The plagioclase reaches 2.0 mm. in diameter; many crystals are rounded or broken or fissured. Its composition varies between andesine $32An_{32}$ to oligoclase $25An_{25}$. Sericitisation develops in the vicinity of microfractures. Quartz occurs in granulated crystals some of them reaching a diameter of 8.0 mm. The biotite flakes are 2.0 mm. long and concentrated in thin layers; alteration to sphene or, if more complete, to sphene and chlorite is developed near microfractures. Grains of ore and zircon occuring in the groundmass are often arranged in thin strings, parallel to the general foliation of the rock.

D.- PETROGENETIC CONSIDERATIONS

(a).- Regional facies

Rocks of the southern belt have non-distinctive mineral associations. The significant minerals are plagioclase, quartz, biotite and hornblende. Though almandine is rare, the assemblage hornblende-plagioclase is diagnostic and demonstrates that the general facies of this group of rocks belongs to the almandine-amphibolite facies (TURNER and VERHOOGEN, 1960, p. 545 : "By no means all amphibolites of this paragenesis, however, contain almandine"). Owing to the lack of other symptomatic features it is impossible to determine the subfacies.

(b).- Petrogenesis and origin

The narrow banding, pelitic composition and frequent gradational transitions point to a sedimentary origin of the gneisses and banded amphibolites. This is verified under the microscope by several features indicating clastic origin : aligned stringers of ore and zircon (local concentrations of heavy minerals during sedimentation); rounded clastic plagioclase and quartz.

Though many amphibolite layers merge into the gneisses, it cannot be proved that all of them are of sedimentary origin. However, no traces of truly igneous texture have ever been found by the writer in these rocks; it is probably safe to assume that the majority of amphibolites too are of metasedimentary origin.

Phenomena of secondary alteration are very well displayed, though they occur only in the immediate vicinity of microfractures. They are : chloritisation and/or muscovitisation of biotite and sericitisation of plagioclase.

In the chloritisation of biotite, sphene or, less often, rutile are the first minerals to form : they crystallize in cleavages after exsolution of titanium from the biotite. In 1958, SCHWARTZ also concluded that titanium tended to separate rapidly from altering biotite. In the following stage, formation of chlorite or muscovite takes place. The latter involves removal of iron and magnesium (SCHWARTZ, op. cit.) and the introduction of potassium. It is very significant that these alterations have only been developed in the vicinity of microfractures : hydrothermal solutions circulating in these fractures were responsible of the removal of these elements and the supply of potassium.

The presence in some biotite flakes of two minerals of alteration (chlorite and muscovite) shows that the conditions of alteration were essentially variable and that equilibrium was not reached.

The sericitisation of plagioclase necessitates no introduction of potash to take place. According to MICHOT (1938), potash is always present to a certain extent in plagioclase and could react with the anorthite component of plagioclase to form mica :

4 anorthite + 1 orthoclase + 3 water = 1 clinozoisite + 1 phengite

However, in this case, the plagioclase is sericitised only near microfractures and it is evident that potassium-bearing solutions circulating in these fissures, and not potash in solid solution in plagioclase, were responsible for this alteration.

(c).- Deformation

The uniform vertical dip of various layers in the metasediments is complicated by abundant plications in the vertical plane. The nature and the aspect of these folds are a direct function of the relative mechanical properties of the rocks involved, i.e. their competence or incompetence. It has been emphasised (GOGUEL, 1952) that this concept of competence is entirely relative; i.e. a rock can only be competent or incompetent relative to another. Observation in this area proves the truth of this assertion. In folded alternations of quartzofeldspathic and biotite gneiss, the former is deformed by straightforward flexure and, except in narrow bands, shows little variation in thickness in folds, while the latter is laminated and flows plastically during deformation (Photo 7, Plate IV). Carried to the extreme, this may lead to shearing out of the biotite gneiss and formation of arrowheads (under strong lateral compression, according to KRANCK, 1957)

(Photo 9, Plate V). Hence, quartzofeldspathic gneiss is competent relative to biotite gneiss. However, this same "competent" material behaves in an incompetent way relative to amphibolite : it yields plastically and flows into the zones separating boudins of amphibolite. In fact, the very occurrence of boudinage, as described by several authors (GOGUEL, 1952; RAMBERG, 1959; WILSON, 1961), necessitates the gneiss to be plastic : boudinage takes place when a layer of brittle material is intercalated in plastic material. Compression normal to the layering causes the plastic rock to flow outwards and under the frictional drag on the surface of the brittle material, the latter will fail by tension. Boudins form and are dragged farther apart under this strain. Zones in between boudins are subjected to a deficit in pressure relative to their environment (GOGUEL, 1952). In the central belt these are often filled with quartz segregations squeezed from the surrounding rocks into the low pressure areas in between boudins (Photo 33, Plate XVII, chapter IIB).

The relative nature of competence is thus proved : though quartzofeldspathic gneiss is competent relative to biotite gneiss, it is incompetent relative to amphibolites. Since this behaviour can be observed in a single outcrop, the validity of this conclusion is unquestionable.

However, the isoclinal folds shown in Photo 6, Plate III, although they affect narrow alternations of biotite and quartzofeldspathic gneiss do not show evidence of plastic flow : they are of the normal concentric fold type. KRANCK (1957) has pointed out that plastic folding involves a low degree of internal friction compared with concentric folding. Thus, two periods, or two phases, of folding must be distinguished in these outcrops : plastic folding, which took place at depth, and normal folding of the concentric type which took place at higher levels in the crust, in more brittle rocks.

(d).- Conclusions

The origin of these rocks is metasedimentary; during metamorphism, a grade of the almandine-amphibolite facies has been reached.

There are two phases of tectonism : one involving plastic folding at depth; the other of the normal concentric type, at higher levels in the crust. Secondary alteration of minerals has taken place as the result of circulation of hydrothermal solutions in fissures formed during rock deformation postdating metamorphic recrystallization.

III.- PEGMATITIC MATERIAL IN THE METASEDIMENTARY ROCKS

The abundance of pegmatitic material in augen, patches, streaks, conformable veins and crosscutting dykes in rocks of the southern area (mostly in biotitic and quartzofeldspathic gneisses but also in amphibolites) will strike the most casual observer. Under close scrutiny, it becomes evident that two types of quartzofeldspathic crystallization coexist in the area. One, composed of quartz, plagioclase and microcline, is intimately connected with intrusive dykes of pegmatite and is characterized by a pink or red colour; the pegmatitic material occurs parallel to the layering, as well as across it, but always in veins or oriented streaks which can ultimately be traced back as offshoots of a dyke of red pegmatite. The other pegmatitic material is white and always parallel to the layering. Microscopic examination shows it to be essentially composed of quartz and plagioclase, it has no relationships with dykes, and its conformable pegmatites are of the accretion or exsudation type. This latter recrystallization will be dealt with in the next paragraph.

IV.- RECRYSTALLIZATION IN THE METASEDIMENTARY ROCKS

A.- INTRODUCTION

The pegmatitic material of accretion or exsudation type shows no marked localisation, but affects all gneisses to more or less the same degree. It is present but less frequent in amphibolites.

B.- OCCURRENCE

The first stage of development of the white pegmatitic material is the growth of rounded porphyroblasts or augen up to I cm. in diameter (Photos 13 and 14, Plate VII). In the next stage the quartzofeldspathic components concentrate in irregular bands or streaks (Photo 15, Plate VIII) which may, eventually, "fuse" into cloudy and nebulous conformable bodies of pegmatite (Photo 16, Plate VIII). Ultimately, discontinuous conformable lenses of pegmatite up to 10 or 20 yards in length are formed (Photos 17 and 18, Plate IX). Most of these pegmatites are never entirely made up of quartz and plagioclase; schlieren or stringers of remanent biotite, parallel to the bedding of the surrounding rocks, are usually abundant. Pinch-and-swell (see RAMBERG, 1952, 1959) structures (Photo 17, Plate IX) or boudinage structures are very well displayed in some of these pegmatites.

Occurrences of lit-par-lit gneiss have also been developed by exsudation processes : salic layers a few millimeters thick alternate with thin cafemic layers (Photos 19 and 20, Plate X).

C.- PETROGRAPHY

(a).- The porphyroblasts

Porphyroblasts, or augen, are up to 1 cm. in diameter. Under the microscope they are granular and consist of quartz and plagioclase in varying proportions. They are found mainly in gneisses, to a lesser extent in amphibolites. During growth they have incorporated parts of the gneiss matrix; biotite is often found in inclusions within the plagioclase. The latter is albite-twinned and its composition varies from andesine-oligoclase An_{30} to oligoclase An_{25}.

The average modal composition of these porphyroblasts is displayed in table IV.

TABLE IV

Plagioclase	54.6
Quartz	34.6
Biotite	10.8
	100.0

Thin sections show every gradation between these augen segregations, or streaks, of quartzofeldspathic material. The overall mineralogical composition of gneisses rich in these veins is given in table V. The plagioclase retains the above-mentioned composition.

TABLE V

	1	2
Plagioclase	43.9	54.9
Quartz	38.4	39.7
Biotite	17.7	5.4
	100.0	100.0

There are no fundamental differences in modal compositions of tables IV and V.

(b).- Pegmatitic veins and other bodies

The main minerals of these are plagioclase and quartz with some biotite and subsidiary sericite, epidote, ore and chlorite. Although modal analyses have been carried out on several slides per specimen, the results must be treated with caution on account of the large grain-size of these rocks (up to 5 cm!).

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TABLE VI

	I	2
Plagioclase	77.9	58.2
Quartz	15.5	38.4
Biotite	6.6	3.4
	100.0	100.0

The plagioclase may reach 5 cm. in diameter and is albite-twinned, its composition varies from andesine ~~31~~An$_{31}$ to oligoclase ~~25~~An$_{25}$. It is slightly sericitised in the vicinity of fractures. Quartz is up to 2 cm. in diameter and is mostly interstitial. Biotite flakes reach 10 mm. and are partially altered to sphene and chlorite.

A specimen of the lit-par- lit gneiss mentioned earlier has the following overall mineralogical composition (table VII).

TABLE VII

Plagioclase	47.9
Quartz	37.5
Hornblende	9.9
Biotite	4.7
	100.0

The composition of the light layers is essentially quartzofeldspathic. The grain-size of the plagioclase reaches 5 mm. and its composition varies from oligoclase An28 to ~~24~~An$_{24}$. Quartz is 6 mm. in max. diameter. The dark layers in this specimen consist of hornblende and biotite up to 2 or 3 mm. in length with a little plagioclase and no quartz at all.

D.- PETROGENETIC CONSIDERATIONS

A complete gradation has been observed between biotite gneisses and quartzofeldspathic gneisses, augen gneisses and, ultimately, pegmatitic bodies. The main characteristics of this white pegmatitisation are its composition (quartz and plagioclase) and its conformable nature. Comparing the mineralogical compositions of tables IV and V with those of the ordinary gneisses in tables II and III, it can be seen that there are no fundamental differences in composition between the gneiss and the augen. In both rock types the composition of the plagioclase ranges between andesine ~~35~~An$_{35}$ and oligoclase ~~25~~An$_{25}$ and no foreign minerals are present, even in the largest pegmatite lenses.

Bearing these facts in mind, the writer has ruled out the possibility of feldspathization with metasomatic introduction of mineral components. Redistribution and recrystallization of quartzofeldspathic material originally present in the metasedimentary rocks can account for all features : there are no significant differences in mineralogical composition between recrystallized and normal gneisses; there is no trace of foreign minerals (such as microcline) in the quartzofeldspathic layers; the strictly conformable character of the recrystallization and its confinement to certain layers show that its development is, partly, a function of the original composition of the rocks subjected to metamorphism.

Extraction of a granitic phase from suitable metasediments is a rather old concept. HOLMQUIST was the first to observe, in 1920, that quartz and feldspar are the first to melt during metamorphism. Separation of an ichor (general granitic emanation) from deepseated rocks has been postulated by SEDERHOLM (1926). Using this same concept, ESKOLA (1932, 1933) defined partial anatexis as the selective fusion bringing about the formation of granitic magma which may eventually be squeezed out into higher levels of the crust.

Recent works (von PLATEN, 1965; BOWES and PARK, 1966) have shown that, under a metamorphism of the grade of the amphibolite facies, quartz and acid plagioclase are the most soluble phases.

Exudation and redeposition in bodies of the quartzo-plagioclasic phase in the rocks of the southern area may be explained by several processes which could, possibly, have acted together : selective fusion of quartz and plagioclase and recrystallization in suitable parts of the rock; differentiation due to heterogeneous pressure; differentiation by differences in interfacial tension.

It is known (von PLATEN, op.cit.) that quartz and acid plagioclase are soluble under the conditions of this metamorphism. This dissolved quartzo-feldspathic phase will be reprecipitated in suitable parts of the rock, with other crystals of quartz and plagioclase acting as foci. Augen will begin to form. As a function of their original composition, certain rocks will undergo recrystallization faster than others. The role played by nucleation has been emphasised by LAFFITE (1957); according to this author, slight original differences in composition in adjacent horizons will influence the kinetics of nucleation and recrystallization. For instance, the presence of a few porphyroblasts of feldspar in a suitable layer may initiate the migration of feldspathic material from the immediate surroundings into this layer. Eventually, it may be transformed into an exclusively feldspathic one. Applied to the rocks under discussion, this process could explain the concentration and accretion of quartz and plagioclase in some layers and, eventually, the formation of pegmatite bodies, such as that in Photo 17, Plate IX.

Differentiation can also be caused by the existence of a pressure gradient (RAMBERG, 1952) : the most diffusive constituents (here, plagioclase and quartz) have a tendency to migrate towards low-pressure areas and to reprecipitate there.

RAMBERG (op.cit.) has also shown that clustering of minerals such as quartz and feldspar could lead to a decrease of the total free energy of a mass of rock.

Hence, it is very likely that quartz and plagioclase were mobilised in the rocks of the southern area by selective melting; recrystallization and redeposition of these minerals were controlled, in function of the predominating factors, by one or several of the above-mentioned processes.

To conclude, it appears necessary to the author to recall NIGGLI's (1942) statement to the effect that enrichment in feldspar does not mean feldspathization and the bulk of the rock may remain unaffected. This is in accordance with the writer's observations and conclusions.

E.- DEFORMATION

Photo 17, Plate IX, shows a conformable vein of pegmatite affected by pinch-and-swell structure; it occurs in an alternation of quartzo-feldspathic and biotite gneiss. This emphasises the competent character of pegmatite relative to gneiss. According to experiments by RAMBERG (1955, 1959), a conformable and competent layer occuring in more plastic rock, if submitted to a pressure perpendicular to the layering, will develop pinch-and-swell structure as the result of extensive plastic flow in the incompetent rock. Here, the pegmatite responds to the frictional drag of the more plastic gneiss by stretching and tending to break down into lenses while the gneiss yields plastically.

F.- CONCLUSIONS

Gneisses of appropriate composition in the southern belt have been submitted to the initial processes of ultrametamorphism resulting in the separation of a quartzo-plagioclasic phase. This aggregated into augen, diffuse pegmatitic accretions and finally pegmatitic bodies immediate surroundings into this layer. Eventually, it may be transformed into an exclusively feldspathic one. Applied to the rocks under discussion, this process could explain the concentration and accretion of quartz and plagioclase in some layers and, eventually, the formation of pegmatite bodies, such as that in Photo 17, Plate IX.

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Gneisses of appropriate composition in the southern belt have been submitted to the initial processes of ultrametamorphism resulting in the separation of a quartzo-plagioclasic phase. This aggregated into augen, diffuse pegmatitic accretions and finally pegmatitic bodies conformable to the layering.

The writer believes this to be a case of partial anatexis without extensive spatial separation of the granitic phase from its parent rocks.

V.- METASOMATISM IN THE METASEDIMENTARY ROCKS

A.- INTRODUCTION

Segregation, without introduction of extraneous material, of a pegmatitic phase from the rocks of the southern belt by in situ generation and redistribution of quartz and plagioclase has been described. Another fundamentally different pegmatitic phase will next be dealt with. It is distinguished from the former by its pink colour and by its mode of occurrence; it will be shown to involve metasomatic processes.

B.- OCCURRENCE

This pegmatitisation is roughly concentrated in a belt, up to 1/2 mile in width, parallel to the regional strike of the metasedimentary rocks (see geological map, Plate XXXIV) and confined to the northern and central parts of the southern belt.

C.- STRUCTURE

The typical aspect of this feldspathisation is shown in Photos 21 and 22, Plate XI. In its most intense manifestations quartzofeldspathic and biotite gneisses loose the layering or foliation possessed by them previously. In its initial phases nebulous aggregates or streaks of pegmatitic material give the rock - to use a term of DE SITTER (1960) - the aspect of "stirred porridge". Rocks subjected by this thorough soaking are very often affected by rock flowage (Photo 21, Plate XI); non feldspathised rocks occuring only a few yards away show no trace of this feature.

Though feldspathisation may produce bodies oriented obliquely to the layering, mostly it takes place parallel to the latter. Replacement may be extensive and some outcrops are seen to consist entirely of pegmatitic material (Photo 24, Plate XII) or including only a few schlieren of biotite (Photo 25, Plate XIII), residues of the regional rock, or rounded relicts of gneiss undergoing dissolution and corrosion by the pegmatitic material (Photo 26, Plate XIII).

Close field examination shows these aggregates, clusters or streaks of pink quartzofeldspathic material to be always related to massive dykes of pink pegmatite. The latter may be oblique or parallel to the layering, with offshoot veins or veinlets or vague streaks of pegmatite in the surrounding gneiss (Photo 29, Plate XV). In any sufficiently large outcrop, the pink pegmatitic veins or clusters can be traced to a pink "mother-dyke" of pegmatite. Injections of veins into the gneiss from the dyke may take place in a very fine, minute way (Photo 30, Plate XV); veins sent into the gneiss perpendicularly to its layering often show ptygmatic folding (Photo 27, Plate XIV).

In contrast with these dykes impregnating the regional rock thoroughly, other, less common dykes of pink pegmatite, up to 10 yards thick, cut cleanly across the gneiss without offshoots and with no visible sign of modification at the contacts. They are clearly of a later age.

D.- PETROGRAPHY

(a).- Feldspathised regional rocks

This refers to all the rocks in which new feldspathic material is so thoroughly mixed with the gneiss, that no clear differentiation is possible between feldspathised gneiss and actual pegmatite.

Under the microscope, all minerals appear to be completely mixed. The mineralogical composition of 6 samples is given in table VIII.

TABLE VIII

	1	2	3	4	5	6
Plagioclase	50.2	38.1	64.1	30.7	44.7	52.3
Microcline	0.8	13.6	8.0	23.6	4.8	1.2
Biotite	14.9	7.2	1.0	11.0	6.8	18.7
Quartz	34.1	41.1	26.9	34.7	43.7	27.8
	100.0	100.0	100.0	100.0	100.0	100.0

The plagioclase is 2 or 3 mm. in diameter and amoeboid (porphyroblasts may reach several cm.); it is albite-twinned and more or less sericitised. Its composition varies between oligoclase An_{29} to An_{20}. It is corroded by microcline and often separated from this mineral by an albitic rim showing myrmekite intergrowths. Microcline is mainly interstitial, but occasional porphyroblasts may reach 1 or 2 cms. It is often perthitic. Biotite is 1 to 3 mm. long and is concentrated in layers; it is partially altered to sphene, chlorite and ore. Quartz grains are 4 to 5 mm. in diameter. Susidiary rutile, sphene, epidote and ore occur in the groundmass.

Two feldspathised amphibolites have the following mineralogical composition (table IX) :

TABLE IX

	1	2
Plagioclase	46.8	50.2
Microcline	5.2	2.3
Hornblende	17.8	13.0
Biotite	18.5	23.7
Quartz	11.7	10.8
	100.0	100.0

Plagioclase, microcline and quartz often occur in layers or streaks. The composition of plagioclase is andesine ~~31~~An_{31} to oligoclase ~~25~~An_{25}; it is often corroded by microcline. In cafemic layers, no microcline can be seen but hornblende is extensively replaced by biotite associated with epidote.

(b).- Veinlets, dikelets and patches of pegmatite

Most of these bodies are too small for modal analysis. Plagioclase, microcline and quartz are the main minerals with subsidiary biotite, muscovite, epidote, sphene and ore. The grain-size of the main minerals is about 1 to 2 cm. The plagioclase is albite-twinned and partly corroded by microcline which is mostly interstitial. The plagioclase is about oligoclase 20An in composition and is usually rather heavily sericitised.

When the vein has a clear-cut contact, the only transformation visible in the gneiss around the vein is heavy sericitisation of the plagioclase. When the boundary between the two rock types is less sharp and when there is a tendency for gradation, sericitisation also occurs; but this is coupled with introduction of microcline into the biotite or quartzofeldspathic gneiss. This microcline corrodes the plagioclase in the host-rock; at the contact between the two minerals an albitic rim with myrmekitic intergrowths is common. A few grains of microcline may reach several centimeters.

When these veinlets cut across amphibolites, the hornblende of these rocks is completely or partially altered to biotite over several cms. away from the veinlet, while the plagioclase is heavily sericitised. Little microcline has been introduced into the amphibolite rock. This difference in behaviour of amphibolite relative to gneiss will be enlarged upon in the petrogenetic considerations.

(c).- Red pegmatite

No fundamental differences have been observed between the thick dykes, cutting straight across the regional rocks and sending no offshoots into them and the thinner pegmatite veins and veinlets which have resulted in intense feldspathisation. Thus, both types will be described together.

On account of the very large grain-size (several cms.), the results of modal analyses differ widely. Averages of 6 analyses carried out on thick dykes (1) and feldspathising veins (2) are given in table X.

TABLE X

	1	2
Plagioclase	28.3	34.2
Microcline	23.3	22.7
Biotite	2.7	1.0
Quartz	45.7	42.1
	100.0	100.0

There is very little difference. Most plagioclases are sericitised. They are oligoclase and their composition varies between An_{26} and An_{16}. ~~26 to 16An.~~ They are albite-twinned and most, as well as microcline and quartz, have undergone a certain degree of granulation. Microcline is interstitial and corrodes the plagioclase. Quartz tends to crystallise in strained elongate crystals. Biotite is concentrated in sheared layers. It is partially altered into chlorite, sphene and muscovite. Subsidiary minerals are sphene, epidote, tourmaline, muscovite and ore.

E.- PETROGENETIC CONSIDERATIONS

(a).- Structure

The implications of the above-mentioned facts are clear : the regional rocks have been suffused in certain regions by pegmatitic material from outside sources. This is characterised in the field by the presence of pink streaks or veins rich in microcline.

Several stages can be distinguished in this impregnation, which has been demonstrated to be related to dykes of pink pegmatite. In the first stage, numerous small dykes of pegmatite have been emplaced on a regional scale sending offshoots and/or diffusing pegmatitic material into the injected rocks.

In the neighbourhood of these injections, the country rock is thoroughly soaked; but complete granitization of any significant volume can only be seen in a few outcrops.

In a later stage, clean cutting thicker dykes of pink pegmatite were emplaced in regional rocks already cold and unreactive.

It is clear that the initial phase took place at depth : intimate impregnation and diffusion of pegmatitic material from dykes could never have occurred in cold, unreactive regional rocks. The thick dykes of pink pegmatitite, which cut cleanly across the gneisses, have produced no effect on them probably because they were emplaced when these rocks were cooler and capable of fracturing.

It can be demonstrated that the pegmatitic material was emplaced as a fluid : rock flowage is always associated with pegmatitic soaking and is never seen to such an extent in gneisses not affected by red pegmatites. In 1960, DE SITTER and ZWART pointed out that an increase in water content of metamorphites can reduce the yield value of these rocks, causing the transition from elastico-viscous to flow folding to occur. This transition was caused here by the entry of pegmatitic material as fluids.

The supply of pegmatitic material was limited; though complete replacement has occured in some small areas, the bulk of the regional rocks in the area specified has remained relatively unaffected by this granitization.

(b).- Metasomatism

Pure physical injection of pegmatite, as has been shown, is not the only phenomenon. It has been accompanied by the introduction of foreign materials into the regional rocks and by processes of reaction. The pegmatitic fluids were rich in potash. The action of these on the quartzofeldspathic and biotite gneisses led to the replacement of plagioclase by microcline. In amphibolites, potash-bearing solutions reacted preferentially with hornblende which was altered to biotite. Intense sericitisation of plagioclase in the gneiss in the vicinity of pegmatites is further proof of the presence of potash-bearing solutions.

There is here a close parallel with the action of magmatic solutions in the northern "granitic" massif. Since this is still to be described (chapter IV), suffice it to say here that the acid magma of the northern massif reacted with its amphibolitic wall-rocks to form biotite from hornblende, little microcline being evolved. In more central portions of the "granitic" massif, potash-bearing solutions, in the absence of hornblende, reacted with plagioclase to form microcline.

Hence, the metamorphic action of potash-bearing solutions has been strikingly similar in the case of the northern "granitic" massif and of the injection of acid material in the southern metasedimentary rocks: biotite formed from hornblende when it was present (with deficit in microcline) or the action of potash-bearing solutions transformed plagioclase into microcline in the absence of hornblende.

F.- CONCLUSIONS

The southern metasedimentary rocks have undergone potash metasomatism in a belt situated more or less centrally in the region of their occurence and parallel to the strike. This took the form of the emplacement of pegmatites which acted as channelways for the permeation of the regional rocks by granitizing fluids. In the presence of amphibolites, potash formed biotite from the existing hornblende, while the action of the fluids formed, in the case of the gneisses, microcline from plagioclase.

VI.- INTRUSIVE ROCKS OTHER THAN PEGMATITES

These are relatively rare and comprise both acid and basic intrusions.

A.- ACID INTRUSIONS

In the south of the area, a few dykes of adamellitic granite crop out. They have the following mineralogical composition (table XI) :

T A B L E XI

Plagioclase	3I.8
Microcline	35.3
Quartz	3I.2
Biotite	I.7
	I00.0

The average grain-size is about 2 to 3 mm. The plagioclase is Carlsbad-twinned albite of composition An_{10}. Potash feldspar is interstitial and is microcline. Quartz is also interstitial. Subsidiary biotite is partly altered to chlorite and sphene.

B.- BASIC INTRUSIONS

These occur only in the south of the area and are very few. They have been emplaced in dilatation fractures of the regional rocks (Photo 20, Plate X). They are amphibolites with hornblende and amoeboid plagioclase as main minerals and with subsidiary quartz, biotite and ore.

In a few instances, the dykes show an agmatite aspect : they are brecciated and the fragments are cemented by lighter quartzofeldspathic material (Photo 31, Plate XVI). Under the microscope, the cement is seen to be composed of plagioclase (andesine An_{32} to oligoclase An_{28}) and quartz; hornblende is nearly absent. The fragments are made of normal amphibolite. The writer explains this aspect by selective fusion of quartz and plagioclase in the fragments of amphibolite and migration into zones of minimum stress (fractures) (RAMBERG, 1952). The brecciation of the amphibolite itself was brought about by differences in mechanical properties between the dyke of rigid unyielding rock, oblique to the layering, and the regional plastic gneisses. This was followed by minor recrystallisation in the fractures.

Two other occurrences of basic rocks must be noted in a western tributary of the Hlimbitwa river. These have been identified as post-Karroo tholeitic basalt made of labradorite, clinopyroxene, glass and subsidiary ore.

VII.- CONCLUSIONS

The bulk of the southern metasedimentary rocks consists of a rather monotonous series of quartzofeldspathic and biotite gneisses and some amphibolites. These rocks dip vertically though the structure is somewhat complicated by secondary folds. Boudinage is common in amphibolite layers.

Recrystallisation "sensu largo" has taken two aspects here :

(i).- Selective melting of quartz and plagioclase in gneisses has led to redistribution and aggregation of these minerals in conformable streaks and, eventually, into conformable exsudation pegmatites. This phase is characterised by a white colour.

(ii).- Pink pegmatite veins and dykes have been emplaced oblique to the layering of the gneisses and have sent numerous offshoots of pegmatitic material into the gneisses. Locally, rock flowage has been brought about by the introduction of these pegmatitic fluids.

Thorough impregnation of the rocks by potash solutions brought about the formation of biotite in amphibolites and microcline in gneisses.

It is remarkable that in one and same area two types of "feldspathisation" are illustrated: the first resulting from simple redistribution of pre-existing salic minerals, while the second involved the introdution of material from outside sources.

To the writer, the close parallel between the type of reaction of the introduced pegmatitic material with the gneisses and that of the northern "granitic" massif with its amphibolitic wall-rocks is rather striking; in both cases, reaction of the fluid with hornblende produced biotite and the production of microcline from plagioclase is identical. This does not mean that the pegmatitic fluids are offshoots from this "granitic" massif (this is very unlikely if one considers that the central belt along the Lilani valley in between these two regions shows no trace of feldspathization due to pink pegmatite).

The conclusion is rather that both rock-types have been emplaced in their wall-rocks under similar geochemical conditions, i.e. in the same PT conditions. Fluids from rock types not dissimilar in composition reacted in the same way with the same regional rocks or the same minerals (hornblende or plagioclase). Thus, it is proven that both the northern "granitic" massif and the southern metasedimentary rocks have reached-at least, at some stage of their evolution-the same geochemical conditions. Also, it is not entirely impossible that the "granitic" rocks and the pegmatites have the same source at deeper levels.