributed to the production of the hornblende of the amphibolite from the augite of the dolerites or gabbros not only produced a shearing in the rocks themselves, but developed actual fissures in the rock masses, a main series at right angles to the direction of stress and no doubt a minor at right angles to the latter. Moreover, along several lines the shearing and crushing stresses were probably greater than along

others, with the result that distinct lines of weakness were produced in the rocks.

At a later date, along these lines of weakness and doubtless along various fissures in the mass, there were intrusions of a highly acid dyke-rock rich in soda and with frequent hornblende phenocrysts—the albite—porphyrite or keratophyre. That this is decidedly later in origin than the greenstones is proved by its occurrence in tongues in them, and by the frequent examples in one locality of included chloritic xenoliths.

Accompanying the acid intrusions were boric vapours which not only caused the production of tourmaline both in the keratophyre and in the quartz leaders, but which, in association with other gases, without doubt exerted a pneumatolytic action on the surrounding rocks. Harker¹ has briefly described the main views now held as to this type of alteration. According to him, with the completion of crystallization in a rock magma the combined water and other volatile substances must be disengaged. The bulk of these are collected in druses and geodes or occupy fissures in the now solid rock body. Such cavities and fissures may be sufficient to permit of a general circulation through the rock mass. As cooling proceeds, however, some of the compounds crystallized at higher temperatures cease to be stable in the presence of the concentrated gaseous residuum and are decomposed with the production of new minerals. The volatile substances may or may not enter into the composition of these new minerals, but in general they do so at a greater extent at this stage than during the magmatic crystallization.

The pneumatolytic agents themselves are merely the final residuum of an igneous rock magma, and the processes are conducted at temperatures more or less elevated, though progressively declining. It is probable, therefore, that the tourmaline of the keratophyre has been produced during the later stage of the consolidation of the magma and possibly by action of the boric vapours on some of the felspar.

Further, in the lode formations kaolin and sericite are particularly abundant, and, as Flett has pointed out, this kaolinization and sericitization may be attributed in great part to pneumatolytic action. Moreover, the action of the vapours was doubtless also exerted on the surrounding greenstones, causing a propylitization which has given rise to some at least of the soft greenish chloritic rocks.

When the high acidity of the dyke is taken into consideration, and also the fact that frequent cases occur of the quartz leaders enclosing tourmaline needles, most of the leaders and of the auriferous quartz of the lodes may be regarded as genetically connected with the dyke, as being the later more acid or wholly acid phase in which the rarer mineralizers—in this case boric vapours—were particularly abundant. It is probable also that auriferous veins will be found not only at the junction of the dyke with the greenstones, but in some cases for some distance into the greenstones themselves.

¹ Harker, *Natural History of Igneous Rocks*.