ROCKS
OF
CAPE COLVILLE PENINSULA, N.Z.
BY
PROF. SOLLAS, F.R.S.
WITH
INTRODUCTION & DESCRIPTIVE NOTES
BY
ALEXANDER McKAY, F.G.S.

VOL. I.

THE ROCKS OF CAPE COLVILLE PENINSULA,

AUCKLAND, NEW ZEALAND.

BY

PROFESSOR SOLLAS, F.R.S.;

WITH AN

INTRODUCTION AND DESCRIPTIVE NOTES

BY

ALEXANDER McKAY, F.G.S.,

Government Geologist, N.Z.

VOL. I.

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Alexander McKay, F.G.S., Government Geologist, to the Under-Secretary for Mines, New Zealand.

Wellington, 25th November, 1903.

Sir,—

I have the honour to submit a short account of the geology of that part of the Hauraki Mining District lying within the limits of Cape Colville Peninsula, which is intended to introduce and furnish additional information to a description of the rocks of the district by Professor Sollas, which constitutes the more important part of this work.

A. McKay, F.G.S.,
Government Geologist.

The Under-Secretary for Mines,
Wellington.

PREFACE.

In the following work that part which is from the pen of Mr. McKay is introductory to or explanatory of the locality and geological position of the rocks described by Professor Sollas, and the whole relates to the Hauraki goldfields of the Auckland Provincial District, and mainly to Cape Colville Peninsula.

The descriptions by Professor Sollas, with accompanying notes, constitute the report on the rocks submitted to him by the New Zealand Government, and the greater part of the information added was supplied with the specimens sent to England. As, however, the report deals with the specimens by number only, the portion contributed by Professor Sollas would not of itself have effected the object for which the collections were made, hence the need of an introduction and the information which follows the descriptions in each case.

It is hoped that the work will facilitate the further study of the rocks in the district to which the descriptions refer, and advance the interests of mining on the Hauraki goldfields of the Auckland Provincial District.

Jas. McGowan,
Minister of Mines.

Wellington, N.Z.,
May 2nd, 1905.

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JAS. McGOWAN,
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ROCKS OF CAPE COLVILLE PENINSULA.

VOL. I.

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THE

ROCKS OF CAPE COLVILLE PENINSULA.

INTRODUCTION.

The discoveries at different times of gold in California, New South Wales, and Victoria were events of much consequence, conducing as they did to the rapid progress of settlement and the greatly increased prosperity of these countries. When, therefore, a like discovery was made in New Zealand the estimated importance of this was not lessened by the fact that very rich finds had recently been made in a neighbouring colony, finds so fabulously rich as to, at the time, fix the attention of the world, and in 1852 the people of Auckland had every right to suppose that at Coromandel the glories of Bendigo and Ballarat would be rivalled if not eclipsed. Gold had been found, and consequent on this there had been excitement and a rush had taken place; but the gold occurred in the alluvial deposits of small rivers draining into Coromandel Harbour, and these, limited in extent, were soon worked out, and, no fresh finds being made, the yield, never great, rapidly declined, and by 1858 had ceased altogether.

During the year mentioned Dr. Ferdinand Hochstetter, of the "Novara" Expedition, visited Coromandel and washed, or saw washed, from the bed of Driving Creek some small amount of gold on the primary source of which he speculated, and came to the conclusion that it had been set free from reefs of quartz in the rocks of the main range adjacent to Coromandel. Hochstetter's opinion as to the source of the gold stimulated prospecting in the direction indicated, and within the next few years the Kapanga and other mines on quartz lodes had been established, and were being worked with payable results. After a time this form of mining languished also, and it seemed as though those engaged in this industry on Cape Colville Peninsula were doomed to disappointment.

Once again, in 1866, fresh and more important discoveries were made, this time some thirty miles further to the south, between Tararu Creek and the Kauaeranga River, on the shore of the Firth of Thames. The original find at the Thames and those by which this was immediately followed were of a character leading to the conclusion that a great and permanent goldfield had been discovered. Such a conclusion, as the event proved, was well founded, and for a considerable time the Thames continued to absorb profitably all the capital and labour that availed for its development.

The discoveries at the Thames again stimulated prospecting at Coromandel, and the opening-up of reefs on Tokatea Hill was the result.

The Thames proved a rich but a limited field, the bulk of the payable reefs being confined within an area little more than a mile square, and prospecting in the adjacent districts, though resulting in the discovery of gold at Tapu Creek, was generally far from encouraging.

South of the Thames the Natives were obstructive, and it was thought their attitude retarded successful prospecting. When at length the southern goldfields of the upper Thames were thrown open prospectors rapidly determined the different auriferous areas at Karangahake, Te Aroha, Waitekauri, and Waihi, and then for a considerable interval no further discoveries were made, and large areas up till the present time have proved wholly without gold.

The Thames Goldfield maintained for more than twenty years the credit of being a rich and highly profitable field, but finally the cost of production became greater and the yield declined. The southern goldfields of the Ohinemuri district were also but slowly developed, and the rich returns of the present time were only faintly indicated during the decade between 1880 and 1890.

Further prospecting and in localities yet more removed from the old centres of mining was resorted to as a hopeful means of supplementing the reduced output of gold, and, as there was then no actual bar to the prospecting of any part of the peninsula, there can be little doubt that between 1885 and 1895 all likely places had been examined for outcropping reefs and indications at the surface which might warrant a test being made. It was during this period that a new field was discovered at Kuaotunu; but here, again, payable gold was confined to but a few reefs and within a limited area, and subsequent prospecting has failed to extend the limits of the field.

On the whole, the results of prospecting during the period mentioned were unsatisfactory and disappointing, but in extenuation of comparative failure it was claimed that there yet remained barriers to the free entry and prospecting of all parts of the peninsula. There was, however, the general opinion that most parts had been fairly examined as regarded mere surface indications; but as there was urgency that prospecting should be carried to a successful issue further and more exhaustive prospecting was encouraged, and in 1895 was greatly stimulated by discoveries made during that year.

Deep sinking and prospecting for fresh shoots of gold at lower levels in what had once been productive mines was now advocated, without at the same time losing sight of the possibility of discoveries in new ground being made, and vigorous and systematic prospecting on both lines was recognised as essential to maintain mining as it then stood. To this end outside capital was invited to supply in part the means, and anticipations of success were con-

COROMANDEL TOWNSHIP FROM PREECE'S POINT.

MILL CREEK, SOUTH SIDE OF COROMANDEL HARBOUR.

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fidently indulged in. What conspired to strengthen and confirm the hopes entertained was the discovery of a very rich auriferous lode in the Hauraki Mine at Coromandel, the first important returns from which settled the question, and thereupon followed a period of "boom" in mining which lasted for the next three years, during which time the prospector was at work everywhere, even to the most inaccessible parts of the peninsula. Claims were taken up in all directions, many new properties were placed upon the market, there was vigorous prospecting in new ground and to lower levels in the old established mines, and there was everywhere evidence of a determination to force to a successful issue what the entire community approved and had undertaken. But all this ended, and when the results were tallied and gauged they were found to be not wholly satisfactory. A few, but very few, paying mines were added to the list, and one or two of which there is yet uncertainty.

As an offset to the above somewhat pessimistic account of the progress of discovery on Cape Colville Peninsula and the development of the Hauraki goldfields it is but right to state that since the first finding of gold at the Thames in 1866 till the present date—1903—some 11,500,000 pounds' worth of bullion, or alloy of gold and silver, has been raised, the greater portion of which has come from the Thames Goldfield. The goldfields of the upper Thames, in the southern part of the peninsula district, are at present the principal producers, and since 1893 the famous Martha Lode and other lodes of the Waihi Mine have yielded values to the amount of £3,056,000.

On the discovery of gold at the Thames many who were not miners in any sense of the term had to engage in the active work of mining or necessarily abandon their holdings; but as usually an experienced miner formed one of the party, or the service of such might be engaged, under such conditions mining was carried on till definite registered companies directed by an experienced manager were formed. All in this manner became miners, some having experience of mining elsewhere, others experienced only on the field in which they were engaged. To all alike there was a necessity to speak of and distinguish between the lode-stuff and the rock within which this was enclosed, and as no one had before mined for gold in rocks of the same class there was a consequent difficulty in determining their nature and the names which should apply. To this the miner addressed himself without the aid of scientific advice, and where the rocks were moderately soft and friable they were called "sandstone," where in a less-decomposed state they were called "bluestone" or "hard bars"; and there was a variety of terms common to most metal-miners, as "pug," "mullock-bands," and the like.

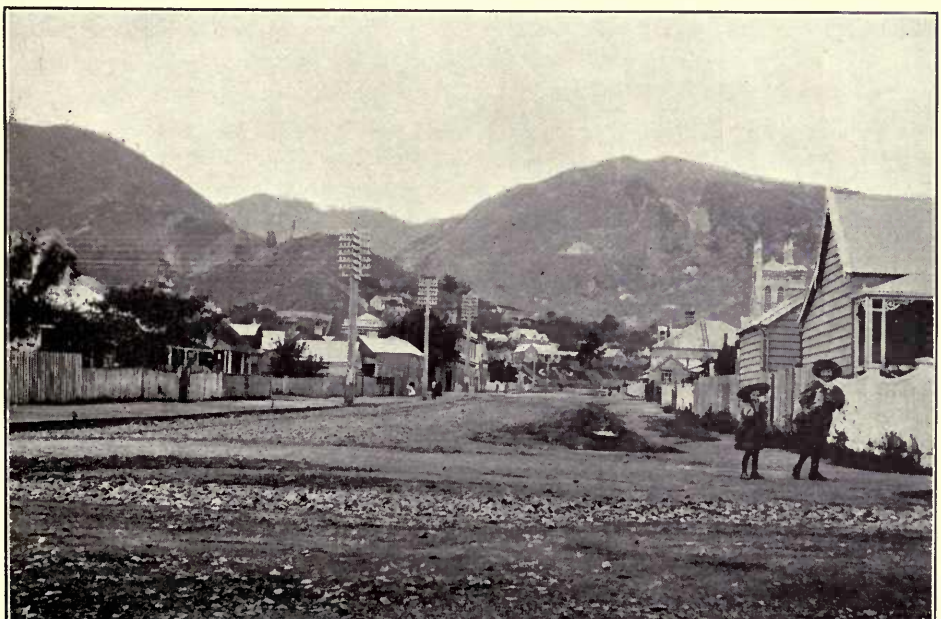
After the miner came the geologist, but the names which he applied to the rocks were unfamiliar, and sounded strange in the ears of those unaccustomed to them, and at most the more accurate terms were but slowly adopted; or, rather, for a time they were totally disregarded and the miner further developed his own nomenclature as suited his taste and requirements. He further distinguished as "kindly" or "barren" the nature of the country, and more specifically spoke of "flatheads," "flinties," and the like, and at this time was happily innocent of diorite, propylite, and other names terminating in "ite"; but, nevertheless, he won more gold under the old and vulgar names than he has done since the adoption of a classical and systematic nomenclature. However, the world beyond the Thames, and more especially the world of science, had to be informed according to system and a recognised method of dealing with such subjects.

In 1866 the New Zealand Geological Survey had been established under the directorship of Dr. (now Sir James) Hector, on behalf of which Captain F. W. Hutton reported on the discoveries at the Thames. Captain Hutton determined the rocks at the Thames as volcanic material of Miocene or Middle Tertiary date, while Sir James Hector considered similar rocks at Coromandel as of greater age. Both, however, agreed that the gold occurred in connection with igneous volcanic rocks, a conclusion which has not since been disputed, and thus the true source of the gold at the Thames and west of the main range at Coromandel was determined. But, while broadly it was agreed that the gold had its origin in igneous rocks which in part at least were acknowledged to be of a volcanic character, not at that time nor up till the present has there been agreement among geologists as to the precise nature of the rocks carrying the auriferous reefs, either as regards their mode of occurrence, their exact constitution, or the nomenclature that should be applied to them; and as the number of workers increased so also the diversity of opinion became greater.

During the earlier years of mining on the Hauraki goldfields modern methods of rock-determination by means of the microscope were unknown, and in the naming and classification of the rocks chemical analysis for the most part had to be depended upon. Not infrequently simple identification in the field was relied on, and as a consequence a profusion of names led to no better result than uncertainty as to which should be considered correct. As time went on, and with the advance of petrography and its better methods of investigation, the atmosphere cleared somewhat, and the determinations by Hutton and Ulrich pointed distinctly to the advent of a better state of things. But the labours of these two eminent investigators were chiefly confined to a study of the rocks of the western side of the peninsular part of the Hauraki Mining District, and, valuable though the results obtained were, they have not till now secured universal acceptance.

Prior to 1893, but principally during the last decade, most of the altered and decomposed rocks of the goldfields, whether in the northern or the southern parts of the peninsula, came to be designated and spoken of as "propylite," and the harder and less-decomposed rocks had also come, in a general way, to

WEST SLOPE OF UNA HILL AND LOWER GROUNDS TO KAUAERANGA RIVER.



UNA HILL AND VALLEY OF KARAKA CREEK, THAMES.

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be called "diorite," and, though some may have doubted their correctness, the greater part of those engaged in mining appreciated and applied these two terms to the greater bulk and variety of rocks with which their work made them acquainted. The application of the term "propylite" to the altered andesites of the Thames Goldfield and other parts of the peninsula is advocated by both Professor Hutton and Professor Park, even though they admit it a term of convenience only; and as various rocks may be altered to a condition not to be distinguished from miners' sandstone, or propylite, while propylite itself had strictly to be considered an altered hornblende andesite, or an andesite "in which the bisilicates have been altered into hydrated magnesian unisilicates," there could not be other than difficulty in connection with the naming of the rocks. Thus, when in 1897 there was occasion to report on the geology of the peninsula, in this respect there was difficulty, and it was resolved to avoid, as far as possible, the introduction of new names till the nomenclature of the rocks had been determined by an authority whose conclusions would be respected. During 1896–97 a large collection of rock-specimens had been made, and the further collecting of rocks was specially a work of the following year, at the close of which there had been accumulated fully three thousand specimens, obtained from all parts of Cape Colville Peninsula and the Hauraki goldfields.

The result showed yet more decidedly than at the close of the previous year that in more than one locality, as regarded the nature of the rocks, my opinion would differ from those of previous observers, and as there was little likelihood of making converts to the new opinion it seemed the proper thing to place the issue where neither bias nor mistaken judgment would affect the decision. It was accordingly proposed that a selection of the rocks of Cape Colville Peninsula should be submitted, for naming and description, to a petrologist in Europe or America, and those to whom the recommendation was made took action and secured the services of Professor W. J. Sollas, Oxford, England, who undertook the work of naming and describing the selection, and also supplying a slice of each rock-specimen prepared for microscopic examination.

Since July, 1900, up till February, 1903, Professor Sollas has been engaged in the study of the rocks forwarded to him, and on the 20th June, 1902, he supplied through the Agent-General a report on the first consignment of 204 specimens. The descriptions principally constituting the report were accompanied by Notes in which the author discussed various questions arising out of or consequent on a study of this first consignment of the rocks of Cape Colville Peninsula; so also of a like number of specimens constituting the second consignment, the report on which was forwarded to the Agent-General on the 31st July, 1902.

These two consignments embraced 405 specimens of the rocks of Cape Colville Peninsula and 3 from other districts. Subsequently a third consignment, of 92 specimens, was sent, none of which were from within the limits of the Hauraki goldfields. On this consignment a third and final report has been received (embracing descriptions only), and with these results it is now possible to write definitely on the subject of what the igneous rocks of Cape Colville Peninsula are, and what they should be called.

On the arrival of the reports on the first and second consignments they were carefully copied and placed in the hands of the printer, so that as soon as possible a batch of proofs might be despatched to the author for correction and revision. Owing to the limited amount of type that could be kept standing only what was from the pen of Professor Sollas was set up, it being intended on return of the proofs to add to the descriptions information as to the locality and formation to which the specimens were referable. However, as it now appears that more than three years must elapse before the work can be published, and as further delays are not improbable, it has been decided to publish the introductory report without submitting the proofs to Professor Sollas.

Cape Colville Peninsula is formed chiefly of volcanic rocks, which in the south reach far below the datum of sea-level, so that the underlying fundamental rock can nowhere be seen ; but north of the Thames, on the west side of the peninsula, slates and sandstones of Palæozoic age crop out along the shore of the Hauraki Gulf, and on these the volcanic rocks are seen to rest. Farther to the north the sedimentary rocks rise to greater elevations, and north of Coromandel reach to the crest of the main divide between the east and west sides of the peninsula.

The Tertiary volcanic rocks are semibasic and acidic in character, ultrabasic rocks being absent. The intermediate rocks consist mainly of andesites, but dacites are also strongly represented, and it is in these rocks, solid or fragmental, that most of the gold-mines have been worked. There is, however, in the Coromandel district an older series of volcanic rocks interbedded with Palæozoic sediments of Upper Devonian age, which, penetrated by numerous dykes of dacite porphyrite, are also gold-bearing. These rocks have until recently been confounded with the Tertiary volcanic series, for, although peculiarities in connection with them were noted by Cox in 1882, it was not till 1896 or later that their true position was made clear.

The earlier reports on the geology of the different goldfields made no distinction between these groups of igneous or volcanic rocks, and scarcely distinguished between the upper and lower parts of the Tertiary series. Hochstetter designated the rocks on and near the shores of Coromandel Harbour "trachyte tuff," and subsequent reports speak freely of rocks of this class as present where now it would appear only andesitic rocks can be found.

Between 1858 and 1900 some sixty Reports, Papers, and Notes on the geology of the Hauraki goldfields and Cape Colville Peninsula have appeared in a variety of publications, many of which are inaccessible to the author of this report; but, fortunately, the "Transactions of the New Zealand Institute," Vol. xxxv., for 1902 contains an exhaustive list of papers on the Geology of New Zealand by A. Hamilton, Director of the New Zealand Museum, and from that I have compiled a list of authors, books, and papers that deal with or make reference to the geology of Cape Colville Peninsula. In this list I have made one or two corrections and one or two additions to bring the work to date.

In the following list "Trans." means the "Transactions of the New Zealand Institute," "VI." means "Vol. VI.," and "847" means "p. 847."

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The principal object of this report being to put on a correct footing the naming of the rocks of the Hauraki goldfields, which up till the present time has been neither complete nor entirely satisfactory, as showing the requirements of the case, from such of the papers of the above list as are available the following list of rocks mentioned as occurring in one or other parts of Cape Colville Peninsula has been taken:—

List of Rocks of Cape Colville Peninsula identified between 1854 and 1885.

(Determinations by Physical Characteristics or by Chemical Analysis.)

Granite,
Clay-slate,
Trachyte tuff,
Trachyte conglomerate,
Porphyry,
Aphanite slates,
Quartzose gravels,
Greywacke,
Trachyte breccia,
Trachyte (Dykes of),
Trachyte tufa
Diorite (Dykes of)
Felsite tufa,
Felstone,
Trap (Dykes of),
Sub-metamorphic slates,
Blue and reddish-yellow banded slates,
Trachyte breccia agglomerate,
Dolerite,
Trachy-dolerite,
Obsidian,
Granular tufa,
Green felspar porphyry,
Pink felspar porphyry,
Purple felspar porphyry,
Hornblende porphyry,
Dolerite (Dykes of),
Greenstone (Dykes of),
Melaphyre,
Timazite,
Greenstone breccia,
Diorite sandstone,
Tufa (Dykes of),
Porphyritic sandstone,
Calcareous chlorite sandstone,
Chloritic gneiss,
Pyriteous quartz sandstone,
Tufa mudstone,
Metamorphosed tufa,
Trachyte,
Trachyte porphyry,
Tufaceous porphyry,
Claystone porphyry,
Porphyritic tufa,
Sandstone,
Tufaceous sandstone,
Decomposing sandstone,
Metamorphosed beds of green decomposing sandstone,
Felspathic slate,
Tufaceous porphyritic sandstone,
Indurated sandstone,
Siliceous slate,
Indurated claystone,
Argillaceous slate,
Porphyritic breccia,
Volcanic agglomerate,
Trachyte agglomerate,
Greenstone tufa,
Doleritic basalt,
Trap basalt,
Diorite tufa,
Greenstone porphyry,
Quartz trachytes,
Rhyolite,
Scoriæ,
Basalt,
Vesicular dolerite,
Tufanite,
Propylite,
Andesite,
Diorite,
Greenstone trachyte,
Diabase,
Tufaceous breccia,
Indurated mudstone,
Pyritous felsite,
Calcareous slates,
Compact felsite,
Diorite porphyry,
Trachydolerite breccia,
Anamesite (Dykes of),
Pumice,
Porphyritic felsite,
Felspathic porphyry.

Names applied to the same Rocks since the Adoption of Slicing and Microscopic Examination as a Means towards the Classification of Rocks.

[The names marked with inverted commas are miners' terms.]

Felsite tuff,
Clastic felsite,
Blue sandy slate,
Andesite,
Propylite,
Rhyolite,
Hornblende dacite,
Enstatic dacite,
Hornblende andesite,
Augite andesite,
Chloritic augite andesite,
Slaty shale,
Siliceous mudstones,
Volcanic breccia,
Volcanic tuff,
Felspar rock,
Green tufaceous sandstone,
Sandstone,
Decomposed sandstone,
Trachyte,
Tufaceous clay,
Ash,
Agglomerate,
Basic andesite,
Greywacke,
"Gold-bearing andesite,"
Andesic tuff,
"Kindly sandstone,"
Rhyolitic lava,
Rhyolitic tuff,
Andesite (Dykes of),
Hypersthene augite andesite,
Shelly limestone,
Marly sandstone,
(Black) sandy shales,
Conglomerate,
Dacite,
Chloritic rock,

"(Miners') sandstone,"	Decomposed andesite,	Slaty brecciated tuff,
Mottled breccia,	Marly greensands,	Green and purple breccias,
Hypersthene andesite,	Pumiceous rhyolite,	Variegated sandstones,
Gold-bearing propylite,	Pitchstone,	Variegated clays,
Siliceous breccias,	Quartzose rhyolite,	Compact propylite,
Banded sinter,	Felspathic sandstone,	Siliceous sinter.
Sandstone conglomerate,	Yellowish-grey mudstone,	

The above list is sufficient to show the need there was to correct and place on a satisfactory footing the nomenclature of the rocks of the district.

At the close of the second year's work, and when between three and four thousand specimens had been collected, after eliminating duplicates, quartz, siliceous sinters, &c., of what remained 406 examples of the more important and characteristic rocks were selected and in due course forwarded to England for examination and description. The rocks were not all forwarded at the same time, and, consequently, have been examined and reported on—those relating to Cape Colville Peninsula—as two separate consignments; and a third consignment, 92 in number, culled from collections made in various parts of New Zealand, totalled 500 specimens for the description of which arrangements had been made.

The specimens named and described have been returned to the Mines Department accompanied in each case by a rock-slice. There also accompanies the reports on the first and second consignments special notes in which Professor Sollas discusses various questions arising out of the studies which he had made. The information thus gained, apart from the first and primary object of the investigation, it has been resolved to publish for the benefit of miners and mining students in particular, and generally for the information of all who may care to consult this work.

The results are satisfactory, particularly in so far as the number of names are concerned, for, including all the finer distinctions that have been made, there are yet not more than 48 species or varieties of rock. Of these the rhyolites alone claim 22; but many of the finer distinctions in common use are sure to drop out and be forgotten. The generic distinctions are few, and are as follows:—

Andesites	including	7 varieties.
Dacite	"	5 "
Dacite porphyrite	"	3 "
Diorite	"	3 "
Diorite porphyrite	"	1 variety.
Rhyolite	"	22 varieties.
Obsidian	"	1 variety.
Perlitic glass with spherulites and phenocrysts	"	1 "
Pitchstone	"	1 "
Opal	"	1 "
Pumice	"	1 "
Volcanic ash (basic and acidic) ...	"	2 varieties.

Trachyte is doubtfully present, and occurs only on Karangahake Mountain.

ON MAKING THE COLLECTION OF ROCKS.

One result of the examinations made during 1896–98 being the bringing-together of a large collection of the rocks of Cape Colville Peninsula, something has to be said as to the rule and method followed in collecting, and how far the examples selected conform in general characteristics to those of the greater rock-bodies whence they were taken. To collect as above indicated was in some cases simple enough; in others it required judgment and often no little labour. To represent the rocks as they appear at the surface of the ground it only required the taking and the dressing of a rock-sample; but in most cases the specimens would be much decomposed, and would be a bad sample for slicing and microscopic examination. Therefore, in general, a sound and undecomposed example of the rock was desirable if principally it was intended for examination under the miscroscope. How far the specimen taken agrees with the general character of the rock at the same place is information which the field worker must supply. Rarities must not be sought for and when found regarded as representative specimens, otherwise misapprehension of the character and condition of the rock-formation must arise. The practice of taking specimens showing one part apparently fresh and elsewhere the weathered surface was not followed, since thus there was no likelihood of securing a really fresh sample of the rock, and the fresh and decomposed examples had to be taken as different specimens.

A correct knowledge of the locality of the specimen being of the highest importance, this matter was carefully attended to, and even the field tickets had the full address of the specimen. This is a matter that is often insufficiently attended to, especially when dealing with specimens from surface-exposures. It is of less consequence in mines, though here also careful reference to place should not be neglected. Mines, as the workings progress, become inaccessible in the parts that have been worked out or abandoned, and therefore the recording of the general position and the level from which the specimen came is in most cases sufficient. Mine-workings soon become blackened with smoke and dirt to such a degree that, except at great labour, a better idea of the whole can be obtained from the spill-heap than from the mine itself, and not a few specimens in the collection have been so taken, of course, after making inquiries as to the part of the mine whence that part of the heap had come.

Although the collector may know the exact place whence came any particular rock in a collection, it yet often happens that full particulars are not given with the descriptions or published lists. This is much to be regretted, as no matter what the labour spent in securing the specimen, the cost of preparing it for examination, or the talent displayed in ascertaining what it is composed of, its present state, and original condition, all is lost if there be not the means of referring it back to the place where it was collected. It may be true that the specimen was not taken from the solid, but this is not an excuse for the neglect to particularise whence it came, and in every case it should be distinctly stated whether the specimen was taken *in situ* or collected from the rock-*débris* of a slip or shingle-fan or obtained from the bed of a stream. It is quite legitimate to collect the best specimen from wherever it can be obtained provided its position is exactly stated, and if not taken from the solid every reasonable effort should be made to show whence the specimen has been derived.

In this connection it must be remembered that frequently the best specimens are not obtainable *in situ*, but for that reason they are not to be passed by. On the contrary, they must be collected, but with due regard to all the surrounding conditions and a reasonable reference to some known outcrop of rock of similar or identical character, but which may not yield specimens in the same state of preservation. If the rock *in situ* does, then the vagrant specimen may be discarded.

It may, however, and very often does, happen that specimens are collected not *in situ* which cannot be referred to any rock seen outcropping in the same watershed, in which case the utmost care and skill is required to show what the probabilities are of its being actually derived from that watershed or whether it may have been transported from another. The skilful geologist alone can determine in the latter case, and after search he may be able to refer the specimen to its source; but in no case is he warranted in substituting reference of the vagrant boulder to the identified source of the rock *in situ*—its actual source must always be stated.

Owing to the almost general surface-decomposition and deeper-seated alteration of the rocks in all parts of the peninsula there has been great difficulty in securing specimens at all approaching the original condition of the rocks, whether as lava-streams, dyke intrusions, or coarse- or finer-grained fragmental material. Often it proved impossible to obtain *in situ* specimens in even a passably fair condition, and resort had, perforce, in such cases to be had to the loose material in dry channels or the beds of watercourses. Castle Rock, crowning the main range at the source of the Matawai River, some six miles south of Coromandel, is an example of this. In 1897 I examined this great castellated crag, rising some 400 ft. above the average height of the range, but found it almost impossible to obtain a passably well-preserved sample of the rock, and had to leave disappointed in this respect. Similar rocks as boulders in the beds of the Matawai and Waiau Streams, showing a good state of preservation, may, however, be collected, and I secured examples of these, one of which was sent for description in the hope that it would prove identical with that from Castle Rock. The specimen from Castle Rock is No. 1331, and that from the junction of the Matawai with the Waiau is No. 2877, and the description of each under the respective numbers will show how far they are identical. The same trouble was experienced in many other localities, and, though labouring to secure good specimens, I had often to be content with that which very imperfectly satisfied requirements.

Not infrequently it happened that the deeper I broke into the rocks the worse in appearance they became, for, though the more decomposed surface parts might be hard and compact, and to all seeming be sufficient, below this outer skin the rock would prove of less strength and much stained throughout.

In the steep creek-beds and watercourses among the mountains a stream of rock-masses and boulders are, by the action of the creeks during floods, gradually translated from higher to lower levels, and material of an incoherent nature rapidly gets converted into small gravel and sand; but such masses as possess an undecomposed core on being divested of the outer decomposed part give the opportunity for securing the best specimens that can be obtained. This method of collecting has been resorted to only when it was well ascertained that the parent rock was exposed within the watershed of the stream whence the specimens were taken. As far as possible the main stream along a valley was avoided, and only the tributaries coming direct from the range were collected from, and the main stream till above the last branch was disregarded. Thus only could fairly fresh specimens derived from Castle Rock Range be secured.

In another prominent case—that of the dyke rocks of Moehau—this method of collecting fairly good specimens had to be adopted. The conditions were different, but the methods followed equally safeguarded the reference of the specimens to their source. From the area of intrusion where this reaches to the coast-line, by wave-action and the set of currents the material denuded is drifted along the coast to the southward, and a great lodgment of this takes place at the mouth of Waiaro Creek. Inland of the heaped-up sea-beach the creek brings down only sandstone and slate belonging to the Palæozoic series. Any younger volcanic material that may exist on the higher part of Moehau being outside the watershed of this creek, or, at least, not contributing to the gravels of its bed, it follows that the igneous material piled on the beach at the mouth of Waiaro Creek is derived from the western spur of Moehau, in which the dykes occur. That the material collected from did not come from the south is certain, as there is an extent of beach beyond the last traces of Moehau rocks and before the volcanic rocks of Cabbage Bay begin to appear.

In order to avoid all misunderstanding, when specimens not taken *in situ* have been supplied the fact is distinctly stated in the notes that accompany each specimen. When rocks have been taken from the spill-heap of a mine they are referred simply to the mine in question, or to a particular adit level of that mine. Where they have been taken from a given level or working-face such details are given.

In the Puriri and Hikutaia Valleys collections of rhyolite rocks were made that, strictly speaking, were not obtained *in situ.* In the Puriri the rhyolites form the higher part of the mountain-range on the south-east side of the valley. The rhyolites *in situ* are practically inaccessible till they are crossed by the road from Omahu to Whangamata. As the upper east and northern sources of the Puriri lie among mountains composed of andesic breccias belonging to the Kapanga group, the few rhyolites and other acid rocks which are from the Puriri can have no other source than the mountains on the south-east side of the valley, which in their higher part are known to consist of acid rocks.

In the case of the collections from the Hikutaia, I visited all the main sources of the river for the purpose of determining the whence of the different varieties of acidic rocks. Neither the north-east nor the south-west branch bring acid rocks into the bed of the main stream, and the source of the material is therefore the upper valley of the main stream itself. I followed the main stream to where the rhyolites appear in its bed. The mountains on the north side of the main valley between the Hikutaia and the valley of Omahu Creek (the south branch) are composed at heights above 1,000 ft. of acid rocks, but these supply little or no material to the Hikutaia River bed; and the same may be said of the west margin of the acidic area that from the "Steps" extends to the "Wires," on the road from Hikutaia to Whangamata. Neither in the Puriri nor the Hikutaia Valleys are these deposits other than due to the denudation of the rocks within the watershed of each, so that in all cases the reference made as to locality is correct.

The following list in the first column gives the full name, taken from the description by Professor Sollas. In the second column is given the shorter name, by which it is most likely the rock and specimen will be known. In the lists accompanying the reports the names were not in all cases identical with those at the close of the descriptions, and for this reason new lists have been compiled. In most cases the name is given distinctly as that which the description warrants. Sometimes alternative names are given, and in a few cases the names, though clearly indicated in the description, have not been separately given at its close. In such cases the omission has been rectified.

List of Described Rock-specimens from Cape Colville Peninsula.

Descriptive Name in full.	Shorter Name.
(1.) 2709. Quartz augite diorite.	2709. Quartz augite diorite.
(2.) 2718. Quartz plagioclase augite rock.	2718. Altered andesite.
(3.) 2719. Altered dacite or andesite.	2719. Altered dacite.
(4.) 2721. Altered andesite.	2721. Altered andesite.
(5.) 2727. Quartz hornblende porphyrite, or hornblende dacite porphyrite.	2727. Quartz hornblende porphyrite.
(6.) 2735. Quartz diorite porphyrite, or dacite porphyrite.	2735. Quartz diorite porphyrite.
(7.) 2736. Pilotaxitic hornblende dacite porphyrite, or quartz pyroxene diorite porphyrite.	2736. Hornblende dacite porphyrite.
(8.) 2738. Pilotaxitic hypersthene andesite.	2738. Pilotaxitic hypersthene andesite.
(9.) 2752. Pilotaxitic hypersthene hornblende andesite.	2752. Pilotaxitic hypersthene hornblende andesite.
(10.) 2760. Quartz muscovite rock.	2760. Quartz muscovite rock.
(11.) 2788. Quartz sericite rock.	2788. Quartz sericite rock.
(12.) 2790. Hyalopilitic hypersthene andesite with very little hornblende.	2790. Hyalopilitic hypersthene andesite.
(13.) 2792. Quartz sericite rock.	2792. Quartz sericite rock.
(14.) 2808. Quartz(?) hornblende pyroxene porphyrite, or a pilotaxitic hornblende dacite.	2808. Hornblende pyroxene porphyrite, or pilotaxitic hornblende dacite.
(15.) 2817. Quartz uralite porphyrite, or uralite dacite.	2817. Quartz uralite porphyrite.
(16.) 2827. Altered hornblende andesite containing quartz in the ground-mass.	2827. Altered hornblende andesite.
(17.) 2833. Altered hornblende dacite.	2833. Altered hornblende dacite.
(18.) 2836. Altered hornblende dacite, or dacite porphyrite.	2836. Altered hornblende dacite.
(19.) 2840. Altered dacite.	2840. Altered dacite.
(20.) 2853. Altered dacite.	2853. Altered dacite.
(21.) 2865. Uralite dacite porphyrite.	2865. Uralite dacite porphyrite.
(22.) 2868. Altered hornblende dacite.	2868. Altered hornblende dacite.
(23.) 2869. Pilotaxitic hornblende enstatite(?) andesite.	2869. Pilotaxitic hornblende andesite.
(24.) 2872. Hypersthene andesite containing hornblende.	2872. Hypersthene andesite.
(25.) 2874. Dacite, or dacite porphyrite.	2874. Dacite, or dacite porphyrite.
(26.) 2877. Hornblende hypersthene andesite much altered by hydration.	2877. Hornblende hypersthene andesite.
(27.) 2900. (Spotted) adinole or grauwacke.	2900. Spotted adinole.
(28.) 2913. Fine-grained grauwacke.	2913. Grauwacke.
(29.) 2914. Hornblende dacite porphyrite.	2914. Hornblende dacite porphyrite.
(30.) 2918. Hyalopilitic hypersthene hornblende andesite.	2918. Hyalopilitic hypersthene hornblende andesite.
(31.) 2930. Highly altered andesite.	2930. Altered andesite.
(32.) 2933. Dacite or andesite.	2933. Dacite.
(33.) 2941. Altered quartz pyroxene hornblende rock.	2941. Altered dacite.
(34.) 2945. Fragmental volcanic rock, chiefly pyroxene andesite, containing hornblende.	2945. Pyroxene andesite.
(35.) 2948. Black rhyolite glass with grey spherulites.	2948. Spherulitic rhyolite glass.
(36.) 2952. Pilotaxitic andesite containing very little hornblende.	2952. Pilotaxitic andesite.
(37.) 2957. Altered dacite with hornblende.	2957. Altered dacite.
(38.) 2969. Altered dacite with some hornblende.	2969. Altered dacite.
(39.) 2974. Altered dacite.	2974. Altered dacite.
(40.) 2981. Altered dacite or andesite.	2981. Altered dacite.
(41.) 2992. Grauwacke.	2992. Grauwacke.
(42.) 2995. Altered orthoclase(?) plagioclase pyroxene rock.	2995. Altered andesite
(43.) 3010. Hyalopilitic hypersthene andesite.	3010. Hyalopilitic hypersthene andesite.
(44.) 3012. Hypersthene andesite.	3012. Hypersthene andesite.
(45.) 3023. Hornblende dacite.	3023. Hornblende dacite.
(46.) 3024. Indeterminate.	3024. Uncertain.

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

Descriptive Name in full.	Shorter Name.
(47.) 3032. Altered pyroxene andesite or dacite.	3032. Altered pyroxene andesite.
(48.) 3036. Fragmental andesite rock.	3036. Andesite breccia.
(49.) 3042. Augite microgranite, or perhaps microgranitic dacite.	3042. Augite microgranite.
(50.) 3053. Hypersthene andesite.	3053. Hypersthene andesite.
(51.) 3064. Hornblende dacite with a trachytic habit and composed chiefly of felspar.	3064. Hornblende dacite.
(52.) 3077. Hornblende andesite.	3077. Hornblende andesite.
(53.) 3083. Quartz diorite approaching a diorite porphyrite.	3083. Quartz diorite.
(54.) 3084. Quartz diorite.	3084. Quartz diorite.
(55.) 3093. Quartz biotite diorite porphyrite.	3093. Quartz biotite diorite porphyrite.
(56.) 3102. Quartz augite diorite porphyrite.	3102. Quartz augite diorite porphyrite.
(57.) 3103. Hornblende dacite porphyrite.	3103. Hornblende dacite porphyrite.
(58.) 3119. Hypersthene or enstatite andesite containing some hornblende.	3119. Hypersthene andesite.
(59.) 3125. Hypersthene andesite containing hornblende.	3125. Hypersthene andesite.
(60.) 3126. Dacite porphyrite.	3126. Dacite porphyrite.
(61.) 3138. Hypersthene hornblende andesite.	3138. Hypersthene hornblende andesite.
(62.) 3168. Spotted adinole or grauwacke.	3168. Spotted adinole.
(63.) 3178. Spotted adinole.	3178. Spotted adinole.
(64.) 3186. Hornblende dacite porphyrite.	3186. Hornblende dacite porphyrite.
(65.) 3188. Spotted adinole(?).	3188. Spotted adinole(?).
(66.) 3189. Rhyolite replaced by quartz.	3189. Altered rhyolite.
(67.) 3199. Fine-grained siliceous grit.	3199. Siliceous grit.
(68.) 3200. Rhyolite replaced by quartz.	3200. Altered rhyolite.
(69.) 3208. Quartz-mica rock, originally a rhyolite.	3208. Altered rhyolite.
(70.) 3216. Spotted adinole.	3216. Spotted adinole.
(71.) 3222. Pilotaxitic dacite porphyrite.	3222. Pilotaxitic dacite porphyrite.
(72.) 3223. Spotted adinole, or fine-grained grit.	3223. Spotted adinole.
(73.) 3241. Indeterminate.	3241. Uncertain.
(74.) 3260. Fragmental rock.	3260. Fragmental rock.
(75.) 3277. Fragmental rock.	3277. Fragmental rock.
(76.) 3290. Fine quartz felspar grit or grauwacke.	3290. Grauwacke.
(77.) 3312. Altered fragmental rock containing large fragments of volcanic flow rock.	3312. Fragmental rock.
(78.) 3313. No slice.	3313.
(79.) 3350. Dacite porphyrite.	3350. Dacite porphyrite.
(80.) 3352. Altered hornblende andesite.	3352 Altered hornblende andesite.
(81.) 3354. Dacite.	3354. Dacite.
(82.) 3356. Much-altered hornblende dacite, or andesite.	3356. Altered hornblende dacite.
(83.) 3390. Hyalopilitic hypersthene andesite containing some hornblende.	3390. Hyalopilitic hypersthene andesite.
(84.) 3411. Adinole(?).	3411. Adinole.
(85.) 3424. Hyalopilitic hypersthene andesite.	3424. Hyalopilitic hypersthene andesite.
(86.) 3433. Hyalopilitic hypersthene andesite containing hornblende.	3433. Hyalopilitic hypersthene andesite.
(87.) 3443. Conglomerate, with rounded pebbles of igneous rocks.	3443. Comprising— (*a.*) Grauwacke. (*b.*) Pilotaxitic andesite. (*c.*) Hyalopilitic andesite. (*d.*) Dacite. (*e.*) Rhyolite.
(88.) 3450. Conglomerate, with rounded pebbles of igneous rock.	3450. Comprising— (*a.*) Andesite. (*b.*) Rhyolite.

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

Descriptive Name in full.	Shorter Name.
(89.) 3463. Conglomerate of rounded pebbles of igneous rocks.	3463. Comprising— (*a.*) Grauwacke. (*b.*) Andesite. (*c.*) Rhyolite.
(90.) 3453. Conglomerate of rounded pebbles of igneous rocks.	3453. Comprising— (*a.*) Calcareous grauwacke. (*b.*) Pilotaxitic andesite. (*c.*) Hyalopilitic andesite. (*d.*) Silicified rhyolite.
(91.) 3464. Conglomerate of rounded pebbles of igneous rocks.	3464. Comprising— (*a.*) Grauwacke. (*b.*) Pilotaxitic andesite. (*c.*) Hyalopilitic andesite. (*d.*) Banded rhyolite.
(92.) 3469. Hornblende dacite.	3469. Hornblende dacite.
(93.) 3476. Hyalopilitic hypersthene andesite containing hornblende.	3476. Hyalopilitic hypersthene andesite.
(94.) 3482. Hyalopilitic hypersthene andesite containing hornblende.	3482. Hyalopilitic hypersthene andesite.
(95.) 3527. Pilotaxitic hypersthene andesite with hornblende.	3527. Pilotaxitic hypersthene andesite.
(96.) 3543. Pilotaxitic hypersthene andesite.	3543. Pilotaxitic hypersthene andesite.
(97.) 3551. Pilotaxitic hypersthene hornblende andesite.	3551. Pilotaxitic hypersthene hornblende andesite.
(98.) 3557. Hornblende dacite. Tuff.	3557. Hornblende dacite tuff.
(99.) 3558. Pilotaxitic andesite.	3558. Pilotaxitic andesite.
(100.) 3586. Greenish-white decomposed fragmental rock.	3586. Fragmental andesitic rock.
(101.) 3626. Problematical.	3626. Sandstone.
(102.) 3630. Hyalopilitic hypersthene andesite.	3630. Hyalopilitic hypersthene andesite.
(103.) 3632. Altered pilotaxitic hypersthene andesite.	3632. Altered pilotaxitic hypersthene andesite.
(104.) 3635. Pilotaxitic hypersthene andesite.	3635. Pilotaxitic hypersthene andesite.
(105.) 3636. Pilotaxitic andesite.	3636. Pilotaxitic andesite.
(106.) 3638. Hornblende dacite porphyrite.	3638. Hornblende dacite porphyrite.
(107.) 3643. Obscurely pilotaxitic hypersthene andesite.	3643. Pilotaxitic hypersthene andesite.
(108.) 3664. Obscurely pilotaxitic andesite.	3664. Pilotaxitic andesite.
(109.) 3665. Volcanic rock replaced by quartz, sericite, and pyrites.	3665. Altered volcanic rock.
(110.) 3668. Altered flow rock with rhyolite.	3668. Rhyolitic flow rock.
(111.) 3672. Dacite or rhyolite.	3672. Dacite.
(112.) 3680. The phenocrysts point to a basic glass, but they cannot, perhaps, be trusted.	3680. Basic volcanic glass(?).
(113.) 3691. Rhyolite.	3691. Rhyolite.
(114.) 3692. Hyalopilitic hypersthene andesite.	3692. Hyalopilitic hypersthene andesite.
(115.) 3697. Dacitic rhyolite.	3697. Dacitic rhyolite.
(116.) 3703. Perlitic pitchstone, with plagioclase, augite, and hypersthene. This may be an andesitic glass.	3703. Perlitic pitchstone.
(117.) 3708. Microspherulitic rhyolite.	3708. Microspherulitic rhyolite.
(118.) 3709. Microspherulitic rhyolite containing phenocrysts of plagioclase.	3709. Microspherulitic rhyolite.
(119.) 3711. Rhyolite crowded with xenoliths.	3711. Rhyolite.
(120.) 3713. White spherulitic rock with violet-grey interspherulitic residue.	3713. Spherulitic rhyolite.
(121.) 3735. Quartzose pseudomorph after an igneous rock; probably a rhyolite.	3735. Altered rhyolite(?).
(122.) 3739. Glass rarely spherulitic, containing phenocrysts of plagioclase, hypersthene, and augite, and rarely hornblende.	3739. Andesitic glass.
(123.) 3747. Rhyolite containing phenocrysts of plagioclase.	3747. Rhyolite.

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

Descriptive Name in full.	Shorter Name.
(124.) 3749. Pumiceous fine-grained agglomerate.	3749. Pumiceous agglomerate.
(125.) 3751. Rhyolite with plagioclase phenocrysts.	3751. Rhyolite.
(126.) 3758. Positive spherulitic rhyolite containing plagioclase.	3758. Positive spherulitic rhyolite.
(127.) 3759. Rhyolite.	3759. Rhyolite.
(128.) 3768. Spherulitic rhyolite the matrix of which has been replaced by a quartz mosaic.	3768. Spherulitic rhyolite.
(129.) 3772. Rhyolite replaced by quartz.	3772. Altered rhyolite.
(130.) 3800. Highly quartzose rhyolite.	3800. Altered rhyolite.
(131.) 3809. Spherulitic rhyolite largely replaced by quartz.	3809. Altered spherulitic rhyolite.
(132.) 3818. Hyalopilitic hypersthene andesite.	3818. Hyalopilitic hypersthene andesite.
(133.) 3819. Hypersthene andesite, chiefly hyalopilitic, partly pilotaxitic.	3819. Hypersthene andesite.
(134.) 3822. Rhyolite containing plagioclase and a few pseudomorphs after pyroxene.	3822. Rhyolite.
(135.) 3823. Spherulitic rhyolite with plagioclase and pseudomorphs after pyroxene.	3823. Spherulitic rhyolite.
(136.) 3825. Pitchstone containing phenocrysts of plagioclase, hypersthene, and augite (andesitic pitchstone).	3825. Andesitic pitchstone.
(137.) 3828. Rhyolite with xenoliths of another rhyolite, altered.	3828. Altered rhyolite.
(138.) 3833. Positive spherulitic rhyolite with plagioclase and pyroxene pseudomorphs, also lithophysal.	3833. Positive spherulitic rhyolite.
(139.) 3838. Pitchstone containing plagioclase, augite, hypersthene, and various xenoliths.	3838. Pitchstone.
(140.) 3840. Hyalopilitic hypersthene andesite.	3840. Hyalopilitic hypersthene andesite.
(141.) 3846. Hyalopilitic hypersthene andesite.	3846. Hyalopilitic hypersthene andesite.
(142.) 3847. Lithophysal rhyolite with plagioclase.	3847. Lithophysal rhyolite.
(143.) 3866. Augite diorite with hypersthene and a little quartz and orthoclase.	3866. Augite diorite.
(144.) 3889. Hornblende andesite.	3889. Hornblende andesite.
(145.) 3898. Highly altered igneous rock.	3898. Highly altered igneous rock.
(146.) 3901. Hornblende hypersthene andesite with a little quartz, or hypersthene dacite.	3901. Hypersthene dacite.
(147.) 3905. Highly altered igneous rock; not further determinable.	3905. Highly altered igneous rock.
(148.) 3921. Much-decomposed andesite or dacite with secondary quartz and carbonates.	3921. Decomposed andesite.
(149.) 3932. Andesite or dacite highly decomposed.	3932. Decomposed andesite.
(149A.) 3948. Spherulitic rhyolite containing plagioclase.	3948. Spherulitic rhyolite.
(150.) 3949. Pitchstone containing plagioclase and hypersthene.	3949. Pitchstone.
(151.) 3954. Negative microspherulitic rhyolite with positive spherulitic growths.	3954. Negative microspherulitic rhyolite.
(152.) 3966. Microspherulitic rhyolite replaced by quartz.	3966. Microspherulitic rhyolite.
(153.) 3969. Negative microspherulitic rhyolite with plagioclase.	3969. Negative microspherulitic rhyolite.
(154.) 3979. Spherulitic rhyolite containing plagioclase.	3979. Spherulitic rhyolite.
(155.) 3985. Microspherulitic rhyolite with plagioclase and quartz.	3985. Microspherulitic rhyolite.
(156.) 4001. Minutely pilotaxitic hypersthene andesite.	4001. Pilotaxitic hypersthene andesite.
(157.) 4013. Much-altered andesite, or perhaps dacite.	4013. Altered andesite.
(158.) 4035. Pilotaxitic hypersthene andesite containing hornblende.	4035. Pilotaxitic hypersthene andesite.
(159.) 4044. Pilotaxitic hypersthene andesite with very little hornblende.	4044. Pilotaxitic hypersthene andesite.
(160.) 4053. Volcanic agglomerate, composed largely of andesitic rocks.	4053. Andesitic agglomerate.

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

Descriptive Name in full.	Shorter Name.
(161.) 4058. Pilotaxitic hypersthene andesite traversed by rhyolite.	4058. Pilotaxitic hypersthene andesite.
(162.) 4061. Pilotaxitic hypersthene andesite.	4061. Pilotaxitic hypersthene andesite.
(163.) 4064. Volcanic or dyke rock altered by quartz and pyrites; probably once an andesite.	4064. Altered andesite(?).
(164.) 4080. Hyalopilitic hypersthene andesite with but little hornblende.	4080. Hyalopilitic hypersthene andesite.
(165.) 4081. Fragmental rock composed of andesitic material.	4081. Andesitic fragmental rock.
(166.) 4088. Pilotaxitic hypersthene andesite.	4088. Pilotaxitic hypersthene andesite.
(167.) 4096. Quartz biotite diorite.	4096. Quartz biotite diorite.
(168.) 4153. Altered spherulitic rhyolite.	4153. Altered spherulitic rhyolite.
(169.) 4161. Spherulitic rhyolite.	4161. Spherulitic rhyolite.
(170.) 4162. Spherulitic rhyolite.	4162. Spherulitic rhyolite.
(171.) 4175. Spherulitic rhyolite.	4175. Spherulitic rhyolite.
(172.) 4182. Spherulitic rhyolite.	4182. Spherulitic rhyolite.
(173.) 4185. Spherulitic rhyolite.	4185. Spherulitic rhyolite.
(174.) 4204. Spherulitic rhyolite.	4204. Spherulitic rhyolite.
(175.) 4205. Spherulitic rhyolite.	4205. Spherulitic rhyolite.
(176.) 4216. Spherulitic rhyolite.	4216. Spherulitic rhyolite.
(177.) 4219. Banded rhyolite with spherulites and lithophysæ.	4219. Banded lithophysal rhyolite.
(178.) 4223. Spherulitic rhyolite with lithophysæ.	4223. Lithophysal spherulitic rhyolite.
(179.) 4226. Spherulitic rhyolite with lithophysæ.	4226. Lithophysal spherulitic rhyolite.
(180.) 4229. Spherulitic rhyolite, in places lithophysal.	4229. Lithophysal spherulitic rhyolite.
(181.) 4230. Banded spherulitic rhyolite with small lithophysæ.	4230. Banded lithophysal spherulitic rhyolite.
(182.) 4233. Spherulitic rhyolite.	4233. Spherulitic rhyolite.
(183.) 4212. Banded rhyolite with spherulites and lithophysæ.	4212. Banded lithophysal spherulitic rhyolite.
(184.) 4279. Quartz sericite rock; probably once a rhyolite.	4279. Altered rhyolite(?).
(185.) 4286. Hyalopilitic hypersthene andesite.	4286. Hyalopilitic hypersthene andesite.
(186.) 4293. Rhyolite replaced by quartz and sericite.	4293. Altered rhyolite.
(187.) 4298. Rhyolite transformed into quartz sericite.	4298. Altered rhyolite.
(188.) 4304. Negative microspherulitic rhyolite with secondary quartz.	4304. Negative microspherulitic rhyolite
(189.) 4310. Rhyolitic glass passing into pumice containing plagioclase.	4310. Rhyolitic glass.
(190.) 4345. Altered spherulitic rhyolite.	4345. Altered spherulitic rhyolite.
(191.) 4359. Positive spherulitic rhyolite.	4359. Positive spherulitic rhyolite.
(192.) 4364. Pitchstone.	4364. Pitchstone.
(193.) 4366. Pitchstone.	4366. Pitchstone.
(194.) 4372. Spherulitic rhyolite.	4372. Spherulitic rhyolite.
(195.) 4375. Negative spherulitic rhyolite.	4375. Negative spherulitic rhyolite.
(196.) 4381. Spherulitic rhyolite with lithophysæ.	4381. Lithophysal spherulitic rhyolite.
(197.) 4384. Spherulitic rhyolite finely and evenly banded, pinkish-white, violet, and chalky-white bands.	4384. Banded spherulitic rhyolite.
(198.) 4386. Finely banded rhyolite.	4386. Banded spherulitic rhyolite.
(199.) 4387. Positive microspherulitic rhyolite.	4387. Positive microspherulitic rhyolite.
(200.) 4388. Finely and evenly banded rhyolite.	4388. Banded rhyolite.
(201.) 4394. Spherulitic glassy rhyolite containing plagioclase and augite.	4394. Glassy spherulitic rhyolite.
(202.) 4396. Spherulitic rhyolite, spherulites immersed in altered glass.	4396. Glassy spherulitic rhyolite.
(203.) 4425. Black glassy rhyolite with brown spherulites.	4425. Glassy spherulitic rhyolite.
(204.) 4574. Spherulitic rhyolite with brown spherulites in white altered glass and lithophysæ containing opal.	4574. Glassy spherulitic rhyolite.
(205.) Has not been named or described.	

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

	Descriptive Name in full.	Shorter Name.
(206.)	1. Rhyolite containing plagioclase and pyroxene: much-altered perlitic glass.	1. Rhyolite.
(207.)	3. Glassy rhyolite containing plagioclase, pyroxene, and hornblende.	3. Glassy rhyolite.
(208.)	6. Rhyolite containing microperthite and hornblende, largely replaced by quartz, with associated pyrites.	6. Microperthitic rhyolite.
(209.)	21. Rhyolite containing plagioclase, hornblende, and quartz.	21. Rhyolite.
(210.)	27. Hyalopilitic hypersthene andesite; black.	27. Hyalopilitic hypersthene andesite.
(211.)	31. Hypersthene andesite altered by waters containing quartz and pyrites.	31. Altered hypersthene andesite.
(212.)	39. Black hyalopilitic hypersthene andesite.	39. Hyalopilitic hypersthene andesite.
(213.)	40. Altered andesite; partly replaced by subsequent quartz.	40. Altered andesite.
(214.)	42. Altered andesite; partly replaced by quartz.	42. Altered andesite.
(215.)	44. Altered andesite with subsequent quartz.	44. Altered andesite.
(216.)	47. Rhyolite.	47. Rhyolite.
(217.)	50. Black hypersthene andesite with microgranular matrix.	50. Hypersthene andesite.
(218.)	51. Hyalopilitic hypersthene andesite containing a barkevikite-like amphibole.	51. Hyalopilitic hypersthene andesite.
(219.)	64. Black pilotaxitic hypersthene andesite.	64. Pilotaxitic hypersthene andesite.
(220.)	87. Light-grey hyalopilitic hypersthene andesite with hornblende and biotite.	87. Hyalopilitic hypersthene andesite.
(221.)	91. Rhyolite with plagioclase.	91. Rhyolite.
(222.)	94. Tuff containing fragments of pumice.	94. Tuff.
(223.)	100. Very possibly this rock was originally an andesite.	100. Andesite(?).
(224.)	107. Quartz pyroxene and soda orthoclase rock, or soda pyroxene rhyolite.	107. Soda pyroxene rhyolite.
(225.)	108. Anorthoclase or microperthite pyroxene rhyolite.	108. Microperthitic pyroxene rhyolite.
(226.)	110. Anorthoclase(?) pyroxene rhyolite.	110. Anorthoclase pyroxene rhyolite.
(227.)	124. Hornblende dacite.	124. Hornblende dacite.
(228.)	127. Hornblende dacite.	127. Hornblende dacite.
(229.)	129. Hornblende dacite.	129. Hornblende dacite.
(230.)	133. Spherulitic dacite, or rhyolite.	133. Spherulitic dacite.
(231.)	147. Grey pyroxene andesite.	147. Pyroxene andesite.
(232.)	155. Black hyalopilitic hypersthene andesite with a little hornblende.	155. Hyalopilitic hypersthene andesite.
(233.)	158. Pyroxene dacite.	158. Pyroxene dacite.
(234.)	167. Originally this may have been an andesite: it is completely transformed.	167. Andesite(?).
(235.)	181. Probably an altered andesite.	181. Altered andesite(?).
(236.)	185. Rhyolite with a few phenocrysts of plagioclase felspar and pseudomorphs probably after pyroxene.	185. Rhyolite.
(237.)	199. A stratified fragmental volcanic rock.	199. Stratified fragmental volcanic rock.
(238.)	200. This rock may have been a dacite.	200. Dacite(?).
(239.)	207. Hyalopilitic hypersthene andesite.	207 Hyalopilitic hypersthene andesite.
(240.)	210. Pyroxene dacite, or dacite porphyrite.	210. Pyroxene dacite.
(241.)	212. Spherulitic and glassy hornblende hypersthene dacite.	212. Spherulitic dacite.
(242.)	213. Hyalopilitic hypersthene andesite containing olivine, or hypersthene basalt.	213. Hyalopilitic hypersthene andesite.
(243.)	217. Hyalopilitic hypersthene andesite (with serpentine after olivine).	217. Hyalopilitic hypersthene andesite.
(244.)	231. Pyroxene dacite.	231. Pyroxene dacite.
(245.)	248. Black hypersthene dacite.	248. Hypersthene dacite.

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

	Descriptive Name in full.	Shorter Name.
(246.)	249. Pyroxene hornblende dacite.	249. Pyroxene hornblende dacite.
(247.)	258. Hypersthene dacite poor in quartz, or quartz hypersthene andesite.	258. Hypersthene dacite.
(248.)	268. Spherulitic rhyolite with plagioclase.	268. Spherulitic rhyolite.
(249.)	292. Spherulitic and crystalline granular rhyolite.	292. Spherulitic rhyolite.
(250.)	301. Spherulitic rhyolite partly replaced by quartz mosaics.	301. Spherulitic rhyolite.
(251.)	307. Andesite fractured internally and cemented by quartz.	307. Andesite.
(252.)	309. Hypersthene andesite.	309. Hypersthene andesite.
(253.)	324. Rhyolite with pyroxene.	324. Rhyolite.
(254.)	330. A pyroxene andesite, altered partly by weathering, partly by subsequent introduction of quartz.	330. Altered pyroxene andesite.
(255.)	335. Altered pyroxene andesite.	335. Altered pyroxene andesite.
(256.)	338. Microperthite pyroxene rhyolite.	338. Microperthite pyroxene rhyolite.
(257.)	339. Rhyolite(?) glass.	339. Rhyolite(?) glass.
(258.)	347. No slice.	347. Overlooked; specimen returned without name or description.
(259.)	348. Spherulitic rhyolite with plagioclase, hypersthene, and augite.	348. Spherulitic rhyolite.
(260.)	350. Volcanic ash.	350. Volcanic ash.
(261.)	354. Plagioclase pyroxene rock: phanerocrystalline andesite.	354. Phanerocrystalline andesite.
(262.)	367. Hyalopilitic hypersthene andesite.	367. Hyalopilitic hypersthene andesite.
(263.)	380. Altered hypersthene andesite.	380. Altered hypersthene andesite.
(264.)	382. Pyroxene trachyte.	382. Pyroxene trachyte.
(265.)	394. Greyish-white rhyolite-like rock with long lenticular streaks of black glass.	394. Rhyolite.
(266.)	400. Altered andesite.	400. Altered andesite.
(267.)	401. Altered felspar pyroxene flow rock; possibly an altered andesite.	401. Altered andesite(?).
(268.)	402. Altered felspar pyroxene flow rock; possibly an altered andesite.	402. Altered andesite(?).
(269.)	406. Altered felspar pyroxene flow rock; possibly altered andesite.	406. Altered andesite(?).
(270.)	418. Indeterminate: a flow rock, possibly an andesite.	418. Uncertain.
(271.)	420. Black quartz hypersthene andesite with hornblende.	420. Quartz hypersthene andesite.
(272.)	422. Black quartz hypersthene andesite with hornblende.	422. Quartz hypersthene andesite.
(273.)	423. Micropœcillitic andesite.	423. Micropœcillitic andesite.
(274.)	424. Altered dacite.	424. Altered dacite.
(275.)	441. Pumice.	441. Pumice.
(276.)	444. Pyroxene felspar rock, an altered andesite, or pyroxene rhyolite.	444. Altered pyroxene andesite.
(277.)	445. Altered pyroxene andesite containing microperthite, or soda pyroxene rhyolite.	445. Altered pyroxene andesite.
(278.)	452. Andesitic pitchstone.	452. Andesitic pitchstone.
(279.)	454. Hyalopilitic hypersthene andesite.	454. Hyalopilitic hypersthene andesite.
(280.)	456. Rhyolite with plagioclase phenocrysts.	456. Rhyolite.
(281.)	463. Purplish stony rhyolite with diffuse spherulites and white felspar phenocrysts.	463. Spherulitic rhyolite.
(282.)	485. Quartz felspar pyroxene flow rock, much altered; probably altered pyroxene rhyolite.	485. Altered pyroxene rhyolite(?).
(283.)	494. Quartz hypersthene andesite with hornblende.	494. Quartz hypersthene andesite.
(284.)	497. Altered andesite.	497. Altered andesite.
(285.)	498. Altered quartz hypersthene andesite with a little hornblende.	498. Altered quartz hypersthene andesite.

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

	Descriptive Name in full.	Shorter Name.
(286.)	499. Black quartz hypersthene andesite with hornblende.	499. Quartz hypersthene andesite.
(287.)	504. Black hypersthene andesite.	504. Hypersthene andesite.
(288.)	505. Black quartz hypersthene andesite with a good deal of hornblende.	505. Quartz hypersthene andesite.
(289.)	509. Pyroxene rhyolite.	509. Pyroxene rhyolite.
(290.)	510. A much-altered quartz felspar pyroxene flow rock.	510. Altered volcanic rock.
(291.)	512. Decomposed rhyolite.	512. Decomposed rhyolite.
(292.)	517. Common opal.	517. Common opal.
(293.)	518. Rhyolite with plagioclase, showing contorted flow-lines.	518. Rhyolite.
(294.)	521. Rhyolite with plagioclase, showing contorted flow-lines.	521. Rhyolite.
(295.)	527. Hornblende pyroxene rhyolite.	527. Hornblende pyroxene rhyolite.
(296.)	534. Spherulitic hornblende dacite.	534. Spherulitic hornblende dacite.
(297.)	541. Spherulitic hornblende pyroxene dacite.	541. Spherulitic hornblende dacite.
(298.)	547. Spherulitic rhyolite with orthoclase and microperthite.	547. Spherulitic rhyolite.
(299.)	549. Spherulitic rhyolite much altered by siliceous waters.	549. Altered spherulitic rhyolite.
(300.)	553. Spherulitic hornblende dacite.	553. Spherulitic hornblende dacite.
(301.)	556. Glassy and spherulitic hornblende pyroxene dacite.	556. Spherulitic hornblende dacite.
(302.)	582. Spherulitic rhyolite with microperthite.	582. Spherulitic rhyolite.
(303.)	608. Decomposed rhyolite.	608. Decomposed rhyolite.
(304.)	612. Consolidated volcanic ash.	612. Consolidated volcanic ash.
(305.)	618. Rhyolite with spherulitic structure, containing plagioclase.	618. Spherulitic rhyolite.
(306.)	626. Black micropœcillitic hypersthene andesite.	626. Micropœcillitic hypersthene andesite.
(307.)	628. Altered pyroxene andesite.	628. Altered pyroxene andesite.
(308.)	629. Completely replaced by carbonates and chlorite, with vesicles filled in with quartz.	629. Uncertain.
(309.)	631. Cannot be determined with certainty; possibly an altered dacite.	631. Altered dacite(?).
(310.)	636. Black hypersthene andesite with micropœcillitic matrix.	636. Micropœcillitic hypersthene andesite.
(311.)	637. Volcanic (andesic) tuff.	637. Andesic tuff.
(312.)	649. Grey hypersthene hornblende andesite.	649. Hyalopilitic hornblende andesite.
(313.)	656. A much-altered rock; may have been a dacite originally.	656. Dacite(?).
(314.)	658. Decomposed hornblende pyroxene andesite.	658. Decomposed hornblende pyroxene andesite.
(315.)	662. Black hypersthene andesite.	662. Hypersthene andesite.
(316.)	670. Altered hornblende pyroxene andesite.	670. Altered hornblende pyroxene andesite.
(317.)	671. Black hypersthene andesite.	671. Hypersthene andesite.
(318.)	675. Highly altered; probably originally hypersthene andesite.	675. Hypersthene andesite(?).
(319.)	678. Altered andesite; probably hypersthene andesite.	678. Altered hypersthene andesite.
(320.)	679. Altered hornblende pyroxene andesite.	679. Altered hornblende pyroxene andesite.
(321.)	682. Altered andesite(?).	682. Altered andesite(?).
(322.)	687. Altered andesite(?).	687. Altered andesite(?).
(323.)	692. Black hypersthene andesite.	692. Hypersthene andesite.
(324.)	696. Hornblende pyroxene dacite.	696. Hornblende pyroxene dacite.
(325.)	699. Altered andesite.	699. Altered andesite.

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

Descriptive Name in full.	Shorter Name.
(326.) 703. A fine-grained breccia, composed chiefly of fragments of dacite.	703. Dacite breccia.
(327.) 705. Altered andesite containing hornblende.	705. Altered andesite.
(328.) 709. Hornblende pyroxene andesite.	709. Hornblende pyroxene andesite.
(329.) 712. Pyroxene hornblende dacite.	712. Pyroxene hornblende dacite.
(330.) 713. Altered pyroxene andesite.	713. Altered pyroxene andesite.
(331.) 719. Altered pyroxene andesite.	719. Altered pyroxene andesite.
(332.) 721. Hornblende hypersthene andesite.	721. Hornblende hypersthene andesite.
(333.) 724. Altered hypersthene hornblende dacite, or quartz hornblende hypersthene andesite.	724. Altered hypersthene hornblende dacite.
(334.) 732. Altered pyroxene andesite containing orthoclase with radiate felspar laths in matrix, or pyroxene rhyolite.	732. Altered pyroxene andesite.
(335.) 733. A fragmental volcanic rock consisting of andesite.	733. Andesite.
(335A.) 734. Hornblende pyroxene andesite much altered.	734. Altered hornblende pyroxene andesite.
(336.) 736. Altered pyroxene andesite.	736. Altered pyroxene andesite.
(337.) 737. Hornblende dacite with pyroxene.	737. Hornblende dacite.
(338.) 745. Indeterminate.	745. Uncertain.
(339.) 748. Hornblende hypersthene andesite.	748. Hornblende hypersthene andesite.
(340.) 749. Hypersthene andesite.	749. Hypersthene andesite.
(341.) 754. Spherulitic rhyolite.	754. Spherulitic rhyolite.
(342.) 759. Cream-white vesicular and spherulitic rhyolite containing orthoclase and plagioclase.	759. Vesicular spherulitic rhyolite.
(343.) 761. Pumiceous rhyolite.	761. Pumiceous rhyolite.
(344.) 763. Tuff.	763. Tuff.
(345.) 794. Rhyolite with flow structure.	794. Rhyolite.
(346.) 795. Breccia of rhyolite.	795. Rhyolite breccia.
(347.) 797. This may be a hornblende andesite.	797. Hornblende andesite(?).
(348.) 799. Altered pyroxene andesite.	799. Altered pyroxene andesite.
(349.) 802. Black micropœcillitic hypersthene andesite.	802. Micropœcillitic hypersthene andesite.
(350.) 813. Altered pyroxene andesite (with hornblende ?)	813. Altered pyroxene andesite.
(351.) 818. (Altered) pyroxene andesite.	818. Altered pyroxene andesite.
(352.) 822. Altered pyroxene labradorite holocrystalline rock, a phanerocrystalline representative of pyroxene andesite, or quartz diabase.	822. Quartz diabase.
(353.) 823. Hypersthene andesite of an unusual kind.	823. Hypersthene andesite.
(354.) 833. Micropœcillitic pyroxene andesite.	833. Micropœcillitic pyroxene andesite.
(355.) 836. Altered pyroxene dacite, or pyroxene rhyolite.	836. Altered pyroxene dacite.
(356.) 846. Hyalopilitic (in places micropœcillitic) hypersthene andesite.	846. Hyalopilitic hypersthene andesite.
(357.) 847. Spherulitic rhyolite with a perlitic glassy matrix now converted into quartz mosaic.	847. Spherulitic rhyolite.
(358.) 853. Consolidated rhyolitic(?) ash.	853. Rhyolitic(?) ash.
(359.) 863. Spherulitic rhyolite.	863. Spherulitic rhyolite.
(360.) 878. Quartz hornblende pyroxene andesite.	878. Quartz hornblende pyroxene andesite.
(361.) 881. Volcanic ash and lapilli; probably derived from an acid magma(?)	881. Volcanic ash.
(362.) 899. Hyalopilitic hornblende pyroxene dacite, or quartz hornblende pyroxene andesite, rich in glass.	899. Hyalopilitic hornblende pyroxene dacite.
(363.) 911. Perlitic glass containing positive spherulites.	911. Perlitic glass.
(364.) 912. Perlitic glass containing plagioclase, hypersthene, and hornblende.	912. Perlitic glass.

LIST OF DESCRIBED ROCK-SPECIMENS FROM CAPE COLVILLE PENINSULA—*continued.*

Descriptive Name in full.	Shorter Name.
(365.) 914. Hyalopilitic (in places micropœcillitic) pyroxene andesite.	914. Hyalopilitic pyroxene andesite.
(366.) 923. Spherulitic and glassy flow rock, rhyolite, or dacite rhyolite.	923. Spherulitic rhyolite.
(367.) 935. Glassy hornblende dacite.	935. Glassy hornblende dacite.
(368.) 942. Vesicular spherulitic flow rock with perlitic glass: rhyolite or dacite rhyolite.	942. Vesicular spherulitic rhyolite.
(369.) 950. Glassy and spherulitic rhyolite containing plagioclase.	950. Glassy and spherulitic rhyolite.
(370.) 976. Dacite or soda rhyolite with flow structure.	976. Dacite.
(371.) 991. Hyalopilitic quartz hypersthene andesite.	991. Hyalopilitic quartz hypersthene andesite.
(372.) 994. Hyalopilitic quartz hypersthene andesite.	994. Hyalopilitic quartz hypersthene andesite.
(373.) 995. A dacite, and may be a soda rhyolite.	995. Dacite.
(374.) 1002. Dacite or soda rhyolite with flow structure.	1002. Dacite.
(375.) 1013. Obsidian with flow structure and rare spherulites	1013. Obsidian.
(376.) 1034. Hyalopilitic (in places micropœcillitic) hypersthene andesite.	1034. Hyalopilitic hypersthene andesite.
(377.) 1035. Dacite, or soda rhyolite.	1035. Dacite.
(378.) 1038. Altered spherulitic rhyolite (silicified).	1038. Altered spherulitic rhyolite.
(379.) 1039. Hyalopilitic pyroxene andesite with phenocrysts.	1039. Hyalopilitic pyroxene andesite.
(380.) 1040. Micropœcillitic hornblende andesite, somewhat altered.	1040. Micropœcillitic hornblende andesite.
(381.) 1041. A much-altered andesite(?).	1041. Altered andesite(?).
(382.) 1042. Hornblende hypersthene andesite (hyalopilitic).	1042. Hyalopilitic hornblende hypersthene andesite.
(383.) 1046. Hyalopilitic (partly micropœcillitic) hypersthene andesite.	1046. Hyalopilitic hypersthene andesite.
(384.) 1071. Spherulitic rhyolite.	1071. Spherulitic rhyolite.
(385.) 1072. Spherulitic rhyolite partly replaced by quartz.	1072. Spherulitic rhyolite.
(386.) 1075. Hyalopilitic hypersthene andesite with hornblende.	1075. Hyalopilitic hypersthene andesite.
(386A) 1078. Rhyolite containing plagioclase.	1078. Rhyolite.
(387.) 1131. Spherulitic rhyolite.	1131. Spherulitic rhyolite.
(388.) 1139. Microspherulitic rhyolite.	1139. Microspherulitic rhyolite.
(389.) 1149. Rhyolitic glass containing plagioclase.	1149. Rhyolitic glass.
(390.)	
(391.) 1170. Pyroxene hornblende dacite.	1170. Pyroxene hornblende dacite.
(392.) 1172. Spherulitic dacite, or dacite rhyolite.	1172. Spherulitic dacite.
(393.) 1286. Flow rock, indeterminate.	1286. Uncertain.
(394.) 1295. Altered pyroxene andesite.	1295. Altered pyroxene andesite.
(395.) 1309. Pyroxene andesite (micropœcillitic).	1309. Micropœcillitic pyroxene andesite.
(396.) 1311. Rhyolite.	1311. Rhyolite.
(397.) 1314. Hornblende pyroxene andesite.	1314. Hornblende pyroxene andesite.
(398.) 1320. Pyroxene andesite.	1320. Pyroxene andesite.
(399.) 1328. Hornblende hypersthene andesite.	1328. Hornblende hypersthene andesite.
(400.) 1331. Hypersthene hornblende dacite.	1331. Hornblende hypersthene dacite.
(401.) 1336. Hypersthene andesite.	1336. Hypersthene andesite.
(402.) 1383. A layered fragmental rock composed chiefly of volcanic material.	1383. Volcanic rock.
(403.) 1392. Possibly an andesite replaced by quartz (very little) and hyalite or opal.	1392. Altered andesite(?).
(404.) 1423. Hyalopilitic hypersthene andesite.	1423. Hyalopilitic hypersthene andesite.
(405.) 1434. Glassy dacite rhyolite.	1434. Glassy dacite rhyolite.
(406.) 1480. Silicified rhyolite.	1480. Silicified rhyolite.

THE SEQUENCE AND CLASSIFICATION OF THE ROCK-FORMATIONS OF CAPE COLVILLE PENINSULA.

The classification of the rocks of Cape Colville Peninsula is even now a matter of difficulty, owing to the general absence of fossils in the sedimentary formations and of bold lines of demarcation between some of the divisions of the volcanic series.

The sandstones and slates of the Palæozoic series have not hitherto yielded satisfactory proof of their age. Professor Park noted indications of fossils in the neighbourhood of Port Charles which he thought supported the assumption that the rocks of that part might be of Devonian age; and on the Great Barrier Island, from what are probably rocks of the same formation, Captain Hutton collected a species of coral which was considered to indicate a Silurian age for the beds in which it was found. Carboniferous rocks are supposed to be present along the west side of the peninsula north of Tapu Creek to Manaia and from Cabbage Bay to Port Jackson, and rocks of Triassic age between the upper parts of Coromandel and Manaia Harbours. Cretaceous or Cretaceo-tertiary rocks are present a little south of Cabbage Bay and on the higher part of the range at the source of Waiaro Creek, in the Moehau district. The Tertiary volcanic rocks succeed, and are capable of fourfold division into the Thames-Tokatea, Kapanga, Beeson's Island, and Acidic groups, while a series of intrusive dykes breaking through the youngest of these may be regarded as constituting a fifth division of the series of igneous rocks of Tertiary date. The fragmental rocks of the Pleistocene and Recent periods are unimportant.

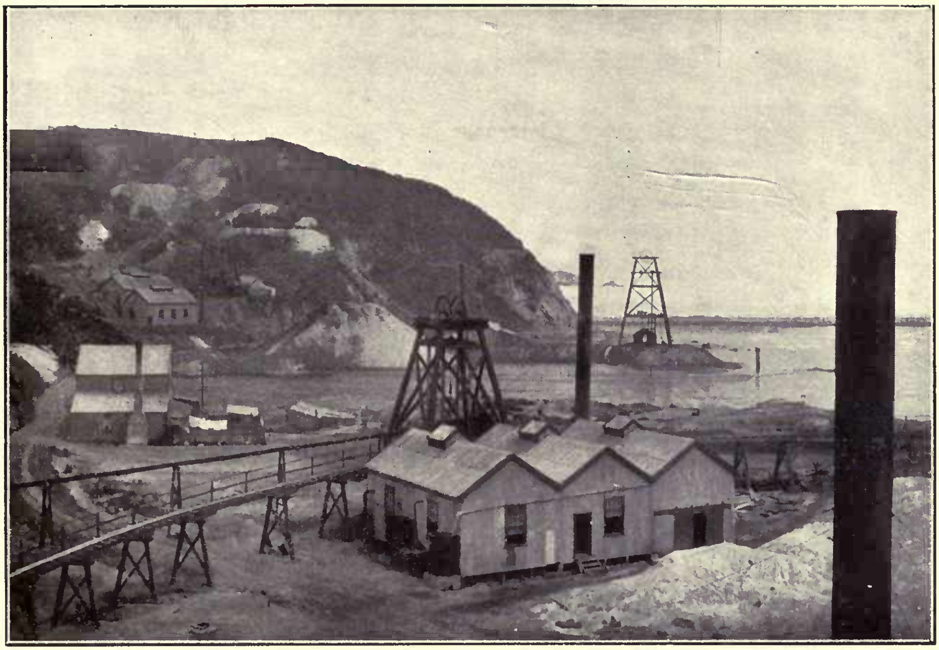
Neither Hochstetter, Hector, Hutton, nor Davis can be said to have produced a classification of the different rock-formations which they casually mention or describe in different reports.

Hochstetter refers to *trachyte tuff* on the shores of Coromandel Harbour, and to a clay-slate formation forming the mountains of the Main Range near Coromandel.

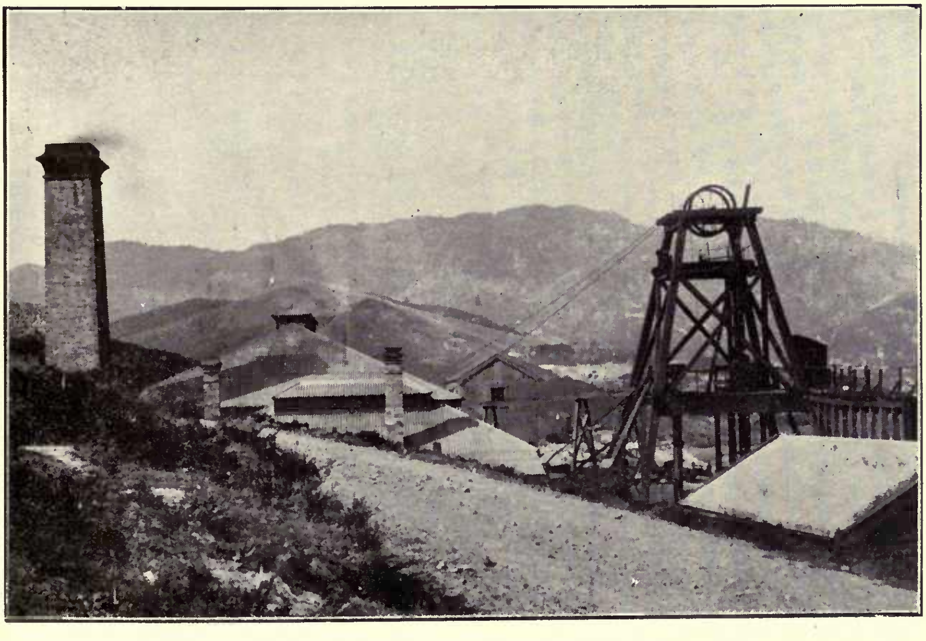
Captain Hutton, in his first report on the Thames Goldfield, describes the volcanic rocks as *trachyte tufa*, and in his second report the tufa is regarded as formed of a higher and a lower part, and the whole is referred to the Miocene period.* In 1887 Captain Hutton makes further reference to the rocks of the peninsula, and speaks of the older sedimentary series as not being younger than Trias. The coal-bearing beds of Cabbage Bay are regarded as of Oligocene age, and the volcanic series are doubtfully referred to the Miocene period.

Dr. (now Sir James) Hector, in a report dated 1867, gives the following

* N.Z. Geol. Surv. Rep., 1867 and 1869, p. 15.



UNION BEACH, KEVIN'S POINT, COROMANDEL.



THE HAURAKI MINE, COROMANDEL.

To face p. 26.]

as the sequence of the rocks met with in a traverse of the range which separates the Thames Valley from the Bay of Plenty :—

1. Aphanite interbedded with green brecciated and greywacke slates, being part of the *Upper Palæozoic series ;* and
2. The *Tertiary series,* consisting of—
   (*a.*) Brown-coal formation (very local).
   (*b.*) Quartzose gravels, cemented.
   (*c.*) Waitemata series (Pliocene).
   (*d.*) Trachyte tuff.
   (*e.*) Trachyte breccia.*

Reporting, in 1870, on the geology of the Cape Colville district, the same author considered that in the Tapu Creek district there was an *Older* (greenstone) and a *Younger* (trachyte breccia) formation, but he assigns to these no particular date or age.(2)

In 1879 Sir James ascribes to the Cretaceo-tertiary period the age of the *Propylite group,* which he describes as consisting of " greenstone trachytes and fine- and coarse-grained breccia rocks, which form the matrix of the auriferous reefs of the Thames goldfields."(3)

E. Heydelbach Davis, in his Notes on the Thames Goldfields, 1870, deals in nothing with the succession of the rocks, and no classification can be compiled from his report.(4)

S. Herbert Cox, first during 1880 and again in 1882, made examinations in different parts of Cape Colville Peninsula, and subsequently reported fully on the geology of the district. He treated of the rocks as—

1. Rhyolite formation (Pliocene).
2. Beeson's Island group (Lower Miocene).
3. Auriferous rocks of the Thames (age ?).
4. Coal-bearing series of Cabbage Bay (Cretaceo-tertiary).
5. Slates, sandstones, and felsites (Lower Carboniferous and Upper Devonian).

Mr. Cox is uncertain as to the position of the auriferous rocks of the Thames in relation to the coal-bearing series, and this is a matter which has not yet been finally settled. There is very little doubt that they are younger than the coal beds, and I have taken the liberty of so placing them in the above sequence of formations, though in 1880 Mr. Cox thought the coal beds rested on the auriferous series. As it stands this is the first fair approximation to the correct sequence of the rocks and their age.

In 1883 I examined Cabbage Bay district and determined the sequence as —

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* N.Z. Geol. Surv. Rep., 1867, p. 72.
(2) N.Z. Geol. Surv. Rep., 1870–71, p. 88.
(3) N.Z. Geol. Surv. Rep., 1878–79, p. 16.
(4) N.Z. Geol. Surv. Rep., 1870–71, p. 56.

1. Trachy-dolerite breccias and tuffs with coal (Miocene).
2. Grey trachytic tufaceous rocks (Kapanga group).
3–6. Cretaceo-tertiary, including limestones, marls, and coal beds underlain by conglomerates.
7. Palæozoic rocks (Lower Carboniferous).

Professor Park, in 1890, stated the sequence and character of the rocks of the Thames Goldfield as—

1. Upper Eocene—Volcanic breccias and tuffs; Mount Brown series.
2. Lower Eocene—Auriferous series; Grey Marl series.
3. Palæozoic—Slaty shales, &c.; Te Anau series.*

In 1897 Professor Park read as a paper to the New Zealand Institute of Mining Engineers an account of the "Geology and Veins of the Hauraki Peninsula," in which the various formations are classified thus:—

1. Recent and Pleistocene.
2. Pliocene—Lavas and tuffs.
3. Miocene—Andesic breccias, &c.
4. Upper Eocene—Great gold-bearing series, andesites solid and decomposed, tuffs, breccias, and agglomerates.
5. Lower Eocene—Brown-coal series.
6. Palæozoic—Probably Devonian.

The same year I published the following classification of the rocks of Cape Colville Peninsula:—

8. Carboniferous—Maitai series.
7. Cretaceo-tertiary—Coal formation.
6. (?)—Thames-Tokatea group.
5. Older Tertiary—Kapanga group.
4. Miocene—Beeson's Island group.
3. Older Pliocene—Acidic group.
2. Newer Pliocene to Pleistocene—Kauaeranga beds.
1. Recent—Recent deposits.†

Although not having reference to the whole of the peninsula, as the most recent that has appeared, the classification of the rocks of the Coromandel Goldfield by J. Malcolm Maclaren may be given. It is as follows:—

6. Carboniferous (Maitai of Hochstetter).
5. Lower Eocene (Cretaceo-tertiary of Geological Survey).
4. Upper Eocene or Oligocene.
3. Miocene.
2. Pleistocene.
1. Recent.‡

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* Aust. Assoc. Adv. Sci., 1890, Melbourne.
† Mines Reports, 1897, Parliamentary Paper C.–9, p. 40.
‡ Mines Reports, 1900, Parliamentary Paper C.–9.

OF THE PENINSULA AS A WHOLE—ITS POSITION, PHYSICAL FEATURES, AND GEOLOGY.

Position.—Cape Colville Peninsula lies to the eastward of and is separated from the southern part of the northern district of Auckland by the Hauraki Gulf, of which it forms the eastern shore. It extends nearly due north and south, and on the east forms the western shore of the Bay of Plenty, a broad expanse of sea, the eastern limit of which is from Cape Runaway to Opotiki.

Strictly speaking, the peninsula may be considered as terminated along a line drawn between the mouths of the Thames and Tairua Rivers, but it must be apparent to every one having knowledge of the district that the tract of broad, low, swampy plain along which the Thames and Piako Rivers find their way to the sea is of extremely modern date, and that a slight depression of the land—a few feet only—would again bring the sea to the foot of Te Aroha, and the peninsula would thus connect with the mainland to the south by an isthmus between Te Aroha and the shore of Tauranga Harbour. The Great Barrier Island formed at one time a northern continuation of Cape Colville Peninsula, and has been separated from it by the denuding action of the sea. Disregarding this fact, the peninsular area from Cape Colville to Te Aroha has a length of about eighty and an average breadth of fifteen miles.

Physical Features.—The surface of the peninsula is generally broken, in some parts extremely rugged, in outline, and along the main axis the mountains rise to an elevation of 2,000 ft. to 3,000 ft. The culminating-points are, in the extreme north and south parts, Moehau and Te Aroha, these being mountains of about equal height, the former 2,900 ft., the latter 3,126 ft., above the sea. Plains are few and not extensive. On the east side the land is penetrated by a number of inlets and tidal estuaries of the more considerable streams, some of which are tidal along their course to the outer slopes of the main range. On the west side of the peninsula deep inlets and tidal streams are absent, or the latter are tidal for a short distance only. The Thames or Waihou River is tidal almost to Te Aroha, but is not a river of the peninsular tract under consideration, further than that it receives and carries to the Firth of Thames the waters of the Puriri, Hikutaia, and Ohinemuri Rivers, and a number of lesser streams that drain the western slopes of the southern part of the district.

Inland of Mercury Bay, on the north side of Whitianga Harbour, there is a swampy plain of some five by two miles in extent, and flat lands of lesser area in the same watershed, but it is only the Upper Ohinemuri or

Waihi Plain that might claim special consideration under this head. This is six to seven miles in length east and west, and three to four miles across, but the whole of the area is not flat; indeed, but little of it can be regarded as flat, and still less of it is alluvial.

The Tairua River is the largest, and has the longest course, of all the streams draining the peninsula, due to its general direction, which is north-north-east, and for a considerable distance parallel to the main range. The Whitianga River, which is next in importance, gathers its waters from a semicircular basin the eastern limit of which is almost on the coast-line, while towards the west it drains from between Table Mountain and the northern section of the main range at the source of the Puru. The Ohinemuri and the Kauaeranga are next in importance; all the others are inconsiderable. The Ohinemuri is remarkable in this: that it breaks through the south continuation of the main mountain-chain and gathers the waters of a large area that should have been discharged to the Bay of Plenty, but, as a matter of fact, are carried westward through the Ohinemuri Gorge and discharged by the Thames River into Hauraki Gulf.

The trend of the main range is not in a continuous and direct line between the north and south limits of the peninsula. Near the Thames the main divide trends closely towards the western limit of the land, and, in fact, this section of it may be said to terminate near the mouth of the Kauaeranga River. Before this so terminates, opposite the source of the Puru, the water-divide trends east to Table Mountain, and thence is continued south to the Hikutaia. On the north side of the Hikutaia Valley the water-divide trends south-east to the main source of the river, and in the same general direction to the northern main source of the Ohinemuri River, and farther follows the coast range to Waihi Beach, and by a very sinuous line is thence returned west to Te Aroha, which, rising from the verge of the Waitoa Plain, is thus again on the extreme western limit of the mountain region.

Geology.—The oldest rocks on the peninsula are slates and sandstones, evidently of Palæozoic age, with which are associated contemporaneous volcanic rocks, and dyke intrusions also of Palæozoic age. These rocks have been regarded as belonging to the Carboniferous, sometimes to the Devonian, period. Probably both formations are present, but from the lack of fossil evidence this is a matter that awaits definite settlement. Some of the slates and sandstones that hitherto have collectively been spoken of as Palæozoic must in future be regarded as belonging to the Mesozoic period, and representing the Trias formation. For the time being, speaking of these as the Palæozoic series of rocks, mainly sedimentary, as one formation, their southern known limit is, on the west side of the peninsula, at Rocky Point, near the Thames. They there occupy but a small area, younger volcanic rocks overlying and obscuring

TOKATEA HILL FROM THE SOUTH-EAST.

EAST SLOPE OF TOKATEA HILL—KENNEDY'S BAY IN THE DISTANCE.

To face p. 30.]

them till, twelve miles further north, they again appear near Hastings, in the gorge of Tapu Creek (Waipatukahu). From this point they are continuous along or a little inland of the eastern shore of the Hauraki Gulf to the southern shore of Coromandel Harbour, and thence almost continuously to Tokatea Hill, where for the first time they reach the crest and pass to the east side of the main range. Further north, on the west side of the range, the slates and sandstones are exposed in isolated outcrops to Cabbage Bay, north of which they are continuous along the west side of the range to Port Jackson.

On the east coast a considerable area of these rocks is found at Kuaotunu, showing on the coast-line, in the valley of the Kuaotunu Stream and on the Waitai Range, to the east.

These rocks appear on the eastern lower slopes of the Tokatea Range exposed in the deep gullies north of Tokatea Hill, on the north shore of Kennedy's Bay, and on the coast-line and lower eastern slopes of Moehau, on the road from Port Charles to Port Jackson, and they terminate the peninsula in Cape Colville.

Between the Tiki and Tokatea Hill, and more to the north-west, in the valley of Paul's Creek (according to Maclaren), what seems to be the lowest of the Palæozoic rocks are largely composed of igneous material which has apparently intruded into them dyke-like masses of crystalline rocks; and dykes of various igneous rocks also appear among the sandstones, &c., forming the west spur of Moehau. The younger Triassic rocks have been identified only at the Tiki, and thence across the Waiau Valley to the Thames–Coromandel Road, between Coromandel and Manaia Harbours.

The rocks next in age are Upper Secondary or Lower Tertiary—Cretaceo-tertiary; but in the Moehau district little evidence of their Secondary age is forthcoming. They consist of conglomerates followed by sandstones and shales, with thin, impure, and unworkable seams of coal, in which are streaks and nests of bituminous coal or anthracite of high quality. The coal beds are followed by marly beds with concretions, and the sequence in one place at least is closed by the limestones that in other parts are the characteristic higher beds of the Cretaceo-tertiary series.

It cannot with certainty be affirmed what were the outlines of the land over which the lowest of the coal-bearing beds accumulated, but the higher beds, from their chalky and constant character and their wide distribution, do not favour the idea that they accumulated on a very uneven surface or sea-bottom. However this may be, the fragments of the formation that have survived denudation or total destruction are found at varying heights up to 1,250 ft. above sea-level, and at some places patches show a difference in elevation of 800 ft. to 1,000 ft. within a distance of two to three miles, and it is evident the beds were largely denuded and highly disturbed before the commencement of the Tertiary volcanic outbursts. These rocks are found only in the northern part of the peninsula.

The volcanic rocks of Tertiary date are spread over four-fifths of the total area of the peninsula. For the most part they are andesitic in type and fragmental in character, especially along the west side and over all the northern part of the district. In the middle east and south-east parts of the peninsula the rocks are largely of an acid type, and of younger date than the andesites and dacites of the western and northern districts.

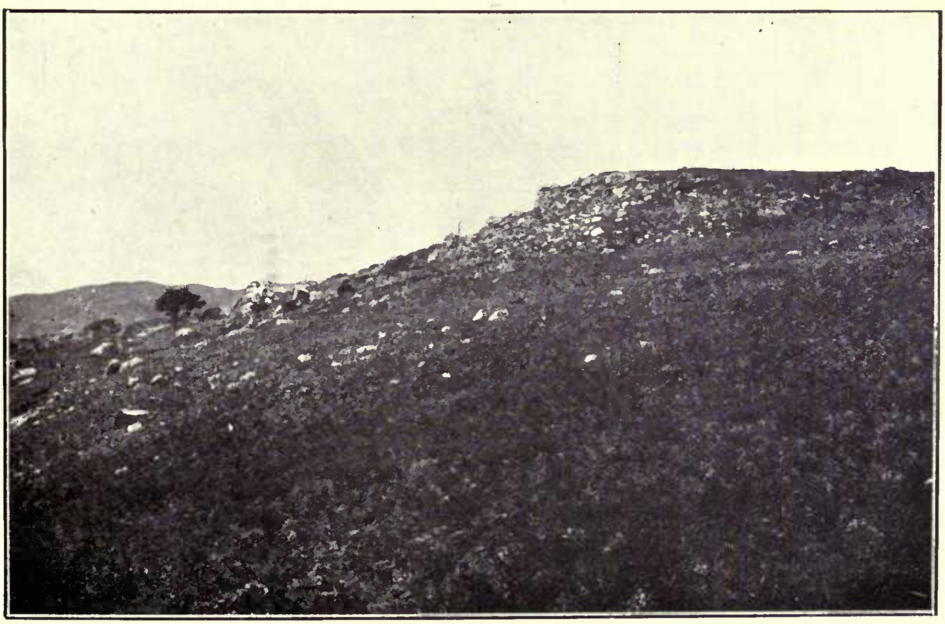
The subdivision of the volcanic rocks of the peninsula into groups of different age is a matter on which there is yet differences of opinion. It is for the most part agreed that some andesitic rocks often spoken of as the Beeson's Island group, and referred to the Miocene period, are separate and distinct from the older auriferous group or groups. The division of the older Tertiary volcanic rocks, although first made under a misapprehension of the true relation of the rocks of Tokatea Hill to those of the main range farther to the south and at the Thames, has yet an array of facts in support of the division which has been made, and there has been nothing advanced against the theory that may not be easily and effectually answered.

The acidic group of Pliocene age could easily be divided into a series of four sub-groups, as has been done in the table of formations (see page 34). The acid rocks as a whole constitute a most important group, not only on account of their great petrological interest, but also on account of their economic value. These rocks are now recognised as gold-producers, and at places contain gem opal, the mining of which may yet prove an important industry. Their value as building-stones has also to be considered.

There is a small group of intrusive andesites of Middle or Younger Pliocene age to which the great dyke forming Table Mountain and some bosses of similar rock in the Omahu district have been referred. There is, however, no evidence that basic lava-streams or volcanic ejecta of any kind were deposited at the surface during the Post-pliocene period, and the acidic rocks of the Upper Ohinemuri or Waihi Plain must be considered as the youngest volcanic rocks of Cape Colville Peninsula.

The evidences of the existence formerly of hot springs are abundant over all parts of the district, and active thermal springs still exist, especially in the south part of the peninsular area; but they are in comparison as nothing to the thermal displays in various parts of the peninsula immediately subsequent to the deposits of the Pliocene rhyolites. It is more than possible that the great deposits of siliceous sinter that occur are of different ages, but this is a matter difficult to determine, for, though some appear resting on older rocks, the enormous display of thermal effects on the mountain-range between the Tairua and Kauaeranga Valleys rests mainly or wholly on acidic rocks forming the third

SILICEOUS SINTER DEPOSITS, WAITAIA RANGE, KUAOTUNU.



SILICEOUS SINTER TERRACE, WAITAIA RANGE, KUAOTUNU.

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division of the Pliocene group. Here and at many other places, especially on the Waitai Range, in the Kuaotunu district, the preservation of the old terrace mounds is remarkably complete. Near Mackaytown, in Ohinemuri County, great quantities of fossil wood are found in the sinter deposits lying between there and the Rahu Saddle, and it is evident that many deposits of quartz in veins, some of which are worked for gold, were made by the same agency that piled up terraces of siliceous sinter in the same locality. The Silverton Hills, at Waihi, show many remains of hot-spring deposits, and in one of the mines on these hills, at 300 ft. from the surface, remains of fern-trees have been found in cavities in the reefs. These remains were several feet in length, and quite recognisable as a species of fern-tree.

POSITION AND RELATION TO EACH OTHER OF THE DIFFERENT FORMATIONS AND GROUPS OF ROCKS.

The classification of the different formations and groups of rocks on Cape Colville Peninsula, owing to the general, but not complete, absence of fossils and the presence of a great bulk of volcanic rock, is necessarily a matter of difficulty and some uncertainty. It was not till 1897 that what claimed to be a complete classification of the rocks of the peninsula made its appearance. Cox, indeed, had indicated what the classification of the larger groups of strata and volcanic rocks was likely to be. He was not, however, acquainted with every part of the peninsula, and but imperfectly with some formations of which he notes the presence. In 1897 a classification of the whole of the rocks of the peninsula appeared in the "Geology and Veins of the Hauraki Goldfields," and the same year a classification by the writer also appeared (see *ante*, page 28).

The classification here proposed is based upon the most recent information available—in part the results of field examinations made since 1897, and in part consequent on the results of examinations of rock-specimens by Professor Sollas, which in the first case led to the subdivision of the Older Mesozoic and Palæozoic rocks, and in the second case confirms the distinctions made in 1897, and has led to further subdivision of the younger volcanic rocks.

Table of Formations on Cape Colville Peninsula.

No.	Probable Age.	Formation.	Series or Group.	Nature of the Rocks.
9	Upper Devonian	Devonian ..	Te Anau series ..	Stratified beds of igneous material with associated eruptive and dyke rocks.
8	Lower Carboniferous	Carboniferous	Maitai series ..	Sandstones, slaty shales, and mudstones, with intruded dyke rocks.
7	Triassic ..	Trias ..	Wairoa series ..	Sandstones and conglomerates formed of igneous rocks and slates and mudstones.
6	Cretaceous—Eocene	Cretaceo - tertiary	(*a.*) Lower or coal-bearing series	Conglomerates, sandstones, and shales, with coal.
			(*b.*) Middle and Upper beds	Marly greensands with concretions, compact limestones, and calcareous sandstone.
5	Eocene(?) ..	Volcanic series	Thames-Tokatea group	Eruptive matter, mostly andesitic flow rocks and breccias, &c., cut by dykes.
4	Upper Eocene	"	Kapanga group ..	The same as 5.
3	Miocene ..	"	Beeson's Island group	Eruptive matter wholly andesitic or dacitic ; stratified tuff beds, with coal.
2	Pliocene ..	Acid group of Pliocene age	(*a.*) Older rhyolites	
			(*b.*) Pumiceous agglomerate or Whitianga beds	Breccia agglomerates, mostly of acid rocks, pumiceous sands, &c., with beds of lignite.
			(*c.*) Middle rhyolites	Massive flow and intrusive rocks for most part resting on 2, (*b*).
			(*d.*) Younger rhyolites	Brecciated or pitchstone rhyolites chiefly developed in the upper basin of the Ohinemuri watershed.
1	Post-pliocene	Pleistocene and Recent	(*a.*) Raised beaches	Coarse beach-gravels chiefly along the west side of the peninsula.
			(*b.*) Alluvial ..	Coarse gravel, river-deposits, and finer sediments.

Intrusions of Younger Pliocene Age—Table Mountain, &c.

Of the different formations and groups of rocks present on the peninsula and classified as above, apart from the general sketch which has been given, a short account is necessary, and will be best given in this place, followed by a list of the rock-specimens which have been described from the formation.

9. *Te Anau Series.*—The older sequence, collectively called Palæozoic slates and sandstones by previous writers, by some of which they more particularly were referred to the Maitai series of Hochstetter (Old Secondary), or the Maitai series of the Geological Survey of New Zealand (Carboniferous), or Upper Devonian, Te Anau series, can now no longer be dealt with under one heading. All the sedimentary rocks of this older series present a Palæozoic facies in the condition of their mineral constituents which is in agreement with that of the Palæozoic rocks of the mountains of the north-east of the South Island and the eastern slopes of the Southern Alps. Of previous writers Park and Cox only refer the older rocks of Cape Colville Peninsula to the Te Anau series, and in so doing the whole is considered to belong to the Upper Devonian period. Here, however, only the rocks lying within the Tiki-Tokatea district and part of the Kapanga district are so referred, and this on account of a difference in mineral

character more than any proved stratigraphical unconformity that has been shown or may be supposed to exist between the Te Anau series and the overlying Carboniferous or Maitai series.

The rocks of the Te Anau series are developed along the western middle and lower slopes of the main range from the Tiki Spur and Pukewhau Saddle in the south to the higher part of Tokatea Hill in the north. More to the north-east they are found on the road to Kennedy's Bay as far as the compressor for the Royal Oak and Tokatea Mines, and more to the north-west in the valley of Paul's Creek, as described by Maclaren.*

Research by Professor Sollas as to the nature of the material of specimens of the rocks submitted to him tends to show that to a large extent the rocks of the series are of igneous origin, solid or fragmental, as the case may be. The various specimens described as grauwackes show that clastic igneous matter was widespread during the deposition of these rocks. Grauwackes appear in the highest and lowest horizons of the series as far as can be traced. Several samples of a rock occurring in close association with the grauwackes, and sometimes scarcely to be distinguished from them, are described as and named "adinole," but it is uncertain whether in all cases this distinction can be maintained. In some cases the name was given subject to revision on its being shown that the requisite amount of soda was not present in the rock, and, as analysis proves that it is not, the alternative name "fine-grained grauwacke" would thus apply. In the lists that follow this change has not been made.

The grauwackes and adinole have associated with them rocks of an acid type so much altered that their original condition can only be guessed at. There are the quartz muscovite and quartz sericite rocks of the descriptions which follow, on some of which Professor Sollas remarks, "It is tempting to think of these rocks as altered rhyolite," and it would seem that such a conclusion, the natural consequence of this tendency, would have reasonable grounds for its adoption, not on account only that the rocks themselves give evidence of the fact, but, further, that this is confirmed by the actual presence of thick masses of rhyolite on the east side of Tokatea Hill and Saddle in connection with and as part of the Te Anau series; and more to the eastward, on the road to Kennedy's Bay, similar rocks have been noted. These rhyolites, though altered, still retain flow structure sometimes to an extraordinary degree, and at places are crowded with bipyramids of quartz.

The rocks described constitute the body and mass of the formation, but wherever rocks of the Te Anau series appear they are crowded with dyke intrusions, chiefly dacite porphyrite.

The dykes mentioned may have appeared during the latter part of the Devonian period, during Carboniferous or even during Permian times, but not

* Mines Reports, 1900, Parliamentary Paper C.-9.

later, as the proceeds of their denudation form conglomerates in Triassic strata. There is evidence of this in the Waiau, &c., district, adjacent to that in which the Te Anau rocks are chiefly developed.

The fact that during Devonian times volcanic action made great display within the area of what is now Cape Colville Peninsula had escaped detection by all who examined the geology of the district prior to 1898, and this is so remarkable that nothing must be omitted to make certain and sure the position here taken up. The igneous character of the rocks is undoubted. That need not for a moment be called in question. The ancient rhyolites are interbedded with the other strata of the formation. This also must be admitted. Younger strata, evidently pre-Jurassic and supposed to be Triassic in age, contain what is claimed to be the proceeds of the denudation of the Te Anau rocks and the dykes intruded into them. This also may be agreed to; and yet it may be asked, What are the proofs that the rocks are of Devonian age, or the dykes by which they are cut are of greater age than the Permian period?

Up till the present time the study of Palæozoic volcanic rocks has been a difficulty in connection with the geology of New Zealand. The rocks of the Dun Mountain mineral belt are of Lower Carboniferous or Upper Devonian age, and are usually thought to belong to the latter period; and the Te Anau series, developed west of Lake Wakatipu, in the Provincial District of Otago, and thence extended along the Takatimu Mountains and Longwood Range, in Southland, are the only rocks that may with confidence be considered as belonging to the Te Anau series, the typical locality of the Te Anau series lying between Lake Te Anau and Lake Wakatipu. West of Lake Wakatipu and in Nelson igneous material is characteristic of the strata composing or of rocks included in the Te Anau series, and, although in the southern districts the material of the Te Anau series may not exactly coincide with rocks of the same age on Cape Colville Peninsula, it can yet be shown that other eruptive centres active during the same or a prior period afforded material practically identical with what is met with on Tokatea Hill and thence to the Tiki.

During the last two months of 1902 the writer was engaged in south-east Nelson, within Cheviot County, in connection with seismic disturbances then taking place, and in the course of various examinations acquired a knowledge of the occurrence of a heavy band of conglomerate in the reputed Carboniferous rocks of the Cheviot Coast Range. The individuals of this conglomerate, it was observed, were often of a volcanic character, and a collection—by no means an exhaustive one—was made of the various kinds of rock which made up this conglomerate. On closer inspection it was seen that many rocks contained in this conglomerate agreed in character with the igneous rocks of the Te Anau series of Tokatea Hill and the conglomerates of the Trias rocks on the range between Coromandel and Manaia Harbours.

These conglomerates in Carboniferous strata, as regarded the individual rocks represented in them, must have been derived from the Te Anau or an older formation, and other than the Te Anau no formation is likely to yield such rocks.

A selection of the different rocks as far as collected was made from this Cheviot conglomerate; but before being despatched to England this was supplemented by a further collection from a conglomerate associated with the older rocks of south-east Wellington, which, as part of the Rimutaka (equivalent to the Maitai) series, is thus also considered Carboniferous in age. These conglomerates had been noted in 1875, after which they remained unheeded till attention was again directed to them as likely to supplement the rocks that had already been collected from the Cheviot Coast Range. Further collection of these rocks was made, and a selection of the whole was forwarded to Professor Sollas.

Twelve samples of these conglomerate rocks have been described and named, as follows :—

1. Rhyolite.
2. Altered rhyolite.
3. Rhyolites.
   (*a.*) With plagioclase.
   (*b.*) With quartz grains.
   (*c.*) Without quartz.
4. Spherulitic rhyolite.
5. Quartz felsite.
6. Altered micropœcillitic andesite.
7. Granophyre (of Rosenbuch).
8. Micrographic albite granite.
9. Rhyolite with albite.
10. Altered andesite.
11. Granite.
12. Foliated granite.

If these are compared with a list of the rocks of the Te Anau series of the Tiki-Tokatea district, or of the conglomerates in Trias strata on the range between Coromandel and Manaia Harbours, it will probably be admitted that there is more than a passing chance correspondence between them, and with a deeper knowledge of the subject a stronger conviction must be the result. These facts, as far as they go, and the evidence in favour of unconformity between the Te Anau rocks and the series next overlying, are the grounds on which Devonian rocks are considered present on Cape Colville Peninsula.

The dykes that appear through the sedimentary and volcanic rocks of the Te Anau series within the Tiki-Tokatea district are at places so crowded together or of such size that their *débris* obscures the rocks through which they break, and in the case of Tokatea Hill its eastern slope is said to have a covering of volcanic rocks of Tertiary age which, having considerable thickness, have to be penetrated in order to reach the felsitic rocks that form the inner part and core of the mountain. Except a superficial covering on the very top of the hill and its northern continuation as part of the Tokatea Range, where Tertiary volcanic rocks are strongly developed, a stray boulder from the north end of the Success Range can alone support the statement that Tertiary volcanic rocks must be driven through in order to reach the Te Anau rocks.

List of Rocks of the Te Anau Series, and of the Dyke Rocks occurring in Connection with the Same.

Sedimentary and doubtfully Volcanic Rocks.

(1.) Specimen No. 2760. Quartz muscovite rock.
(Cadman's Creek, Tiki-Tokatea district.

(2.) „ 2788. Quartz sericite rock.
(Cadman's Creek, Tiki-Tokatea district.

(3.) „ 2792. Quartz muscovite rock.
(Tiki Creek, Tiki-Tokatea district.)

(4.) „ 2900. Spotted adinole.*
(Tiki Creek, Tiki-Tokatea district.)

(5.) „ 2913. Grauwacke.
(Pukewhau Creek, Tiki-Tokatea district.

(6.) „ 2992. Grauwacke.
(Courthouse Creek, Tiki-Tokatea district.

(7.) „ 3168. Spotted adinole.
(Tokatea Mine, Tiki-Tokatea district.

(8.) „ 3178. Spotted adinole.
(Tokatea Mine, Tiki-Tokatea district.)

(9.) „ 3188. Spotted adinole.
(No. 6 level, Tokatea Mine, Tiki-Tokatea district.)

(10.) „ 3216. Spotted adinole.
(Hauraki Associated (upper level), Tiki-Tokatea district.)

(11.) „ 3223. Spotted adinole or fine-grained grit.
(Success Range, near Tokatea Saddle, Tiki-Tokatea district.)

(12.) „ 3241. Indeterminate.
(Hauraki Associated Mine, Tiki-Tokatea district.)

(13.) „ 3290. Quartz felspar grit or grauwacke.
(No. 7 level, Tokatea Mine, Tiki-Tokatea district.)

(14.) „ 3411. Adinole.
(No. 3 level, Royal Oak Mine, Tiki-Tokatea district.)

Contemporaneous Volcanic Rocks.

(15.) Specimen No. 3189. Rhyolite replaced by quartz.
(On road from Tokatea to Kennedy's Bay, half a mile above compressor, Tiki-Tokatea district.)

(16.) „ 3200. Rhyolite replaced by quartz.
(On road from Tokatea Saddle to Kennedy's Bay, about a mile above compressor, Tiki-Tokatea district.)

(17.) „ 3208. Rhyolite replaced by quartz.
(Ridge between Kennedy's Bay Road and north end of Success Range, Tiki-Tokatea district.)

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* Owing to the low percentage of soda these rocks find place with the grauwackes, but the name "adinole" is retained.

DYKE INTRUSIONS NOT LATER THAN THE CARBONIFEROUS PERIOD.

Dacite Porphyrite.

(18.) Specimen No. 2735. Dacite porphyrite.
(Left branch of Cadman's Creek, Tiki-Tokatea district.)

(19.) " 2736. Hornblende dacite porphyrite.
(Right branch of Cadman's Creek, Tiki-Tokatea district.)

(20.) " 2817. Quartz uralite porphyrite, or uralite dacite.
(Tiki Creek, Tiki-Tokatea district.)

(21.) " 2865. Uralite dacite porphyrite.
(Right branch of Cadman's Creek, Tiki-Tokatea district.)

(22.) " 2914. Hornblende dacite porphyrite.
(Tiki Creek, Tiki-Tokatea district.)

(23.) " 3186. Hornblende dacite porphyrite.
(Near waterfall, east side of Tokatea Saddle, Tiki-Tokatea district.)

(24.) " 3222. Pilotaxitic dacite porphyrite.
(No. 7 level, Tokatea Mine, Tiki-Tokatea district.)

Dacite.

(25.) Specimen No. 2808. Pilotaxitic hornblende dacite.
(Tiki Creek, Tiki-Tokatea district.)

(26.) " 2853. Altered dacite.
(Right branch of Cadman's Creek, Tiki-Tokatea district.)

8. *Maitai Series.*—The position and the relation of this series to the Te Anau rocks underlying and the overlying Triassic beds have already been referred to. It may be admitted that the development of Carboniferous rocks on Cape Colville Peninsula closely resembles the typical rocks in the Maitai Valley, Nelson, but in the absence of recognisable fossils identity is beyond proof, and it is on the resemblance of the rocks only that they are referred to and considered part of the Maitai series.

The chief developments of this series lie along the coast-line between Tapu Creek and Kirita Bay, and inland the same area extends across the Manaia watershed into that of the Waiau River; and in the northern part of the peninsula from Cabbage Bay to Port Jackson, on the west side, and at Kennedy's Bay and Kuaotunu, on the east side, of the peninsula.

The rocks are hard sandstones, thin or thicker bedded slaty shales, and mudstones, the latter more or less calcareous and sometimes containing nodules of impure limestone. Bands of pebbly grit and slaty grauwacke breccias are also not uncommon, and in some localities the dark slaty rocks become highly indurated and resemble lydian stone. Highly carbonaceous or impure coaly beds are found on both sides of the northern termination of the Waitai Range, Kuaotunu.

Dyke intrusions of Palæozoic age occur in the northern part of the peninsula, and of later date at Cabbage Bay and more to the south, between Manaia and Tapu Creek watersheds.

Few of the sedimentary rocks of the formation were collected from, and only two examples were included in the collections sent to England. The igneous rocks in connection with this series are all dyke intrusions, no contemporaneous volcanic rocks being known, with the doubtful exception of the "felsite tuff" of Rocky Point, near the Thames. As the lower layers of this are clearly interbedded with the dark slaty shales on the beach north of the point, the presumption is that the whole has been laid down under water, otherwise, in material at least, the deposit corresponds to the adinole rocks of Tokatea Hill, and in part may also be of the same age.

The dyke rocks of Moehau, being for the most part dioritic in character and Palæozoic in age, are thus to be distinguished from the dykes in the Cabbage Bay district and farther south, on the shore of Hauraki Gulf, north of the mouth of the Mata River, which are chiefly andesites.

These rocks are of interest chiefly as forming in the northern part of the peninsula the main water-divide, and more to the south the nucleus of the mountain-range as far as the sources of the Manaia River, and as carrying the diorite dykes of Moehau and auriferous quartz lodes on the Kuaotunu Goldfield and of Tapu Creek.

List of Rocks of the Maitai Series, and of the Dyke Rocks penetrating them.

SEDIMENTARY.

(1.) Specimen No. 3199. Fine-grained siliceous grit.
(Tapu Creek, Mata River, Tapu Creek district.)

(2.) " 3626. Problematical.
(Western base of Black Jack, Kuaotunu district.)

INTRUSIVE.

Igneous Dykes in Moehau District.

Diorite.

(3.) Specimen No. 2709. Quartz augite diorite.
(South shore of Coromandel Harbour, but evidently derived from Moehau district.)

(4.) " 3083. Diorite with quartz.
(Mouth of Waiaro Creek, Moehau district.)

(5.) " 3084. Quartz diorite.
(Mouth of Waiaro Creek, Moehau district.)

(6.) " 3093. Quartz biotite diorite porphyrite.
(Mouth of Waiaro Creek, Moehau district.)

(7.) " 3102. Quartz augite diorite porphyrite.
(Mouth of Waiaro Creek, Moehau district.)

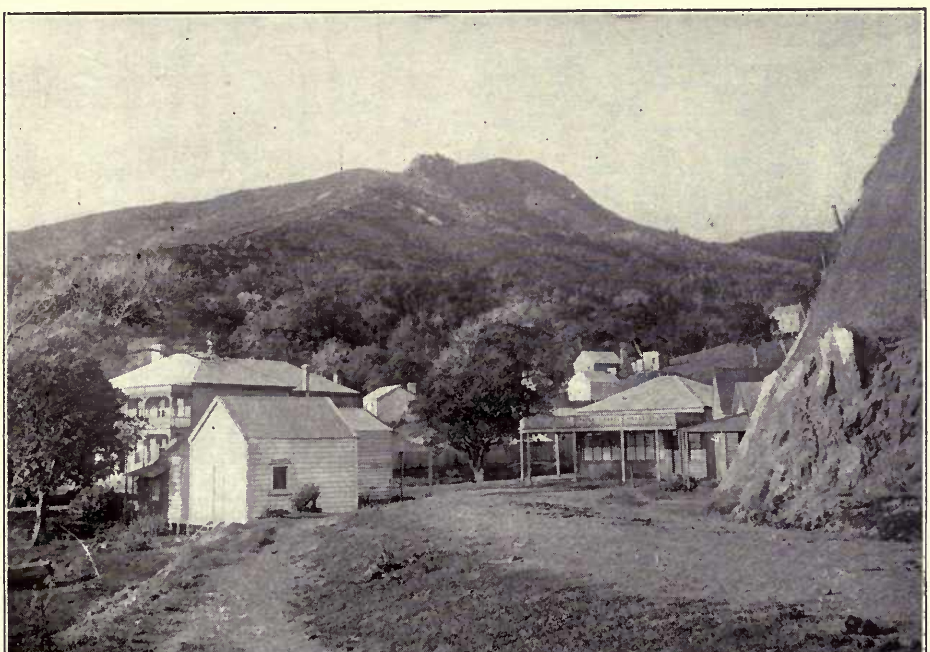
(8.) " 4096. Quartz biotite diorite.
(Coast-line, west spur of Moehau, Moehau district.)

Dacite Porphyrite.

(9.) Specimen No. 3103. Hornblende dacite porphyrite.
(Mouth of Waiaro Creek, Moehau district.)

(10.) " 3126. Dacite porphyrite.
(Mouth of Waiaro Creek, Moehau district.)

BLACK JACK, WAITAIA RANGE, FROM MATARANGI.



BLACK JACK FROM KUAOTUNU TOWNSHIP.

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Dacite.

(11.) Specimen No. 3042. Microgranitic dacite.
(Mouth of Waiaro Creek, Moehau district.)
(12.) „ 3064. Hornblende dacite with a trachyte habit.
(Mouth of Waiaro Creek, Moehau district.)

Andesite.

(13.) Specimen No. 3053. Hypersthene andesite.
(Mouth of Waiaro Creek, Moehau district.)
(14.) „ 3077. Hornblende andesite.
(Mouth of Waiaro Creek, Moehau district.)

Igneous Dykes in Cabbage Bay District.

Andesite.

(15.) Specimen No. 3138. Hypersthene hornblende andesite.
(Coast-line south of Tawhetarangi Creek.)

Igneous Dykes in Waiau Valley District.

Dacite Porphyrite.

(16.) Specimen No. 3350. Dacite porphyrite.
(Forks of Manaia River.)

Andesite.

(17.) Specimen No. 3352. Hornblende andesite, much altered.
(Forks of Manaia River.)

Igneous Dykes in Mata River, Tapu Creek District.

Andesites.

(18.) Specimen No. 3889. Hornblende andesite.
(Coast north of Mata River.)
(19.) „ 3901. Hornblende hypersthene andesite.
(Coast north of Mata River.)

7. *Wairoa Series.*—As far as has yet been ascertained rocks belonging to this series are confined to a restricted district extending from the Pukewhau Saddle across the Matawai Valley into and across that of the Waiau River to the Thames–Coromandel Road between Manaia and Coromandel Harbours.

There is evident unconformity between the rocks of this and the Te Anau series in the upper part of Pukewhau Creek near the Saddle, and there should also be like evidences of unconformity between the Wairoa and Maitai series in the Waiau Valley, but for the most part the junction between the two is in rugged mountain country or covered by volcanic rock.

The various branches of the Manaia drain slate and sandstone mountains capped by volcanic rocks, but most of the upper watershed of this river is unexplored, and it is uncertain how far into this watershed the Wairoa rocks extend.

The rocks of the Wairoa series are coarse- and fine-grained sandstones with pebble-beds, sometimes passing into fine-grained conglomerate and dark slaty or brick-red and purple coloured shales. The red shales are seen on the

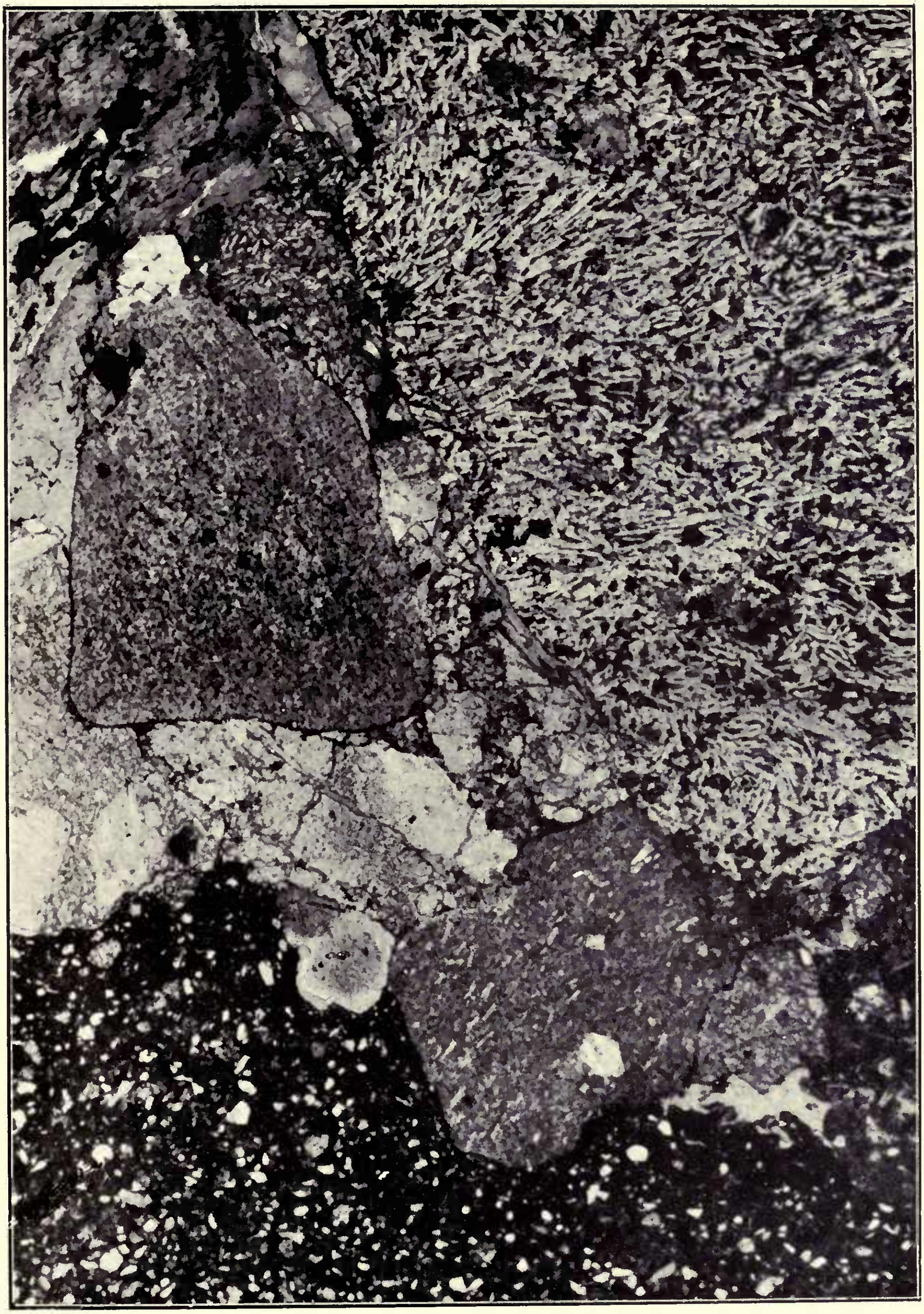
Pukewhau Saddle, the other rocks are best seen along the Thames–Coromandel Road. On the south shore of Coromandel Harbour the rocks are sandstones and sandy shales much crushed and jointed often with white powdery joints, and distinctly different from what the rocks are on the higher part of the range between Coromandel and Manaia Harbours; and it is possible that the rocks along the shore of Coromandel Harbour east of Mill Creek may belong to the Te Anau series. Early in 1897 J. M. Maclaren, Director of the Coromandel School of Mines, discovered that these rocks were in part formed of rhyolitic volcanic material, and the same year the writer discovered the conglomerates on the range between Coromandel and Manaia Harbours. The rocks on the higher part of the range are evenly bedded, and do not show crush to the extent seen in the low grounds to the north; they are also—perhaps due to weathering—of a lighter colour. As the range is ascended an occasional pebble is met with on the hill-slope, evidently liberated from the sandstones exposed in the road-cuttings, and from the higher part of the range masses of conglomerate are seen lodged in the gully below and parallel to the road, but it is not till reaching the south slope of the range on the fall to Manaia that the conglomerates are fully exposed in the road-cuttings. A band of conglomerate 10 ft. to 20 ft. in thickness has been exposed in cuttings in connection with a deviation from the old road on the descent to Manaia. From this conglomerate all the specimens sent to England were obtained, and the proofs of the unconformity between the Wairoa and Maitai series rests mainly on the nature of the rocks included in these conglomerates, igneous rocks derived both from the Te Anau and the Maitai formations forming the greater bulk of the conglomerate.

The beds are thus of a later date than the Carboniferous period. Permian they might be, but it is more probable that they are of Triassic age. What positive evidence there is of the age of the beds is slender indeed, and consists of an external imprint of a fragment of *Monotis salinaria*, var. *richmondiana*, very common in and characteristic of the Trias rocks of New Zealand, a fossil which is often found in coarse grits and conglomerates elsewhere than on Cape Colville Peninsula. A single fragment of this fossil was found, unrecognisable it may be to some, but I had minute acquaintance with the fossil species in the condition of casts, and, doubting not its identity, the rocks have been referred to the Wairoa series of the Geological Survey.

List of Rocks found in the Conglomerates of Triassic Age on the Range between Coromandel and Manaia Harbours.

(1.) Specimen No. 3443. Conglomerate formed mainly of pebbles of igneous rocks—

(*a.*) Grauwacke.
(*b.*) Andesite (both pilotaxitic and hyalopilitic).
(*c.*) Dacite.
(*d.*) Rhyolite.



No. 87/3443.—CONGLOMERATE OF ROUNDED PEBBLES OF IGNEOUS ROCKS.

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(2.) Specimen No. 3450. Conglomerate composed mainly of igneous rocks—
(*a.*) Andesite.
(*b.*) Rhyolite.

(3.) „ 3453. Conglomerate composed mainly of igneous rocks—
(*a.*) Pilotaxitic andesite.
(*b.*) Silicified rhyolite.
(*c.*) Hyalopilitic andesite.
(*d.*) Calcareous grauwacke.

(4.) „ 4363. Conglomerate composed mainly of igneous rocks—
(*a.*) Andesite.
(*b.*) Rhyolite.
(*c.*) Fine-grained grauwacke.

(5.) „ 3464. Conglomerate composed mainly of igneous rocks—
(*a.*) Banded rhyolite.
(*b.*) Pilotaxitic andesite.
(*c.*) Hyalopilitic andesite.
(*d.*) Grauwacke.

6. *Cretaceo-tertiary.*—In separate localities or together this appears as (*a*) the lower or coal-bearing division, and (*b*) an upper or calcareous part. The rocks were not specially collected from, and none were forwarded for description. Nevertheless, the occurrence of small areas of this formation at various places in the northern part of the peninsula is of general interest, and is held to be important as likely to determine the age of some at least of the volcanic groups. Unfortunately, what is of most importance in this connection —viz., the age of the Thames-Tokatea group—is not likely to be so determined, since none of its rocks occur in contact with or in the near vicinity of known areas of the Cretaceo-tertiary formation.

The complete sequence in one section can nowhere be seen, but that which is most nearly so is displayed on the coast-line at Torihine, and a little inland of that place, in the Cabbage Bay district. This shows both the higher and the lower beds; but the rocks are far short of the total thickness which is found in other parts of the country. Two lesser areas of these rocks lie to the south-east and south-west of that on the coast-line at Torihine. These represent the lower beds, and have associated as part of this series thin seams of coal of a bituminous character, but in every case the seams are too thin or too impure to admit of their being worked.

The small area to the south-west in Tawhetarangi Creek is of little importance, seeing that, like the better-known outcrop on the coast-line, it rests upon Maitai rocks, and disappears under rocks of the Beeson's Island group, the rocks of the Kapanga group lying farther to the south-east and east. In the latter direction, under the northern end of the Tokatea Range, there are two small outcrops of the lower division of these beds, and that of the two which lies most to the south-west in section shows clearly that its rocks are overlain, necessarily unconformably, by stratified volcanic tuffs and breccia-beds belonging to the Kapanga group, which forms the area (and parts adjacent thereto) of the northern end of the Tokatea Range, and this to the exclusion of the Thames-Tokatea rocks.

Unfortunately, there are no Cretaceo-tertiary rocks farther to the south, where Thames-Tokatea rocks are present, and thus there is little hope of determining by infra-position of the Cretaceo-tertiary rocks that the Thames-Tokatea group is the younger. There is, however, no evidence to the contrary, and in the classification here adopted the whole of the latter sequence of volcanic rocks is considered Post-cretaceo-tertiary. The occurrence of an outcrop of Cretaceo-tertiary rocks on the main ridge north of Moehau has already been mentioned, and to that account nothing need here be added.

5. *Eocene(?) Thames-Tokatea Group.*—This is the oldest division of the Post-cretaceous volcanic series, and, with the Kapanga group, constitutes the auriferous series or group of most writers on the geology of the Hauraki goldfields. The separation of the auriferous volcanic rocks into two groups was first suggested and carried out by the writer in a report embodying the results of the examinations made by him during 1896–97.* After a comparison of the rocks forming the lower grounds of the Kapanga district with those of Tokatea Hill, Tokatea Saddle, and the northern part and western slope of the Success Range, in the Tiki-Tokatea district, it became abundantly manifest that in the parts first and last specified the rocks were different, even though in both groups they consisted mainly of fragmental ejecta and solid rocks of an andesitic or dacitic character, or, as described in identical terms in the classification adopted in the report above referred to. There could be no doubt as to the distinctness of the rocks on Tokatea Hill; but as no one had previously described the igneous rocks of that locality as other than the result of the Tertiary volcanic outburst, and finding that to the south and along the east slope of the main range the rocks were indeed the product of Tertiary eruptions, the Tokatea rocks were considered identical with the Tertiary volcanic rocks, but distinct from the same rocks in the lower grounds to the west. After tracing the rocks of the higher part and east slope of the Success Range south to the limits of Coromandel County, and yet further south to the Thames goldfields, there seemed sufficient grounds for regarding the Kapanga rocks as distinct, and accordingly the auriferous volcanic rocks were divided into what has since been known as the Thames-Tokatea and Kapanga groups.

The investigations carried on during 1897–98 showed that the rocks of Tokatea Hill and the middle and lower west slopes of the main range to the Tiki, though largely igneous and in part volcanic, belonged to an older series of Palæozoic age, and could no longer be considered as having originated so late as Tertiary times. They had consequently to be removed from the Thames-Tokatea group of the report above mentioned, and in this report they are described as an important and characteristic part of the Te Anau series.

* Mines Reports, 1897.

The more radical distinction between the Thames-Tokatea and Kapanga groups was thus lost, and it became a question whether it was or was not advisable to again unite in one the Thames-Tokatea and Kapanga groups. In the meantime the relation of the two groups had been investigated in all parts of the peninsula, and sufficient evidence had been collected to render probable the conclusion that, apart from the rocks of Tokatea Hill and the west slope of the range thence to the Tiki, the Thames-Tokatea as a group of rocks was distinct from and older than the Kapanga group.

It were needless, and scarcely here in place, to detail the evidence upon which this conclusion rests; but the identification of the Thames-Tokatea rocks in the Puriri Valley at Karangahake, and doubtfully in Te Aroha, will be accepted by most, whilst the rocks of Boat Harbour, Broken Hills, Neavesville, Waitekauri, and Waihi are none the less surely to be correlated with the Kapanga rocks occurring in the neighbourhood of Coromandel. The rocks themselves, and that in a remarkable manner, testify the correctness of the distinction that has been made.

The rocks of the Thames-Tokatea group are in the main andesites and dacites, solid or fragmental; but in connection with the same rocks there is in Karangahake Mountain a considerable development of acid rocks, including spherulitic rhyolite, and there are also traces of rhyolitic intrusion farther south in Te Aroha. The fragmental rocks of this group can usually be distinguished from those of the Kapanga group by their darker green or purple colour, and the greater degree of their compactness.

List of Rocks described from the Thames-Tokatea Group.

Andesitic.

(1.) Specimen No. 637. Andesic tuff.
(Una Hill, Thames district.)

(2.) " 733. Fragmental andesitic rock.
(Adelaide Mine, Thames district.)

(3.) " 3636. Pilotaxitic andesite.
(Last crossing of river, Coromandel to Whangapoua, Opitonui district.)

(4.) " 3664. Obscurely pilotaxitic andesite.
(First crossing of river on road, Coromandel to Whangapoua, Opitonui district.)

(5.) " 3921. Andesite or dacite much altered.
(Bluff south of Tapu Creek, Mata to Waiomio district.)

(6.) " 3932. Andesite or dacite much altered.
(Blackstone Creek, Opitonui district.)

(7.) " 4053. Andesite agglomerate.
(Cascade Creek, Te Aroha district.)

(8.) " 4081. Fragmental andesitic rock.
(Cascade Creek, Te Aroha.)

Pyroxene Andesite.

(9.) Specimen No. 40. Altered pyroxene andesite.
(Ravenswood Claim, Karangahake district.)
(10.) " 44. Altered pyroxene andesite.
(West slope of Karangahake Mountain.)
(11.) " 147. Grey pyroxene andesite.
(Ravenswood Mine, Karangahake district.)
(12.) " 307. Brecciated pyroxene andesite.
(Near Township of Karangahake.)
(13.) " 330. Altered pyroxene andesite.
(Woodstock Mine, Karangahake district.)
(14.) " 335. Altered pyroxene andesite.
(Woodstock Mine, Karangahake district.)
(15.) " 628. Altered pyroxene andesite.
(Una Hill, Thames district.)
(16.) " 699. Altered pyroxene andesite.
(Tararu Creek, Thames district.)
(17.) " 705. Altered pyroxene andesite.
(Tararu Creek, Thames district.)
(18.) " 713. Altered pyroxene andesite.
(Tararu Creek, Thames district.)
(19.) " 719. Altered pyroxene andesite.
(Tararu Creek, Thames district.)
(20.) " 732. Altered pyroxene andesite.
(West slope of Una Hill, Thames district.)
(21.) " 736. Altered pyroxene andesite.
(North Star Claim, Una Hill, Thames district.)
(22.) " 745. Altered pyroxene andesite(?).
(Adelaide Mine, Una Hill, Thames district.)
(23.) " 799. Altered pyroxene andesite.
(Shellback Creek, Thames district.)
(24.) " 813. Altered pyroxene andesite.
(Shellback Creek, Thames district.)
(25.) " 818. Altered pyroxene andesite.
(Tararu Creek, Thames district.)
(26.) " 822. Altered pyroxene andesite.
(Moanataiari Tunnel, Thames district.)
(27.) " 833. Pilotaxitic pyroxene andesite.
(Caledonian Mine, Thames district.)
(28.) " 1309. Micropœcillitic pyroxene andesite.
(Waiorongomai, Te Aroha district.)

Hypersthene Andesite.

(29.) Specimen No. 27. Hyalopilitic hypersthene andesite.
(Karangahake district.)
(30.) " 31. Hypersthene andesite altered by quartz.
(Karangahake district.)
(31.) " 50. Black hypersthene andesite.
(Karangahake district.)
(32.) " 309. Hypersthene andesite.
(Karangahake district.)

(33.) Specimen No. 380. Altered hypersthene andesite.
(Woodstock Mine, Karangahake district.)

(34.) „ 626. Black micropœcillitic hypersthene andesite.
(Gloucester Claim, Thames district.)

(35.) „ 636. Black micropœcillitic hypersthene andesite.
(Top of Una Hill, Thames district.)

(36.) „ 662. Black hypersthene andesite.
(Tararu Creek, Thames district.)

(37.) „ 671. Black hypersthene andesite.
(Hape Creek, Thames district.)

(38.) „ 675. Black altered hypersthene andesite.
(Adelaide Claim, Una Hill, Thames district.)

(39.) „ 692. Black hypersthene andesite.
(Quarries, Hape Creek, Thames district.)

(40.) „ 749. Black hypersthene andesite.
(East of Una Hill, Thames district.)

(41.) „ 802. Black micropœcillitic hypersthene andesite.
(Source of Shellback Creek, Thames district.)

(42.) „ 823. Hypersthene andesite.
(Tararu Creek, Thames district.)

(43.) „ 3632. Pilotaxitic hypersthene andesite.
(Blackstone Creek, Opitonui district.)

(44.) „ 3635. Pilotaxitic hypersthene andesite.
(Opitonui Creek, Opitonui district.)

(45.) „ 3643. Obscurely pilotaxitic hypersthene andesite.
(Maiden Mine, Opitonui district.)

(46.) „ 4001. Pilotaxitic hypersthene andesite.
(Monowai Mine, Mata-Monowai district.)

(47.) „ 4035. Pilotaxitic hypersthene andesite.
(Tapu Creek, half-way from Hastings to Martha Royal Mine.)

(48.) „ 4038. Pilotaxitic hypersthene andesite.
(Monowai Mine, Mata-Monowai district.)

(49.) „ 4044. Pilotaxitic hypersthene andesite.
(Waiorongomai Creek, Te Aroha district.)

(50.) „ 4058. Pilotaxitic hypersthene andesite with rhyolite.
(Cascade Creek, Te Aroha district.)

(51.) „ 4061. Pilotaxitic hypersthene andesite.
(Cascade Creek, Te Aroha district.)

(52.) „ 4080. Hyalopilitic hypersthene andesite.
(Waiorongomai Creek, Te Aroha district.)

Hypersthene Hornblende Andesites.

(53.) Specimen No. 649. Grey hypersthene hornblende andesite.
(Hape Creek, Thames district.)

(54.) „ 2877. Hypersthene hornblende andesite.
(Matawai-Waiau Junction, Waiau, &c., district.)

Hornblende Pyroxene Andesite.

(55.) Specimen No. 658. Decomposed hornblende pyroxene andesite.
(Karaka Creek, Thames district.)

(56.) „ 670. Altered hornblende pyroxene andesite.
(Hape Creek, Thames district.)

(57.) Specimen No. 679. Altered hornblende pyroxene andesite.
(Karaka Creek, Thames district.)

(58.) „ 709. Hornblende pyroxene andesite.
(Tararu Creek, Thames district.)

(59.) „ 734. Altered hornblende pyroxene andesite.
(Tararu Creek, Thames.)

Hornblende Hypersthene Andesite.

(60.) Specimen No. 721. Hornblende hypersthene andesite.
(Tararu Creek, Thames district.)

(61.) „ 748. Hornblende hypersthene andesite.
(North Star Claim, Una Hill, Thames district.)

Altered Andesites.

(62.) Specimen No. 167. Completely transformed andesite(?).
(Ohinemuri Gorge, Karangahake district.)

(63.) „ 181. Completely transformed andesite.
(Ohinemuri Gorge, Karangahake district.)

(64.) „ 400. Altered andesite.
(Crown Mines, Karangahake district.)

(65.) „ 401. Altered andesite.
(Crown Mines, Karangahake district.)

(66.) „ 402. Altered andesite(?).
(Crown Mines, Karangahake district.)

(67.) „ 406. Altered andesite(?).
(Crown Mines, Karangahake district.)

(68.) „ 629. Completely transformed into carbonates and chlorite; vesicles filled with quartz.
(North Star Claim, Thames district.)

(69.) „ 678. Altered andesite.
(Gloucester Claim, Thames district.)

(70.) „ 682. Altered (andesite?).
(Deep Sinker Mine, Thames district.)

(71.) „ 687. Altered (andesite?).
(Deep Sinker Mine, Thames district.)

(72.) „ 2995. Altered andesite.
(Buffalo Mine, Tiki-Tokatea district.)

(73.) „ 4013. Andesite, or perhaps dacite, much decomposed.
(Tapu Creek Gorge, Thames County.)

(74.) „ 4064. Probably once an andesite; altered by quartz and pyrites.
(Waiorongomai Creek, Te Aroha district.)

Dacite.

(75.) Specimen No. 703. Dacite breccia.
(Tararu Creek, Thames district.)

(76.) „ 3354. Dacite.
(Success Mine, Tiki-Tokatea district.)

Pyroxene Dacite.

(77.) Specimen No. 836. Altered pyroxene dacite or pyroxene rhyolite.
(Chicago Mine, Tararu Creek, Thames district.)

Pyroxene Hornblende Dacite.

(78.) Specimen No. 712. Pyroxene hornblende dacite.
(Tararu Creek, Thames district.)

(79.) " 724. Altered hypersthene hornblende dacite or quartz hornblende hypersthene andesite.
(Tararu Creek, Thames district.)

Hornblende Pyroxene Dacite.

(80.) Specimen No. 696. Hornblende pyroxene dacite.
(Tararu Creek, Thames district.)

Hornblende Dacite.

(81.) Specimen No. 737. Hornblende dacite with pyroxene.
(Adelaide Mine, Una Hill, Thames district.)

(82.) " 3356. Hornblende dacite.
(Success Mine, Tiki-Tokatea district.)

Altered Dacite.

(83.) Specimen No. 200. Completely altered dacite.
(Ravenswood Mine, Karangahake district.)

(84.) " 631. Altered dacite.
(Gloucester Claim, Thames district.)

(85.) " 656. Altered dacite.
(Tararu Beach, Thames district.)

Hornblende Dacite Porphyrite.

(86.) Specimen No. 3638. Hornblende dacite porphyrite.
(Maiden Mine, Opitonui district.)

Diorite.

(87.) Specimen No. 3866. Augite diorite with hypersthene.
(Coast, Tapu Creek to Waiomio, Thames County.)

Rhyolite.

(88.) Specimen No. 292. Spherulitic and crystalline granular rhyolite.
(Talisman Extended, Karangahake district.)

(89.) " 301. Spherulitic rhyolite partly replaced by quartz.
(Talisman Extended, Karangahake district.)

(90.) " 324. Rhyolite with pyroxene.
(Maria Lode, Woodstock Mine, Karangahake district.)

(91.) " 338. Anorthoclase or microperthite pyroxene rhyolite.
(Golden Fleece Claim, Karangahake district.)

(92.) " 382. Pyroxene rhyolite, more probably a trachyte.
(Talisman Mine, Karangahake district.)

(93.) " 485. Altered pyroxene rhyolite.
(Imperial Mine, Karangahake district.)

Indeterminate.

(94.) Specimen No. 199. Stratified fragmental volcanic rock.
(Ravenswood Mine, Karangahake district.)

(95.) " 3665. Volcanic rock replaced by quartz, sericite, and pyrites.
(Maiden Mine, Opitonui district.)

(96.) Specimen No. 3898. Highly altered igneous rock.
(First bay south of mouth of Mata River, Thames County.)

(97.) " 3905. Highly altered igneous rock.
(Monowai Mine, Thames County.)

4. *Kapanga Group.*—From the typical district on the shores of Coromandel Harbour the rocks of the Kapanga group are developed toward the north-east and north, passing the crest of the main range two to two miles and a half north of Tokatea Saddle, reaching the east coast about as far north of Kennedy's Bay; and thence they extend along the east side of the peninsula a short distance from the coast-line to where they appear on the shore-line, at Port Charles. On the west side of the northern part of the peninsula the rocks of the Kapanga group are not found on the coast-line north of Paparoa, though at the head of Cabbage Bay there is but a narrow belt of slate between them and the sea. The peak of Moehau seems to show an outlier of these rocks, and they crown the main ridge of the mountain-chain for a short distance to the south, and the same rocks descend the northern slope of Moehau towards Port Jackson. On the west side of the peninsula, south of the typical area, they are met with in the hills on the west side of the Waiau Valley, and are evidently developed within the Manaia watershed, but to what extent is unknown. They are not met with further to the south on the west side of the peninsula, as to the west of the main range the rocks of the Thames-Tokatea group are everywhere followed by those of the Beeson's Island group. South of Kennedy's Bay the rocks of this group are not present on the east side of the main range till reaching the upper part of the Whenuakite Valley and Boat Harbour, on the coast-line a few miles north of the mouth of Tairua River. South of the Tairua River andesic rocks on the coast-line and more inland towards and at Broken Hills may be and have been considered as belonging to this group, as also should be regarded the rocks at Neavesville and round the west sources of the Fourth Branch of the Tairua. Within the Wharekawa watershed, on the east coast, is the beginning of an extensive and continuous area of these rocks, the south-east termination of which is at Waihi and the south-west in the lower Waitekauri, towards Owharoa. Rocks belonging to this group have not been identified farther to the south within the bounds or beyond the borders of the peninsular district of the Hauraki Goldfields.

The following is a list of the rocks described from the Kapanga group:—

Andesites.

(1.) Specimen No. 423. Black micropœcillitic andesite.
(Water-race above township, Waitekauri Valley.)

(2.) " 2952. Pilotaxitic andesite.
(Road quarries, Britannia Claim, Kapanga district.)

(3.) " 3036. Fragmental andesic rock.
(Kapanga Mine, Kapanga district.)

Pyroxene Andesite.

(4.) Specimen No. 1295. Altered pyroxene andesite.
(Grand Junction Mine, Waihi district.)
(5.) " 1320. Pyroxene andesite.
(Britannia Mine, Kapanga district.)
(6.) " 2945. Fragmental pyroxene andesite.
(Kapanga North Mine, Kapanga district.)
(7.) " 3032. Altered pyroxene andesite.
(Kapanga Mine, Kapanga district.)

Hypersthene Andesite.

(8.) Specimen No. 87. Grey hyalopilitic hypersthene andesite.
(Near Waihi, Waihi district.)
(9.) " 207. Hyalopilitic hypersthene andesite.
(Wharekiraupunga, Waihi district.)
(10.) " 258. Quartz hypersthene andesite.
(Coast Range, Waihi district.)
(11.) " 367. Hyalopilitic hypersthene andesite.
(Upper crossing of Ohinemuri, Waihi district.)
(12.) " 420. Black quartz hypersthene andesite.
(Waitekauri Cross Mine, Waitekauri district.)
(13.) " 422. Black quartz hypersthene andesite.
(Water-race above township, Waitekauri district.)
(14.) " 494. Quartz hypersthene andesite.
(Waihi Consols Mine, Waihi district.)
(15.) " 498. Altered quartz hypersthene andesite.
(Grand Junction Mine, Waihi district.)
(16.) " 499. Black quartz hypersthene andesite.
(Waihi South Mine, Waihi district.)
(17.) " 504. Black hypersthene andesite.
(Waihi Consols Mine, Waihi district.)
(18.) " 505. Black quartz hypersthene andesite.
(Waihi South Mine, Waihi district.)
(19.) " 1046. Hyalopilitic hypersthene andesite.
(Road near Waitekauri Township.)
(20.) " 1336. Micropœcillitic hypersthene andesite.
(Britannia Mine, Kapanga district.)
(21.) " 2738. Pilotaxitic hypersthene andesite.
(Preece's Point, Kapanga district.)
(22.) " 2872. Hypersthene andesite.
(Bunker's Hill, Kapanga district.)
(23.) " 3119. Hypersthene or enstatite andesite.
(Austral Hill, Cabbage Bay district.)

Hypersthene Hornblende Andesite.

(24.) Specimen No. 2752. Pilotaxitic hypersthene hornblende andesite.
(Uncle's Farm, Tiki-Kapanga district.)
(25.) " 2918. Hyalopilitic hypersthene hornblende andesite.
(Kikowhakarere Bay, Kapanga district.)

Hornblende Andesite.

(26.) Specimen No. 2827. Altered hornblende andesite.
(Kathleen Crown Mine, Kapanga district.)

Hornblende Hypersthene Andesite.

(27.) Specimen No. 2869. Pilotaxitic hornblende enstatite (or hypersthene) andesite).
(Kikowhakarere Bay, Kapanga District.)

Altered Andesites.

(28.) Specimen No. 100. Pseudomorphous with quartz, perhaps once an andesite.
(Waihi Consolidated Mine, Waihi district.)
(29.) „ 418. Altered andesite.
(Waitekauri Cross Mine, Waitekauri district.)
(30.) „ 444. Altered andesite or pyroxene rhyolite.
(Waihi-Silverton Mine, Waihi district.)
(31.) „ 445. Altered andesite or pyroxene ryolite.
(Waihi-Silverton Mine, Waihi district.)
(32.) „ 497. Altered andesite.
(Grand Junction Mine, Waihi district.)
(33.) „ 2718. Altered andesite or dacite(?).)
(Hauraki South Mine, Kapanga district.)
(34.) „ 2719. Altered andesite or dacite.
(Welcome Find Mine, Kapanga district.)
(35.) „ 2721. Altered andesite.
(Hauraki Mine, Kapanga district.)
(36.) „ 2930. Highly altered andesite.
(Kapanga Mine, Kapanga district.)

Dacite.

(37.) Specimen No. 2874. Dacite or dacite porphyrite.
(Kikowhakarere Bay, Kapanga district.)
(38.) „ 2933. Fragmental dacite or andesite rock.
(Britannia Mine, Kapanga district.)
(39.) „ 2941. Altered quartz pyroxene hornblende rock.
(Scotty's Mine, Kapanga district.)

Pyroxene Dacite.

(40.) Specimen No. 210. Pyroxene dacite.
(Waitekauri Cross Mine, Waitekauri district.)

Pyroxene Hornblende Dacite.

(41.) Specimen No. 1331. Hypersthene hornblende dacite.
(Castle Rock, Waiau Valley, &c., district.)

Hornblende Dacite.

(42.) Specimen No. 124. Hornblende dacite.
(Waitekauri kilns, Waitekauri district.)
(43.) „ 127. Hornblende dacite.
(Waitekauri kilns, Waitekauri district.)
(44.) „ 129. Hornblende dacite.
(Waitekauri Kilns, Waitekauri district.)
(45.) „ 534. Spherulitic hornblende dacite.
(Door Tunnel, Owharoa district.)
(46.) „ 553. Spherulitic hornblende dacite.
(Door Tunnel, Owharoa district.)

(47.) Specimen No. 2833. Altered hornblende dacite.
(Hauraki Mine, Kapanga district.)
(48.) „ 2836. Altered hornblende dacite.
(Kathleen Mine, Kapanga district.)
(49.) „ 2868. Altered hornblende dacite.
(Kikowhakarere Bay, Kapanga district.)

Hornblende Pyroxene Dacite.

(50.) Specimen No. 541. Spherulitic hornblende pyroxene dacite.
(Door Tunnel, Owharoa district.)
(51.) „ 556. Glassy spherulitic hornblende pyroxene dacite.
(Door Tunnel, Owharoa district.)

Quartz Hornblende Porphyrite.

(52.) Specimen No. 2727. Quartz hornblende porphyrite.
(Golden Pah, Union Beach, Kapanga district.)

Spherulitic Dacite or Rhyolite.

(53.) Specimen No. 133. Spherulitic dacite or rhyolite.
(Long Drive, Ohinemuri Syndicate, Owharoa district.)
(54.) „ 1172. Spherulitic dacite or dacite rhyolite.
(Ruapehu Claim, Owharoa district.)

Altered Dacite.

(55.) Specimen No. 424. Altered dacite.
(Maratoto Creek, Hikutaia district.)
(56.) „ 2840. Altered dacite.
(Kathleen Mine, Kapanga district.)
(57.) „ 2957. Altered dacite with hornblende.
(Scotty's Mine, Kapanga district.)
(58.) „ 2969. Altered dacite with hornblende.
(Britannia Mine, Kapanga district.)
(59.) „ 2974. Altered dacite.
(Scotty's Mine, Kapanga district.)
(60.) „ 2981. Altered dacite or andesite.
(Britannia Mine, Kapanga district.)

Rhyolite.

(61.) Specimen No. 512. Decomposed rhyolite.
(Madden's Folly, Owharoa district.)

Microperthitic Rhyolite.

(62.) Specimen No. 6. Rhyolite containing microperthite and hornblende replaced by quartz.
(Pool in river below Owharoa, Ohinemuri County.)
(63.) „ 108. Anorthoclase or microperthite pyroxene rhyolite.
(Waihi Union Mine, Waihi district.)
(64.) „ 110. Anorthoclase(?) or microperthite pyroxene rhyolite.
(Waihi Union Mine, Waihi district.)
(65.) „ 547. Spherulitic rhyolite with microperthite.
(Ohinemuri Syndicate's shaft, Owharoa.)
(66.) „ 582. Spherulitic rhyolite with microperthite.
(Old working, left bank of river, at Owharoa.)

Spherulitic Rhyolite.

(67). Specimen No. 549. Spherulitic rhyolite replaced by secondary quartz.
(Ohinemuri Syndicate's shaft, Owharoa.)

Rhyolite with Plagioclase and Hornblende.

(68.) Specimen No. 21. Rhyolite containing plagioclase, hornblende, and quartz
(Ohinemuri River bank, opposite Victoria Battery.)

Rhyolite containing Plagioclase and Pyroxene.

(69.) Specimen No. 1. Rhyolite containing plagioclase and pyroxene, with much-altered perlitic glass.
(Ruapehu Claim, Owharoa district.)

Rhyolite containing Plagioclase, Pyroxene, and Hornblende.

(70.) Specimen No. 3. Glassy rhyolite containing plagioclase, pyroxene, and hornblende.
(Ruapehu Claim, Owharoa district.)

Rhyolite containing Pyroxene—Pyroxene Rhyolite.

(71.) Specimen No. 107. Pyroxene soda rhyolite.
(Waihi-Silverton Mine, Waihi district.)

(72.) " 509. Pyroxene rhyolite.
(Waihi Union Mine, Waihi district.)

(73.) " 527. Hornblende pyroxene rhyolite.
(No. 3 level, Waihi Mine, Waihi district.)

Opal.

(74.) Specimen No. 517. Common opal.
(Waterfall Creek, Waikino, Owharoa district.)

Indeterminate.

(75.) Specimen No. 510. Altered quartz felspar pyroxene flow rock.
(Waihi West Mine, Waihi district.)

3. *Beeson's Island Group.*—In the northern part this group of rocks is represented on both sides of the peninsula. The typical locality, Beeson's Island, lies on the northern side of the entrance to Coromandel Harbour. The peninsula on the north side of the harbour is almost wholly composed of these rocks, but more to the north they are not present till reaching the vicinity of Cabbage Bay, south of which the hills between the Umangawha River and the coast-line are formed of rocks of this age. North of Cabbage Bay the Beeson's Island group is absent on the west coast, but on the east coast of this part they extend from Port Charles to Whangapoua.

On the west side of the peninsula the rocks of this group form hilly country between Coromandel and Manaia Harbours, and south of the latter extend on the coast-line to Kirita Bay, and further inland probably continuously into the watershed of the Mata River, within which these rocks for a time terminate. On the east coast, south of Whangapoua Harbour, they

KUAOTUNU VALLEY FROM THE GOLD-WORKINGS NORTH-EAST TO THE SEA.

KUAOTUNU VALLEY—LOOKING UP THE VALLEY.

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form an extensive tract of hill and mountain country between Opitonui and the extremity of Kuaotunu Peninsula, and between Mercury Bay and the main range these rocks are continued in the hilly country east of the main range to the Waiwawa Valley, near Gumtown, and follow the Waiwawa River south-west to its source between Table Mountain and the source of the Puru Stream, draining to the Hauraki Gulf. West of Table Mountain the Beeson's Island rocks are continued south and south-west into and along the Kauaeranga watershed till near the mouth of that river they again reach almost to the shore-line of the gulf.

South of the Kauaeranga this group of rocks is found nearly continuous in the hills forming the western border of the mountain country to the Ohinemuri River, crossing which they extend farther to the south, and form, nearly opposite Karangahake, a group of hills that stands outwards on to the Waitoa Plain and reaches nearly to the Thames River; and thence they spread to the south-east between Karangahake and Te Aroha Mountains, both of which mountains belong to an older formation. On the north side of the Ohinemuri River, by way of Mackaytown and the Rahu Saddle, a narrow strip of these rocks passes between the Thames-Tokatea rocks of Karangahake and the Kapanga rocks of Owharoa and the Waitekauri Valley, and from the Upper Waitewheta spreads over the whole country to the east and south, from Waihi Beach to Te Aroha, and to the south far beyond the limits of the district here dealt with.

The rocks of this group are often very coarse breccias, varying from light-grey to purple or almost black, and are often rubbly angular fragments without matrix. The solid rocks also vary from light-grey to black, and the lighter-coloured weather rough and harsh to the touch, which may be a reason why these rocks have been sometimes described as trachytes. With the coarser material of the fragmental rocks there are often beds of finer grain and seams of lignite or brown coal, both to the east and west of the main mountain-ridge. Since their first reference to the Miocene period (by Cox) these rocks have been considered distinct from and younger than the auriferous rocks.

List of Rocks described from the Beeson's Island Group.

Andesites.

(1.) Specimen No. 3558. Pilotaxitic andesite.
(Road to Mercury Bay, Kuaotunu district.)

(2.) „ 3586. Fragmental rock, chiefly andesitic.
(Kapai-Vermont Claim, Kuaotunu district.)

Pyroxene Andesite.

(3.) Specimen No. 42. Altered (pyroxene) andesite.
(Docherty's Creek, Paeroa, &c., district.)

(4.) „ 1039. Hyalopilitic pyroxene andesite.
(Waihi Beach, Waihi district.)

Hypersthene Andesite.

(5.) Specimen No. 39. Black hyalopilitic hypersthene andesite.
(Tararipi Creek, Paeroa, &c., district.)

(6.) " 51. Hyalopilitic hypersthene andesite.
(Left bank of Ohinemuri River, Mackaytown.)

(7.) " 64. Black pilotaxitic hypersthene andesite.
(Half a mile up river from Mackaytown, Paeroa, &c., district.)

(8.) " 155. Black pilotaxitic hypersthene andesite.
(Rahu Saddle, Paeroa, &c., district.)

(9.) " 213. Hyalopilitic hypersthene andesite.
(South-west side of Waihi Plain, Waihi district.)

(10.) " 217. Hyalopilitic hypersthene andesite.
(Road quarries, near Paeroa, Paeroa district.)

(11.) " 454. Hyalopilitic hypersthene andesite.
(Omahu Peak, west slope, Thames County.)

(12.) " 846. Hyalopilitic hypersthene andesite.
(Kauaeranga district(?).)

(13.) " 1034. Hyalopilitic hypersthene andesite.
(Quarries, Omahu Hill, Thames County.)

(14.) " 1075. Hyalopilitic hypersthene andesite.
(Tauranga Road, Hikurangi district.)

(15.) " 1423. Hyalopilitic hypersthene andesite.
(Blind Bay, Great Barrier Island.)

(16.) " 3010. Hyalopilitic hypersthene andesite.
(Section south shore of Cabbage Bay.)

(17.) " 3012. Hypersthene andesite.
(Section south side of CabbageBay.)

(18.) " 3125. Hypersthene andesite with hornblende.
(Left branch of Umangawha, Cabbage Bay district.)

(19.) " 3390. Hyalopilitic hypersthene andesite.
(Peninsula, north side Coromandel Harbour.)

(20.) " 3424. Hyalopilitic hypersthene andesite.
(Upper part of Manaia Harbour, north side.)

(21.) " 3433. Hyalopilitic hypersthene andesite.
(Highest part of road, Coromandel to Manaia.)

(22.) " 3476. Hyalopilitic hypersthene andesite.
(Matarangi Bluff, east side.)

(23.) " 3482. Hyalopilitic hypersthene andesite.
(Coast section, Matarangi district.)

(24.) " 3527. Pilotaxitic hypersthene andesite.
(Coast section, Matarangi district.)

(25.) " 3543. Pilotaxitic hypersthene andesite.
(Brown's Camp, Kuaotunu district.)

(26.) " 2790–3601. Hyalopilitic hypersthene andesite.
(Matarangi Hill, Matarangi district.)

(27.) " 3630. Hyalopilitic hypersthene andesite.
(Matarangi Hill, Matarangi district.)

Hypersthene Hornblende Andesite.

(28.) Specimen No. 3551. Pilotaxitic hypersthene hornblende andesite.
(Road to Mercury Bay, Kuaotunu district.)

Hornblende Andesite.

(29.) Specimen No. 797. Completely altered (? hornblende) andesite.
(The Booms, Kauaeranga district.)
(30.) „ 1040. Micropœcillitic hornblende andesite.
(Near Hooker's, Mahakirau district.)
(31.) „ 3557. Hornblende andesite.
(Coast section, Matarangi district.)

Hornblende Pyroxene Andesite.

(32.) Specimen No. 878. Quartz hornblende pyroxene andesite.
(Kauaeranga Valley and district.)
(33.) „ 1042. Hyalopilitic hornblende hypersthene andesite.
(Near Hooker's, Mahakirau district.)
(34.) „ 1314. Hornblende pyroxene andesite.
(Matarangi Hill, Matarangi district.)
(35.) „ 1328. Hornblende hypersthene andesite.
(Kennedy's Bay, Tiki-Tokatea district.)

Altered Andesite.

(36.) Specimen No. 1041. Much altered (andesite ?).
(Near Hooker's, Mahakirau district.)
(37.) „ 1392. (Andesite ?) completely replaced by opal and quartz.
(Kennedy's Bay, Tiki-Tokatea district.)

Dacite.

Pyroxene Dacite.

(38.) Specimen No. 158. Pyroxene dacite.
(Left bank of river half a mile below Owharoa.)
(39.) „ 231. Pyroxene dacite.
(Second road quarry below Owharoa.)

Hypersthene Dacite.

(40.) Specimen No. 248. Black hypersthene dacite or quartz hypersthene andesite.
(First road quarry below Owharoa.)

Pyroxene Hornblende Dacite.

(41.) Specimen No. 249. Pyroxene hornblende dacite.
(Second road quarry, Cumming's to Owharoa.)

Hornblende Dacite.

(42.) Specimen No. 935. Glassy hornblende dacite.
(Kauaeranga Valley, Thames County.)
(43.) „ 3023. Hornblende dacite.
(Section south side of Cabbage Bay.)
(44.) „ 3469. Hornblende dacite.
(Murphy's Hill, Matarangi district.)

Indeterminate.

(45.) Specimen No. 1383. Fragmental rock of rudely stratified volcanic material.
(Otaheo Stream, Coromandel County.)
(46. „ 3024. Indeterminate.
(Section south side of Cabbage Bay.)

2. *Acidic Group of Pliocene Age.*—Collectively this group covers an area equal to that of any other of the volcanic series, but until recent years little attention was paid to these rocks, and their existence in many parts of the peninsula was unknown. Formerly geological examinations, if not confined to the vicinity of mining centres, dealt but little with outlying districts. And the acidic group even more than the Palæozoic rocks was regarded with disfavour by miners and pronounced hopeless for gold by some geologists. Consequently, prior to 1896 their actual extent, general characteristics, and great importance were unknown and unappreciated. Up till that time they were supposed to be confined to the southern part of the district within Ohinemuri County, even though thin veins of rhyolite had been described by Hutton as occurring in the lower part of the Tararu breccias, near Rocky Point, Thames district. It was also known that acid rocks formed a portion of the shingle of the Kauaeranga River bed, but, if more than the fact was had in consideration, the whence of this rhyolitic material was merely speculated about, and expeditions to the upper sources of the river failed to locate the derivation of the rhyolitic *débris*. The Puriri, Omahu, and Hikutaia Streams carry along their beds an abundance of acid rocks in considerable variety, but these were passed unnoticed by the miner, and were equally disregarded by the geologist. During a period of excitement in mining that, beginning in 1895, continued till 1898 prospectors dispersed themselves over all parts of the peninsula, and sought for mineral riches wherever siliceous veins and segregations could be found. Even deposits of siliceous sinter forming terrace mounds at the surface of the ground were prospected, sometimes, it is said, not without results. Many of these thermal deposits occur with or cover rhyolite rocks, and thus the rhyolites came in for a share of the prospecting that was being carried on. To prospect areas of acid rock was considered a profitless undertaking, but sometimes rhyolite rock was mistaken for miners' sandstone.

At this time (1897) Professor James Park had opportunity and occasion to visit many of the outlying districts in which, at a distance from established mining centres, prospecting was being carried on, and thus became acquainted with the fact that a very considerable extent of country south and south-west of Mercury Bay was formed of acidic rocks, largely pumiceous agglomerate, but also to a large extent of solid rhyolite rock. This formation he traced from the eastern seaboard west to Gumtown; but under slightly altered conditions he failed to recognise it between Stony Creek and Table Mountain, or west of Table Mountain within the Upper Waiwawa and Kauaeranga watersheds, or on the main range between the Kauacranga and Tairua Rivers south to the Fourth Branch of the latter river. In the Tairua and Wharekawa Valleys, to the source of each of these streams, especially the latter, there are extensive developments of acidic rocks the true character and age of which were not realised by Professor Park when he included them with and as forming the upper part of

SILICEOUS SINTER TERRACE ON WAITAIA RANGE, KUAOTUNU—GENERAL VIEW.

SILICEOUS SINTER TERRACE ON WAITAIA RANGE, KUAOTUNU—NEARER VIEW OF PART OF TERRACE.

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the andesitic auriferous series of older Tertiary date.* Between the sources of the Puriri and Hikutaia Rivers the higher part of the main range is formed of rhyolite or pumiceous agglomerate, with the exception of some younger intrusive rocks of a semi-basic character which appear on the main range at the source of Omahu Creek. In the southern part of the district acidic rocks are largely developed within the Ohinemuri watershed, and south of the Waihi Plain Hikurangi Mountain, within Tauranga County, is formed of acid rocks; but in this direction the bulk of the country from Waihi Beach to Te Aroha consists of andesic rocks belonging to the Beeson's Island group.

At the close of the second year's examination of the rocks of Cape Colville Peninsula it became apparent that the acidic rocks of Pliocene date were not all exactly of the same age, but constituted a series embracing four divisions, of which the oldest is represented by the rhyolites of Paku Island and Omahu Peak, the second division by the pumiceous deposits of Mercury Bay and Gumtown, the third by the solid rhyolites overlying the second in the mountains south of the Rangihau Valley and east of Stony Creek, while the youngest division forms the brecciated rhyolites spread over the low grounds of the Upper Ohinemuri or Waihi Plain.

2 (*a*). *Acidic Rocks of Paku Island and Omahu Peak.*—The oldest rocks of this group appear to be, on the east coast, the rhyolites of Paku Island and the pumiceous rhyolites of Marsh's Farm, at the junction of the Hikuwai Stream with the Tairua River, which rocks appear also on the opposite bank of the Tairua, and are thence continued in a south-west direction till, crossing the Tairua, they reach on to the mountains of the main water-divide at the source of the Puriri River, and southward dominate this as far as the north side of the Hikutaia Valley. The intrusive rhyolites at and between the upper sources of the Tairua and Hikutaia Rivers may also be considered as belonging to the oldest of the Pliocene rhyolites, as may also the greater part of Hikurangi Mountain, on the south-east border of the district. From Neavesville to Boat Harbour these rocks are separated from a second area of acid rocks lying to the north-west by a belt of andesic rocks belonging to the Kapanga group, and to the south the main area is limited by a similar but much broader belt of Kapanga rocks that stretch along the south-east side of the Wharekawa Valley past the sources of the Tairua and Hikutaia into the Ohinemuri watershed. Along this south-eastern boundary of the Kapanga Group solid flows of acid rock are also found. In the central space, generally conforming to the valleys of the Tairua and Wharekawa Rivers, coarse conglomerates of various rhyolite rocks, pumiceous breccias, and sands overlie the solid rhyolites, and reach on to the higher part of the main range and some of the outrunning spurs on the west side of the water-parting.

2 (*b*). *Pumiceous Agglomerate or Whitianga Beds.*—The breccias, &c., over-

* "Geology and Veins of the Hauraki Goldfields," p. 31, and map.

lying the solid rhyolites of the Tairua and Wharekawa watersheds belong to this division of the acidic group. In the Mercury Bay district the beds are present over most of the area between the coast-line and the foot of the mountain region of the main range, and by way of the Rangihau Valley reach to the eastern base of Table Mountain, which, as a huge dyke of andesite, breaks through these rocks. The portion cut off from the main body and lying to the west of Table Mountain is partly within the Kauaeranga watershed, and the *débris* thereof is thus carried west to the Firth of Thames and the Hauraki Gulf.

2 (*c*). *Middle Rhyolites.*—At many places over the eastern parts of the district the pumiceous breccias are overlain by solid rhyolites, but this covering does not become general till (to the south) the mountain region drained by Stony Creek, the Kopuwai, and Rangihau Rivers is reached. Then it is seen that a great succession of the beds 2 (*b*) passes under solid rhyolites more than 1,000 ft. in thickness which latter stretch east and south, covering all the high ground between the Tairua and Kauaeranga Rivers, and constitute the division (*c*) of the Pliocene acidic rocks.

2 (*d*). *Younger Rhyolites.*—These as glassy and pumiceous rhyolites presenting a brecciated appearance are developed only over the low grounds of the Upper Ohinemuri Plain. In the lower part of the Waitekauri Valley they rest on beds of pumiceous agglomerate and tuff, and similar but coarser beds lie towards the east along the western base of the coast range.

List of Rocks which have been described from the Acid Group of Pliocene Age.

Rhyolite.

(1.) 394. Waterfall Creek, Owharoa district.
(2.) 608. Saddle east of Omahu Peak, Omahu district.
(3.) 794. Kauaeranga River bed, Kauaeranga district.
(4.) 795. " "
(5.) 1286. Waihi-Silverton battery, Waihi district.
(6.) 3668. Hot-water Beach, Mercury Bay district.
(7.) 3691. New Slip, Slip Creek, Gumtown district.
(8.) 3711. Kapowai Crossing, Gumtown district.
(9.) 3159. Welcome Jack Mine, Gumtown district.
(10.) 3828. Klondike Claim, Omahu district.

Rhyolite with Plagioclase.

(11.) 91. Upper Ohinemuri Plain, Waihi district.
(12.) 185. Nut Tunnel, Owharoa district.
(13.) 456. Saddle east of Omahu Peak, Omahu district.
(14.) 463. North face of Omahu Peak, Omahu district.
(15.) 518. Waterfall, Waikino Creek, Owharoa district.
(16.) 521. Waihi Mine, Waihi district.
(17.) 618. Creek east of Omahu Peak, Omahu district.
(18.) 1078. Hikutaia River bed, Hikutaia district.
(19.) 3747. Slip Creek, Gumtown district.
(20.) 3751. Rangihau Valley, Gumtown district.

GENERAL VIEW OF THE ACID ROCKS OF THE GUMTOWN DISTRICT.

NEW SLIP, WITH THE OLD SLIP IN THE DISTANCE, GUMTOWN - RANGIHAU DISTRICT.

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Rhyolite with Plagioclase and Pyroxene.

(21.) 3822. North slope of Omahu Peak, Omahu district.

Pumiceous Rhyolite.

(22.) 761. The "Wires," Tairua-Wharekawa district.
(23.) 4310. Marsh's Farm, Tairua-Wharekawa district.

Dacitic Rhyolite.

(24.) 3697. New Slip, Slip Creek, Gumtown district.

Glassy Dacitic Rhyolite.

(25.) 1434. Marsh's Farm, Tairua-Wharekawa district.

Dacite or Soda Rhyolite.

(26.) 976. Puriri River, Puriri district.
(27.) 1002. Table Mountain, Kauaeranga district.
(28.) 1035. Rangihau Valley, Gumtown district.

Microperthite Rhyolite.

(29.) 1139. Hikutaia Valley, Hikutaia district.

Highly Quartzose Rhyolite.

(30.) 3800. Slip Creek, Gumtown district.

Altered Rhyolite.

(31.) 1480. Ohui.
(32.) 3735. Slip Hill, Gumtown district.
(33.) 3772. Kapowai No. 2 Mine, Gumtown district.
(34.) 4279. Low level, Broken Hills, Tairua-Wharekawa district.
(35.) 4293. Road-cutting, left bank of Tairua, Tairua-Wharekawa district.
(36.) 4298. Upper workings, Broken Hills Mine, Tairua-Wharekawa district.

Spherulitic Rhyolite.

(37.) 754. Hikutaia Valley, Hikutaia district.
(38.) 863. Hihi Stream, Kauaeranga district.
(39.) 1071. Hikurangi Mountain, Hikurangi district.
(40.) 3713. Kapowai Valley, Gumtown district.
(41.) 4161. Paku Island.
(42.) 4162. "
(43.) 4175. "
(44.) 4182. "
(45.) 4186 (5). "
(46.) 4204. "
(47.) 4205. "
(48.) 4212. "
(49.) 4216. "
(50.) 4219. "
(51.) 4223. "
(52.) 4226. "
(53.) 4229. "
(54.) 4233. "
(55.) 4372. "

Spherulitic Rhyolite with Plagioclase.

(56.) 268. East Coast Range, Waihi district.
(57.) 3948. Hikutaia Valley, Hikutaia district.
(58.) 3979. " "

Spherulitic Rhyolite with Pseudomorphs after Plagioclase and Pyroxene.

(59.) 3823. North slope of Omahu Peak, Omahu district.

Spherulitic Rhyolite with Plagioclase, Hypersthene, and Augite.

(60.) 348. Quarries west end of tunnel, water-race, Waitekauri district.

Banded Spherulitic Rhyolite.

(61.) 4230. Paku Island.
(62.) 4384. "
(63.) 4386. "
(64.) 4388. "

Glassy Spherulitic Rhyolite.

(65.) 923. Kauaeranga Valley, Kauaeranga district.
(66.) 942. " "
(67.) 4396. Paku Island.
(68.) 4425. "

Glassy Spherulitic Rhyolite with Plagioclase and Augite.

(69.) 950. Puriri Valley, Puriri district.
(70.) 4394. Locality uncertain.

Glassy Lithophysal Spherulitic Rhyolite.

(71.) 759. " Wires," Upper Tairua, Tairua-Wharekawa district.
(72.) 4425. Paku Island.

Positive Spherulitic Rhyolite with Plagioclase.

(73.) 3758. Slip Hill, Slip Creek, Gumtown district.

Altered Spherulitic Rhyolite.

(74.) 847. Waihi Beach Claim, Waihi district.
(75.) 1038. " "
(76.) 1072. Hikurangi Mountain, Hikurangi district.
(77.) 3768. Big Beetle Claim, Gumtown district.
(78.) 3809. Big Slip, Slip Creek, Gumtown district.
(79.) 4345. Paku Island.

Microspherulitic Rhyolite.

(80.) 1131. Hikutaia Valley, Hikutaia district.
(81.) 1139. " "
(82.) 3708. New Slip, Slip Creek, Gumtown district.

Microspherulitic Rhyolite with Plagioclase.

(83.) 3709. New Slip, Slip Creek, Gumtown district.
(84.) 3969. Hikutaia Valley, Hikutaia district.

Microspherulitic Rhyolite with Plagioclase and Quartz.

(85.) 3985. Hikutaia Valley, Hikutaia district.

Positive Microspherulitic Rhyolite.

(86.) 4387. Paku Island.

Negative Microspherulitic Rhyolite.

(87.) 3954. Hikutaia River bed, Hikutaia district.
(88.) 4304. Ohui, Tairua-Wharekawa district.

Altered Microspherulitic Rhyolite.

(89.) 3966. Hikutaia River bed, Hikutaia district.

Lithophysal Rhyolite with Plagioclase.

(90.) 3847. Omahu Creek, North Branch, Omahu district.

Banded Lithophysal Rhyolite.

(91.) 4219. Paku Island.

Spherulitic Lithophysal Rhyolite.

(92.) 4381. Paku Island.

Glassy Spherulitic Lithophysal Rhyolite.

(93.) 4574. Paku Island.

Rhyolitic Glass with Plagioclase.

(94.) 399. Waterfall Creek, left bank of Ohinemuri, Owharoa district.

Pumice and Pumiceous Agglomerate.

(95.) 94. One mile south-east of Waihi Monument, Waihi district.
(96.) 441. Road, Waikino to Waihi, Waihi district.
(97.) 3749. Track to Rangihau Valley, Gumtown district.

Obsidian, Spherulitic and with Flow Structure.

(98.) 1013. Pannikin Hill, Mercury Bay district.

Pitchstone.

(99.) 4364. Paku Island.
(100.) 4366. "

Andesitic Pitchstone.

(101.) 452. Omahu Peak, Omahu district.

Andesitic Pitchstone with Quartz, Plagioclase, and Pyroxene.

(102.) 3703. New Slip, Slip Creek, Gumtown district.
(103.) 3825. North Branch of Omahu Creek, Omahu district.
(104.) 3949. Hikutaia River bed, Hikutaia district.

Perlitic Andesitic Glass with Plagioclase, Hypersthene, and Hornblende.

(105.) 912. Kauaeranga River bed, Kauaeranga district.
(106.) 3739. Slip Creek, Gumtown district.

Perlitic Glass with Spherulites.

(107.) 911. Kauaeranga River-bed, Kauaeranga district.

Perlitic Pitchstone.

(108.) 1149. Hikutaia River-bed, Hikutaia district.

Dacite.

(109.) 3672. Track, Gumtown to Rangihau Valley, Gumtown district.

Hornblende Pyroxene Dacite.

(110.) 899. Kauaeranga River bed, Kauaeranga district.

Glassy Spherulitic Dacite with Hornblende and Pyroxene.

(111.) 212. Whangamata Track, Waihi district.
(112.) 4394. Locality uncertain.

Hyalopilitic Pyroxene Andesite.

(113.) 914. Kauaeranga River bed, Kauaeranga district.

Volcanic Ash, Tuff, &c.

(114.) 350. Tunnel, Waikino–Waitekauri Water-race, Waitekauri district.
(115.) 612. Creek east of Omahu Peak, Omahu district.
(116.) 763. Road, Hikutaia to the "Wires," Hikutaia district.
(117.) 853. Kauaeranga River bed, Kauaeranga district.
(118.) 881. " "
(119.) 995. West side of Table Mountain, Kauaeranga district.
(120.) 3680. New Slip, Slip Creek, Gumtown district.

Intrusive Andesites, Post-acidic, or of Younger Pliocene Age.—The time at which these rocks made their appearance cannot with certainty be determined. Had there been less evidence of their considerable age it might have been possible, as it would have been convenient, to speak of them as the product of Post-pliocene times; but the amount of denudation that has taken place in the district since the last of the acidic rocks made their appearance—to which also the intrusive andesites have been subjected—makes it probable that there was no great interval between the eruption of the last of the rhyolites and the intrusion of these less-acid rocks.

There is usually uncertainty as to the age of intrusions appearing in any formation unless the next in the sequence affords proof that such intrusions are older than the first-formed deposits of that formation. On Cape Colville Peninsula we know that the dykes in the Palæozoic, Maitai, and Te Anau series were intruded into these beds and were themselves being denuded before the close of the Permian period, the proceeds of this denudation forming conglomerates in connection with other strata not younger than Trias. This, however, applies only to dykes in the Tiki-Tokatea and Moehau districts, and there are no definite proofs that dykes elsewhere appearing in Carboniferous strata made their appearance or were consolidated before the close of the Palæozoic period. It may, however, be said that there is no positive proof that they did so at a more recent date, and the negative proof that they had not appeared at the surface nor were being denuded prior to Tertiary times is not to be trusted.

As an instance of this latter Professor Park tells us that he searched, with all the skill of the practised collector, the conglomerates forming the base of the coal-bearing series at Torehine for igneous rocks and found none, and from the absence of such inferred that the oldest volcanic rocks of the peninsula were younger than any of the Cretaceo-tertiary beds at Torehine.* The unreliability of this evidence is manifest when consideration is had of the occurrence of igneous conglomerates in Triassic strata on the south side of Coromandel Harbour, and the occurrence of the identical rocks *in situ* in the Tiki-Tokatea and Moehau districts.

Neither can a similarity in the character and constitution of the dykes occurring in the older Tertiary groups be a good ground for the supposition that they were intruded at the same time as, or for being described with, those dykes that post-date the acid rocks of Pliocene age.

Here, therefore, will be considered only such dykes as are known to be younger than the acid rocks of Pliocene age, dykes possibly of the same age appearing in connection with the older groups being considered simply as dykes breaking through the formation in which they occur.

There is in the Whitianga or Mercury Bay district, and on the east side of the harbour, some three to four miles above the township, a high hill the top of which is said to be formed of andesite, and west of the river, between Mill Creek and the Waiwawa River, a high table-topped hill or mountain the upper part of which also is said to be andesite, but neither of these hills was collected from. In the first instance the statement rests on the authority of Mr. Bradshaw, schoolmaster, Whitianga, who was an industrious collector of the rocks of the district, many of which he sliced and determined; and I have the authority of Professor Park in the second case, though I did not learn that he actually ascended the mountain in question. In both cases the andesic rocks must break through the pumiceous agglomerate of the Mercury Bay and Gumtown districts, as does also the greater dyke of Table Mountain.

Table Mountain, as a mass of intrusive rock, rises between the sources of the Rangihau and the upper southern sources of the Waiwawa River and extends, north and south, from the gorge of the Waiwawa into the watershed of the Kauaeranga River. The dyke itself is continued considerably further to the south of this river. To the north, in the gorge of the Waiwawa, the dyke is not present; at all events, it cannot be traced. In the southern part of Table Mountain it has a width of about a mile, and stands 600 ft. to 800 ft. above the surrounding country. At its southern end the mountain terminates in sheer precipices fully 1,000 ft. in height, and both the east and west sides for some distance to the north are precipitous, almost vertical.

Appearing through the beds (*b*) of the acidic group, Table Mountain

* Mines Reports, 1893, p. 94.

separates a small area of the pumiceous agglomerates from the main development to the east and north-east, and it is somewhat remarkable that the solid rhyolites to the east of the mountain that overlie the beds (*b*) are absent on the west side.

The intrusive mass is continued to the south, and where seen in the valley of Hihi Stream the distance across it is inconsiderable; but it appears to expand to something like its original proportions on the main range overlooking the Fourth Branch of the Tairua River.

From the higher part of the main range south of the Hihi its course alters to the south-east, and the dark solid dyke-like andesite between the Fourth Branch and the main stream of the Tairua is probably the same, and this may be continued towards Wharekawa Inlet, on the north shore of which similar dyke rocks make their appearance.

More in the direct line of the northern part of this great dyke there are two outcrops of andesic rocks that show on the mountain track between Omahu and Whangamata, but, as on the traverse from the Puriri by way of Neavesville to the Fourth Branch there are no signs of the southern prolongation of Table Mountain dyke, the outcrops to the southward must be considered independent of it.

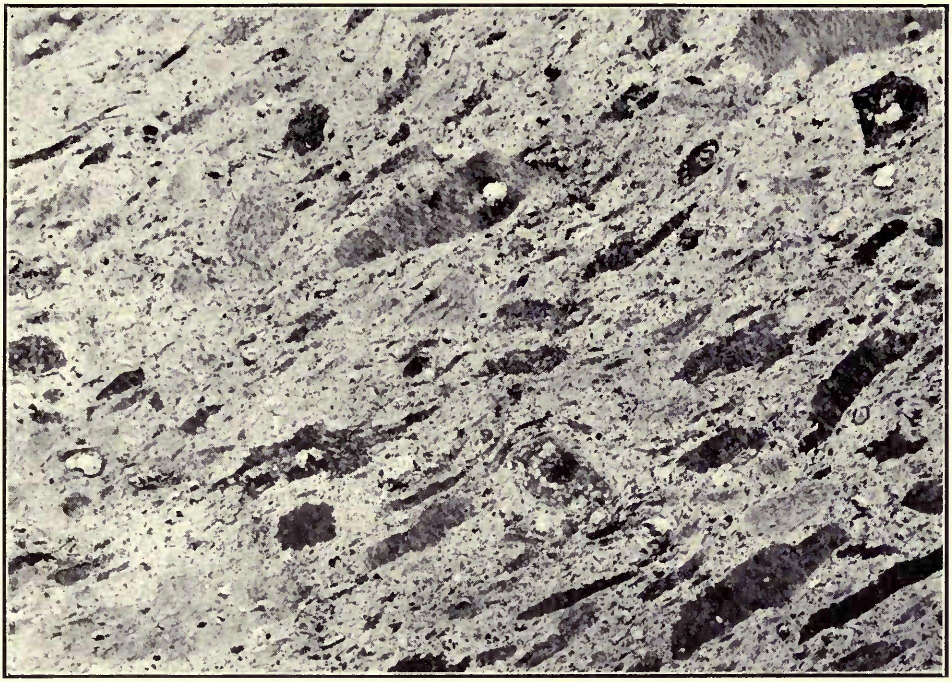
The intrusive andesites on the Omahu–Whangamata Track appear on the higher western slope and on the crest of the range. To the east the andesites are in contact with solid light-grey or cream-coloured rhyolites, and on the west with spherulitic rhyolites and pumiceous agglomerates. These intrusions have not been traced south into the Hikutaia watershed.

The hypersthene-andesite dyke appearing in the Ohinemuri River bed between the Crown battery and the Township of Karangahake in its north continuation may pass from Thames-Tokatea rocks to those of the Beeson's Island group, and it is just possible that it is an intrusion of younger Pliocene date. The same may be said of the columnar mass forming the conical hill in the sharp bend of the Ohinemuri at the southern end of the Silverton Hills, which, though flanked by acid rocks to the east and west, in reality has been intruded into rocks of the Kapanga group, and for the reasons already given neither of these two last-mentioned intrusions can be dealt with in this place.

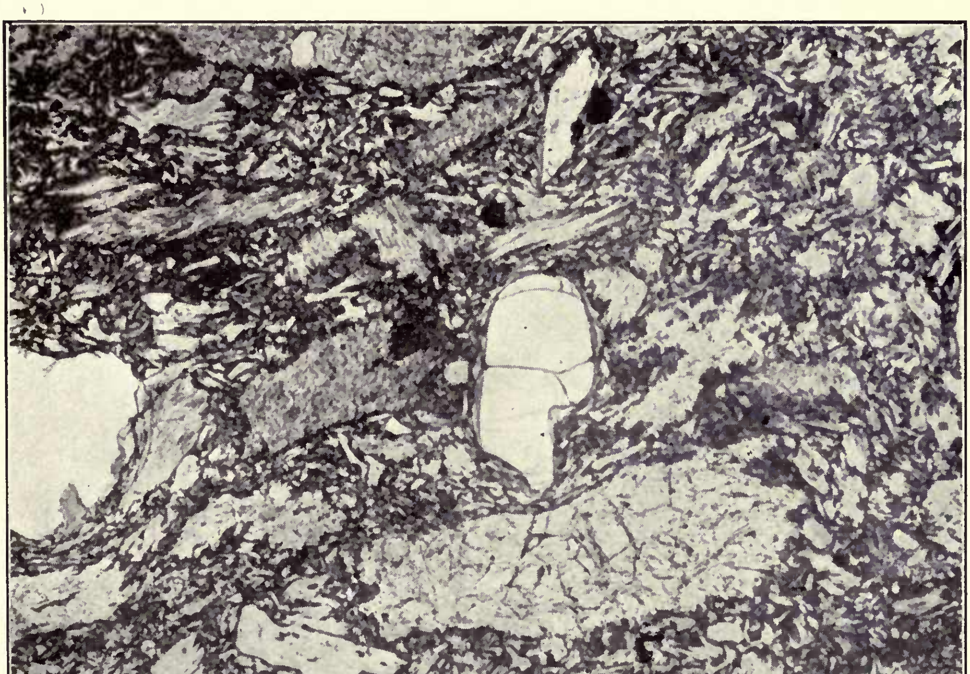
List of Rocks which have been described from the Igneous Intrusions of Younger Pliocene Age.

Hyalopilitic Hypersthene Andesite.

(1.) 991. West side of Table Mountain, Kauaeranga district.
(2.) 994. " "
(3.) 3692. Rangihau Valley, Gumtown district (derived from Table Mountain)
(4.) 3818. Main Range, Omahu district.
(5.) 3819. " "
(6.) 3840. West slope of Omahu Peak, Omahu district.
(7.) 3846. Spur south of Omahu Peak, Omahu district.



WILSONITE. REFLECTED LIGHT. 10 DIAMETER.



WILSONITE. TRANSMITTED LIGHT. 25 DIAMETER.

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DESCRIPTION OF THE SEVERAL DISTRICTS FROM WHICH SPECIMENS WERE COLLECTED.

As for a time the collector must be located in a particular district, it follows that, whatever may be the more comprehensive view he takes of the whole, the geology of his immediate surroundings must for the time being constitute a prominent and necessarily an important part of that whole as known to him; and as he accumulates facts and material, adding specimen to specimen, the importance of the district may loom large, and for the time being appear of more consequence than it really is. Admitting this, it is still necessary that its full influence should be appreciated—not exaggerated nor forgotten in any description that is built up, as here proposed, of separate accounts of individual districts.

A general description of the peninsula has already been given, and in a broad sense the geology of the whole has been indicated, and therefore what further information seems necessary will be given in connection with the descriptive details that are required to make clear the relation of the different rock-masses as they appear in sections and districts that were conveniently studied from one centre or otherwise constituted a natural subdivision of the whole peninsula.

Commencing in the north, the first to be considered is—

Moehau District.

This occupies the part of the peninsula that lies north of a line drawn from the mouth of Waiaro Creek to Port Charles on the east coast.

With some trifling exceptions, the district is mountainous, and Moehau, rising to a height of 2,900 ft. above sea-level, steeply descends to the sea on each hand, to the east and west, and dominates the other heights of the main axis to the north and south till to the north these sink to sea-level at Port Jackson, or terminate in the eastern headland, Cape Colville, while to the south the out-running spur that constitutes the main ridge in that direction is continued to the limits of the district, though gradually lessening in height to where it is crossed by the Cabbage Bay–Port Charles Road at a height of 500 ft. above sea-level.

The rocks forming the mass of the mountain and the main ridge to the south and the western slopes of these to the shore of Hauraki Gulf are sandstones and slaty mudstones, the former varying in grain from coarse grit to fine sandstone, and the mudstones from a dense black lydian-like slate to an ordinary Palæozoic mudstone that yields rapidly to the influence of the weather. Where the latter is not being speedily removed it assumes a pale-yellowish-brown colour, which penetrates to a considerable depth from the surface. The eastern slopes of the main ridge and the higher part of Moehau are covered with or mainly formed of volcanic rocks of an andesitic type that, generally of a dark-grey colour, consist of lava-streams and vast accumulations of fine or coarse breccia that spread over the country to the south, form also lesser hills on the west side of the inner or upper part of Port Charles, and are found north on this side of the peninsula almost to Port Jackson. These rocks are of Tertiary age, and correspond to the rocks of the Kapanga group in the vicinity of Coromandel. As they have not proved gold-bearing—at least, not payably so—in the Port Charles district their geology has been to some extent neglected. Towards the source of Waiaro Creek there is a small area of coal-bearing rocks presumably belonging to the Cretaceo-tertiary formation. Only the lower part of the sequence is present, but there is little doubt that the formation is the same as that at Torehine, in the Cabbage Bay district, where the higher part of the Cretaceo-tertiary sequence is present. Several bands of coaly shale were discovered in these rocks, and in them were streaks of, and pockets filled with, comparatively pure coal. These rocks occur outcropping on the western slope of the main ridge at a height of 1,250 ft. above the sea, and, showing a dip to the eastward, may have under the Tertiary volcanic rocks in that direction extension greater than the facts already ascertained will warrant. As, however, workable seams of coal could not be found along the outcrop, there is but little inducement to prospect for coal under the volcanic rocks that lie on the eastern slope of the main ridge. The coal is highly altered, the fixed carbon amounting to 82·47 per cent., and had there been a continuous seam of this quality it might have been possible to work it with profit, but such coal was rare in the band of shale, and as a consequence the prospecting-works were soon abandoned.* The chief matter of interest in connection with these beds is their height above sea-level, and the fact that, resting on Palæozoic rocks, they seem to underlie the volcanic rocks that occur along the eastern slopes of the mountain-ridge, thus showing that the beds are older than the volcanic rocks of the Kapanga group, with which they are presumably in contact. The condition of the coal and the nature of the plants associated makes correlation of these with the coal measures of the west coast of the South Island a reasonable conclusion.

The sandstones and slates that constitute the greater mass of Moehau and form the bold western spur of the mountain are intersected by numerous dykes of diorite, dacite porphyrite, dacite, and andesite. Many of these rocks have a resemblance to granite, and they are not infrequently spoken of as such. These dykes do not begin in the slate formation till north of Waiaro Creek and directly abreast of the higher part of Moehau. Thence dykes are abundant to the termination of the peninsula on the west side of Port Jackson. The *débris* of these rocks, more or less rounded on the coast-line by prevailing winds and ocean currents, is swept southwards along the shore and reaches

* For a more particular account of these beds see "Geology of Coromandel Goldfields," by J. M. Maclaren: "Reports of Mines Department, New Zealand," 1900, Parliamentary Paper C.-9, pp. 6, 7.

the mouth of Waiaro Creek in great quantity. Through an accident I was prevented collecting from the rocks *in situ*, and the rocks representing the dykes, of which a list is given below, were, with one exception, obtained from the mouth of Waiaro Creek. The names given in the list are taken from the description of the specimen by Professor Sollas.

List of Dyke Rocks from Moehau District.*

(1.)	Specimen No.	2709.	Quartz augite diorite.
(2.)	„	3042.	Augite microgranite.
(3.)	„	3053.	Hypersthene andesite.
(4.)	„	3064.	Hornblende dacite.
(5.)	„	3077.	Hornblende andesite.
(6.)	„	3083.	Quartz diorite.
(7.)	„	3084.	Quartz diorite.
(8.)	„	3093.	Quartz biotite diorite porphyrite.
(9.)	„	3102.	Quartz augite diorite porphyrite.
(10.)	„	3103.	Hornblende dacite porphyrite.
(11.)	„	3126.	Dacite porphyrite.
(12.)	„	4096.	Quartz biotite diorite.

No. 4096 occurs three miles north of Waiaro Creek. The boulders on the beach constitute quarries of the rock, and the specimen numbered 4096 was taken from one of the masses. Nos. 3053, 3064, and 3077, as hypersthene and hornblende andesite and hornblende dacite, are of such a nature that they might very well have been derived from the Tertiary volcanic rocks of the Kapanga group developed on the opposite slopes of the mountain and of the main range south of Moehau. Such rocks are absent, and it has already been stated on what grounds is based the conclusion that no Kapanga rocks now or for a very long time past have reached to the eastern shores of the Hauraki Gulf between a little north of Cabbage Bay and the north-west spurs of Moehau.

The other rocks mentioned in the list are completely absent from or so rare among the Tertiary volcanic rocks that they must here be considered peculiarly distinctive of the Palæozoic formation with which they occur associated. Similar and identical rocks occur in Tokatea Hill and along the west slopes of the main range thence to the Tiki; but, although elsewhere dykes occur in connection with the Palæozoic sedimentaries, they are unlike those of Moehau, and may very well have appeared or been intruded during the later volcanic outbursts on the peninsula.

In the notes by Professor Sollas that accompany the report on the first consignment of specimens from Cape Colville Peninsula the following remark appears: "The dykes of the Palæozoic series form a very distinct and interesting group of rocks, ranging from quartz diorites through dacite porphyrites into dacite. They would appear to have been intruded and consolidated before the Mesozoic period, since fragments closely resembling them are found to occur in the supposed Triassic rocks." The facts upon which this statement is based

* With the exception of 4096, all these rocks were collected at the mouth of Waiaro Creek.

amount to a discovery the full meaning of which will be made to appear when dealing with the Tiki-Tokatea and the Waiau Valley and hills to the west districts; further reference in this place thus becomes unnecessary.

Cabbage Bay District.

South of Moehau the first indentation of the land on the west side of the peninsula is Cabbage Bay. Between this and Port Charles the height of the main water-divide is lowered to 500 ft., and between the head of Cabbage Bay and Wakanae Bay on the east coast the breadth of the peninsula is little more than four miles. Cabbage Bay is about two miles long and a little less in breadth, and is open to the north-west. From the upper part a valley about a mile in width is continued south-east and south, a distance of from two to three miles, and along this flows the Umangawha River. The bay and the Umangawha Valley divide the district into two parts. The eastern part is occupied by the Cabbage Bay range northwards to the saddle leading to Port Charles, and southwards to a like saddle leading to Kennedy's Bay; more to the south the upper valley is bounded by the northern part of the Tokatea Range. On the western side is a group of hills between the valley and the shore of Hauraki Gulf stretching from Cabbage Bay south to Torehine, and more to the south-west the country rises in broken or irregular ranges to a height approaching that of the main range itself. On the east side of Cabbage Bay the rocks are sandstones and dark slaty shales or mudstones that weather to a pale yellowish-brown, and these reach eastward to the crest of the main divide; but immediately south-east of the bay the area of the slates is narrowed, and the higher part of the Cabbage Bay ranges standing forward to the westward is formed of or capped by volcanic rocks belonging to the Kapanga group. The Palæozoic rocks form the lower slopes of the range to the saddle leading to Kennedy's Bay. Further to the south and south-west slates appear to 800 ft. above sea-level, and between the saddle mentioned and Austral Hill, on the old road to Tokatea, the rocks of the higher elevations are coarse- or finer-grained grey volcanic breccia-beds similar to and of the same age as those appearing on the higher part of the Cabbage Bay range. On the north-west spurs from Austral Hill, and resting on the slate formation, is a patch of the coal-bearing series, which, extending south along the valley of a branch of the Umangawha, is seen to pass under the rocks of the Kapanga group at 1,150 ft. above the sea. South-west of Cabbage Bay slates and sandstones appear, near the head of the bay and in an isolated hill on the west side of the lower valley, at Torehine and thence for some distance along the coast to the south.

Coal-bearing rocks of Cretaceo-tertiary date appear at Torehine, and thence extend but a short distance inland till they are overlain and obscured by volcanic accumulations; but one or two exposures of these rocks occur in the mountains to the south, covered by Kapanga rocks.

West of the Umangawha Valley and north-east of Torehine the volcanic rocks of the coastal part of the district belong to the Beeson's Island group of Miocene age. They consist largely of a coarse grey breccia agglomerate, as seen in the south-west headland of Cabbage Bay, and of particoloured rocks of finer grain further south on the hill-slopes facing inland from the sea. Solid rocks also are abundant, and specially a massive flow of grey rock that forms high cliffs on the coast-line and strikes inland to the junction of the west branch of the Umangawha with the main stream.

The formations therefore present in the district are—

1. Palæozoic slates and sandstones (Carboniferous).
2. Coal-bearing rocks closed by limestones (Cretaceo-tertiary).
3. Grey breccia ash-beds and lava-streams (Kapanga group).
4. Coarse agglomerate and breccia beds with lava-streams (Beeson's Island group).
5. Dyke rocks cutting through Palæozoic rocks appearing on the coast-line at Torehine.

Reefs of gold-bearing quartz appear in connection with the Kapanga group, but do not occur in connection with the rocks of the Beeson's Island group.

During the period of mining excitement between 1895 and 1898 much prospecting was carried on in the district, and a considerable number of reefs were shown to be gold-bearing, but the amount of gold was not sufficient to enable the mines to work profitably, the cost of mining and the expenses of treatment being considered, and work in most has therefore been discontinued.

During the period referred to the district was visited and a collection of the rocks made, from which a selection was forwarded to England, and, as there named, a list of them is given below.

Volcanic and Dyke Rocks from the Cabbage Bay District.

(1.)	Specimen No.	3010.	Hyalopilitic hypersthene andesite. (Beeson's Island group.)
(2.)	„	3012.	Hypersthene andesite. (Beeson's Island group.)
(3.)	„	3023.	Hornblende dacite. (Beeson's Island group.)
(4.)	„	3024.	Indeterminate.* (Beeson's Island group).
(5.)	„	3119.	Hypersthene andesite. (Kapanga group.)
(6.)	„	3125.	Hypersthene andesite. (Dyke rock, Beeson's Island group).
(7.)	„	3138.	Hypersthene hornblende andesite. (Dyke in Carboniferous slates.)

* This is a grey tuff rock, consisting almost entirely of separated crystals of felspar, and containing fragments of wood and other plant-remains. Seemingly it could not be sliced so as to fit it for examination under the microscope.

Kapanga District.

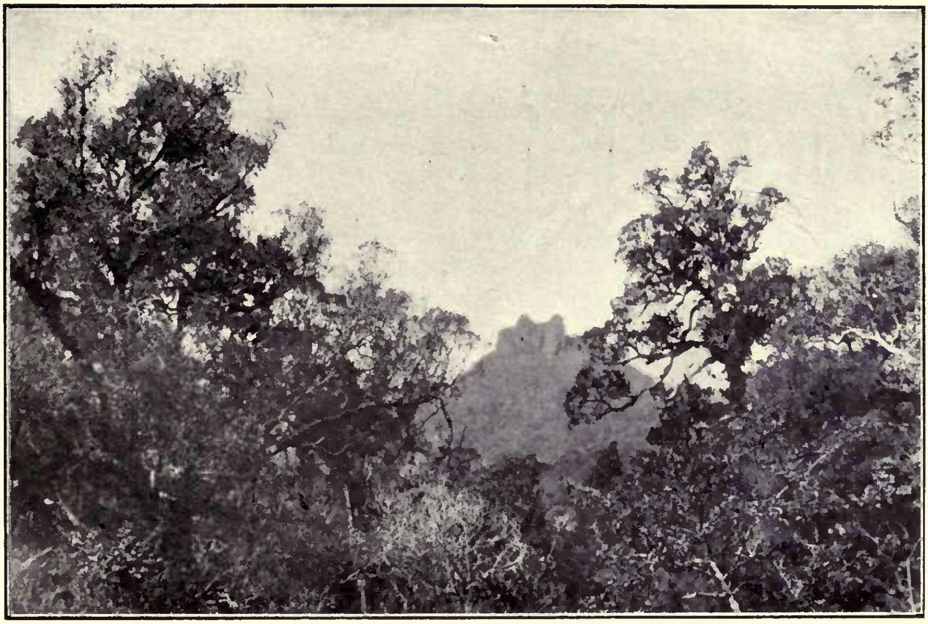
The Kapanga district, from the Tokatea Range at the Triumph Mine, has its northern boundary west to the sea north of Kikowhakarere Bay. The eastern boundary is the limit of the Kapanga group of rocks in that direction, which from the northern boundary followed south gradually descends to lower levels on the Tokatea Range till it reaches the low grounds of the Kapanga Valley at the upper township. Thence it skirts the foot of the Success Range to where Cadman's Creek debouches on to Kapanga Flat, and farther follows the mid-slope of the outer range opposite Preece's Point Peninsula to the Tiki, from which the boundary goes west to the south shore of Coromandel Harbour. Excluding most of the peninsula on the north side of Coromandel Harbour, the western boundary is the shores of the harbour and Hauraki Gulf to the northern limit of the district. The only rocks within these limits are those of the Kapanga group and the alluvial deposits of Kapanga Flat.

The district is hilly in the north to Coromandel Township and Kevin's Point, and in the south flat, with the exceptions of Preece's Point Peninsula and the lower slopes of the range to the eastward.

The rocks are mainly volcanic, but north-east of the Upper Township (Coromandel) there is a small area of slate on the eastern boundary. More to the south the Palæozoic rocks reach to the very foot of the range, but the Kapanga rocks are not found to the eastward of the west boundary-line of the slates and sandstones. Hochstetter, it has been supposed, observed slates in the bed of the Kapanga, and more recently it has been asserted that such outcrops do occur; but after search on more than one occasion the writer failed to locate any outcrops of slate in the bed of the main stream. The nearest outcrop that could be discovered was in the bed of a small stream, the first that comes from the Success Range south of Tokatea Saddle.

The Kapanga rocks are mainly grey and greenish breccias, but with several flows of darker volcanic rocks and some dykes having the same characteristics.

It was within this district that the first discovery of gold was made in New Zealand, and the locality is still pointed out, being south-east of Scotty's Mine on the slope of the hill between the mine and Kapanga Stream, but before reaching that by forty or fifty yards. At the time of the discovery a dense forest covered the hill-slopes, and at the present time the stumps of gigantic kauri-trees still remain. Most of the gold-mines of the Kapanga district lie within a belt of country about a mile in width that stretches from the shore of Coromandel Harbour across the Wynyardtown Hills by way of the Kapanga Mine and Scotty's Hill to the foot of the Tokatea Range. The Success Mine, in the Tiki-Tokatea district, is outside this belt, as also is the Preece's Point Mine, in the peninsula of that name. How far this is a distinctive belt or zone of mineralised country has not towards the south been



CASTLE ROCK FROM THE WAIAU VALLEY.

CASTLE ROCK FROM THE TIKI—TELEPHOTO VIEW.

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determined, as no mine-workings are extended under the Kapanga Flat, and the volcanic rocks *in situ* are not seen at the surface. Along the north-western side of the belt there is nothing in the character of the rocks at the surface that would lead one to suppose that a change has taken place, yet it is true that outside the limits specified north-west from the Kapanga Flats there are no mines being worked or gold-bearing reefs known to occur.

The collection of rocks made from this district was considerable, and of this the following specimens were included in the selection of rocks of the peninsula that was sent to England :—

List of Rocks from the Kapanga District.

(1.) Specimen No. 1320. Pyroxene andesite.
(Kapanga group.)
(2.) " 1336. Hypersthene andesite.
(Kapanga group.)
(3.) " 2721. Altered andesite.
(Kapanga group.)
(4.) " 2727. Quartz hornblende porphyrite.
(Kapanga group.)
(5.) " 2738. Pilotaxitic hypersthene andesite.
(Kapanga group.)
(6.) " 2752. Pilotaxitic hypersthene hornblende andesite.
(Kapanga group.)
(7.) " 2827. Altered hornblende andesite.
(Kapanga group.)
(8.) " 2833. Altered hornblende dacite.
(Kapanga group.)
(9.) " 2836. Altered hornblende dacite.
(Kapanga group.)
(10.) " 2840. Altered dacite.
(Kapanga group.)
(11.) " 2868. Altered hornblende dacite.
(Kapanga group.)
(12.) " 2869. Pilotaxitic hornblende (enstatite ?) andesite.
(Dyke in the Kapanga group.)
(13.) " 2872. Hypersthene andesite.
(Kapanga group.)
(14.) " 2874. Dacite.
(Dyke in the Kapanga group.)
(15.) " 2918. Hyalopilitic hypersthene hornblende andesite.
(Kapanga group.)
(16.) " 2930. Altered andesite.
(Kapanga group.)
(17.) " 2933. Dacite.
(Kapanga group.)
(18.) " 2941. Altered quartz pyroxene hornblende rock.
(Kapanga group.)
(19.) " 2945. Pyroxene andesite.
(Kapanga group.)

(20.) Specimen No. 2952. Pilotaxitic andesite.
(Kapanga group.)
(21.) " 2957. Altered dacite.
(Kapanga group.)
(22.) " 2969. Altered dacite.
(Kapanga group.)
(23.) " 2974. Altered dacite.
(Kapanga group.)
(24.) " 2981. Altered dacite.
(Kapanga group.)
(25.) " 3032. Altered pyroxene andesite.
(Kapanga group.)
(26.) " 3036. Andesite breccia.
(Kapanga group.)

Beeson's Island, Te Kouma, and Manaia District.

This includes Beeson's Island and nearly the whole of the peninsula opposite, which forms the northern shore of Coromandel Harbour and the Te Kouma district between Coromandel and Manaia Harbours east to the Thames–Coromandel Road, also the seaward block of hills between Manaia Harbour and flats to a line east and west from the upper part of Kirita Bay.

The country, except Manaia Flat, is everywhere hilly, and south of Manaia Harbour in some parts mountainous.

The rocks on the north side of Coromandel Harbour are generally coarse grey breccias. Beeson's Island was not examined, but opposite is a continuation of the peninsula forming the north shore of Coromandel Harbour, separated by a narrow channel of the sea, and the rocks of Beeson's Island as described by Cox are manifestly the same as those of the peninsula. Te Kouma district largely shows the presence of the same rocks, with, however, flows of dark and lighter grey volcanic rock, and towards the east hills of particoloured tuff clays and beds of finer grain than the generality of these rocks. The hills along the north shore of Manaia Harbour as seen from a distance discover a rude stratification of even the coarser breccias. In the hills on the south side of Manaia Harbour the rocks are again very coarse breccias.

On the east border of the Te Kouma part of the district, from the height of land along the descent to Manaia, and continued at lower elevations to sea-level at the head of Manaia Harbour, there is a line of siliceous-sinter deposits the material of which is now at many places hard chalcedonic quartz, and petrified wood is plentifully scattered over the Te Kouma hills.

No mining is being carried on in any part of this district, and no quartz veins carrying gold are known.

The following is a list of the specimens which have been described and named by Professor Sollas :—

List of Specimens from Beeson's Island, Te Kouma, and Manaia District.

(1.) Specimen No. 1383. Fragmental rock composed of rudely stratified volcanic material.*
(Beeson's Island group.)

(2.) " 3390. Hyalopilitic hypersthene andesite.
(Beeson's Island group.)

(3.) " 3424. Hyalopilitic hypersthene andesite.
(Beeson's Island group.)

(4.) " 3433. Hyalopilitic hypersthene andesite.
(Beeson's Island group).

Tiki-Tokatea District.

This is bounded on the west by the Kapanga district and on the north by a line from the Triumph Mine east to Kennedy's Bay, and thence the uncertain boundary of the Thames-Tokatea rocks to where these run out on Whangapoua Harbour, the Coromandel–Kuaotunu Road forming the southern boundary on the east side of the main range, the eastern slope of the main range further south being included in the Opitonui district.

The district everywhere is hilly, if not mountainous. The western part, being occupied by the main range, has definite direction in the arrangement of its greater heights, but the area east of the main range is a multitudinous assemblage of hills having no definite arrangement, and this description characterizes the whole of the block of country between Kennedy's Bay and Whangapoua.

On the east side of Tokatea Hill grauwacke grits and sandstones, stratified sandy shales, and close-grained felspathic rocks (adinole, or perhaps only felspathic mudstones) constitute the bulk of the rocks, associated with which are thick beds of rhyolite and intrusive dykes appearing as dacite and andesite porphyrites. These rocks (adinole or grauwacke) are found on Tokatea Saddle, and in the Royal Oak Mine they reach almost to the top of Tokatea Hill. To the north and to the south of the saddle they stretch down the western slope of the range as far at least as the outcrop of the Tokatea Big Reef, but towards the north, on the disappearance of the Big Reef, more modern volcanic rocks appear on the higher part on both sides of the range before the gradual encroachment of the Kapanga rocks reaches the height of land and passes to the eastern slope. Thus, a patch of the Thames-Tokatea rocks lies on the northern end of Tokatea Hill, and this on the east slope of the range has been cut through by the erosion of the deep gorges of the creeks till it can hardly be said that the Thames-Tokatea rocks are continuous with the larger development of the same along the east boundary of the district.

* This specimen comes from outside the district to the south of it, but the locality has not been included in any other district.

Along the west slope of the main range south of the Tokatea Saddle the Te Anau rocks appear between the 850 ft. level on the range and the level of the Kapanga Flat. Between Cadman's Creek and the Tiki Saddle these rocks, besides reaching to the height mentioned on the main range, also form a front range of lower hills to the west. More to the south the Te Anau rocks reach to the Pukewhau Saddle, on the Tiki Spur, where they terminate. The volcanic rocks associated are much altered, so much so that it has been difficult to determine what their character originally was. Professor Sollas considers the specimens of these rocks submitted to him as rhyolites that have undergone an excessive degree of alteration. This is likely, seeing that massive developments of rhyolite are found on the east slope of Tokatea Hill, and further towards Kennedy's Bay within this district. The country rocks of this south-west part of the district, whatever their nature, are intersected by a great number of intrusive dykes, usually some kind of porphyrite, which continue in full force till the formation is terminated on the Pukewhau Saddle. North-west of Tokatea Saddle and Hill an outcrop of the felsitic rocks is reported as appearing in the valley of Paul's Creek, but this is cut off from surface connection with the rocks of Tokatea Hill by Kapanga rocks between Scotty's Hill and the Triumph Mine; and, besides this, the area lies within the Kapanga district.

Resting on the Te Anau rocks and underlying those of the Thames-Tokatea group on the Success Range is a local deposit consisting of soft sandstones and sandy shales or clays, in which occur thin streaks of bright coal, which has attracted some attention as probably being the lowest beds of the Thames-Tokatea group in the northern part of the peninsula. The beds pass upwards into volcanic breccias, and these again into finer-grained stratified tuffs, before the main and characteristic flow rocks of the group make their appearance. The breccia-beds, including the coal, which underlie the more solid rocks are about 300 ft. in thickness. The sandstones and shales, with streaks of coal, rest with high unconformity on the older rocks underlying; but for some distance above the horizon of the coal there are no evidences of the presence of volcanic rocks, and this part of the sequence seems to have accumulated prior to the commencement of the volcanic outburst of Eocene times. It is but at a few places that the junction of the older rocks with the lowest of the Thames-Tokatea group can be seen, and it is important to note that both here and at Rocky Point, near the Thames, there rests on the Palæozoic rocks some thickness of beds that give no clear indication of the coming volcanic outburst; but in neither case do these belong to the Cretaceo-tertiary series. They are merely local deposits that have accumulated in depressions of the land surface such as it was immediately prior to the commencement of the accumulations of volcanic material which in each locality they underlie.

The Thames-Tokatea rocks, on an average, form 700 ft. or 800 ft. of the higher part of the main range. On and beyond the east slopes of the range their thickness is much greater, and cannot be less than 1,400 ft. Like the Kapanga rocks the solid flows are grey and dark, almost black, in colour; but the colour of the consolidated breccia and ash beds is as a rule much darker than those of the Kapanga group, and varies from greenish-grey through reddish-brown to purple.

Quartz lodes are abundant both in the Te Anau series and the younger volcanic group, and specially as a geological feature mention must be made of the great lode of quartz known as the Tokatea Big Reef. This in the north begins on the higher western slope of Tokatea Hill, and holds a course slightly more to the south-west than the trend of the main range. The reef is of great thickness, varying from 20 ft. to 40 ft. or more, and is formed of clear crystalline quartz, the drusy cavities in which are lined with massive crystals of the mineral. North of Courthouse Creek, nearly opposite the middle higher part of the Success Range, it appears to have its greatest thickness, which, judging from the outcrop, cannot be less than 100 ft., and might be considerably more. At this point it is divided into two separate and distinct reefs, the space between which is increased as they are followed farther to the south-west and south. The westerly branch does not continue for any considerable distance, and on the Success Spur, by which the new road leads to the mine, only the eastern branch can be traced, and it is questionable if this, however attenuated, reaches as far as the Coromandel–Whangapoua Road, on the south side of Cadman's Creek.

On Tokatea Hill this great lode seems to lie along the western boundary of the Te Anau series, and almost all the auriferous reefs on the east side of it strike at nearly right angles to the trend of the Big Reef and junction on its foot-wall side.

A large series of rock specimens were collected from this district, and the selection made for transmission to England for description was, as far as possible, a representative one; but the great series of dykes that occur in the valley of Tiki Creek were not fully collected from, and a number of dykes lying along the left upper branch under the higher part of the main range were also neglected. Below the junction of the upper branches all the dykes, nineteen in number, were collected from; but, as their occurrence became more frequent in that direction, probably as many more lay yet further to the east. To reach farther along this branch of the creek was difficult, and, as to the north in a parallel line lay the valley of the right-hand branch of Cadman's Creek, this it was thought would yield examples of the more easterly dykes; but it proved otherwise, and another opportunity was not had to finish collecting in Tiki Creek watershed.

Following is a list of the rock specimens from this district which were sent to England for naming and description:—

List of Rocks from the Tiki-Tokatea District.

(1.) Specimen No. 1311. Rhyolite.
(Beeson's Island group.)
(2.) " 1328. Hornblende hyperthene andesite.
(Beeson's Island group).
(3.) " 1392. Altered andesite(?).
(Beeson's Island group.)
(4.) " 2735. Quartz diorite porphyrite.
(Dyke in the Te Anau series.)
(5.) " 2736. Hornblende dacite porphyrite.
(Dyke in the Te Anau series.)
(6.) " 2760. Quartz muscovite rock.
(Te Anau series.)
(7.) " 2788. Quartz sericite rock.
(Te Anau series.)
(8.) " 2792. Quartz sericite rock.
(Te Anau series.)
(9.) " 2808. Hornblende pyroxene porphyrite.
(Dyke in the Te Anau series.)
(10.) " 2817. Quartz uralite porphyrite.)
(Dyke in the Te Anau series.)
(11.) " 2853. Altered dacite.
(Dyke in the Te Anau series.)
(12.) " 2865. Uralite dacite porphyrite.
(Dyke in the Te Anau series.)
(13.) " 2900. Spotted adinole.
(Te Anau series.)
(14.) " 2913. Fine-grained grauwacke.
(Te Anau series.)
(15.) " 29.4. Hornblende dacite porphyrite.
(Te Anau series.)
(16.) " 2992. Grauwacke.
(Te Anau series.)
(17.) " 2995. Altered orthoclase(?) plagioclase pyroxene rock.
(Dyke in the Te Anau series.)
(18.) " 3168. Spotted adinole.
(Te Anau series.)
(19.) " 3178. Spotted adinole.
(Te Anau series.)
(20.) " 3186. Hornblende dacite porphyrite.
(Dyke in the Te Anau series.)
(21.) " 3188. Spotted adinole(?).
(Te Anau series.)
(22.) " 3189. Altered rhyolite.
(Te Anau series.)
(23.) " 3200. Altered rhyolite.
(Te Anau series.)
(24.) " 3208. Altered rhyolite.
(Te Anau series.)
(25.) " 3216. Spotted adinole.
(Te Anau series.)

26.) Specimen No. 3222. Pilotaxitic dacite porphyrite.
(Dyke in the Te Anau series.)
(27.) " 3223. Spotted adinole.
(Te Anau series.)
(28.) " 3241. Indeterminate.
(Te Anau series.)
(29.) " 3260. Fragmental rock with rhyolite grains of quartz.
(Te Anau series.)
(30.) " 3277. Fragmental rock containing angular fragments of volcanic rocks.
(Te Anau series.)
(31.) " 3290. Grauwacke
(Te Anau series.)
(32.) " 3312. Fragmental rock containing fragments of volcanic rocks.
(Te Anau series.)
(33.) " 3313. A dyke rock not described.
(Te Anau series.)
(34.) " 3354. Dacite.
(Thames-Tokatea group.)
(35.) " 3356. Altered hornblende dacite.
(Thames-Tokatea group.)
(36.) " 3411. Adinole(?).
(Te Anau series.)

Waiau Valley and Hills West to the Thames–Coromandel Road.

The boundary of this district to the north is the Tiki-Tokatea and Kapanga districts; to the east the water-parting of the main range to the Mercury Bay Saddle at the source of the Waiau; the south boundary is a line from the Mercury Bay Saddle to the Manaia River at the junction of the two main branches, and thence the river to Manaia Settlement; and the western boundary is along the Thames–Coromandel Road. With the exception of Manaia Flat and some very limited areas in the Waiau Valley, the whole of the district is hilly and mountainous, and the eastern part along the main range becomes high and often rugged.

The hills west of the Waiau Valley immediately south of Coromandel Harbour are smooth in outline, and do not exceed 600 ft. to 700 ft. in height; but towards the south they increase in height and ruggedness, and are densely covered with forest, the northern hills being denuded of trees for the most part.

The rocks of the district along the higher part of the main range belong to the Thames-Tokatea group. The slates and sandstones within the Matawai watershed and middle part of the Waiau Valley are mostly, if not wholly, of Triassic age. The volcanic rocks spread over the hills to the west of the Waiau mainly belong to the Kapanga group; towards the south the rocks probably belong to the Thames-Tokatea group. On the Pukewhau Saddle the junction of the Te Anau and the Wairoa rocks is seen, the younger rocks being red sandy and slaty shales that cut off the equally distinctive rocks of the Te Anau series. It may be that some of the older sedimentary rocks of this district are of Carboniferous age, and along the road to the Castle Progress Mine, in the Matawai Valley, there is some evidence of this in the presence of thick-bedded rather coarse-grained sandstones and thin-bedded and finer-grained rocks with white powdery joints and thin veins of quartz. And, though present on the Pukewhau Saddle, in great part the Triassic rocks may have been removed from the low grounds and the east side of the Waiau watershed. It is somewhat remarkable that the great abundance of dykes that occur in the Tiki and Pukewhau Creeks is absent in the Matawai and Waiau Valleys, and this itself is an evidence of change of formation. True, Castle Rock crowns the main range at the source of the Matawai, but this, though a dyke, belongs to a late Tertiary age. It is therefore competent to cut through all the rocks on the east side of the Waiau watershed, and by some writers it is supposed to do so and extend for a considerable distance to the north of the Pukewhau Saddle and Tiki Creek. This theory, however, requires verification, and, while the rhyolites and dykes of the Tiki-Tokatea district are plentifully represented in the Trias conglomerates, it is manifest that the hornblende dacite of Castle Rock could not be.

On the road from Coromandel to the Thames, one mile beyond the bridge over the Waiau, supposed Triassic rocks make their appearance on the shore of Coromandel Harbour, and to J. Malcolm Maclaren is due the discovery of igneous rhyolitic material in these rocks where they are exposed in road-cuttings near the crossing of Mill Creek. Moderately coarse conglomerates are brought down by the creek entering the harbour more to the east at the Maori pa, but these are chiefly formed of pebbles of quartz and jasper and splintery fragments of an indurated black slate.

As the road rises on to the range that divides the upper parts of Coromandel and Manaia Harbours scattered pebbles begin to appear in the sandstones exposed in the road-cuttings, and before reaching the crest of the range masses of conglomerate are met with in some of the gullies. It is, however, on the fall to Manaia that the conglomerates appear *in situ* exposed in the cuttings of a deviation of the road made in 1896. Collecting the material of this conglomerate, it was seen that it consisted largely of igneous rocks, porphyritic andesites and rhyolites. The importance of this discovery was at the time fully appreciated, as it was plain that the conglomerate was partly formed by waste from the Te Anau rocks of the Tiki-Tokatea district, and it might be also of the Palæozoic dyke rocks of Moehau. Therefore such variety as could be found was collected, and, with a selection of the other rocks of the district, they formed part of the first consignment forwarded to Professor Sollas for description and naming.

List of Rocks described from the Waiau Valley and District to the West.

(1.) Specimen No. 1331. Hypersthene hornblende dacite.
(Dyke in Thames-Tokatea group.)
(2.) " 2877. Hornblende hypersthene andesite.
(Junction of Matawai with the Waiau.)*
(3.) " 3350. Dacite porphyrite.
(Dyke in Trias(?) rocks.)
(4.) " 3352. Altered hornblende andesite.
(Dyke in Trias(?) rocks.)
(5.) " 3443. Conglomerate of igneous rocks.
(Trias.)
(6.) " 3450. Conglomerate of igneous rocks.
(Trias.)
(7.) " 3453. Conglomerate of igneous rocks.
(Trias.)
(8.) " 3463. Conglomerate of igneous rocks.
(Trias.)
(9.) " 3464. Conglomerate of igneous rocks.
(Trias.)

With reference to the five specimens 3443–3464, representing the Triassic conglomerates of the range between Coromandel and Manaia Harbours, in order to determine the nature of the included rocks reference must be made to the descriptions, from which it appears that No. 3443 shows nearly all the varieties of rock present, there being *grauwacke, andesite,* both hyalopilitic and pilotaxitic, *dacite,* and silicified *rhyolite.* In the other slices there is shown the presence of *rhyolite, spherulitic rhyolite, calcareous grit,* altered *hyalopilitic andesite,* and banded rhyolite, with fragments of various rock-forming minerals that had probably been derived from igneous rocks, such as grains of quartz, orthoclase, plagioclase, chlorite, sericite, brown biotite, leucoxene granules, and zircon. These conglomerates may therefore be fairly compared with those from Cheviot Coast Range and the east district of Wellington, the chief distinction being the absence of granites in the northern conglomerates. The only difficulty in the case is that the southern conglomerates are regarded as being of Carboniferous age, but this is lessened, if not altogether disposed of, on reference of the eruptive period to a Devonian age. All this harmonizes well with what is known as having happened in corresponding time in other parts of New Zealand, and the presence of these ancient igneous rocks in the Cape Colville district but indicates that this region was, in common with several other parts of New Zealand, the scene of volcanic activity in middle Palæozoic times.

Opitonui District.

This lies opposite (east of) the southern part of the Tiki-Tokatea district, and extends south along the east slope of the main range from the Coromandel–Kuaotunu Road to the farther sources of Opitonui Creek and the water-divide

* Supposed to be the same as 1331, from Castle Rock.

between the watersheds draining to Whangapoua Harbour to the north and Mercury Bay in the opposite direction. The eastern part of the district has but a moderate elevation above the sea, and along Opitonui Creek to near the township the country is low and flat. To the east and south it is mountainous, and other than by the main road from Coromandel to Kuaotunu communication with the west coast is only had across the Tiki Saddle by means of a rough mountain bridle-track.

The rocks of the district are wholly referable to the Thames-Tokatea group, and are in certain particulars considerably different from the solid rocks of the Kapanga group, and very markedly so from those of the Beeson's Island group. The hornblende hypersthene dacite of Castle Rock is also a rock of this district, but it is not represented in the selection of the rocks of this district sent to England for description. This was unnecessary, as samples of the Castle Rock formed part of the collection from the Waiau Valley and the hills to the west. Gold-mining is carried on at Opitonui under the shadow of Castle Rock, but the ore has hitherto been of low grade, and the working of the mines has hardly paid.

The following is a list of the rocks which have been described and named from the Opitonui district:—

LIST OF ROCKS FROM OPITONUI DISTRICT.

(1.) Specimen No. 3632. Altered pilotaxitic hypersthene andesite. (Thames-Tokatea group.)
(2.) " 3635. Pilotaxitic hypersthene andesite. (Thames-Tokatea group.)
(3.) " 3636. Pilotaxitic andesite. (Thames-Tokatea group).
(4.) " 3638. Hornblende dacite porphyrite. (Thames-Tokatea group.)
(5.) " 3643. Pilotaxitic hypersthene andesite. (Thames-Tokatea group.)
(6.) " 3664. Pilotaxitic andesite. (Thames-Tokatea group.)
(7.) " 3665. Volcanic rock completely replaced by quartz. (Thames-Tokatea group.)

Matarangi District.

This lies eastward of Opitonui district and west of Kuaotunu. It extends from Whangapoua Harbour and the open sea south to the fall towards Mercury Bay. Towards the north the country is in part or mainly hilly, with broad marsh lands between the different groups of hills. Towards the east the coastline is bold, and in this direction numerous sections of the rocks are displayed. In the south the country is formed of high hills now or formerly covered by heavy kauri forest. Mining or prospecting has been carried on only in the northern part of the district, and not very successfully. Frequent reports are

CASTLE ROCK FROM THE MAIN RANGE NEAR THE PUKEWHAU SADDLE.

MATARANGI HILL, SOUTHERN VIEW, FROM THE EASTWARD.

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circulated as to the occurrence of gold in the southern part of the district, but most of these, it would seem, are without foundation.

The rocks of the district are various, and consist of coarse agglomerates, breccia tuff-beds, and solid flows of grey or dark lavas. In Matarangi Peak is displayed a magnificent section of an old volcanic neck filled with agglomerate. The southern side of this has been denuded away, exposing the pipe, the contained agglomerate, and containing rocks to a depth of some 300 ft. or more from the crest of the peak, which itself is agglomerate.

With the exception of some Palæozoic sandstones and slates, all the rocks of this district are regarded as belonging to the Beeson's Island group.

Eight samples of the rocks of the district were forwarded to England. The numbers and names of these, and the formation to which they belong, are given below :—

List of Rocks described from Matarangi District.

(1.) Specimen No. 1314. Hornblende pyroxene andesite. (Beeson's Island group.)
(2.) „ 3469. Hornblende dacite. (Beeson's Island group.)
(3.) „ 3476. Hyalopilitic hypersthene andesite. (Beeson's Island group.)
(4.) „ 3482. Hyalopilitic hypersthene andesite. (Beeson's Island group.)
(5.) „ 3527. Pilotaxitic hypersthene andesite. (Beeson's Island group.)
(6.) „ 3557. Hornblende dacite tuff. (Beeson's Island group.)
(7.) „ 2790 or 3601. Hyalopilitic hypersthene andesite. (Beeson's Island group.)
(8.) „ 3630. Hyalopilitic hypersthene andesite. (Beeson's Island group.)

Kuaotunu District.

This includes the watershed of the Kuaotunu River and the eastern slope of the Waitai Range, bounding to the east the Kuaotunu Valley, also the southern slopes of the hilly country towards Mercury Bay.

With the exception of the Kuaotunu Valley the district is hilly, and towards the east in the south, overlooking Mercury Bay, there is some very rough country.

The rocks are Palæozoic sandstones and slates, showing at the northern end and along the eastern lower slopes of the Waitai Range and in the spur range between the two branches of Kuaotunu River.

The volcanic rocks of the district are spread over the south-east and southern parts, and sparingly over the northern part of the Waitai Range.

On this range also there are enormous accumulations of siliceous sinter, the product of a great number of hot springs that formerly existed along the whole length of the range. In some cases the outlines of the old sinter terraces can easily be traced, although the surface of these is a tumbled mass of gigantic blocks of what appears to be a hard grey quartz. In many other cases the sites of the terraces have been undermined, and a vast array of huge masses of sinter on their way to the low grounds strew the eastern slopes of the range. Towards the north some terraces on the east side of the range are very well preserved, but in Black Jack, the highest point on the northern part of the range, the outlines of former terraces have been almost destroyed, although the sinter material at lower levels on the mountain-slopes is still very abundant. The peak itself contains the pipe or vent of what must have been the principal of the old thermal springs.

Here and elsewhere may be seen the great alteration which the Palæozoic sandstones and overlying volcanic rocks have undergone. All the strictly volcanic rocks belong to the Beeson's Island group of Miocene age.

Quartz reefs are numerous both in the volcanic rocks and in the slates and sandstones, and a considerable amount of gold has been obtained, more especially from the slates of the district. Most of the better-known mines must finally be worked in the slate and sandstone country.

As the volcanic rocks did not present great variety, and rocks of the same age have been collected from Matarangi district, adjacent to the west, only five samples were submitted to Professor Sollas, and these have received the names that appear in the following list. It would have been of great interest to have had the results of an examination of some of the sinterous deposits from the Waitai Range, but being limited to a given number of specimens from all parts of the peninsula, and the determination of the volcanic rocks being the chief object, the different varieties of siliceous sinter and quartz collected at many parts had to be withheld.

List of Volcanic Rocks described from Kuaotunu District.

(1.) Specimen No. 3543. Pilotaxitic hypersthene andesite (weathered).
(Beeson's Island group.)

(2.) „ 3551. Pilotaxitic hypersthene hornblende andesite.
(Beeson's Island group.)

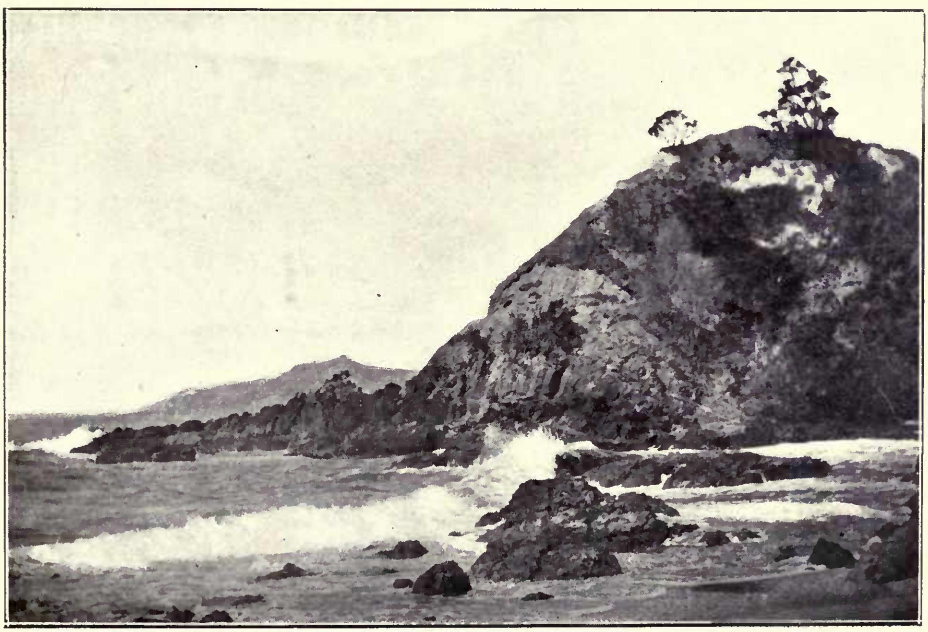
(3.) „ 3558. Pilotaxitic andesite.
(Beeson's Island group.)

(4.) „ 3586. Fragmental rock composed chiefly of andesic material.
(Beeson's Island group.)

(5.) „ 3626. Problematical.*
(Carboniferous.)

* This, as judged of in the field and reported to Professor Sollas, was considered a fine-grained sandstone much altered by thermal action. The specimen is from the mouth of the Kuaotunu River, at the eastern base of Black Jack Mountain, and was forwarded as an example of the alteration to which the sedimentary rocks had been subjected. The next adjacent rocks at the same place are gritty sandstones abounding in small inclusions of black slate.

REEFS OF SANDSTONE, NORTH-EAST ANGLE OF WAITAIA RANGE, KUAOTUNU.



BLACK JACK FROM MATARANGI BLUFF.

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Mahakirau District.

This lies south-west of Matarangi and within the Mercury Bay watershed, and may be considered as including the country north and south from the Matarangi and Opitonui boundaries to Mill Creek, and east and west the country from the main divide to the low grounds inland of Mercury Bay and Whitianga Harbour. The district is hilly and mountainous, with deep narrow valleys winding among the hills or cutting back direct to the main range.

The rocks over the western part of the area belong to the Thames-Tokatea group, but in the east, north of the Kaimarama River, they belong to the Beeson's Island group.

At Hooker's store a northern tributary of the Mahakirau leaves the mountains to join the main stream, and in the valley of this there are stratified beds, in part consisting of coaly shales and, it is said, seams of coal, but of the latter I saw none. The junction of these with the rocks of the Thames-Tokatea group is seen along the valley of this creek, the latter for the last time appearing in characteristic form in the road-cuttings half a mile north-west of Hooker's store. In the search for coal, lava-streams were observed interbedded with and overlying the sedimentary beds, and of the collection made three samples were forwarded as part of the second consignment of rocks sent to England, and these have been named as appears in the following list:—

List of Rocks described from the Mahakirau District.

(1.) Specimen No. 1040. Micropœcillitic hornblende andesite.
(Beeson's Island group.)
(2.) „ 1041. Altered andesite.
(Beeson's Island group.)
(3.) „ 1042. Hyalopilitic hornblende hypersthene andesite.
(Beeson's Island group.)

The Thames-Tokatea group was not collected from in this district, nor were the pumiceous agglomerates of the Pliocene acidic group where they appear in the south-east part. At the time the district was visited bush-fires were raging, and the whole atmosphere was filled with dense and pungent smoke from burning kauri-trees, and it was not safe to leave the leading indications for the return journey. Even the main road became obstructed with fallen trees, and there was fire overhead and on both sides of the highway. Under the circumstances I was content to collect evidence of the presence of the younger group, the presence of the older to the westward being a well-established fact.

Whitianga, or Mercury Bay, District.

This lies south of Mercury Bay and east of the Whitianga River and its tributary the Whenuakite to where this is crossed by the road from Mercury Bay to the Tairua River, and embraces the country east to the seaboard. The country consists of ranges of hills and low and swampy valleys; and the

Whenuakite is tidal as far as it merits consideration as one of the principal rivers of the watershed discharging into Mercury Bay.

The rocks consist of an unknown thickness of pumiceous agglomerates, breaking through and resting on which are solid rhyolites at many places. Much of the pumiceous agglomerate has dispersed through it andesitic material; but where this is less abundant it forms in places a very fair building-stone specially suited for particular purposes. This and the other rocks present form high cliffs on the south shore of Mercury Bay and on the east side of Whitianga Harbour, opposite the wharf and township. In the last-named place the weathering of the rocks has resulted in the production of grotesque and fantastic outlines, which, however, are softened by being intermingled with and partly hidden by flowering shrubs and small trees. At some places the pumiceous deposits contain quantities of obsidian splinters dispersed through the mass, and at one place these are especially abundant, and of large size.

Thermal springs are found on the coast-line at Hot-water Beach, and there is evidence of their former existence at many places. At one place on the west slope of Pannikin Hill, on the fall to Whitianga Harbour, there is a special display of sinterous deposit, and a dark glassy rock has to some extent been prospected for gold under the belief that it was quartz. A little gold is said to have been found, but the rock does not present the appearance of a gold-bearing rock. It is in mass a dark bottle-green glass. Andesites are said to crown some of the highest hills in this neighbourhood, but their occurrence was not verified by me.

The following is a list of the specimens from this district that were forwarded to Professor Sollas for naming and description :—

LIST OF MERCURY BAY AND WHITIANGA ROCKS.

(1.) Specimen No. 1013. Obsidian.
(Acid group of Pliocene age.)

(2.) " 3668. Altered rhyolitic flow rock.
(Acid group of Pliocene age.)

Gumtown and Rangihau Valley District.

This is a hilly and mountainous region lying inland of the east coast, between the upper parts of the streams flowing to Mercury Bay to the north-east and the drainage to the Tairua River in the south-east side of the mountains. For the first few miles south and east of Gumtown the hills—even the higher hills—are of rounded outline, and the valleys, but little above tide-level, are swampy at many places, and only ascertained routes of travel can be followed. Beyond this lower region a vast array of rugged ranges is spread over the country and forms the water-divide to the south. This runs nearly east and west from Boat Harbour to Table Mountain, and is only in part identical with the main axis of the peninsula.

The southern slope to the Tairua is beyond the district now being

SHAKESPEARE CLIFF, MERCURY BAY.

CLIFFS OF PUMICEOUS AGGLOMERATE, WHITIANGA RIVER, MERCURY BAY.

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described, and some account of this will appear under another heading. The mountains towards the south reach to about 2,500 ft. above the sea, and though their northern slopes are not as fantastic as the southern, or as part of the main water-divide adjacent, they yet form extremly rugged country difficult of access. The fundamental rocks, as far as these can be observed, seem to be a pumiceous tuff—the same as is spread over a great part of the Mercury Bay district east of the Whitianga River. Breaking through these or covering them are solid streams of acid lavas, by which the mountains are built up, and these constitute an enormous development of eruptive and intrusive rhyolites. The intrusive rhyolites appear along the northern border of the higher mountain region and form conical mountain-masses, with the pumiceous tuff clinging to their sides for some distance above what is now the general elevation of these rocks. This, however, does not prove that the tuffs have been elevated by the upcoming of the rhyolites, but rather that the loss by denudation has been great over the surface of the pumiceous tuff at a distance, and through, perhaps, an indurating effect they have been better able to resist the agents of waste in the near vicinity of the intrusive rock.

Over many parts of this and in the Mercury Bay district the pumiceous tuffs have weathered and been eroded into the most extraordinary forms of surface-feature, one variety of this appearing in cliffs and nearly vertical faces of rock. This usually assumes the most grotesque of outlines, a good example of which may be seen on the right bank of the Whitianga, at the township and ferry over the river. The other variety consists in deep flutings on slopes, more or less steep, of bare rock-exposures, and these, with an approach to regularity, are yet extremely varied, and in many respects are as remarkable as the other type. The upper part of these tuffs is formed of fine pumiceous sands, but these are seldom preserved at any considerable distance away from the cover of rhyolitic rocks. These finer beds contain seams of lignite, a number of fossil leaves, and a species of fresh-water mollusc (*Unio aucklandicus*), which give evidence of the land-conditions under which they were formed and the overlying solid rhyolites made their appearance.

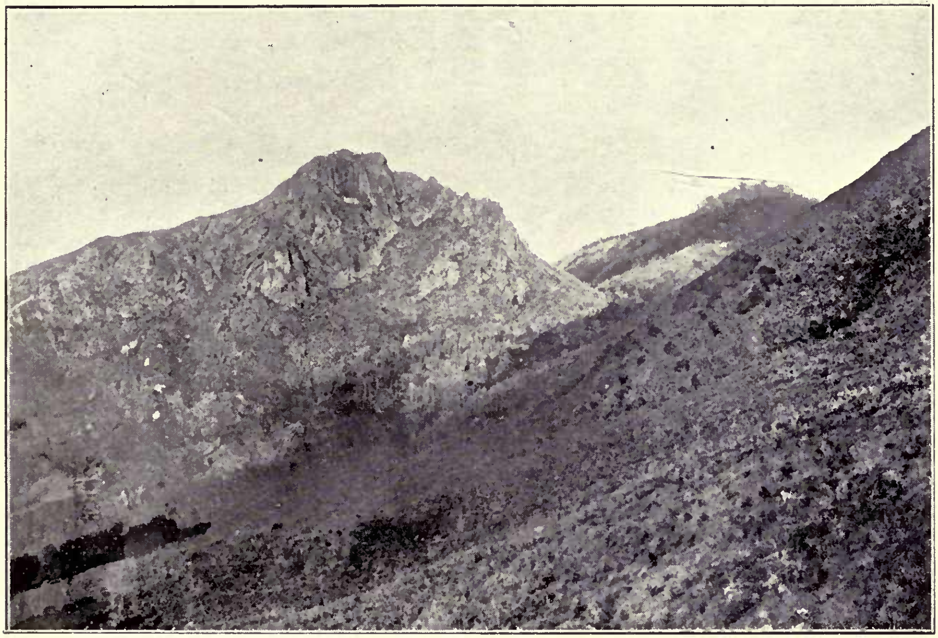
Thermal springs depositing silica are not rare along the margin of the intrusive rocks, though far less abundant than in the adjacent district to the south. The rocks of this area are of special interest as containing a number of auriferous lodes or rock-bodies, which, having but lately been discovered, are yet in the prospecting stage of development. Some of those near the surface are phenomenally rich in the precious metal; others manifestly occur in close connection with and as part of the deposits of hot springs, and thus they are likely to throw additional light on the origin of quartz lodes in other parts of the district. All of them lie within the area of solid rhyolites, and demonstrate the capacity of this rock to carry and contain auriferous veins, a matter on which there has been some diversity of opinion.

The rocks forwarded from this district, and named by Professor Sollas, are enumerated in the list which is given below.

List of Rocks described from the Gumtown and Rangihau District.

(1.) Specimen No. 1035. Dacite.
(Acid group of Pliocene age.)
(2.) " 3672. Dacite.
(Acid group of Pliocene age.)
(3.) " 3680. Glass with basic phenocrysts.
(Acid group of Pliocene age.)
(4.) " 3691. Rhyolite.
(Acid group of Pliocene age.)
(5.) " 3697. Dacite rhyolite.
(Acid group of Pliocene age.)
(6.) " 3703. Perlitic pitchstone.
(Acid group of Pliocene age.)
(7.) " 3708. Microspherulitic rhyolite.
(Acid group of Pliocene age.)
(8.) " 3709. Microspherulitic rhyolite.
(Acid group of Pliocene age.)
(9.) " 3711. Rhyolite.
(Acid group of Pliocene age.)
(10.) " 3713. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(11.) " 3735. Quartzose rock pseudomorphous after rhyolite.
(Acid group of Pliocene age.)
(12.) " 3739. Andesic glass.
(Acid group of Pliocene age.)
(13.) " 3747. Rhyolite with plagioclase.
(Acid group of Pliocene age.)
14.) " 3749. Pumiceous agglomerate.
(Acid group of Pliocene age.)
(15.) " 3751. Rhyolite with plagioclase.
(Acid group of Pliocene age.)
(16.) " 3758. Positive spherulitic rhyolite with plagioclase.
(Acid group of Pliocene age.)
(17.) " 3759. Rhyolite.
(Acid group of Pliocene age.)
(18.) " 3768. Spherulitic rhyolite partly replaced by quartz.
(Acid group of Pliocene age.)
(19.) " 3772. Rhyolite replaced by quartz.
(Acid group of Pliocene age.)
(20.) " 3800. Highly quartzose rhyolite.
(Acid group of Pliocene age.)
(21.) " 4394. Glassy spherulitic rhyolite.
(Acid group of Pliocene age(?).)
(22.) " 3692. Hyalopilitic hypersthene andesite.
(Post acidic or Younger Pliocene Intrusive.)*

* This specimen was not obtained *in situ*, but from the drift in the bed of the Rangihau River. Great numbers of boulders of the same rock are scattered over the high lands on the south side of the Rangihau Valley, and all of them seem referable to Table Mountain, with the rocks of which they are identical.



INTRUSIVE RHYOLITE FLANKED BY PUMICEOUS AGGLOMERATE, GUMTOWN, RANGIHAU DISTRICT.

NEW SLIP, SLIP CREEK, GUMTOWN, RANGIHAU DISTRICT.

To face p. 88.]

Paku Island.

This island lies on the north side of the entrance to the Tairua River, and as a conical hill some 500 ft. to 600 ft. in height forms a remarkable feature in the general view. It is nearly surrounded by the sea and the estuary of the river, the only connection with the mainland being a shingle-spit between the ocean and the inland tidal waters. The sides exposed to the sea are formed of bold precipitous cliffs of a hard grey spherulitic rhyolite the undulations of flow-line in which are of great amplitude, and give to the rock the appearance of contorted gneiss. The island is about a mile in length and somewhat less in breadth, and is formed wholly of acid rocks. The largest and best-preserved examples of microspherulite came from this island.

In the valley of Graham's Creek, which joins the Tairua at the western end of the island, former intense thermal activity is indicated by the number and size of the sinter terraces, partly intact and partly broken up, which may be traced principally on the east side of the valley. Though these thermal springs appeared on country formed of andesitic rocks, they are yet contiguous to Paku Island, and these or others of which the surface evidences are destroyed may have exercised an influence on the neighbouring rhyolitic rocks. Paku Island may prove to be a centre of rhyolitic eruption, as it is isolated by some distance from other areas showing rocks of the same character.

A considerable collection of specimens was made from Paku Island, but it is a field that is yet far from being exhausted, and as it has yielded some unique specimens of spherulitic structure it may with profit be visited by other collectors.

List of Rocks described from Paku Island.

(1.) Specimen No. 4153. Altered spherulitic rhyolite.
(Acid group of Pliocene age.)
(2.) „ 4161. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(3.) „ 4162. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(4.) „ 4175. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(5.) „ 4182. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(6.) „ 4185. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(7.) „ 4204. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(8.) „ 4205. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(9.) „ 4216. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(10.) „ 4219. Spherulitic rhyolite.
(Acid group of Pliocene age.)

(11.) Specimen No. 4223. Lithophysal spherulitic rhyolite.
(Acid group of Pliocene age.)
(12.) " 4226. Lithophysal spherulitic rhyolite.
(Acid group of Pliocene age.)
(13.) " 4229. Lithophysal spherulitic rhyolite.
(Acid group of Pliocene age.)
(14.) " 4230. Lithophysal spherulitic rhyolite.
(Acid group of Pliocene age.)
(15.) " 4233. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(16.) " 4345. Altered spherulitic rhyolite.
(Acid group of Pliocene age.)
(17.) " 4359. Positive spherulitic rhyolite.
(Acid group of Pliocene age.)
(18.) " 4364. Pitchstone.
(Acid group of Pliocene age.)
(19.) " 4366. Pitchstone.
(Acid group of Pliocene age.)
(20.) " 4372. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(21.) " 4375. Negative spherulitic rhyolite.
(Acid group of Pliocene age.)
(22.) " 4381. Lithophysal spherulitic rhyolite.
(Acid group of Pliocene age.)
(23.) " 4384. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(24.) " 4386. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(25.) " 4387. Positive microspherulitic rhyolite.
(Acid group of Pliocene age.)
(26.) " 4388. Banded rhyolite.
(Acid group of Pliocene age.)
(27.) " 4396. Glassy spherulitic rhyolite.
(Acid group of Pliocene age.)
(28.) " 4425. Glassy spherulitic rhyolite.
(Acid group of Pliocene age.)
(29.) " 4574. Glassy spherulitic rhyolite.
(Acid group of Pliocene age.)

Tairua-Wharekawa District.

In 1896 and 1897 much difference of opinion existed as to the nature of the rock mined in at Ohui, on the coast-line between the Lower Tairua and Wharekawa Rivers, the general impression being that the rocks were of an andesitic type. Andesites appear to be in the neighbourhood, as boulders of this rock are found in some of the creeks on the track from the Upper Landing (Tairua River) to Ohui, and possibly rocks of this class are on the eastern face of the coast range north of Ohui, which was not visited. The workings to the west of the swamp at Ohui were not visited, and it is possible that andesites occur there. As the swamp is of considerable length and impassable

I had to determine on which side of it I should continue my journey, examining various prospecting-works by the way. I selected the west side, and collected rocks which I considered to be rhyolite, and saw no other rocks (except the products of thermal springs) at the surface, and the same day continued my journey to Wharekawa over a country entirely rhyolitic till reaching within a mile of the shores of Wharekawa Inlet.

A similar difficulty arose with respect to the rocks mined in at Broken Hills, on the Tairua River. The western slope of the mountain-mass and cluster of peaks that constitute Broken Hills on that side I judged to be rhyolite, while the higher and western parts I concluded were andesitic breccias and ash-beds similar to those of Neavesville, between the source of the Fourth Branch of the Tairua and the Puriri River, draining eastwards to the Thames Valley. At a later date I visited the gold-mines on the Upper Wharekawa River, opposite Whangamata, and those adjacent to the "Wires" basin, near the source of the Tairua River, in both of which localities it was asserted that the rocks were wholly andesitic. This proved not to be the case, for though at the two places last mentioned mining prospecting works were being carried on in andesite country extensive areas of rhyolite were closely contiguous to the mines and different prospecting-works. These differences of opinion as to what the nature of the rocks is led to the making of more abundant collections than otherwise would have been considered necessary, and compelled also the sending to England many duplicates of rocks for no other purpose than simply to obtain an authoritative decision as to the precise nature of such rocks.

List of Rocks described from Ohui, Broken Hills, and the "Wires," in the Upper Tairua Valley.

(1.)	Specimen No.	759.	Spherulitic rhyolite. (The acid group of Pliocene age.)
(2.)	"	761.	Pumiceous rhyolite. (Acid group of Pliocene age.)
(3.)	"	1434.	Glassy dacite rhyolite. (Acid group of Pliocene age.)
(4.)	"	1480.	Silicified rhyolite. (Acid group of Pliocene age.)
(5.)	"	4279.	Quartz sericite rock. An altered rhyolite. (Acid group of Pliocene age.)
(6.)	"	4286.	Hyalopilitic hypersthene andesite. (Kapanga group(?).)
(7.)	"	4293.	Altered rhyolite. (Acid group of Pliocene age.)
(8.)	"	4298.	Altered rhyolite. (Acid group of Pliocene age.)
(9.)	"	4304.	Negative microspherulitic rhyolite. (Acid group of Pliocene age.)

Te Mata, Tapu Creek, and Waiomo District.

This lies on the west side of the peninsula near the coast-line, the country towards the main water-divide between the east and west coasts not having been penetrated. In the gorge of Tapu Creek Palæozoic slates and sandstones and a fine-grained felsitic rock make their appearance, more especially on the north side of the gorge. But to the north of the Township of Hastings, at the mouth of the creek, the volcanic rocks again appear on the coast-line and continue to or a little beyond the mouth of the Mata River. Beyond this on the coast and for some distance back into the hilly parts to the east the country is formed of Carboniferous slates and sandstones. Immediately north of the Mata River these latter rocks are cut by a number of massive dykes which have engaged the attention of geologists since the early days of the Thames Goldfield, and in different reports have been designated variously. Immediately north of the Mata River rocks belonging to the Thames-Tokatea group are seen in contact with Carboniferous strata, but more to the east within this watershed and to the north of it the Beeson's Island group is known to be present between the sedimentary rocks of the coast-line and the water-divide of this part of the peninsula.

South of Tapu Creek the rocks are wholly referable to the Thames-Tokatea group.

In the Waiomo Valley they do not call for special comment, being similar to those in the upper valley of Tapu Creek.

The rocks of the volcanic series on the coast-line have mostly a grey colour, with some bands or flows of darker rock. The hills south of Tapu Creek show a preponderance of light-grey coarse or finer breccias, but in the upper valley there is a number of heavy flows of hard dark-coloured andesitic rock, while yet further up, near the Martha Royal Mine, grey breccias are again seen. Mining has been carried on on both sides of the gorge of Tapu Creek continuously almost since the discovery of gold at the Thames. Auriferous reefs are found in both the Carboniferous slates and sandstones and the volcanic rocks of the Thames-Tokatea group. In Waiomo Valley the developments are more modern, but in this there are some rich (but refractory) ores that in the meantime have to be shipped to Sydney for treatment. Fairly abundant collections of rock were made from this district, a selection from which was forwarded to England and there have been named, as appears in the following list:—

List of Rocks described from Te Mata, Tapu, and Waiomo District.

(1.) Specimen No. 3199. Fine-grained siliceous grit.
(Carboniferous.)

(2.) „ 3866. Augite diorite.
(Thames-Tokatea group.)

(3.) „ 3889. Hornblende andesite.
(Carboniferous.)

(4.)	Specimen No.	3898.	Highly altered igneous rock. (Thames-Tokatea group.)
(5.)	"	3901.	Hypersthene dacite. (Carboniferous.)
(6.)	"	3905.	Highly altered igneous rock. (Thames-Tokatea group.)
(7.)	"	3921.	Decomposed andesite. (Thames-Tokatea group.)
(8.)	"	3932.	Decomposed andesite. (Thames-Tokatea group.)
(9.)	"	4001.	Pilotaxitic hypersthene andesite. (Thames-Tokatea group.)
(10.)	"	4013.	Decomposed andesite. (Thames-Tokatea group.)
(11.)	"	4035.	Pilotaxitic hypersthene andesite containing hornblende. (Thames-Tokatea group.)

Thames District.

This extends along the east shore of the Hauraki Gulf from Rocky Point to the mouth of the Kauaeranga River. Inland it reaches to the upper part of Tararu Creek, and thence south across the Look-out Rocks to the source of Hape Creek, which generally runs along the boundary of the productive part of the field. This area is triangular, the longer side stretching along the shore-line. The country is hilly, and the inland part may be said to be mountainous. Two principal and several smaller creeks drain the district. The largest of these is Tararu Creek, which discharges to the sea the waters of the northern part; and Karaka Creek, more to the south, which drains the middle part of the field. The other creeks from north to south are Waihoanga, Shellback, Kuranui, Moanataiari, Waiotahi, and Hape Creeks. Tinker's and Ohio Creeks are southern branches of Tararu Creek. Between Moanataiari Creek and the mouth of the Kauaeranga there is a narrow coastal plain known as Grahamstown Flat in the northern and lesser part and Shortland Flat over the southern and larger part.

The rocks of the district are, or almost all are, of an andesitic or dacitic character, and for the greater part consist of coarse and fine breccias and fragmental deposits of finer grains which vary in tint and colour—grey, green, brown, or purple. A small area of slate and light-grey felsitic pyritous rock is found on the coast-line at Tararu or Rocky Point, and the same rock has a limited exposure in the valley of Waihoanga Creek. This, like that farther to the north in Tapu Creek, is regarded as being of Carboniferous (possibly of Devonian) age, and is the last of the Palæozoic rocks seen as they are followed from north to south along Cape Colville Peninsula.

The Thames-Tokatea group of volcanic rocks are in this district the next in age and the first in importance, as in them without exception the whole of the gold-mines on the field are being worked. With the breccias and tuff-beds of this formation are associated very considerable bodies of a bluish-grey or yellowish-brown rock, by the miners called "sandstone," and otherwise known and written of as propylite, but which in the descriptions that follow is regarded as altered andesite or dacite.

There are also numerous hard bars of almost black, dark-grey, grey, or greenish rock in a less-decomposed state, which have been variously regarded as dykes or sheets of lava, and variously named by different authors.

On the south-east margin of the field rocks belonging to the Beeson's Island group make their appearance. These as breccias and solid flows of dark lava extend south and east along the Kauaeranga Valley, but are hardly to be taken into consideration in giving a mere sketch of the Thames Goldfield. Some high-level terraces of younger Pliocene or Pleistocene age are to be met with on the east side of Shortland Flat, but these are of no consequence in connection with the auriferous rocks of the Thames.

The section along Tararu Creek gives the best insight into the structure and manner of building-up of the rocks of the Thames-Tokatea group on this field, and the rocks can also in part be well seen on the western face of Una Hill and along the valley of Karaka Creek.

Reefs of gold-bearing quartz are most abundant in the middle part of the field, extending from the shore of the Firth of Thames north-east to and beyond Punga Flat and the upper part of Tinker's Gully. In the valley of Tararu Creek the reefs seemingly extend a greater distance to the east than they have been traced on the other parts of the field. The reefs are of all sizes, from mere threads of quartz to bodies of ore-bearing stone 12 ft. or 15 ft. in thickness, and contain gold from a mere trace that will not pay to work to ore-bodies of phenomenal richness.

A large collection of the rocks of the district was made from surface exposures and from mine-workings, and a judicious selection of these was made, which have been described and named by Professor Sollas. The following list gives the names of the samples sent:—

List of Rocks described from the Thames District.

(1.) Specimen No. 626. Micropœcillitic hypersthene andesite. (Thames-Tokatea group.)
(2.) " 628. Altered pyroxene andesite. (Thames-Tokatea group.)
(3.) " 629. Indeterminate. (Thames-Tokatea group.)
(4.) " 631. Altered dacite(?). (Thames-Tokatea group.)
(5.) " 636. Micropœcillitic hypersthene andesite. (Thames-Tokatea group.)
(6.) " 637. Andesitic tuff. (Thames-Tokatea group.)

MINING ON THE THAMES GOLDFIELD.

MOANATAIARI SLIDE, THAMES GOLDFIELD—LAID BARE BY DENUDATION, HANGING-WALL SIDE.

[To face p. 94.]

(7.) Specimen No. 649. Hypersthene hornblende andesite.
Thames-Tokatea group.)

(8.) „ 656. Altered dacite(?).
(Thames-Tokatea group.)

(9.) „ 658. Decomposed hornblende pyroxene andesite.
(Thames-Tokatea group.)

(10.) „ 662. Hypersthene andesite.
(Thames-Tokatea group.)

(11.) „ 670. Altered hornblende pyroxene andesite.
(Thames-Tokatea group.)

(12.) „ 671. Hypersthene andesite.
(Thames-Tokatea group.)

(13.) „ 675. Altered(?) hypersthene andesite.
(Thames-Tokatea group.)

(14.) „ 678. Altered(?) hypersthene andesite.
(Thames-Tokatea group.)

(15.) „ 679. Altered hornblende pyroxene andesite.
(Thames-Tokatea group.)

(16.) „ 682. Altered andesite(?).
(Thames-Tokatea group.)

(17.) „ 687. Altered andesite(?).
(Thames-Tokatea group.)

(18.) „ 692. Hypersthene andesite.
(Thames-Tokatea group.)

(19.) „ 696. Hornblende pyroxene dacite.
(Thames-Tokatea group.)

(20.) „ 699. Altered andesite.
(Thames-Tokatea group.)

(21.) „ 703. Dacite breccia.
(Thames-Tokatea group.)

(22.) „ 705. Altered andesite.
(Thames-Tokatea group.)

(23.) „ 709. Hornblende pyroxene andesite.
(Thames-Tokatea group.)

(24.) „ 712. Pyroxene hornblende dacite.
(Thames-Tokatea group.)

(25.) „ 713. Altered pyroxene andesite.
(Thames-Tokatea group.)

(26.) „ 719. Altered pyroxene andesite.
(Thames-Tokatea group.)

(27.) „ 721. Hornblende hypersthene andesite.
(Thames-Tokatea group.)

(28.) „ 724. Altered hypersthene hornblende dacite.
(Thames-Tokatea group.)

(29.) „ 732. Altered pyroxene andesite.
(Thames-Tokatea group.)

(30.) „ 733. Andesite.
(Thames-Tokatea group.)

(31.) „ 734. Hornblende pyroxene andesite.
(Thames-Tokatea group.)

(32.) „ 736. Altered pyroxene andesite.
(Thames-Tokatea group.)

(33.) Specimen No. 737. Hornblende dacite.
(Thames-Tokatea group.)
(34.) " 745. Indeterminate.
(Thames-Tokatea group.)
(35.) " 748. Hornblende hypersthene andesite.
(Thames-Tokatea group.)
(36.) " 749. Hypersthene andesite.
(Thames-Tokatea group.)
(37.) " 797. May have been a hornblende andesite.
(Thames-Tokatea group(?).)
(38.) " 799. Altered pyroxene andesite.
(Thames-Tokatea group(?).)
(39.) " 802. Micropœcillitic hypersthene andesite.
(Thames-Tokatea group.)
(40.) " 813. Altered pyroxene andesite.
(Thames-Tokatea group.)
(41.) " 818. Altered pyroxene andesite.
(Thames-Tokatea group.)
(42.) " 822. Quartz diabase.
(Thames-Tokatea group.)
(43.) " 823. Hypersthene andesite.
(Thames-Tokatea group.)
(44.) " 833. Micropœcillitic pyroxene andesite.
(Thames-Tokatea group.)
(45.) " 836. Altered pyroxene dacite.
(Thames-Tokatea group.)
(46.) " 846. Hyalopilitic hypersthene andesite.
(Beeson's Island group.)

Kauaeranga Valley.

Immediately south of the Thames district the Kauaeranga Valley, from the western boundary of the Tairua district and the mountain region of the main range, stretches south-west half the distance across the middle part of Cape Colville Peninsula, the main water-parting from abreast of Table Mountain being displaced considerably to the eastward. The Billy Goat Stream and the Hihi River, as tributaries of the Kauaeranga, drain the higher part and western slopes of the main divide overlooking the Tairua Valley at Broken Hills; and the northern sources drain from the same water-parting as the main source of the Waiwawa, which, from the west of Table Mountain, flows north and east to Mercury Bay.

The Kauaeranga Valley is hemmed in by mountains of considerable height. For the first two miles from the Firth of Thames to the various sources of the river and to the junction of the Hihi the average width is three-quarters of a mile. Gradually towards the east the surroundings become more rugged, and in the direction of Table Mountain the stream is confined in a deep mountain gorge, over the east side of which the waters of the stream forming the Billy Goat Falls are precipitated. The main range, from which these waters come, as seen from a distance, forms a high plateau table-land, from which the descent into the Tairua Valley is extremely rugged and abrupt, being unquestionably the roughest, if also the most scenic, part of the whole peninsula. This part, however, lies outside the Kauaeranga Valley.

The rock-formations within the valley are various, and, with the exception of the Palæozoic and Trias rocks of the northern part and the coal-formation of Cabbage Bay district, there are in the Kauaeranga Valley representatives of all the other groups of rocks found in the peninsula. The Thames-Tokatea group seems to be present for a short distance in the lower part of the valley, and perhaps round the sources of Otonui Creek. The Kapanga group, stretching north from Neavesville, reaches into the upper valley along the Hihi, and passes under the acid rocks that form the higher part of the main range.

Rocks of the Beeson's Island group, however, occupy by far the greater area west of the junction of the main sources of the river, and stretch north and north-east into the Waiwawa watershed.

The acid rocks of Pliocene age form the higher parts of the mountains to the north-east and east, with the exception of Table Mountain, which as a massive intrusion of andesitic rock appears between different areas of acid rocks on the high grounds, and cuts as a dyke through the Kapanga rocks of the low grounds of the Hihi Valley.

No mining is at present carried on in any part of the valley, but gold is known to occur both in the upper and the lower parts, and cinnabar has been found in Otonui Creek.

As this is the first stream draining the west side of the peninsula (proceeding from north to south) that shows the presence of acid rocks in the gravels of its bed, it was explored upwards until these rocks were found *in situ*, and partly direct from the rocks *in situ*, partly also from the gravels of the river-bed, a considerable collection was made. The andesites of the Beeson's Island group were less regarded, while the rocks of the Kapanga group lay too far inland among the mountains to warrant the carrying of much material when already laden with other rocks. Selections from the collections thus made were sent to England, and were there named as in the list below.

List of Rocks described from the Kauaeranga Valley.

(1.) Specimen No. 794. Rhyolite.
(Acid group of Pliocene age.)

(2.) " 795. Rhyolite breccia.
(Acid group of Pliocene age.)

(3.) " 853. Rhyolitic ash.
(Acid group of Pliocene age.)

(4.) " 863. Spherulitic rhyolite.
(Acid group of Pliocene age.)

(5.) Specimen No. 878. Quartz hornblende pyroxene andesite.
(Beeson's Island group(?).)
(6.) „ 881. Volcanic ash.
(Beeson's Island group.)
(7.) „ 899. Hyalopilitic hornblende pyroxene dacite.
(Acid group of Pliocene age.)
(8.) „ 911. Perlitic glass.
(Acid group of Pliocene age.)
(9.) „ 912. Perlitic glass.
(Acid group of Pliocene age.)
(10.) „ 914. Hyalopilitic pyroxene andesite.
(Beeson's Island group.)
(11.) „ 923. Spherulitic glassy rhyolite.
(Acid group of Pliocene age.)
(12.) „ 935. Glassy hornblende dacite.
(Beeson's Island group(?).)
(13.) „ 942. Vesicular spherulitic rhyolite.
(Acid group of Pliocene age.)
(14.) „ 991. Hyalopilitic quartz hypersthene andesite.
(Dyke, Younger-pliocene.)
(15.) „ 994. Hyalopilitic quartz hypersthene andesite.
(Dyke, Younger-pliocene.)
(16.) „ 995. Dacite.
(Acid group of Pliocene age.)
(17.) „ 1002. Dacite.
(Acid group of Pliocene age.)

Puriri Valley District.

The lower part of the valley contains a limited development of the Thames-Tokatea rocks, which to the east are overlain by rocks of the Kapanga group, forming the crest of the range and stretching down the east slope past Neavesville. The Kapanga rocks are also developed to the north of the upper part of the Puriri, and these are to the west followed by rocks of the Beeson's Island group, which latter are largely developed in the Kauaeranga Valley. On the south-east side of the Puriri the higher parts of the mountains are formed of acid rocks, and to the south-west, towards Omaha Peak, the Thames-Tokatea group is overlain by Beeson's Island rocks.

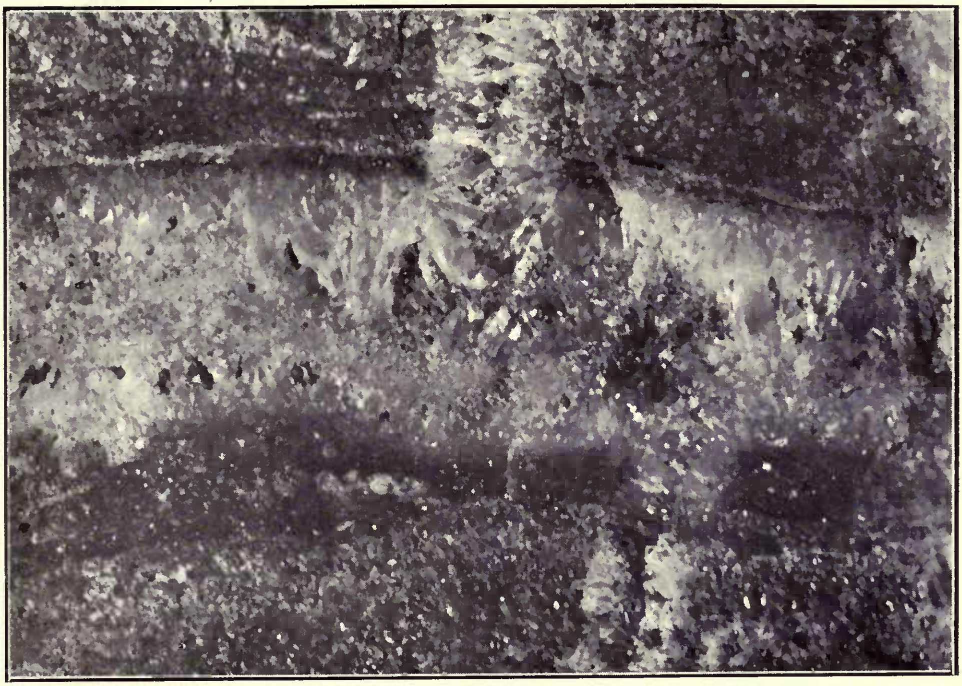
The only specimens from the Puriri sent to England have been derived from the acid rocks on the south-east side of the valley.

List of Rocks described from the Puriri District.

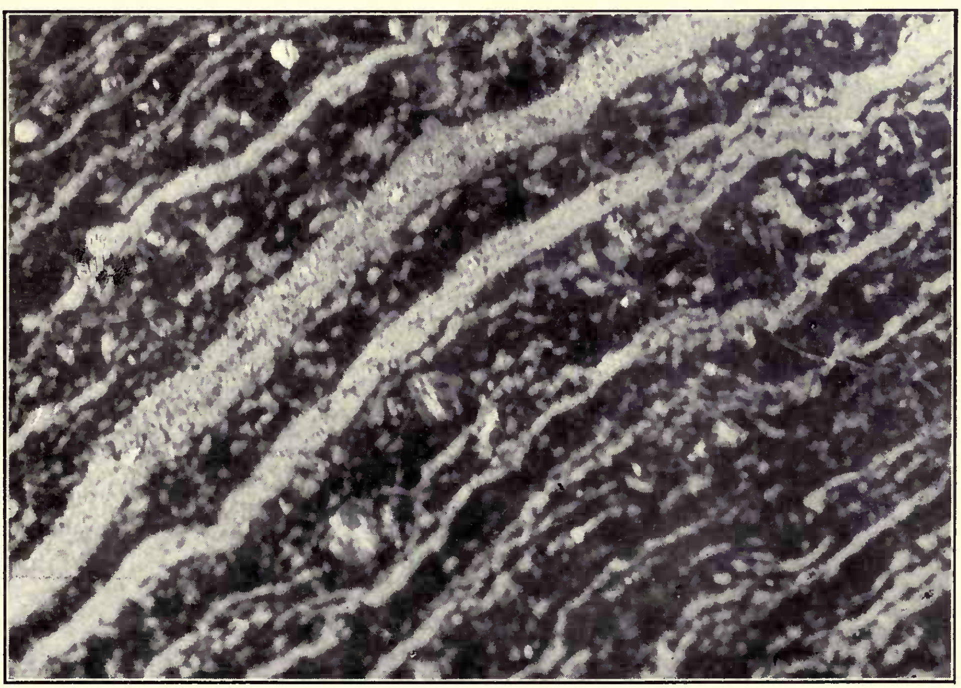
(1.) Specimen No. 950. Glassy spherulitic rhyolite.
(Acid group of Pliocene age.)
(2.) „ 976. Dacite.
(Acid group of Pliocene age).

Omahu District.

This lies south of and adjacent to the Puriri district, and is constituted by the valley of a small river tributary of the Waihou or Thames. Between



QUARTZ VEIN, WITH "FLINTY," BOTH CARRYING GOLD, THAMES GOLDFIELD.



RHYOLITE, PURIRI VALLEY, THAMES COUNTY.

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the Puriri and the Omahu low rounded hills reach west to the main road from the Thames to the southern goldfields, and the river winds through a broad flat which on the south side is again bounded by hills, but higher than those on the north side of the valley. The low grounds extend one to two miles east of the road-line, and at the lesser distance the stream is divided into a north and a south branch, the larger of which is that coming from the south. This south branch a short distance inside the hilly country is itself divided into two, the northerly stream coming directly from the high range at the back of Omahu Peak; the other branch, along a deep impassable gorge, breaks the main range and again throws the water-parting back towards the east. Between the north and middle branches stands Omahu Peak, a conical mountain some 1,800 ft. in height, which as viewed from the low grounds of the Thames Valley is the chief object in the landscape. The high main range lies more to the east, and is partly that already described as bounding the Puriri Valley on its south-east side.

Formerly a road crossed the range to the Tairua Valley by way of a steep spur on the south side of Omahu Peak, but, this being a most difficult route, a new road has been formed, which zigzags upwards and round the northern face of the peak and joins the old track further east to the south of or beyond the middle branch of the Omahu Stream. Both roads were traversed during the progress of making the collections of the rocks of the peninsula, and a number of interesting specimens were obtained.

The northern and western slopes of Omahu Peak below the 1,000 ft. level are for the greater part formed of andesitic breccias and other rocks which are regarded as belonging to the Beeson's Island group. Near the western base a band of rhyolitic rock cuts off a portion of the andesic rocks from the more extensive area to the west, and this strip of acid rocks can be traced into the valley of the south branch of the southern Omahu. Beyond this and higher on the mountain there is a great development of andesitic breccias and some solid flows of volcanic rock much decomposed at and near the surface. Above 1,050 ft. the higher part of the peak is formed of rhyolite, which, in almost sheer cliffs, descends the southern face to much lower levels than where the acid rocks begin on the northern face of the mountain; but the opposite spur, by which the old track reaches on to the main range, shows andesic rocks considerably above the level to which the rhyolites descend on the southern slopes of Omahu Peak. Acid rocks prevail on the west slope of the mountain-ridge forming the main range to more than 2,000 ft. above the sea; but on both sides of the highest point, and on the highest point itself, the rocks are dark andesites that appear to have been intruded into the acid rocks, and probably appear at the surface, due to subsequent denudation of the mountain-range. The evidence of their intrusion is again seen on the lower slopes of the range, within the Tairua watershed.

The area covered by these intrusive andesites is considerably greater than what might be expected on the intrusion of a dyke of ordinary dimensions, and points to the fact that the acid group of Pliocene age was not the result of the latest igneous disturbance of consequence on the peninsula. Unfortunately, when this range was crossed I was not in a position to secure specimens of the andesic rocks from the top of the main divide, and had afterwards to content myself with samples taken from the middle branch of Omahu Creek, where it is crossed by the new track. These samples had been brought down the creek from the heights above, and were yet above the level reached by the Beeson's Island rocks. Of the collections made from the district, the following is a list of the samples sent to England and named by Professor Sollas:—

List of Rocks described from Omahu District.

(1.)	Specimen No.	452.	Andesic pitchstone. (Acid group of Pliocene age.)
(2.)	"	454.	Hyalopilitic hypersthene andesite. (Beeson's Island group).
(3.)	"	456.	Rhyolite. (Acid group of Pliocene age.)
(4.)	"	463.	Spherulitic rhyolite. (Acid group of Pliocene age.)
(5.)	"	608.	Decomposed rhyolite. (Acid group of Pliocene age.)
(6.)	"	612.	Consolidated volcanic ash. (Acid group of Pliocene age.)
(7.)	"	618.	Spherulitic rhyolite. (Acid group of Pliocene age.)
(8.)	"	1034.	Hyalopilitic hypersthene andesite. (Beeson's Island group.)
(9.)	"	3818.	Hyalopilitic hypersthene andesite. (Post acid, intrusive.)
(10.)	"	3819.	Hypersthene andesite. (Post acid, intrusive.)
(11.)	"	3822.	Rhyolite. (Acid group of Pliocene age.)
(12.)	"	3823.	Spherulitic rhyolite. (Acid group of Pliocene age.)
(13.)	"	3825.	Andesitic pitchstone. (Beeson's Island group.)
(14.)	"	3828.	Altered rhyolite. (Acid group of Pliocene age.)
(15.)	"	3833.	Positive spherulitic rhyolite with plagioclase and pyroxene. (Acid group of Pliocene age.)
(16.)	"	3838.	Pitchstone. (Acid group of Pliocene age.)
(17.)	"	3840.	Hyalopilitic hypersthene andesite. (Beeson's Island group; intrusive(?).)
(18.)	"	3846.	Hyalopilitic hypersthene andesite. (Beeson's Island group; intrusive(?).)
(19.)	"	3847.	Lithophysal rhyolite. (Acid group of Pliocene age.)

Hikutaia District.

On a larger scale the Hikutaia repeats all the main characteristics of the Omahu Valley: the broad flat of the lower valley, the sending-off of the first main branch of the river to the north-east and the subdivision of the principal stream once more into two main branches, the bounding of the lower valley by hills formed of Beeson's Island rocks and the appearance on these at about the 1,000 ft. level of acid rocks, are all the same; and Omahu Peak is simulated once, twice, and again by a series of high conical hills between the middle and south-west branches of the river. Between Omahu Creek and the middle part of the Hikutaia Valley the mountain-tops are formed of rhyolite, as also is the higher part of the steep slope by way of which the track from Hikutaia leads to the "Wires," in the upper part of the Tairua Valley. Yet the rocks in the bed of the northern branch are mostly of an andesitic character, the main sources of this stream evidently lying within an area of such rocks. The south-west branch also shows rarely rocks of an acid type, and it is from the upper part of the middle branch that the floods of rhyolitic material which constitute 75 per cent. of the rocks found in the middle and lower reaches of the river-bed have come. This on casual inspection is evident, and renders unnecessary a journey to the upper valley, where the line of rhyolite peaks can be seen from the low grounds of the western part of the valley. On the west side of the upper valley of the main branch of the river the two most easterly of the Maratoto Peaks are seen to be formed of light-grey or white rock, and the great mass of Ngapuketurua, 2,500 ft. in height, is also of rhyolite. This mountain stands nearly opposite the Maratoto Peaks, and, being the highest mountain in the district, it contains on its south slope the more important sources of this branch, and on the opposite north slope the source of the Tairua River above the "Wires" and Big Dam. Although there could be no doubt as to the source of the great bulk of the acid rocks that find their way along the Hikutaia River bed, to be certain on this point a journey was made to the upper valley of the main branch of the river. At the eastern base of the Maratoto Peaks, where the rhyolite is seen in the river-bed, the northern margin of this presented a wall-like junction with the Beeson's Island rocks, with which it was in contact. The Beeson's Island rocks are here an agglomerate of dark andesic rocks absolutely without matrix or infilling of finer grain, and yet forming a hard coherent mass.

A number of specimens from the Hikutaia Valley were obtained *in situ*, and when this was not the case the fact has been noted. The rhyolites in the upper valley appeared to be mainly intrusive; on the road to the "Wires," and on the north side of the valley the rocks have the appearance and disposition of lava-streams.

From the collections made a considerable number of specimens were forwarded to England for naming and description, and of these the following is a list :—

LIST OF ROCK DESCRIBED FROM THE HIKUTAIA VALLEY AND ROAD TO THE "WIRES," TAIRUA VALLEY.

(1.) Specimen No. 754. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(2.) " 761. Pumiceous rhyolite.
(Acid group of Pliocene age.)
(3.) " 763. Tuff.
(Acid group of Pliocene age.)
(4.) " 1078. Rhyolite.
(Acid group of Pliocene age.)
(5.) " 1131. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(6.) " 1139. Microspherulitic rhyolite.
(Acid group of Pliocene age.)
(7.) " 1149. Perlitic pitchstone or rhyolitic glass.
(Acid group of Pliocene age.)
(8.) " 3949. Pitchstone.
(Acid group of Pliocene age.)
(9.) " 3954. Negative microspherulitic rhyolite.
(Acid group of Pliocene age.)
(10.) " 3966. Altered microspherulitic rhyolite.
(Acid group of Pliocene age.)
(11.) " 3969. Negative microspherulitic rhyolite.
(Acid group of Pliocene age.)
(12.) " 3979. Spherulitic rhyolite.
(Acid group of Pliocene age.)
(13.) " 3985. Microspherulitic rhyolite.
(Acid group of Pliocene age.)

Paeroa, Mackaytown, and Rahu Saddle District.

Paeroa.—Outlying from the main mass of the mountains near the Town of Paeroa, on the Ohinemuri River, there are a number of low hills, some isolated and others partly connected with the ranges to the east by low outrunning spurs. These were collected from, and their rocks determined as belonging to the Beeson's Island group.

Mackaytown.—On both sides of the Ohinemuri River at and opposite Mackaytown Beeson's Island rocks are present, and in the road-cuttings below Mackaytown there is an outlier of acidic rocks which, though perhaps of Pleistocene age, on due consideration has been referred to the acid group of Pliocene age; and more to the north, on the old road to Waitekauri, there is another patch (perhaps continuous with the first-mentioned), that with even less probability belongs to the recent pumice deposits of the Waitoa Plain. At the back (east) of Mackaytown the rocks as far as the Rahu Saddle belong to the Beeson's Island group, and through these on the Ascot Terrace has appeared a very powerful thermal spring, which deposited vast quantities of siliceous sinter and siliceous mud in marshy pools adjacent to the principal outlets of subterranean waters. These marsh pools of warm water were surrounded by bushes and trees of moderate size, the remains of which may be collected in a hard finely laminated sinter, between the layers of which the partings are crowded with indistinct remains of reedy plants. On other parts of the terrace (partly destroyed) and on the hill-slopes at lower levels are masses of hard flinty sinter scarcely distinguishable from true quartz.

Rahu Saddle.—A strong body of sinterous quartz rock extends from east of Mackaytown a considerable distance to the south-east, and appears in the cuttings of the road leading to the Rahu Saddle as a massive reef-like deposit bounded by proper walls and having a thickness of between 40 ft. and 60 ft. Other like deposits appear on the west slope and on the higher part of the range between the Rahu Saddle and the deep gorge of the Ohinemuri at Karangahake. Some of these are to all appearances surface deposits; others penetrate deeply into the rocks which enclose them. One massive accumulation on the top of the Rahu Range, said to contain gold, was prospected at lower levels by driving a tunnel under it from one side of the range to the other, but to the surprise of those engaged in the work no more than 4 ft. of sinterous quartz was cut through in the tunnel, and the gold prospects from this not being satisfactory the work was abandoned. This line of siliceous thermal deposit varies greatly in thickness within short distances, and on the Rahu Saddle it is inconsiderable, but to the north-east and south-west develops such proportions as to constitute hills of sinter. These accumulations obscure the junction of the Beeson's Island rocks with those of the Thames-Tokatea group in the Rahu district, but this is a matter of little consequence, as the relation of the two groups can be readily studied along the upper part of the Ohinemuri Gorge above Karangahake.

A good deal of prospecting for gold has been carried on in the south-east part of this district, but the results have not proved satisfactory.

Of the collection of rocks made the following were sent to England :—

List of Rocks described from the Paeroa, Mackaytown, and Rahu Saddle District.

(1.) Specimen No. 39. Hyalopilitic hypersthene andesite.
(Beeson's Island group.)

(2.) " 42. Altered andesite.
(Beeson's Island group.)

(3.) " 51. Hyalopilitic hypersthene andesite.
(Beeson's Island group.)

(4.) " 64. Pilotaxitic hypersthene andesite.
(Dyke, Beeson's Island group.)

(5.) " 155. Hyalopilitic hypersthene andesite.
(Beeson's Island group.)

(6.) " 217. Hyalopilitic hypersthene andesite.
(Beeson's Island group.)

Karangahake District.

This extends on both sides of the Ohinemuri Gorge, above the Township of Karangahake, and embraces part of the Rahu Range on the north side of the gorge and its western slope to the Ohinemuri River, a little below the Crown battery, and the hills on the west side of the valley south of the Ohinemuri Gorge. It includes also a mountain-mass lying between the Ohinemuri and Waitawheta Gorges and on the south-west side of the Waitawheta Gorge, Karangahake Mountain and the spurs adjacent outrunning therefrom.

Over the northern part on both sides of the Ohinemuri River rocks of the Beeson's Island group are present, but the great bulk of the area is occupied by rocks belonging to the Thames-Tokatea group, and apparently to the older part of that group.

South of the Ohinemuri Gorge and in Karangahake Mountain the rocks are mainly hard lava-flows, but bands of breccia and ash-beds are of frequent occurrence over this part also.

But what is remarkable in connection with this area is the occurrence of a strong band of spherulitic rhyolite, which, appearing on the mountain at 1,650 ft. above the sea, descends the north-west spur to at least the middle heights of the mountain. This in connection with the Thames-Tokatea group is noteworthy, and is rendered more so as enclosing reefs of gold-bearing quartz on the Talisman Extended Claim, which where they outcrop at the surface have been partly worked, and are yet being worked at lower levels. This rock is much altered by quartz; and small reefs and leaders ramify through it in different directions. Its southern continuation across the higher part of Karangahake Mountain has not been followed nor ascertained.

Karangahake Mountain reaches a height of 1,786 ft. above sea-level, and its abrupt north and eastern faces rise from the depth of the Waitawheta Gorge, a most striking feature in the landscape. Lodes of gold-bearing quartz have been traced from near the top of the mountain to a considerable depth below sea-level, and apparently these do not become less rich as they are followed in depth. The district is consequently a flourishing mining centre.

As usual, there was uncertainty and a variability of opinion on the question of what the rocks of the district should be called, and it was important that a definite pronouncement should be made by a competent authority. Accordingly, of the collections made a selection was forwarded to England, and the names given them by Professor Sollas appear in the list below.

List of Rocks described from Karangahake District.

(1.) Specimen No. 27. Hyalopilitic hypersthene andesite.
(Dyke, Thames-Tokatea group.)

(2.) " 31. Altered hypersthene andesite.
(Thames-Tokatea group.)

(3.) Specimen No. 40. Altered andesite.
(Thames-Tokatea group.)

(4.) „ 44. Altered andesite.
(Thames-Tokatea group.)

(5.) „ 50. Hypersthene andesite.
(Thames-Tokatea group.)

(6.) „ 147. Pyroxene andesite.
(Thames-Tokatea group.)

(7.) „ 158. Pyroxene dacite.
(Kapanga group.)

(8.) „ 167. Altered andesite(?).
(Thames-Tokatea group.)

(9.) „ 181. Altered andesite(?).
(Thames-Tokatea group.)

(10.) „ 199. Stratified fragmental volcanic rock.
(Thames-Tokatea group.)

(11.) „ 200. Dacite(?).
(Thames-Tokatea group.)

(12.) „ 292. Spherulitic and crystalline granular rhyolite.
(Thames-Tokatea group.)

(13.) „ 301. Spherulitic rhyolite.
(Thames-Tokatea group.)

(14.) „ 307. Andesite.
(Thames-Tokatea group.)

(15.) „ 309. Hypersthene andesite.
(Dyke, Thames-Tokatea group.)

(16.) „ 324. Rhyolite.
(Thames-Tokatea group.)

(17.) „ 330. Altered pyroxene andesite.
(Thames-Tokatea group.)

(18.) „ 335. Altered pyroxene andesite.
(Thames-Tokatea group.)

(19.) „ 338. Anorthoclase or microperthite pyroxene rhyolite.
(Thames-Tokatea group.)

(20.) „ 380. Altered hypersthene andesite.
(Thames-Tokatea group.)

(21.) „ 382. Pyroxene trachyte.
(Thames-Tokatea group.)

(22.) „ 400. Altered andesite.
(Thames-Tokatea group.)

(23.) „ 401. Altered andesite(?).
(Thames-Tokatea group.)

(24.) „ 402. Altered andesite(?).
(Thames-Tokatea group.)

(25.) „ 406. Altered andesite(?).
(Thames-Tokatea group.)

(26.) „ 485. Altered pyroxene rhyolite(?).
(Thames-Tokatea group.)

Owharoa District.

This lies next adjacent to and east of Karangahake district on both sides of the Ohinemuri River, two to five miles from Karangahake Township. The hills on the north side of the valley are bush-clad as far as Owharoa, but covered with fern only on the southern side. Beyond Owharoa the bush has disappeared from both sides of the valley, but it is some distance beyond Waikino and outside the district that we enter upon the upper Ohinemuri Plain. On the north side of the river the hills pass into high ranges bounding on its west side the Waitekauri Valley ; and on the southern side of the valley the hills form a range separating the Ohinemuri from the Waitawheta Valley and Gorge.

The rocks of the district towards the west belong to the Beeson's Island group, which are best displayed on the north bank of the river along the road from Karangahake to Waihi. On the south side of the river the hill-tops are formed of acid rocks similar to those spread over the upper Ohinemuri or Waihi Plain. The Beeson's Island rocks terminate in the valley a few hundred yards below Owharoa, or immediately below the "Pool," in the bend of the river. From this for the next half-mile east the rocks are of a different character, externally resembling "miner's sandstone," but in reality consisting of acid rocks, spherulitic indeed, yet different from the spherulitic rocks of Karangahake Mountain. Some of these spherulitic rocks have been pronounced dacite. They extend north-east into the lower Waitekauri Valley and south-west into the Waitawheta watershed, but in a south-east and north-west direction they have an inconsiderable width of exposure, being to the east shortly overlain by a younger group of acid rocks—that of Pliocene age—which, resting at low angles on the Owharoa rocks, makes difficult the tracing of the boundary-line between the two. This difficulty is not lessened on the south side of the river, where the younger series of rhyolitic pumiceous tuff obscures wholly the underlying rocks, and it is only on the fall to the Waitawheta and in the deeper gullies that they again make their appearance, but this time as a felspathic rock with chalcedonic and opaline segregations, which make the identity of these with the Owharoa spherulitic rocks a matter of some difficulty. Towards the north-east the Owharoa rock also changes, first to a light-grey or white highly felspathic rock, and farther to the north-east to a rusty-brown rock with much hornblende. But, while all this is true, there is still the means at Owharoa of making corelations that would seem to indicate that the complete sequence is there to be studied, only the rocks predominating to the south-west and the north-east have but very feeble development on the banks of the river within or below the township.

The grey rock with chalcedony and opal seems to underlie the others, and is the lowest member of the group yet known. On this lies the dark or

CASTLE ROCK FROM THE SOUTH-WEST.

CLIFFS OF WILSONITE, OHINEMURI VALLEY, NEAR WAIKINO.

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rusty-brown rock with a high proportion of hornblende, which may be taken to represent, and without question does represent, the rock mentioned as occurring farthest to the north-east in the Waitekauri Valley. If this identity can be made clear, the matter of corelation of these rocks with the spherulitic rocks of Owharoa will thus be settled, as this highly hornblendic rock is itself spherulitic at Owharoa.

On the Owharoa acid rocks of older date rest the rocks of the acid group of Pliocene age, the lowest rock of which in this part is a light-grey fine-grained and to the unaided sight almost structureless rock, which but seldom shows lines of flow, and has scattered through it a few minute crystals of felspar and pellets of quartz. This is succeeded by the now well-known brecciated pumiceous rhyolite that covers the greater part of the upper Ohinemuri Plain, and which will be described more in detail when speaking of the Waihi district.

Of the numerous specimens of rock collected in this district a representative set was sent to England, and named as in the following list:—

LIST OF ROCKS FROM OWHAROA DISTRICT.

(1.)	Specimen No.	1.	Rhyolite. (Acid group of older date, Owharoa.)
(2.)	"	3.	Glassy rhyolite. (Acid group of older date, Owharoa.)
(3.)	"	6.	Microperthitic rhyolite. (Acid group of older date, Owharoa.)
(4.)	"	185.	Rhyolite. (Acid group of older date, Owharoa.)
(5.)	"	231.	Pyroxene dacite. (Beeson's Island group.)
(6.)	"	248.	Hypersthene dacite. (Beeson's Island group.)
(7.)	"	249.	Pyroxene hornblende dacite. (Beeson's Island group.)
(8.)	"	394.	Rhyolite. (Acid group of Pliocene age.)
(9.)	"	512.	Decomposed rhyolite. (Acid group of older date, Owharoa.)
(10.)	"	517.	Common opal. (Acid group of Pliocene age.)
(11.)	"	518.	Rhyolite. (Acid group of Pliocene age.)
(12.)	"	534.	Spherulitic hornblende dacite. (Acid group of older date, Owharoa.)
(13.)	"	541.	Spherulitic hornblende dacite. (Acid group of older date, Owharoa.)
(14.)	"	547.	Spherulitic rhyolite. (Acid group of older date, Owharoa.)
(15.)	"	549.	Altered spherulitic rhyolite. (Acid group of older date, Owharoa.)

(16.) Specimen No. 553. Spherulitic hornblende dacite.
(Acid group of older date, Owharoa.)
(17.) " 556. Spherulitic hornblende dacite.
(Acid group of older date, Owharoa.)
(18.) " 582. Spherulitic rhyolite.
(Acid group of older date, Owharoa.)
(19.) " 1170. Pyroxene hornblende dacite.
(Acid group of older date, Owharoa.)
(20.) " 1172. Spherulitic dacite.
(Acid group of older date, Owharoa.)

Waitekauri Valley.

East of Owharoa the Waitekauri Stream is the first northern tributary of the Ohinemuri River. The valley, though in the low grounds of no great width, is a watershed of considerable extent. The lower valley is bounded by steep hills on the east side, but on the opposite side lower hills fill the valley for about a mile back to the foot of the higher western range. The middle division of the valley from the township is narrow up to the basin in which the Waitekauri Cross and other mines are situated, where the higher mountains recede some distance and the lower grounds have an irregular rolling surface. The upper valley is narrow up to the saddle leading into that of the Maratoto branch of the Hikutaia River.

The Waitekauri has, to its junction with the Ohinemuri, its lower course across a breadth of low hilly country forming the northern border of the Waihi Plain. Over this lower part of the valley the only rocks present belong to the acid group of Pliocene age, which also fill the lower grounds of the valley up to within a mile of the township; the Owharoa older acid rocks terminate somewhere within the watershed of Kinsella's Creek, which is the first western branch of the main stream as the valley is followed upwards. No acid rocks of either of the groups mentioned reach to or are found above the township.

The mountains on each side of the lower valley, and bounding the entire watershed of the middle and upper parts, show rocks belonging to the Kapanga group only, and are part of an extensive area of such rocks that, beginning to the north-east in the Wharekawa and upper Tairua watersheds, stretch along the east side of the peninsula to where they terminate to the west in the mountains bounding on each side the Waitekauri Valley, and further to the east on those bounding on that side the Waihi or upper Ohinemuri Plain. Some important gold-mines are situated in the Waitekauri Valley, and at the time the collections from this district were made a great deal of prospecting was being carried on. A selection of the rocks from this district was forwarded to Professor Sollas, and named as in the list below.

LIST OF ROCKS FROM THE WAITEKAURI VALLEY

(1.)	Specimen No.	21.	Rhyolite. (Kapanga group.)
(2.)	"	124.	Hornblende dacite. (Kapanga group.)
(3.)	"	127.	Hornblende dacite. (Kapanga group.)
(4.)	"	129.	Hornblende dacite. (Kapanga group.)
(5.)	"	133.	Spherulitic dacite. (Acid group of older date, Owharoa(?).)
(6.)	"	210.	Pyroxene dacite. (Kapanga group.)
(7.)	"	348.	Spherulitic rhyolite. (Acid group of Pliocene age.)
(8.)	"	350.	Volcanic ash. (Acid group of Pliocene age.)
(9.)	"	418.	Indeterminate. (Kapanga group.)
(10.)	"	420.	Quartz hypersthene andesite. (Kapanga group.)
(11.)	"	422.	Quartz hypersthene andesite with hornblende. (Kapanga group.)
(12.)	"	423.	Micropœcillitic andesite. (Kapanga group.)
(13.)	"	424.	Altered dacite. (Kapanga group.)
(14.)	"	441.	Pumice. (Acid group of Pliocene age.)

Waihi District.

This district includes the hills surrounding the eastern and northern sources of the Ohinemuri River, the upper Ohinemuri or Waihi Plain west to the junction of the Waitekauri River with the Ohinemuri, and the coast-line range and hills near Waihi Beach.

The upper Ohinemuri Plain is a depression almost continuously surrounded by hills or ranges of hills of considerable height. The opening to the westward, along which the drainage is carried by the Ohinemuri River, is narrow, and finally a deep gorge before reaching Karangahake Township, whence to its junction with the Thames or Waihou River the Ohinemuri flows along a valley of moderate width, or, as in its lower course, across an open plain. To the south an opening is presented between the seaward hills terminating between Waihi Beach and the Kati Kati Arm or northern extension of Tauranga Harbour, but this does not appear to have ever been an outlet for the waters of the upper Ohinemuri basin. Between the south-east angle of the plain and the Waihi Beach there is but a low ridge, and from this the drainage is, by a very short course, east to the sea and west into the Ohinemuri River, in the latter case to be finally discharged into the Hauraki Gulf. The peculiarities of this upper basin of the Ohinemuri constitute a problem, though not an unusual one, in physical geography, and it is conceivable that at one time the drainage of the upper Ohinemuri, including that of the Waitekauri Valley, was discharged on the east coast at Waihi Beach. The north-eastern sources of the Ohinemuri also reach close to the eastern seaboard, but there is no low depression through the rim of hills in that direction. The northern and north-western upper sources of the river drain the east slopes of the mountains interposed between the upper Ohinemuri and Waitekauri Valleys.

The rocks to the westward have already been referred to in describing the Owharoa and Waitekauri districts. On the south-west side the plain is bounded by an assemblage of hills and mountains that, as broken and rugged country, contain the sources of the Waitawheta River. This, so far as ascertained, is mainly constituted of rocks belonging to the Beeson's Island group; but highly tilted and partly involved rocks of the acid group are found along its margin on the south-west side and for some distance into the hills bordering the plain on this side. With these deposits are thick seams of lignite of inferior quality. To the south and south-east the block of hills ending on Waihi Beach is composed of rocks that must also be referred to the Beeson's Island group; but at places these are overlain by acid rocks, amongst which, as at Waihi Beach, spherulitic rhyolites are not uncommon.

For some distance north of Waihi Beach the outer coast range is formed of andesic rocks, but the inner range and spurs therefrom are formed almost wholly of spherulitic rhyolite, in many cases, it might be said, of spherulite alone. Further, in the sharp bend of the Ohinemuri and rising from the plain itself, Black Hill is formed of columnar andesite, and the Silverton Hills, more to the north, are formed of andesites and andesic tuffs, much penetrated by quartz and showing bodies of siliceous sinter at the surface. These hills are surrounded by more modern rocks of an acid type and younger than those forming the hills of spherulite farther to the east. More to the north-east, along the east side of the upper Ohinemuri Valley, hard flows of dark andesic rocks form hills of considerable height, and in this part stands an isolated mountain, the Waihi Monument, formed of a coarse-grained rough trachytic-looking rock. To the north-east towards the coast-line acid rocks again make their appearance, and form hills of considerable height immediately overlooking the sea. The rocks of the Silverton Hills and those to the east of the upper Ohinemuri Valley are regarded as belonging to the Kapanga group, which from the north enters the Ohinemuri watershed and forms to the north and west of the upper valley the rocks of the higher ranges in that direction.

A low spur from the higher ranges to the north is projected south on to the plain, and terminates at the Township of Waihi. The terminal point of this is Martha Hill, the site of the famous Waihi Gold-mine. Martha Hill on three sides is surrounded by rhyolite rocks of Pliocene age. To the north a narrow ridge of rocks belonging to the Kapanga group connects Martha Hill with the extensive area of the same rocks in that direction. On the east side of Martha Hill and over the adjacent flat the younger rhyolites are passed through at or about 200 ft. from the surface.

The deeper-seated rocks reached by workings in the Waihi Mine, and also in the Silverton Hills, as far as represented by the specimens sent to England, are seemingly of a more acid type than the bulk of the Kapanga rocks, and have been described as pyroxene rhyolites.

The Kapanga rocks and older Pliocene rhyolites form the hills surrounding the upper Ohinemuri or Waihi Plain, the rocks of which are different, and younger than those of the surrounding ranges. In the Mercury Bay and Gumtown and Rangihau Valley districts, as already described, it has been shown that an enormous development of solid fluidal and spherulitic rhyolites overlies the pumiceous agglomerate or tuff and the finer pumiceous sands of these districts. The same rocks are present in the hills surrounding the upper Ohinemuri Plain. The pumiceous sands, &c., with lignite-seams on the south-west border of the plain and the hills adjacent are equal the pumiceous agglomerates, while the overlying rocks are represented on the east side of the plain by hills of spherulitic rhyolite. Younger than either of these formations, over the low grounds of the plain there extends a brecciated pitchstone and pumiceous rhyolite, unconformable to the tuffs with lignite, and the spherulitic rhyolites of the surrounding hills, and evidently the youngest of the acid rocks of the peninsula. The brecciated pitchstone rhyolite seems to be underlain by a compact lithoidal light-grey rhyolite that is probably of the same age; and this again in places is underlain by beds of pumice-breccia and tuff, and the compact light-grey rhyolite at places appears as though it had been intruded into or through the pitchstone rhyolites.

Such is the position of the younger rhyolites found over nearly the whole of the upper Ohinemuri Plain, which, younger than the rhyolites of older Pliocene age, are probably older than the intrusive andesites of Table Mountain and the main range east of Omahu Peak.

Martha Hill, Waihi, and the Silverton Hills, more to the eastward, constitute the mining centres of the Waihi district. Of the rocks collected from the district and forwarded to England for description the following is a list of the described species :—

List of Rocks from the Waihi District.

(1.) Specimen No. 87. Hyalopilitic hypersthene andesite.
(Dyke, Kapanga group.)

(2.) " 91. Rhyolite.
(Acid group of Pliocene age.)

(3.) " 94. Tuff containing fragments of pumice.
(Acid group of Pliocene age.)

(4.) " 100. Andesite(?).
(Kapanga group.)

(5.) " 107. Pyroxene soda rhyolite.
(Kapanga group.)

(6.) " 108. Anorthoclase or microperthite rhyolite.
(Kapanga group.)

(7.) " 110. Anorthoclase(?) pyroxene rhyolite.
(Kapanga group.)

(8.) " 207. Hyalopilitic hypersthene andesite.
(Kapanga group.)

(9.) " 212. Glassy spherulitic hornblende hypersthene dacite.
(Acid group of Pliocene age.)

(10.) " 213. Hyalopilitic hypersthene andesite.
(Beeson's Island group.)

(11.) " 258. Hypersthene dacite.
(Acid group of Pliocene age.)

(12.) " 268. Spherulitic rhyolite.
(Acid group of Pliocene age.)

(13.) " 339. Rhyolite(?) glass.
(Acid group of Pliocene age.)

(14.) " 367. Hyalopilitic hypersthene andesite.
(Kapanga group.)

(15.) " 444. Altered pyroxene andesite.
(Kapanga group.)

(16.) " 445. Altered pyroxene andesite.
(Kapanga group.)

(17.) " 494. Quartz hypersthene andesite.
(Kapanga group.)

(18.) " 497. Altered andesite.
(Kapanga group.)

(19.) " 498. Altered quartz hypersthene andesite.
(Kapanga group.)

(20.) " 499. Quartz hypersthene andesite.
(Kapanga group.)

(21.) " 504. Hypersthene andesite.
(Kapanga group.)

(22.) " 505. Quartz hypersthene andesite.
(Kapanga group.)

(23.) " 509. Pyroxene rhyolite.
(Kapanga group.)

(24.) Specimen No. 510. Altered quartz felspar pyroxene flow rock. (Kapanga group.)
(25.) „ 521. Rhyolite. (Acid group of Pliocene age.)
(26.) „ 527. Hornblende pyroxene rhyolite. (Kapanga group.)
(27.) „ 1038. Altered spherulitic rhyolite. (Acid group of Pliocene age.)
(28.) „ 1039. Hyalopilitic pyroxene andesite. (Beeson's Island group(?).)
(29.) „ 1286. Indeterminate. (Acid group of Pliocene age.)
(30.) „ 1295. Altered pyroxene andesite. (Kapanga group.)

Hikurangi District.

This district lies south and south-east of the upper Ohinemuri Plain and the sources of the Ohinemuri in that direction.

Towards the north-east the hills on the coast-line are separated from Hikurangi Mountain by a deep valley, and are formed mainly of andesitic rocks belonging to the Beeson's Island group. These are the same as, or are continuous with, those noted as bordering on the south-east the upper Ohinemuri Plain. Towards the western part of the district the mountains around the eastern sources of the Waitawheta, so far as determined, belong to the Beeson's Island group, the ranges to the north and south showing rocks agreeing in character with rocks elsewhere of that age.

Along the eastern slopes of these mountains, towards the south-west angle of the Waihi Plain, there is seen a narrow belt of acid tuff and spherulitic rhyolites that, followed to the southward, increases in width to the base of Hikurangi Mountain, from which they seem to have proceeded.

As seen from Waihi, or at any point where visible from the upper Ohinemuri Plain, Hikurangi is an imposing mountain. Though not the highest, for scenic effect it is second to none in any part of the Cape Colville Peninsula. The mountain does not reach 2,000 ft. in height, but the effect is not lessened by the immediately contiguous ranges to the east and west. The higher part of the mountain contains a crater of large dimensions, which, broken down on the northern side, as seen from the north shows the other three sides quite intact. The lava-streams from the mountain have flowed, as would seem, generally to the north, and undoubtedly have in part contributed towards the rim of older acid rocks that lie along the west and south-west sides of the plain.

On skirting the eastern base of this mountain, it is seen that the lower slopes are formed of andesite, and the south-east spur (a long curved ridge of lesser height than the mountain itself) shows also andesites capped by spherulitic rhyolites.

There is similarity between the rocks of this mountain and those at the source of the middle branch of the Hikutaia River, but in Hikurangi the rocks, more especially the spherulitic rhyolites, form dense masses capable of being used as a building-stone of good quality.

No mining is being carried on in the district.

A few rocks were collected on a journey from Waihi to Tauranga, and of these the following have been named by Professor Sollas:—

List of Rocks from Hikurangi District.

(1.) Specimen No. 1071. Spherulitic rhyolite.
(Acid group of Pliocene age.)

(2.) „ 1072. Spherulitic rhyolite partly replaced by quartz.
(Acid group of Pliocene age.)

(3.) „ 1075. Hyalopilitic hypersthene andesite with hornblende.
(Beeson's Island group.)

Te Aroha District.

This district embraces Te Aroha Mountain and the western side of the southern extremity of Cape Colville Peninsula, this being considered to terminate on a line drawn from the Waitoa Plain, a little south of Te Aroha, to the Katikati entrance to the north part of Tauranga Inlet. Te Aroha, reaching a height of 3,126 ft. above sea-level, is the principal object in what is everywhere a mountainous district. The Waiorongomai, draining the east slopes of the mountain and the west slopes of the mountains to the east, is the only stream of any consequence in the district.

The rocks of Te Aroha are wholly andesic, with the exception of an isolated occurrence of a thin rhyolitic vein in one of the specimens described by Professor Sollas, and consist largely of breccias and ash-beds; but there are also massive developments of dark lavas, one principal flow of which has been mined in for a considerable distance.

The rocks of the district have been doubtfully referred to the Thames-Tokatea group.

The western slope of the mountain yields hot mineral waters, which are much resorted to.

Mining in this district has been carried on since 1875, there being numerous quartz lodes containing gold and silver and a variety of other metallic ores. The refractory character of the ores renders them unsuitable for treatment by the ordinary methods of gold and silver extraction practised on the other goldfields of the Cape Colville Peninsula, and until fire reduction-works are installed here or elsewhere on the peninsula the successful prosecution of mining must still be in anticipation. A variety of rocks was collected from this district, and the samples sent to England have been named as appears in the following list:—

LIST OF ROCKS FROM TE AROHA DISTRICT.

(1.) Specimen No. 1309. Micropœcillitic pyroxene andesite.
(Thames-Tokatea group.)

(2.) " 4044. Pilotaxitic hypersthene andesite with rare hornblende.
(Thames-Tokatea group(?).)

(3.) " 4053. Andesitic agglomerate.
(Thames-Tokatea group(?).)

(4.) " 4058. Pilotaxitic hypersthene andesite.*
(Thames-Tokatea group(?).)

(5.) " 4061. Pilotaxitic hypersthene andesite.
(Thames-Tokatea group(?).)

(6.) " 4064. Altered andesite(?).
(Thames-Tokatea group(?).)

(7.) " 4080. Hyalopilitic hypersthene andesite.
(Thames-Tokatea group(?).)

(8.) " 4081. Fragmental rock composed of andesite material.
(Thames-Tokatea group.)

* Traversed by vein of rhyolite.

REPORT

ON

A COLLECTION OF ROCKS FROM CAPE COLVILLE PENINSULA,

AUCKLAND, NEW ZEALAND,

BY

WILLIAM JOHNSON SOLLAS, D.Sc., CANTAB.; LL.D., DUBLIN; M.A., OXON.; F.R.S.; F.G.S.:
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NOTES TO ACCOMPANY REPORT ON SPECIMENS OF THE ROCKS OF CAPE COLVILLE PENINSULA.

First Consignment (Nos. 1–204).

The work of describing this first consignment of the rocks from the Cape Colville Peninsula has proved of great interest, though very laborious, owing to the excessive amount of change which many of the examples have undergone. The results, however, are likely to prove of some importance in their bearing on general problems. Each specimen is fully named and described in the accompanying report, so that I need only refer here to certain special questions.

(i.) The nature of the matrix in the andesites and dacites offered a very difficult problem, and one of some importance, since in many cases the matrix contributes one-half to the bulk of the rock. Rosenbusch clearly perceived the obvious existence of two types, which he distinguished as the hyalopilitic and pilotaxitic.

The first presents no difficulty; in it the mineral constituents of the rock, felspar laths, and the like, are immersed in a glassy base. The second is more obscure, and was defined by Rosenbusch as consisting entirely of a felt of microliths or minute crystals. I have never seen such a matrix in this class of rocks. As a matter of fact, the second type of matrix differs from the first in this: that the glass of the hyalopilitic matrix is replaced by a mosaic of crystalline grains, which, by reason partly of their irregular jagged outlines, partly of the similarity of their refraction index to that of the felspar microliths, are very difficult to diagnose, especially when, as frequently happens, they are very minute.

When the structure is coarser, however, they may be plainly recognised as quartz, a conclusion long ago reached by Williams and Iddings, and one which I can completely confirm by the decisive observation that when, as in the dacites, primary grains of obvious quartz are present, the mineral forming the pilotaxitic mosaic surrounding them can be traced into optical continuity with these grains. Thus the glass of the hyalopilitic matrix is represented in a number of definitely ascertained cases by the quartz of the pilotaxitic matrix. Williams and Iddings have given the name "micropœcillitic" to such a pilotaxitic structure, and this term may in most cases be substituted for "pilotaxitic" wherever the latter occurs in my report.

It does not follow, however, that the pilotaxitic structure is invariably an expression of micropœcillitic quartz; some other mineral might conceivably play the same part as quartz. A second species of felspar might do so, and, though this may be regarded as improbable, yet its possibility must be borne in mind; and since descriptions should, as far as possible, express facts, and not hypotheses, I may here state that whenever I have used the word "pilotaxitic" in this report it must be taken simply to indicate that the glass of the hyalopilitic matrix is replaced by a crystalline substance forming mosaics.

It will be seen from this that the andesites are divided from the dacites by a very narrow line; both contain quartz. Rosenbusch has proposed to distinguish the dacites by the presence of quartz as a phenocryst, but Zirkel points out that many rocks which, as proved by analysis, are true dacites do not possess such primary grains of quartz. No doubt the presence of primary grains of quartz is a sure indication that we are dealing with a dacite, but their absence does not prove the contrary, and thus there are numerous cases where the application of the name "dacite" or "andesite" must depend on the judgment of the observer. Chemical analysis can be the only court of ultimate appeal in such cases.

(ii.) The dykes of the Palæozoic series form a very distinct and interesting group of rocks, ranging from quartz diorites, through dacite porphyrites into dacite. They would appear to have been intruded and consolidated before the Mesozoic period, since fragments closely resembling them are found to occur in the supposed Triassic rocks.

The term "dacite porphyrite" is a new one, and indicates a rock similar to a dacite, but differing from it by the more obviously crystalline character of the groundmass and the presence of liquid cavities in the quartz. It is a dyke rock which has crystallized at greater depth and under greater pressure than an ordinary dacite. In this respect it recalls the propylite of Richthofen.

For an authoritative exposition of the true nature of propylite we must turn to Zirkel, who distinctly asserts that it is a somewhat deep-seated representative of the dacites, like our dacite porphyrite, and not an altered hornblende andesite—in this again resembling dacite porphyrite, which is certainly not an altered andesite.

There are a few differences in detail which distinguish dacite porphyrite from propylite; thus, according to Zirkel, the distinctive characters of propylite are as follows:—

(1.) The colour of the groundmass is more green-grey than in the hornblende andesites, where it is more purely grey with a tendency to brown. In this it agrees with dacite porphyrite.

(2.) The structure and nature of the constituents resemble that of the pre-Tertiary diorite porphyrites. Disregarding the question of age, this is true of dacite porphyrite, with the difference that the latter is not so coarsely crystallized as diorite porphyrite, and is more closely allied to dacite.

(3.) The groundmass is rich in particles of hornblende. This is not generally true of dacite porphyrite; but it seems possible that the mineral originally regarded by Zirkel as hornblende may be chlorite, and, if so, the two rocks would resemble each other in this respect; but in this case the character would be devoid of any real significance.

(4.) The plagioclase is filled with hornblende-dust, and does not contain glass inclusions. Substitute chlorite for hornblende, and the remarks made under (3) apply to this character.

(5.) The hornblende is green and without an opacite border. This is not a general character of dacite porphyrite.

(6.) The hornblende is fibrous.

(7.) Epidote often results from the decomposition of hornblende. This is true also of dacite and dacite porphyrite.

(8.) Augite is very rare. This does not apply to dacite porphyrite.

(9.) The quartz grains contain liquid inclusions, never glass inclusions. This is another resemblance to dacite porphyrite.

Propylite, however, according to Zirkel, is a Tertiary rock, its pre-Tertiary equivalent being diorite porphyrite. As there seems no good evidence that age affords a basis of classification for igneous rocks, we may then conclude that both our dacite porphyrite and diorite porphyrite are together very close representatives of propylite. The only dacite porphyrites which occur in the post-Palæozoic rocks of Cape Colville Peninsula are No. 3638 of the Thames-Tokatea group and No. 2874 of the Kapanga group, which may be only a dacite, and no purpose would be served in calling these propylites simply on account of a difference of age. At the same time it remains clear that Zirkel was quite correct in asserting that a propylite is not simply an altered hornblende andesite.

(iii.) A suggestion which has been made as to the "re-fusion" of rhyolites may be regarded as definitely disposed of. The evidence adduced by Vogelsang and Rutley in its support is as follows: (*a*) the isotropic character of some of the phenocrysts of felspar in the rhyolites; (*b*) the rounding of the arms of the positive (so-called microfelsitic) spherulites, with indications of streaming movement of the adjacent trichites; (*c*) the presence of an isotropic border to these rounded arms. Rutley remarks that no more ample proof of a secondary fusion could be required.

(*a*.) The existence of apparently glassy clear crystals of felspar, with perfect crystalline outlines, and yet giving absolutely no reaction with polarised light, is a very remarkable but indubitable fact. The idea, however, that it might be explained as a case of felspar glass only occurred to me to be at once rejected. Had it been a glass resulting from the fusion of a felspar an expansion of some ten or twelve per cent. would have occurred, and the swollen material could not in that case have so precisely filled the space formerly occupied by it in the crystalline state. Besides, it looks too perfectly like window-glass, and shows no perlitic cracks nor any of the phenomena one is accustomed to meet with in a volcanic glass.

As no explanation to account for the anomalous behaviour of these apparent phenocrysts occurred to me, I decided to examine into the matter more closely. A thin slice of rhyolite containing these bodies was removed from the glass slide on which it was mounted, and cleared of all trace of balsam first with xylol, and next with absolute alcohol; it was then divided into four portions for subsequent treatment. One was boiled in sodium-hydrate solution; washed and placed in a solution of fuchsin; washed again first with water, next with alcohol; and finally brought through xylol into balsam, and remounted for observation. The supposed felspar-glass phenocrysts were found to be deeply stained. The same result was obtained when the rock was treated with hydrochloric acid, and not only so, but when previous boiling in acid and alkali was omitted and the slice was transferred at once to the staining-solution. As a last experiment the remaining portion of the slice was examined as a dry object without previous staining; the matrix of the felspar phenocrysts was then found to consist of a finely granular porous substance, milky white when viewed by reflected and brown by transmitted light. This material, like hyalophane, when immersed in a medium of refraction index not too far removed from its own, loses its granular semi-opaque appearance, and becomes invisible. The supposed felspar-glass consists, indeed, to a large extent of Canada balsam, a moiety of it being composed of some residual product left after hydration and solution of the original felspar. The phenocryst is thus a pseudomorph, not a metamorph.

This observation is of importance not merely because it disposes of a fantastic supposition, but chiefly on account of the light it throws on much that has proved puzzling in the nature of rhyolites, and which will be found to dispel many of the vague speculations regarding a hypothetical occurrence known as "devitrification."

Before discussing this a word must be said as to remaining evidence in favour of re-fusion. As regards (*b*), the rounding of the arms of the positive spherulites, there need be no difficulty; these are not simple crystals, but crystal aggregates, and may therefore take almost any form. As regards (*c*), it is readily disposed of. The isotropic border which may sometimes be observed margining the processes of a positive spherulite is of a similar nature to the pseudomorphous material which has already been described under (*a*). It is not in any way a result of re-fusion, but of chemical alteration, brought about probably by hydrothermal action.

I think this concludes all that need be said as regards the refutation of the re-fusion hypothesis; but something may be added on the question of devitrification. I have seen nothing even to suggest that such a process has taken place within any of the igneous rocks of the Peninsula. On the contrary, every phenomenon which has hitherto been attributed to it may be much more simply explained as a result of direct crystallization. Thus in the dacites and andesites the pilotaxitic or micropœcillitic structure is that which has given rise to the expression "half-glassy basis," as though there were a stage intermediate between true glass and crystalline material, a notion for which there is not a tittle of evidence. It is true that when the micropœcillitic structure is very minute the overlapping of the crystalline mosaics renders it difficult to define. It is not, however, a half-and-half state, but purely crystalline. True it is also that part of the matrix of an andesite may exist in the hyalopilitic and part in the micropœcillitic state, but there is never any kind of passage between them. Here, as elsewhere in nature, the distinction between glassy and crystalline is not relative, but absolute.

The case, however, to which the petrographer would probably refer as an instance of devitrification is that of the so-called "microfelsite," "a brownish glass having an incipient and peculiar devitrification, which seems to be incomplete."* It may be perhaps sufficient to state that this "brownish glass" is a porous decomposition product, which stains deeply with fuchsin.

Many times have I been puzzled to know why the apparently brown layers of microfelsite remained dark between crossed nicols, till I discovered the reason. I may now add some additional instances of "incomplete devitrification" which may be explained in the same manner. Thus it not uncommonly happens that large negative microspherulites are met with in which

* Rutley, Quart. Journ. Geol. Soc., 1899, p. 486.

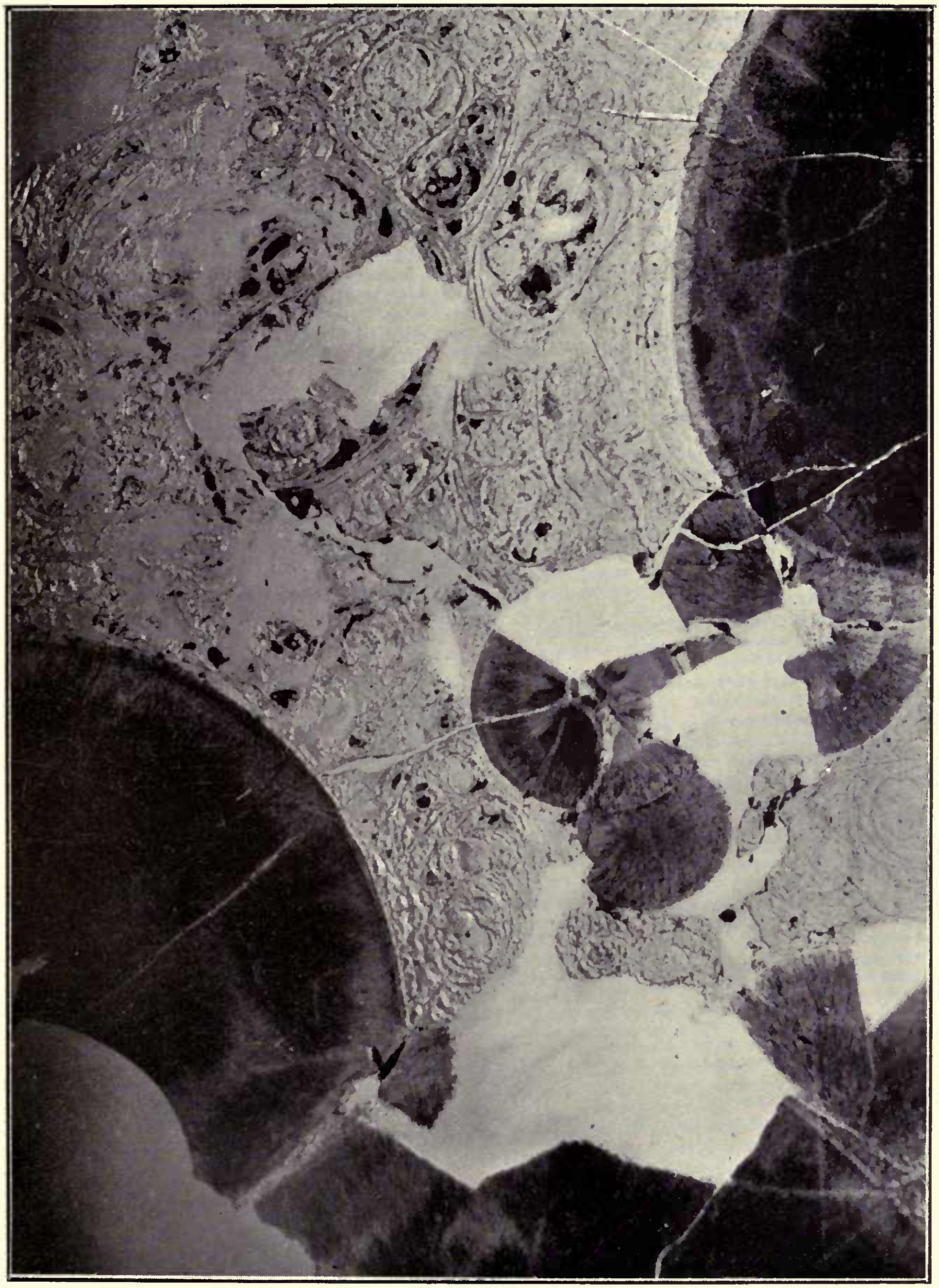
the peripheral portion consists of clearly crystalline fibres, while the central region, incompletely defined from the peripheral by a perlitic crack, is isotropic, with only faint indications of radio-fibrous structure. A casual observer would almost certainly conclude that this was a case of transition from the glassy to the crystalline state. Staining, however, shows that the central region is occupied by a granular residue, the centre of the spherulite having been the earliest part to yield to decomposition owing to the minuteness in that region of the radio-fibrous structure, which increases in coarseness as it is traced to the periphery.

Again, cases are frequently met with in which the coarser crystal complexes, which alternate with the so-called microfelsite in a banded rhyolite, are found to consist not, as usual, of felspar, together with tridymite or quartz, but of an isotropic substance in association with one or the other of the latter minerals. This isotropic substance is the same decomposition product as that which forms the glass-like pseudomorphs after felspar phenocrysts.

A case which greatly exercised me was presented by an andesite in which a phenocryst of andesine, with obvious lamellar twinning, contained a submarginal zone of isotropic substance resembling glass, which completely separated the outer marginal portion of the crystal from the central core. Notwithstanding this, the lamellar twinning of the two regions corresponded precisely, lamina for lamina; and since it seemed impossible to suppose that the orientation of the molecules of the core could act across an intervening sheet of glass to determine a corresponding orientation of the molecules on the other side, I relinquished the problem as insoluble. The explanation is now simple; the isotropic layer is not a sheet of glass, but a subsequent decomposition product which when observed mounted in balsam simulates a glass, and thus all difficulty disappears.

(iv.) The spherulites of the Cape Colville rhyolites are clearly divisible into two groups—(i.) one in which the fibres have a positive sign in relation to their length; (ii.) the other in which their sign is negative. The latter are chiefly microspherulites, but sometimes attain a fairly large size, though never approaching that commonly presented by the positive spherulites. The latter present great variety of form; sometimes they are more or less spherical, frequently they grow out into a profusion of processes ("echinate," McKay; "pseudopodial," Rosenbusch; "microfelsitic," Rutley; sometimes spoken of in this report as "cervicorn"), which may end freely or expand and coalesce to form a continuous envelope, or they may form loose irregular tufts, or pass into micrographic structures. The question of the spherulites will be more fully dealt with when the remaining consignment of rocks have been fully studied.

(v.) The complete transformation of some of the igneous rocks is a point of extreme interest; many instances occur in which the whole material of a rhyolite has been replaced by quartz and sericite, and yet the outlines of some



No. 202/4396.—SPHERULITIC RHYOLITE: SPHERULITES IMMERSED IN ALTERED GLASS.

To face p. 122.]

of the original felspar crystals survive, owing to the happy accident of some slight impurity remaining behind as a row of granules outlining the site of the vanished mineral. The andesites and dacites also present many remarkable instances of replacement, crystals both of felspar and hornblende having been converted into quartz mosaics.

(vi.) The general though by no means complete absence of vesicular and scoriaceous structures is another interesting feature. It suggests that the igneous magmas of the district have been but slightly charged with steam, so that their outflow at the surface was probably rarely accompanied by explosive eruption. It is a singular fact that amongst the few rocks having an ashy appearance that I have examined I have not yet encountered that most distinctive feature of volcanic ash, the occurrence of fragments of vesicular glass with characteristic bizarre shapes like those of collarbones and crossbones.

Second Consignment (Nos. 206–408).

In describing and determining the specimens that have been submitted to me for examination, I have studied each one independently as a separate problem, and have intentionally neglected any other evidence than that afforded by the rock itself. The substance of the reports may thus be regarded as mere statements of matter of fact, unprejudiced by any opinions concerning subjects of controversy, of which, indeed, I have abstained from acquiring any knowledge.

A more comparative study may be carried out in detail in the final report, and it would prove useful for this purpose if the particular specimen of which a comparison is required were to be indicated by numbers, and not merely generally by reference to districts. I should be glad also to receive comments and suggestions as to any points on which further information is desired. Further, if any of the rocks described should prove to be mere duplicates, I should be willing to describe others in their place if specimens be sent to me.

The chief object of these descriptions I understand to be the determination of species; it is the one I have kept constantly in mind, but indirectly much fresh and important information has been acquired which will prove a genuine addition to our knowledge of petrology.

A very important problem is presented by the rock named "wilsonite," which I am quite prepared to accept as having once been in a state of flow.* The specimen No. 189. 393. 1286 does not furnish such conclusive evidence on this point as No. 60. 265. 394, which seems to be very flow-like, stream-lines of a brown glass being traceable round included fragments. Specimen No. 195. 399. 1328 offers conclusive proof of the extreme internal brecciation

* Further observation leads me to qualify this statement. Some of the specimens are formed of material which has fallen through the air, and seems to have retained its viscosity up to the time of reaching the ground.

of previously consolidated material which may take place in a flowing lava. The curious form of the shreds of brown glass in specimens Nos. 394 and 1328 has been generally regarded as a character of ash or tuff; it is conceivable that it might be produced as a consequence of flow.

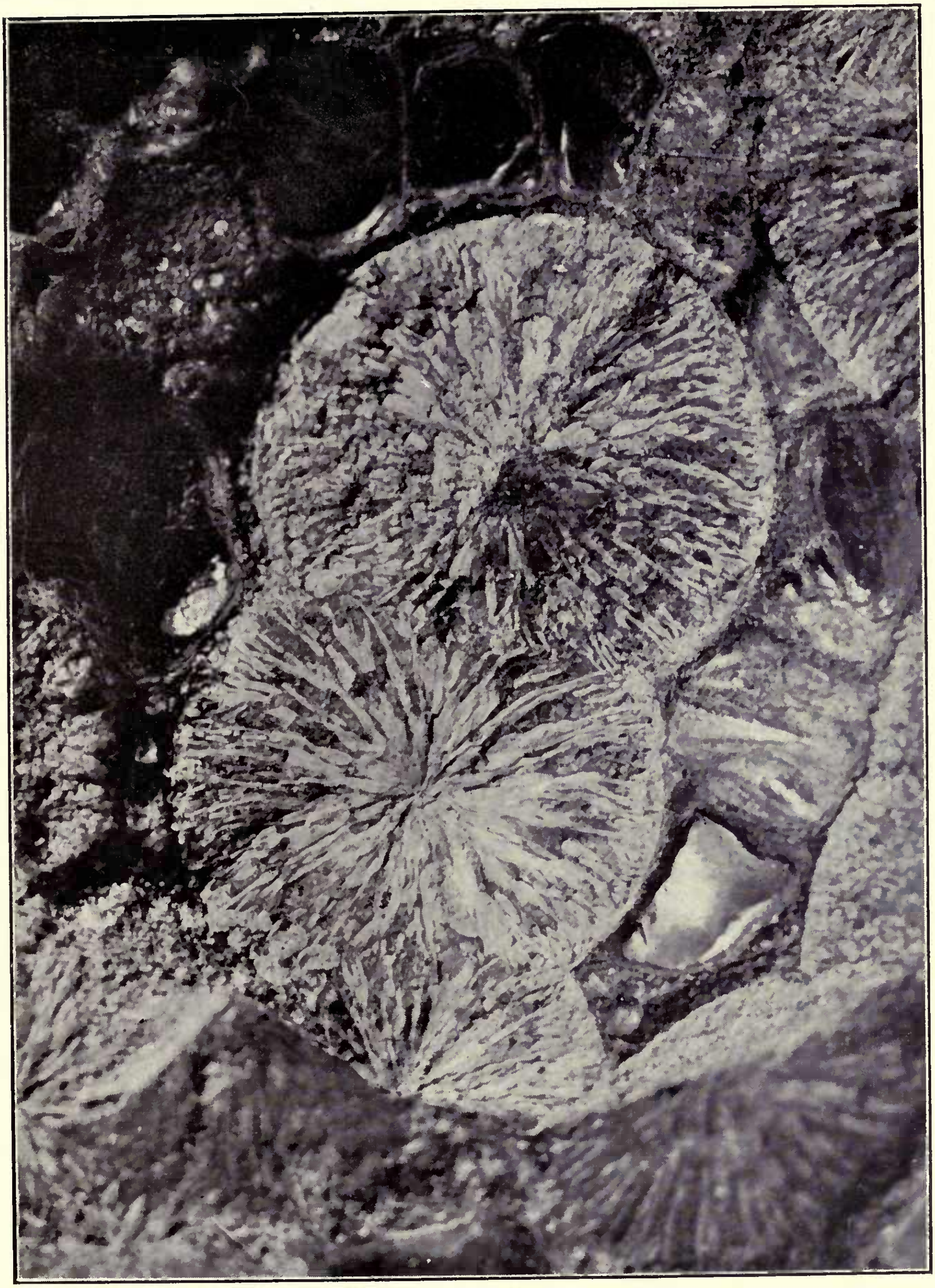
Rocks similarly characterized occur in Ireland, where they have been described as "intrusive tuffs," a seeming contradiction in terms which has given rise to some controversy. I expect, before the completion of the final report, to have an opportunity of examining these rocks, and may then be able to add to what I have already said on the subject of specimens Nos. 394 and 1328.

Questions of equal interest present themselves regarding the changes which rocks may undergo after consolidation, and much light is thrown on this subject by many of the specimens in the collection. Among the most interesting are the two specimens Nos. 153. 357. 847 and 199. 403. 1392. The former was originally a glass with pronounced perlitic fracture. Subsequent to consolidation it suffered a certain amount of decomposition, hydrated fibrous growths proceeding into the glass about the perlitic cracks; water containing silica then pervaded it, and traversed it throughout, carrying away the original material (sulphuric acid must have been present in the water to do this) and replacing it, particle for particle, by quartz which now (in characteristic mosaic) forms the rock. An observer viewing a slice of this rock with ordinary light under the microscope will at once pronounce it a perlitic glass, so well has its structure been preserved; on pushing in the analyser his surprise is great to find that he is looking at a quartz mosaic.

The latter specimen (No. 1392) was originally an andesite-like rock with abundant groundmass and numerous phenocrysts strewn through it. Seen by ordinary light its structure may still be recognised, but between crossed Nicols it has all the appearance of a volcanic glass. To an observer entertaining notions about re-fusion this might be seized upon as an excellent illustration of the vitrification of a once crystalline rock, but close examination proves the isotropic material not to be glass, but one of the silica hydrates (opal) which has replaced the original material of the rock, just as quartz has replaced the glass of No. 847.

The structure and origin of spherulites is another important problem offering many difficulties to its solution. A prolonged study of the New Zealand examples throws much light on the subject, however, and we may hope to arrive at much clearer views than now prevail concerning it. As this does not affect the determination of species and the immediate object of this report, I propose to leave this question for treatment in the final report.

The andesites have furnished two interesting varieties of this species, one linking them on to the dacites and the other the basalts; thus a black hypersthene andesite is several times met with in which corroded quartz grains are obvious constituents, though the general facies of the rock is such as to render



SPHERULITIC RHYOLITE WITH PITCHSTONE FRAGMENTS, ROAD TO THE "WIRES," HIKUTAIA VALLEY.

To face p. 124.]

it impossible to place it among the dacites. On the other hand, some black hypersthene andesites occur in which small crystals of colourless olivine are strewn through the matrix, but not in sufficient quantity to render the rock a basalt. It is of interest to observe that these olivine crystals are surrounded by a reaction border of hypersthene and magnetite; had the reaction proceeded a little further no trace of the olivine would have remained, and, considering how frequently magnetite is associated with hypersthene, the question arises whether in many unsuspected cases an olivine stage may not have preceded that of hypersthene, and whether hypersthene may not more frequently arise from the transformation of olivine than has been supposed.

The rhyolite-like rocks present peculiar difficulties in the way of precise definition, for the phenocrysts, which are our chief guides in other cases towards a determination of species, either fail us here altogether or occur in such comparatively small quantity that it would seem a rash proceeding to argue from them to the composition of the whole rock. At present we have no ready means of arriving at a conclusion as to the acid or basic character of a glassy matrix; and I think the safest plan to adopt in our nomenclature would be, for the present at least, to speak only of glassy or spherulitic rocks containing plagioclase or orthoclase, as the case may be, without indicating their nature further. I have not hitherto adopted this plan, but a more precise terminology must be regarded more or less as guesswork. It is possible that later on we may arrive at a simple means of discriminating between acid and basic glass, and I have a scheme for attempting this already in my mind, but it will require time to make a trial of it. If it succeeds I shall be able to add to the information given in this report.

It will be observed that I have substituted the term "micropœcillitic" for "pilotaxitic," which was used in the first report.

As regards the rhyolites of Karangahake and Owharoa districts, the evidence is as follows: In both districts there are rhyolites containing phenocrysts of orthoclase or microperthite; but in the Owharoa district those rhyolites which do not contain this felspar are characterized by phenocrysts of labrador or oligoclase andesine, and several have been somewhat doubtfully referred to dacites; while in the Karangahake district the plagioclase of the phenocrysts possesses a refractive index below balsam, and is thus more acid than that of the Owharoa rocks. This is shown in the following table:—

Karangahake District.

292.	Spherulitic rhyolite.	Plagioclase *r.i.* below balsam.
301.	"	Orthoclase or microperthite.
324.	Rhyolite with orthoclase or microperthite.	
338.	"	"
485.	"	"

OWHAROA DISTRICT.

1. Rhyolite with labrador.
3. "
6. Rhyolite with orthoclase or microperthite.
185. Rhyolite with oligoclase—andesine.
394. " "
518. " "
547. Spherulitic rhyolite with orthoclase or microperthite.
582. " " "

It is possible that the labrador or andesine may be xenocrysts; if the rhyolites have traversed basic rocks in their course they may have collected basic material on the way. The frequent close association of plagioclase and pyroxene in these rocks rather strengthens this suspicion.

DESCRIPTION OF SPECIMENS* (1–406).

The following abbreviations have been used :—

M.C. Megascopic characters.
U.M. Under the microscope.
Ext. Extinguished.
x.n. Crossed Nicols.
r.i. Refraction index.

Pleochroism is seldom or never fully stated; the simple observation of the colours observed on rotating the analyser is recorded thus—green/yellow.

The value of the angle of extinction is generally given from the twinning trace of the albitic plane—thus, 20°/ 22° means that the specimen examined extinguished at an angle of 20° on one side of the trace and 22° on the other.

No. 1/2709.

M.C.—Holocrystalline somewhat granitic-looking rock, with small but obvious crystals of felspar.

U.M.—Holocrystalline hypidiomorphic.

PHENOCRYSTS.—*Plagioclase,* occasionally in large idiomorphic individuals, forms the greater part of the rock. Various twinning; that following the albite law fairly coarse. Ext. angles, 22°/ 24°, 28°/ 31°. Zonal in many cases. Inclusions of colourless augite, reedy greenish hornblende, and grains of iron-ore. Sometimes cracked, the cracks filled with quartz.

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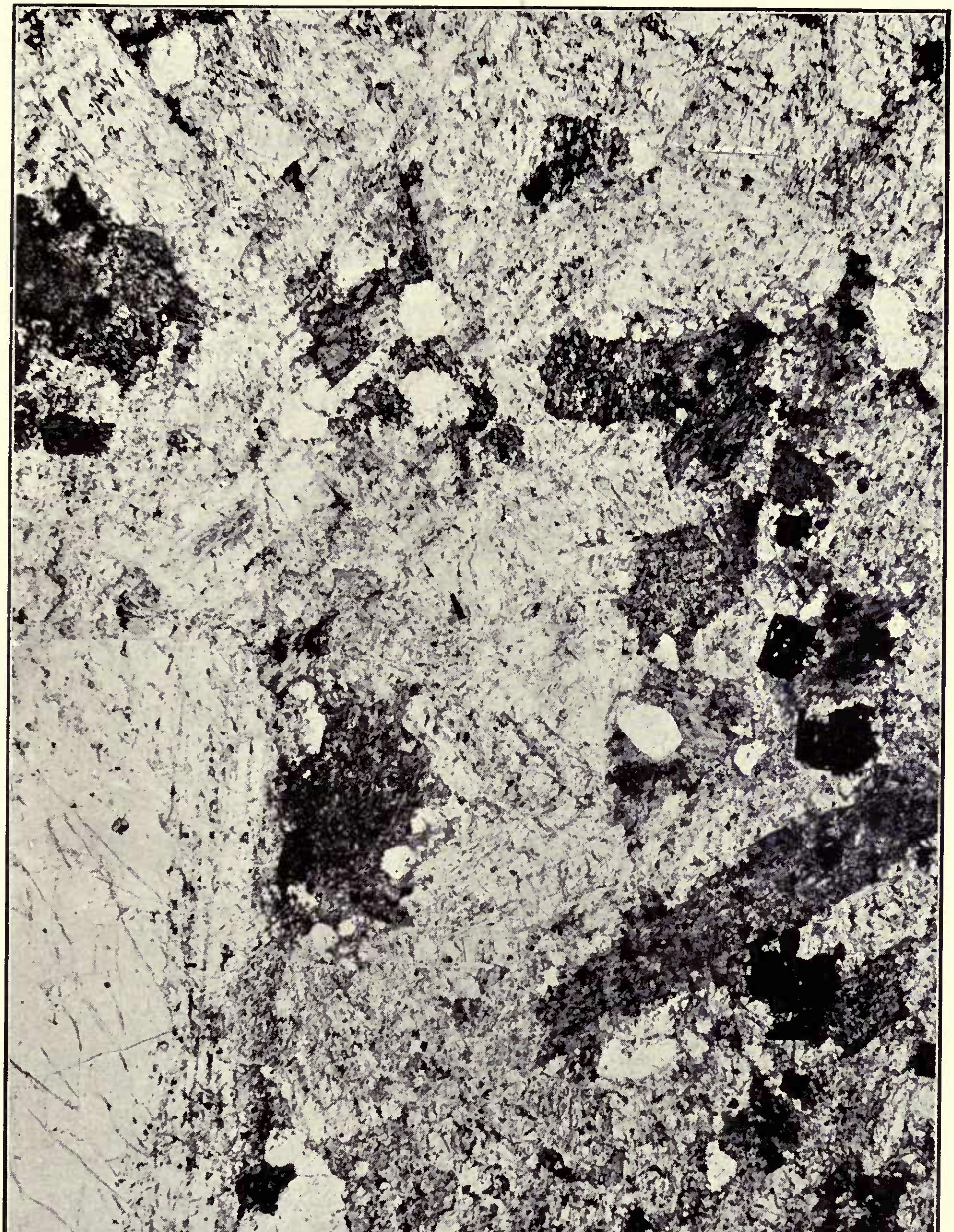
* Professor Sollas disclaims responsibility for the literary style of the descriptive notes, as he states they were not supplied for publication.—A. McKAY.



No. 1/2709. QUARTZ AUGITE DIORITE.

[*To face p. 126.*

Hornblende in single individuals, or mosaic-like clusters, generally altered, greenish-grey in colour; the core sometimes comparatively fresh, giving brighter colours with crossed Nicols; with a single Nicol green / yellowish. Chlorite, epidote, and iron-ores are among the products of alteration. In most cases the core has been transformed into a mixture of colourless augite and quartz; the augite forms a kind of network which extinguishes simultaneously and shows twinning.

Quartz is chiefly interstitial, and contains liquid cavities with large bubbles.

Ilmenite is present in large irregular plates, sometimes divided into separate parallel bars, with quartz and plagioclase filling the interspaces.

Apatite occurs in large transversely jointed crystals, with included rod-like cavities running parallel to the long axis.

Zircon is sparingly present.

Pyrites occurs in cubes, and sometimes includes quartz.

Quartz Augite Diorite.

Illustration.—The slice shows its various constituents in good contrast with each other.

Negative by ordinary light; magnification, 40 diameters; area photographed, the lower right* and parts of the adjacent areas.

A large, clear, much fractured felspar is the principal object, which has a broad but not intensely dark border, also patches of a dark-green mineral towards the middle of the crystal. The surroundings of this crystal, as far as shown in the photograph, represent and are characteristic of the other parts of the slice.

Locality.—South shore of Coromandel Harbour, Waiau Valley, &c., district.

Formation.—Maitai series.

Remarks.—The specimen was not obtained *in situ*, but from the beach below high-water mark. In its constituents it was thought to correspond with Castle Rock, on the main range at the source of the Matawai. It is almost impossible to obtain well-preserved specimens from Castle Rock, and this and yet another specimen, No. 2877, were collected in the hope that they would prove the same rock and be in a better state of preservation. It turns out, however, that neither of the two are identical, and the present Specimen 2709, it is clear, has been brought from the beach at the mouth of Waiaro Creek by the Natives as ballast or anchor for a canoe; and by a comparison of this with the other specimens from the west spur of Moehau there can be no doubt that, in common with the others, this has been derived from dykes in the Carboniferous strata of Moehau.

No. 2/2718.

M.C.—Dark greenish-grey fine-grained compact felstone-like rock.

U.M.—Matrix minutely granular, containing minute felspar crystals, chlorite, quartz, and carbonates, as well as abundant leucoxene grains.

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* Each slice is supposed to be divided into nine different areas—viz., upper left, upper middle, upper right, middle, middle left, middle right, lower left, lower middle, and lower right, and the initial letters may be used to indicate any one of these.

PHENOCRYSTS.—*Plagioclase* largely replaced by carbonates with quartz, but where less altered shows albitic twinning, and extinguishes up to 22°. *r.i.*, above that of balsam. Plagioclase forms the greater part of the rock.

Pyroxene represented by pseudomorphs of green chlorite, polarising in blue colours, perhaps also of muscovite and of carbonates, the last predominating.

Iron-ores are scattered throughout.

Quartz occurs in nests of mosaic and in scattered grains. Some of the quartz mosaics may be pseudomorphs after some vanished mineral, but they do not present the definite crystal outlines of a pseudomorph. Some of the quartz grains possess a radio-fibrous structure.

Ilmenite is represented by leucoxene, but black grains of iron-ores also occur. Orthoclase is absent.

Quartz Plagioclase Augite Rock.

The quartz may be secondary. Possibly an altered andesite; possibly an altered dacite.

Locality.—Hauraki South Mine, Kapanga district.

Formation.—Kapanga group.

Remarks.—This rock when brought from the interior of the mine rapidly darkens, but in time bleaches to a light-grey colour, which is characteristic of all the rocks terminating the Wynyardton Hills, near Kevin's Point and Coromandel wharf. During recent years the rock has been named and known as "propylite" or "miner's sandstone."

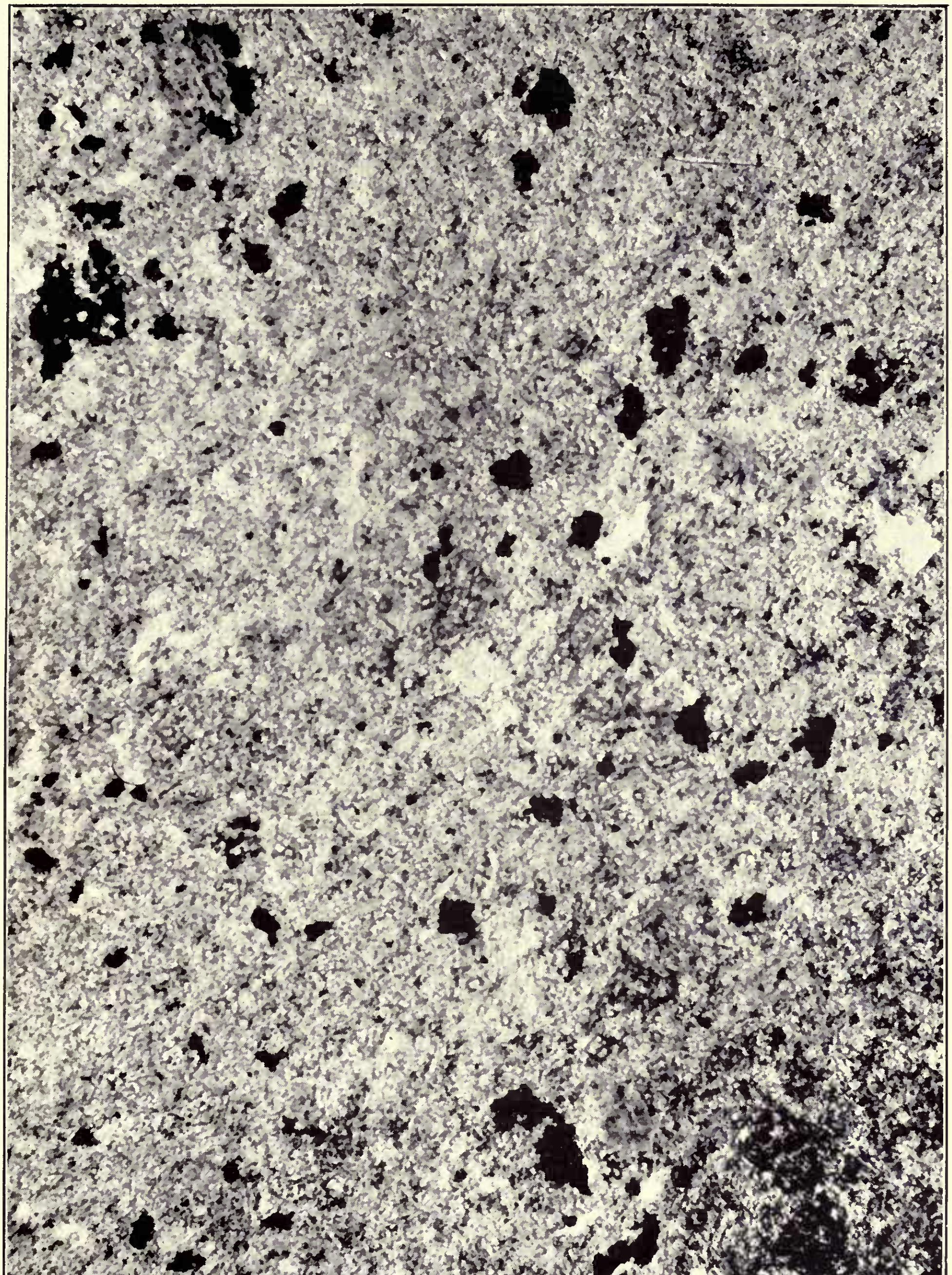
No. 3/2719.

M.C.—White earthy rock, evidently much decomposed, with opaque white pseudomorphs of felspar, and traces of ferro-magnesian minerals.

U.M.—MATRIX finely granular. Quartz, sericite, and some felspar, which has a *r.i.* below that of balsam, and frequently extinguishes at 0°; granules of leucoxene, and streaky patches of arabesque quartz mosaic.

PHENOCRYSTS.—*Plagioclase* replaced by quartz and carbonates. Some large crystals still show albite twinning, and extinguish at 15°/15°. Sometimes only one half of a crystal is replaced by carbonates, and the rest remains fresh. Orthoclase seems also to be indicated by low refractive index (below balsam sometimes) and parallel extinction.

Ferro-magnesian minerals are wholly transformed. Some sections now occupied by carbonates and sericite have the outlines of augite; others filled with a different mineral present transverse sections having the form of hornblende. This mineral, pseudomorphous after hornblende, much resembles muscovite. It possesses a high refractive index, wide double refraction, and has a positive sign in relation to the direction of cleavage. It also extinguishes parallel. It has not the golden-yellow colour of chrysotile.



No. 3/2719. ALTERED DACITE OR ANDESITE.

[*To face p.* 128.

Some pseudomorphs, probably after pyroxene, consist of colourless chlorite polarising blue.

Ilmenite, leucoxene, zircons, and *pyrites* are present.

Rhyolitic quartz is absent, and notwithstanding the presence of orthoclase I think this rock was originally either a dacite or an andesite. The excess of carbonates suggest an originally basic rock.

Altered plagioclase (orthoclase?) pyroxene rock, containing much quartz, carbonates, and pyrites.

Altered Dacite.

Illustration.—The slice in its semi-transparent constituents exhibits but little contrast, but this is heightened by the presence of dark opaque minerals generally present in the slice.

Photographed by ordinary light; magnification, 30 diameters; area represented, near the middle of the slice.

Distinct crystal outlines can be made out, but are not better seen in the photograph than in the slice. The photograph, however, gives a good idea of the whole of the slice.

Locality.—Welcome Find Claim, near Coromandel, Kapanga district.

Formation.—Kapanga group.

Remarks.—Generally the same as 2718, but in a more advanced state of decomposition; locally the rock is known as "propylite" or "miner's sandstone."

No. 4/2721.

M.C. — Light-grey rock spotted with white decomposed felspar, and glistening with pyrites. No signs of flow nor banding.

U.M.—Matrix abundant; minutely crystalline; composed of minute grains of quartz, scales of sericite, and chlorite; indications of flow structure. Scattered leucoxene granules.

Phenocrysts.—*Felspar* largely replaced by carbonates. When twinning (albitic) survives, the extinction angle is found to be 17° / 21°. Most of the felspar when freed from carbonates has a specific gravity of between 2·61 and 2·62, and would thus appear now to be albite, but this may not have been the case originally. Some of the felspar has a specific gravity of from 2·59 to 2·60, and extinguishes at 0°, thus suggesting a soda orthoclase. Sericite shares with carbonates the role of replacement mineral.

Ferro-magnesian minerals: These are completely decomposed, and now represented by pseudomorphs of an almost colourless chlorite, giving bluish or greenish tints, with crossed nicols. Some have the outline of pyroxene, but many, if not most of them, resemble hornblende. Some of the pseudomorphs after hornblende consist of chlorite, and carbonates, with abundant grains of pyrites, and suggest altered resorption pseudomorphs.

Pyrites is disseminated through the rock, but chiefly occurs within the pseudomorphs after ferro-magnesian minerals.

Rhyolitic quartz is absent.

This rock may be regarded as an andesite highly altered by siliceous and carbonated waters. The concentration of the pyrites in the ferro-magnesian pseudomorphs obviously suggests that the waters were sulphur-bearing and re-acted on the iron of the original minerals.

Altered Andesite.

Illustration.—The slice, for a rock so much decomposed, has fair contrast of the different minerals.

Photographs by ordinary light; magnification, 33 diameters; area photographed, the lower left, where a large crystal is outlined by and crowded with pyrites.

The photograph indicates, but not very clearly, the flow structure of the rock. So much of the illustration is occupied by the large pseudomorph that perhaps it cannot be said to be a fair representation of the whole of the slice.

Locality.—Hauraki Mine, near Coromandel, Kapanga district.

Formation.—Kapanga group.

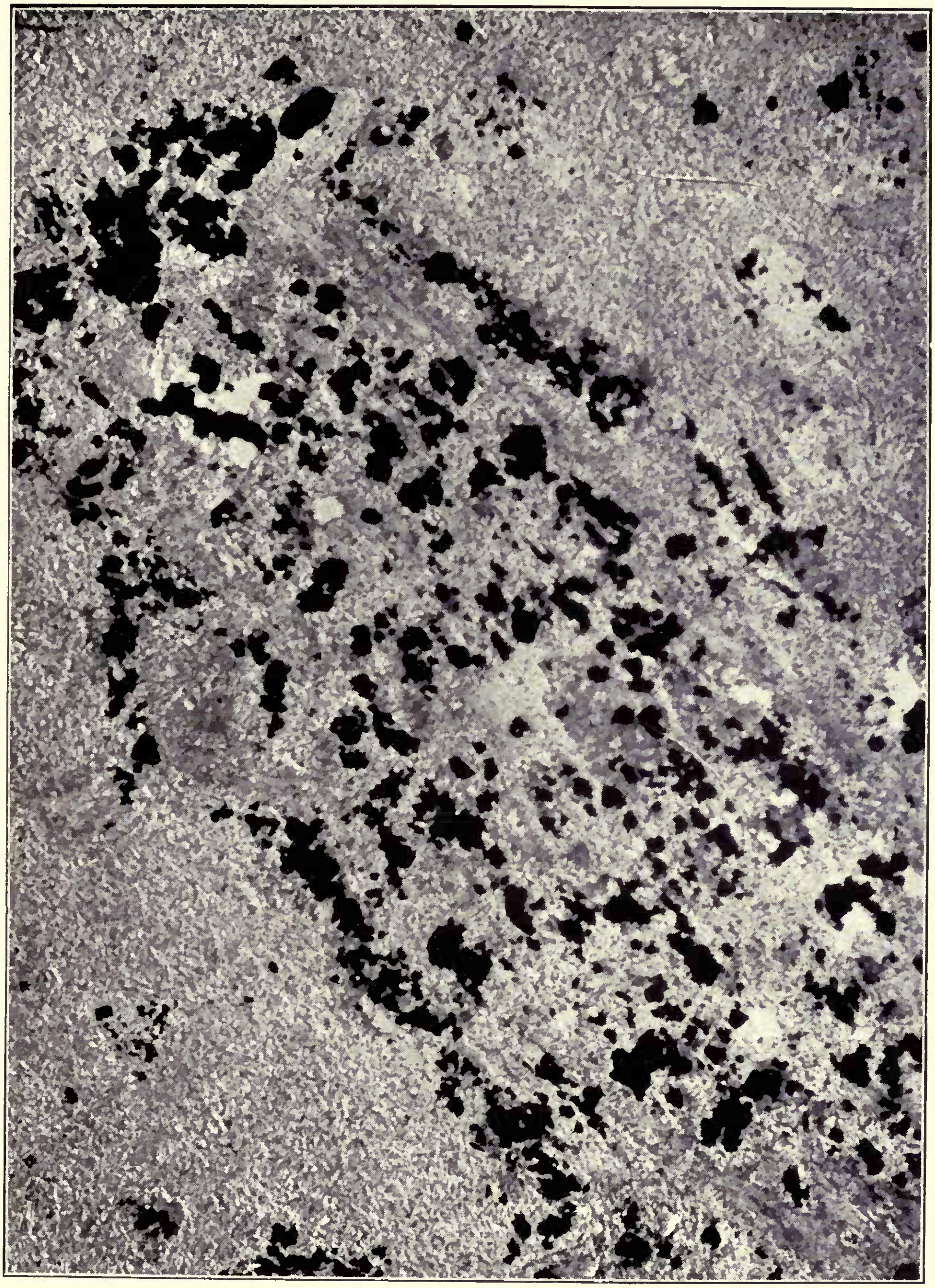
Remarks.—The specimen was taken as an example of the "grey mottled sand-stone" of the miner. Referring to the remark at the close of the description by Professor Sollas, it may be stated that within the boundaries of the Hauraki Claim and the next adjacent to the north there exists a remarkable fissure of unknown depth filled with broken rock and containing much water. No trace of this fissure appears at the surface. It is but suggested that the waters of this fissure might meet the requirements to bring about the present state of the rock above described; and as this fissure is transverse to the direction of the lode in the Hauraki Mine, and the specimen being from the walls of the lode while stoping, it may be that in the above we have an explanation of the facts.

No. 5/2727.

M.C.—Grey felsitic-looking compact rock, mottled with scattered patches of lighter greyish-white; a few small crystals of felspar and ferro-magnesian minerals visible to the unaided eye.

U.M.—Matrix abundant; jagged quartz grains crowded with microliths of felspar; clear jagged quartz grains in mosaics; scattered rectangular felspars and grains of carbonates. A very expressed micropœcillitic structure, in which the felspar-bearing quartz is seen in some instances to be in optical continuity with clear grains of quartz.

Phenocrysts.—*Plagioclase* pervaded by carbonates and radio-fibrous decom-position products; in large idiomorphic crystals. Zonal. Irregular albite twin-ning. Ext. 22° / 27°, 29° / 31°; *r.i.*, above balsam.



No. 4/2721. ALTERED ANDESITE.

[To face p. 130.

Ferro-magnesian minerals: Pseudomorphs after hornblende, of large size, not very common, composed of almost colourless chlorite, polarising in blue tints; carbonates and scattered grains of pyrites, as well as leucoxene after ilmenite. Pyroxene may also have been present.

Quartz in rounded grains, and mosaics with undulous extinction due to radio-fibrous structure. Liquid cavities present. The quartz was undoubtedly present before the consolidation of the rock was completed, as is shown by its continuity with the quartz of the micropœcillitic areas.

Ilmenite in abundant hexagonal plates, now largely sometimes completely replaced by leucoxene.

Apatite in comparatively large crystals.

This rock might be called a hornblende dacite, but the presence of liquid cavities in the quartz suggests consolidation at some depth below the ground, and a more appropriate name would therefore seem to be quartz hornblende porphyrite, or hornblende dacite porphyrite.

Quartz Hornblende Porphyrite, or Hornblende Dacite Porphyrite.

Locality.—Golden Pah Mine, Kapanga district.

Formation.—Kapanga group.

Remarks.—This forms a hard bar in light-grey and seemingly yet more altered rocks, and from the description above given it may be inferred that this is a dyke rock similar to the porphyrites of Cadman's and Tiki Creeks, which are of Palæozoic age. In this case, however, the containing rocks are of Tertiary date, and, however closely the rocks may correspond and the descriptions tally, they cannot have originated at the same time nor be due to the same immediate cause; and this, since the denudation of the dykes occurring in the Devonian and Carboniferous formations, has afforded material towards the formation of conglomerates of Triassic age in which the older dykes are represented.

This rock may be compared with 2874, which is one of the two examples of dacite porphyrite occurring in connection with the Tertiary volcanic outburst, and which might, therefore, be properly termed "propylite"; but Professor Sollas does not think, because of the occurrence of two specimens answering to the definition of propylite, that propylite should thus be considered a characteristic rock of any of the Tertiary volcanic groups. The second instance of a rock in the Tertiary volcanic series which corresponds to propylite is specimen No. 3638, from the Thames-Tokatea group. During the field examinations it was considered that No. 2874 was continued south through the Wynyardton Hills as a dyke, and that No. 2727 is from the same.

No. 6/2735.

M.C. — Light-grey rock, porphyritic, with white decomposed felspar, sprinkled with pyrites.

U.M.—Matrix fairly abundant; consists of not very minute grains of quartz, fairly uniform in size, with angular jagged, but not lobate outlines; felspar in some instances with a *r.i.* above that of balsam, in others below. In the latter case it is unusually clear, and probably orthoclase; many of the felspar grains are sericitised. Sericite is also interstitial to the other constituents; epidote or zoisite is sometimes associated with it.

PHENOCRYSTS.—*Plagioclase* abundant, sometimes in very large crystals, frequently with partly rounded outlines, sometimes in fragments. Twinning various. Ext. 12° / 12° to 29° / 30°. *r.i.*, above that of balsam. Some complex growths, often zonal, often fractured, and cracks filled with quartz or a different felspar. Zoisite, epidote, muscovite (or an undetermined chlorite), pseudomorphic after an included pyroxene, occur within some of the plagioclase.

Ferro-magnesian minerals represented solely by pseudomorphs, the outlines not sufficiently well preserved to determine their original nature. The pseudomorphic minerals are muscovite, chlorite, epidote, zoisite, and a finely granular material of unknown nature, which is brown by transmitted and milky-white by reflected light.

Pyrites in irregular forms occurs both in the ferro-magnesian pseudomorphs and scattered through the rock.

Quartz: Occasional large grains, corroded and invaded by the matrix, are present. They contain numerous large rounded and irregular liquid cavities with large bubbles.

Zircon: An occasional large crystal may be observed.

This is an altered quartz diorite porphyrite, or dacite porphyrite. It makes a near approach to propylite, from which it is distinguished by the absence of reedy hornblende from the plagioclase.

Dacite Porphyrite.

Illustration.—In the slice the semi-transparent minerals are fairly contrasting, but the contrast is improved by the presence of opaque minerals, the others in themselves being insufficient for the production of a good photograph by ordinary light.

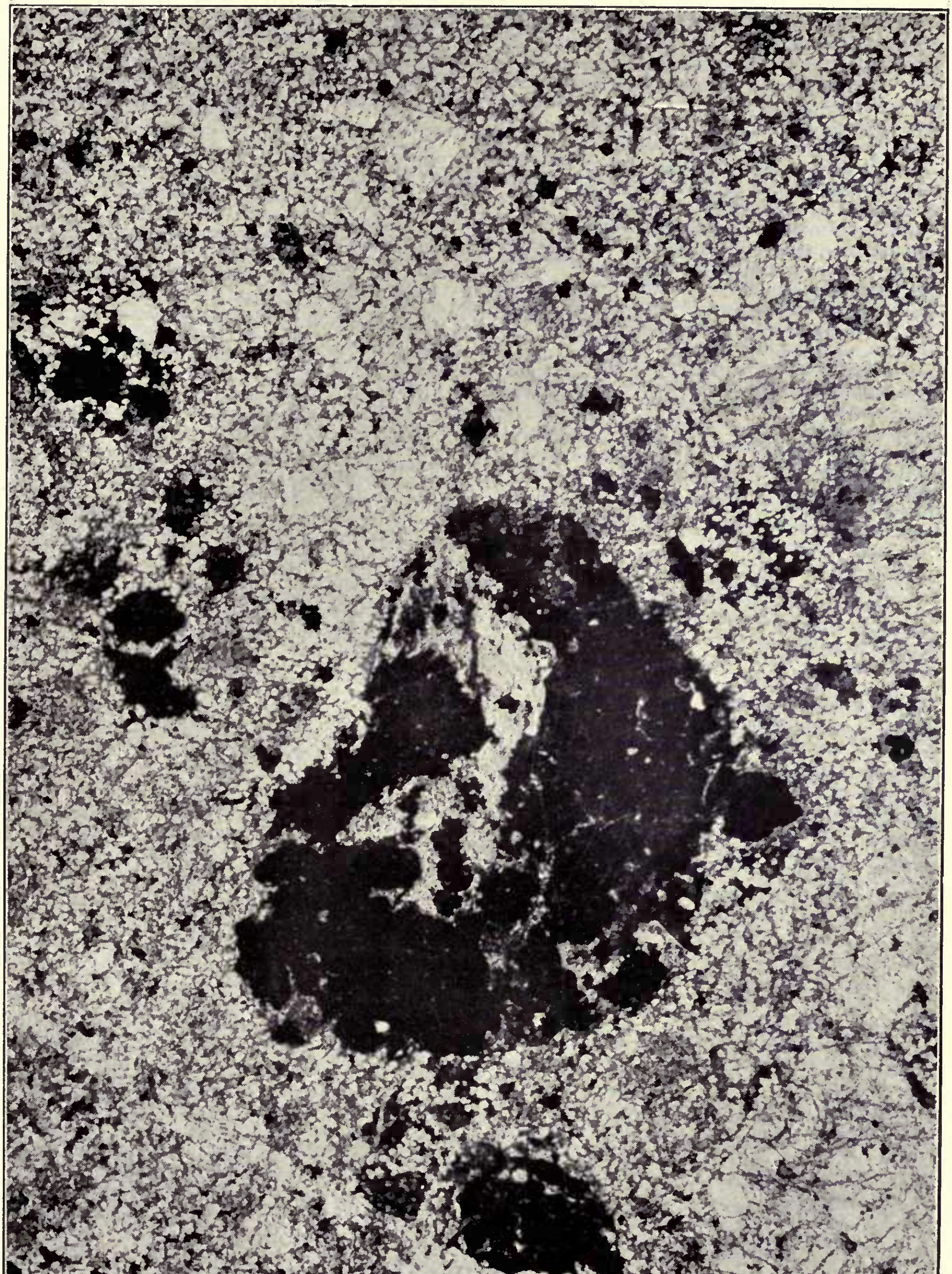
Photographed by ordinary light; magnification, 33 diameters; area photographed, middle and middle right.

Most of the phenocrysts are irregular in outline and much jointed. Secondary deposits in veins are indicated. The photo illustration represents the slice fairly well.

Locality.—Left branch of Cadman's Creek, Tiki-Tokatea district.

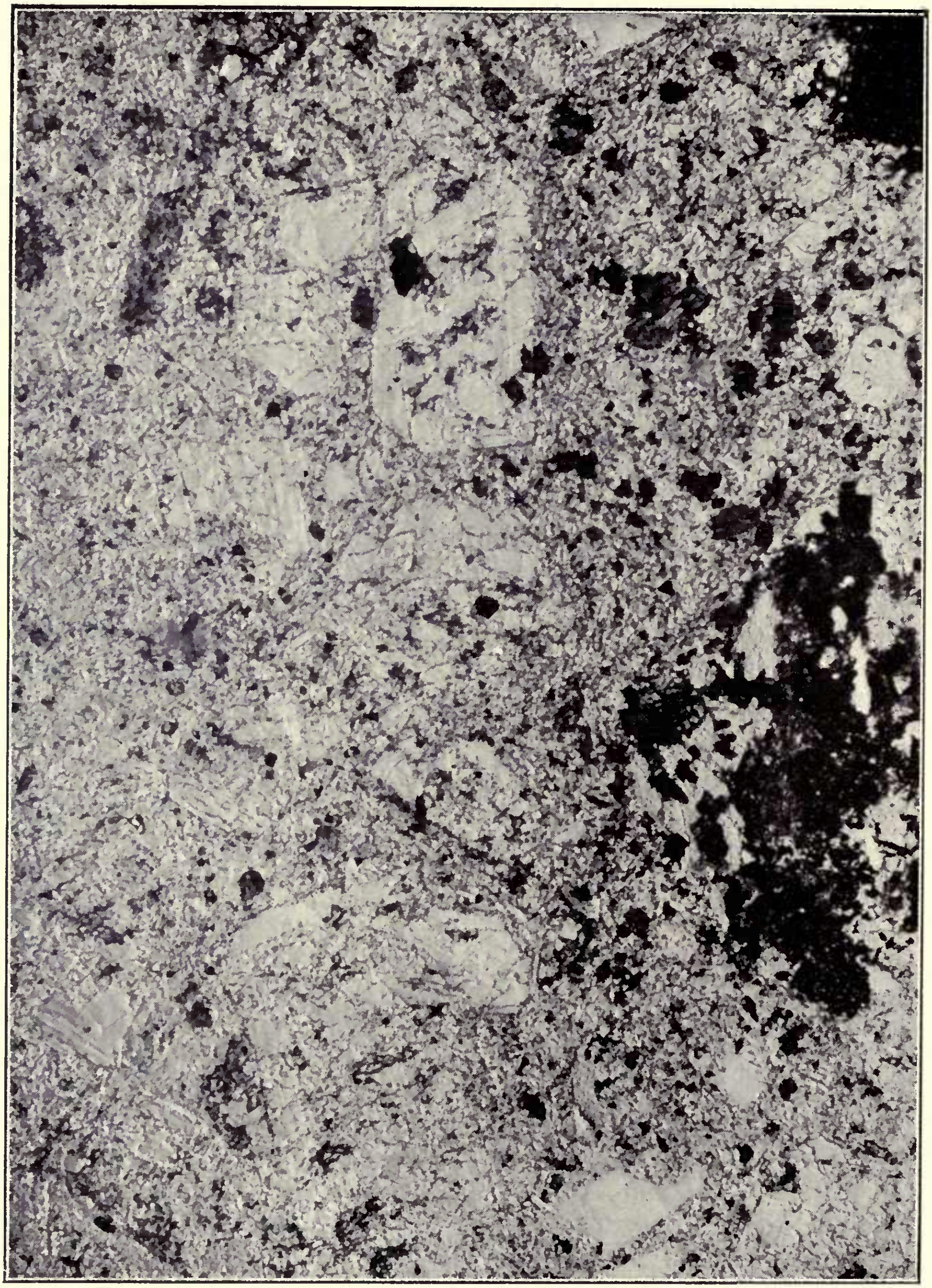
Formation.—A dyke in Te Anau series.

Remarks.—The rock shows in the bed and left bank of the creek, and is the first of a series of dykes met with in following the creek upwards. In the bank of the stream the rock is much affected by surface-decomposition, and from the water-channel the specimen examined was taken. The specimen is described as from an altered rock, but in appearance it differs from the highly altered and decomposed andesites of the Tertiary volcanic series.



No. 6/2735. QUARTZ DIORITE PORPHYRITE OR DACITE PORPHYRITE.

[*To face p. 132.*



No. 7/2736. PILOTAXITIC HORNBLENDE DACITE PORPHYRITE OR QUARTZ PYROXENE DIORITE PORPHYRITE.

[To face p. 133.

No. 7/2736.

M.C.—Greenish-grey fine-grained rock, rich in phenocrysts of felspar and hornblende, with disseminated pyrites.

U.M.—Groundmass coarsely micropœcillitic, the quartz often separated out in irregular grains forming the middle of a micropœcillitic patch. Plagioclase crystals several times twinned. Hornblende in small reedy crystals, often almost colourless, passing into chlorite and epidote. A few magnetite grains.

Phenocrysts.—*Plagioclase* well-formed crystals and complex clusters, often coarsely twinned on the albitic type; *r.i.*, above that of balsam. Ext. 26° / 26°, much cracked in many cases by irregular fractures filled with a second felspar or quartz; marginal zone of rusty inclusions, looking very like vapour cavities; also more generally distributed minute scattered needles of apatite, grains of magnetite, pyrites, and a little chlorite and epidote.

Pyroxene represented by pseudomorphs of chlorite and epidote, with associated leucoxene grains and pyrites. Some pseudomorphs in chlorite surrounded by a fringe of epidote which lies outside the limits of the original pyroxene.

Hornblende often quite fresh, honey-yellow / olive-green, with a resorption border of chlorite and leucoxene.

Quartz in large rhyolitic grains, containing liquid cavities with bubbles.

Ilmenite represented by numerous pseudomorphs in leucoxene.

Pyrites in large irregular grains generally associated with ferro-magnesian pseudomorphs.

This is an altered micropœcillitic hornblende dacite porphyrite, or quartz pyroxene diorite porphyrite. The quartz differs from that of dacite by containing fluid inclusions. The plagioclase differs from that of propylite by the absence of hornblende. The hornblende differs from that of propylite by the presence of a resorption border.

Hornblende Dacite Porphyrite.

Illustration.—In the slice the less opaque minerals are fairly contrasted, but contrast is improved by the presence of opaque patches.

Photographed by ordinary light; magnification, 50 diameters; area photographed, lower left.

Boundaries of the larger crystals not sharply defined. This is due to the condition of these and the matrix. Sharp outlines are shown where pyrites are present. A large field of pyrites, broken up by more transparent material, gives balance to the reproduction, which represents the character of the area shown, but not so well the whole of the slice.

Locality.—Left branch of Cadman's Creek, Tiki-Tokatea district.

Formation.—A dyke in Te Anau series.

Remarks.—This is a large dyke, probably it extends south into the Tiki watershed. It is remarkable for the great plenty of iron-pyrites quite fresh in the rock.

No. 8/2738.

M.C.—Heavy dark-grey basalt-like rock, glistening with felspar crystals.

U.M.—Groundmass pilotaxitic, showing flow structure, abundant. Felspar in rectangular laths; pyroxene in long square jointed prisms, extinguishes at from 39° to 44°; abundant minute grains of magnetite.

Phenocrysts.—*Plagioclase* of the usual andesitic character. Ext. 20°/20°, 35°/35°. Specific gravity from 2·70 to 2·75, thus ranging from labradorite nearly to anorthite. Some of the felspar is, however, less basic, with a specific gravity as low as 2·64, and it is quite possible that the whole range of plagioclase, from albite to anorthite, is present in the rock; the greater part belongs to the more basic species.

Augite in almost colourless crystals with rounded edges, they include magnetite and felspar, and sometimes present lamellar twinning.

Hypersthene in well-formed elongated prisms, with the usual pleochroism, faintly bluish/pinkish; largely altered into faint green serpentinous material, but cores of the fresh mineral remain. Specific gravity over 3·34. Optical sign —.

This is a typical

Pilotaxitic Hypersthene Andesite.

Illustration.—The slice shows good contrast between the matrix and the porphyritic crystals.

Photographed by ordinary light; magnification, 33 diameters; area photographed, the middle right, which represents well the whole of the slice.

In the slice as shown by the illustration there are two or three grades in the size of the phenocrysts, or by stages these grow less and less till they merge into the squares and laths of the matrix. The bordered and zoned character of many of the phenocrysts is very noticeable, and in a scarcely less degree are the fracture-lines by which they are intersected.

Locality.—Near north-west extremity of Preece's Point, Kapanga district.

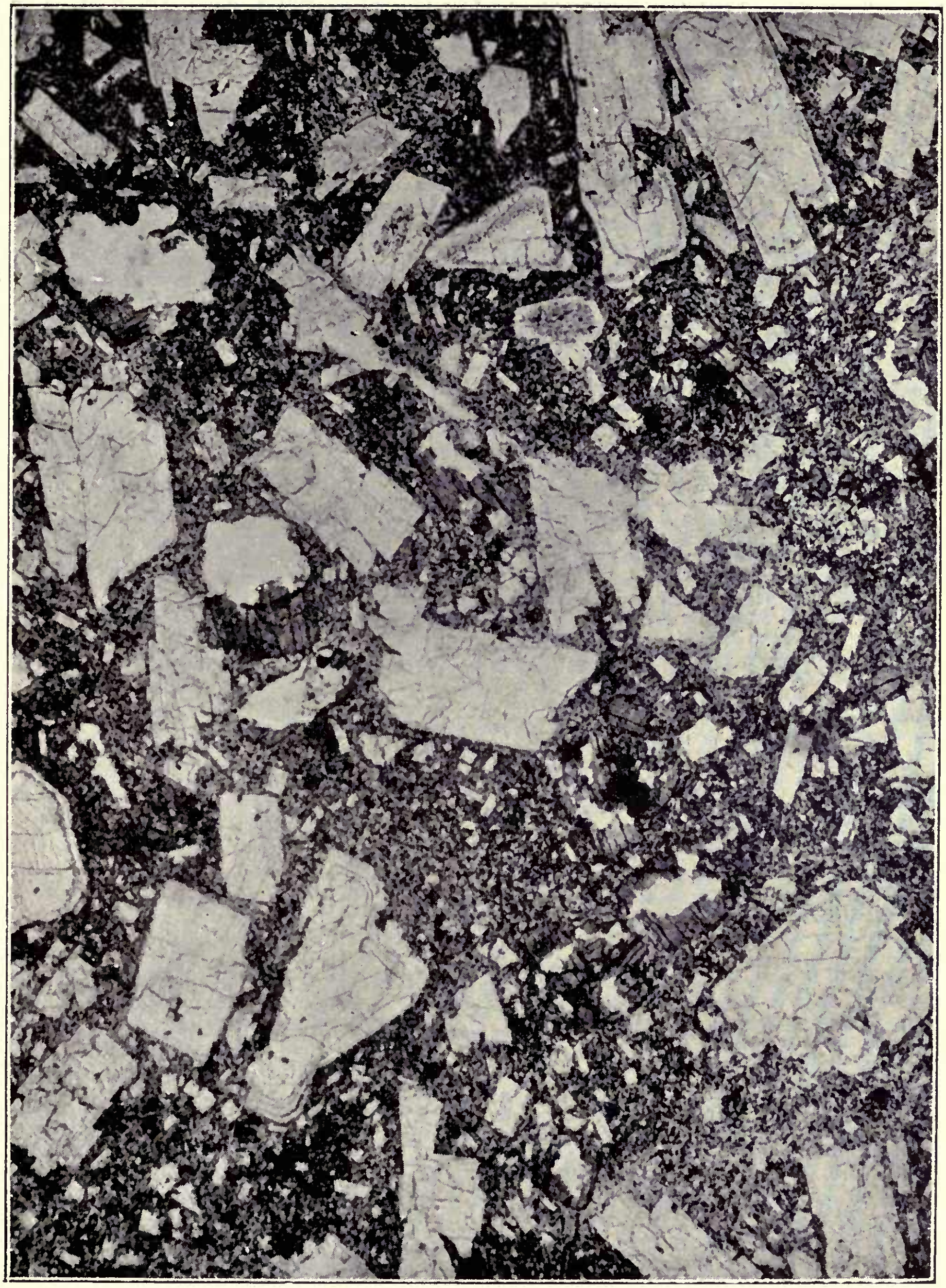
Formation.—Kapanga group.

Remarks.—This rock occurs within a short distance of a remarkable body of bright-red jasperoid quartz crowded with splendent crystals of iron-pyrites. The adjacent volcanic rocks are all very much altered, and consist largely of moderately fine breccias for the most part decomposed at and near the surface. The comparatively fresh condition of this rock makes it prominent among the rocks of Preece's Point Peninsula. It occurs at sea-level and within tide-mark, which may be a reason why fairly good specimens were obtained.

No. 9/2752.

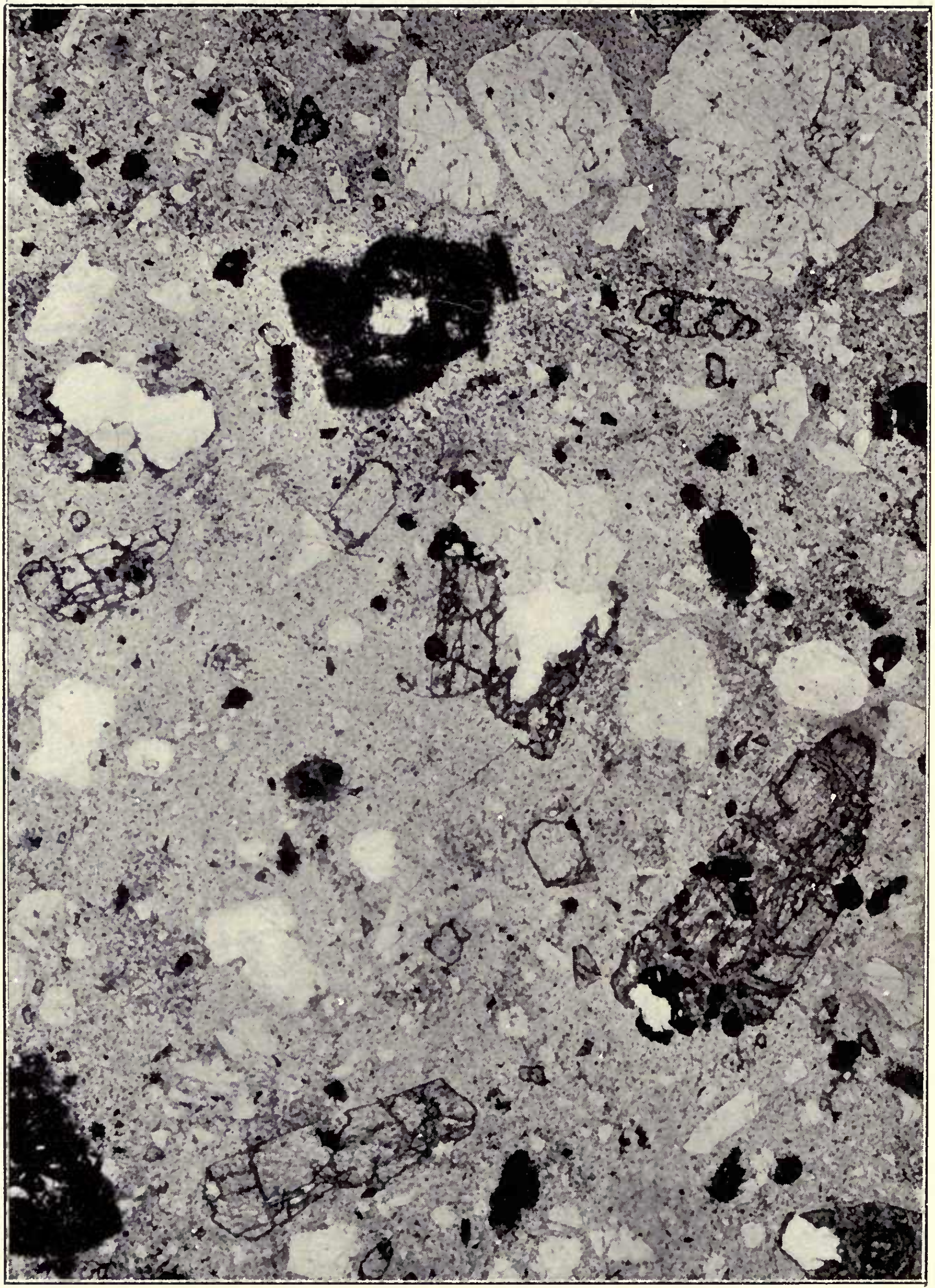
M.C.—Black basalt-like rock, with scattered plagioclase and ferro-magnesian crystals.

U.M.—Groundmass pilotaxitic, minute felspar laths running in lines of flow, crowded with minute magnetite grains, abundant.



No. 8/2738. PILOTAXITIC HYPERSTHENE ANDESITE.

[*To face p. 134.*



No. 9/2752. PILOTAXITIC HYPERSTHENE HORNBLENDE ANDESITE.

[*To face p. 135.*

Phenocrysts.—Often fragmentary.

Plagioclase often very irregular twinning. Ext. 22°/22°, much fractured, cracks filled with Xylotile. Specific gravity for the most part 2·67. Oligoclase to andesine.

Pyroxene subordinate, and more hypersthene than augite.

Augite pale-yellow, very clear, includes small crystals of plagioclase.

Hypersthene fresh, altered into green serpentinous matter along cleavage cracks; alteration has not proceeded far.

Hornblende represented by numerous resorption pseudomorphs, filled with black dust, and margined by a collection of minute augite individuals or their replacement products.

Magnetite or *ilmenite* occurs in fairly large grains.

Pilotaxitic Hypersthene Hornblende Andesite.

Illustration.—The slice shows fair contrast between matrix and phenocrysts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, upper right. In other areas there are larger phenocrysts, but in no other could a more characteristic representation of the whole slice be made.

Locality.—Pa Hill, Uncle's Farm, Tiki-Kapanga district.

Formation.—Kapanga group.

Remarks.—This specimen is from one of the best exposures of a widely extended continuous stream of dark-lava rock that lies at the base of the Kapanga group, as seen in the south part of the Kapanga and north part of the Waiau Valley, &c., districts.

When exposed in the cuttings of the Tiki–Mercury Bay Road it is seen to contain veins and nests of a dull-brown jasper rock. Although at the Tiki it is seen resting on Palæozoic rocks, it by no means follows that this is the oldest of the Kapanga group of rocks. On the contrary, it is almost certain that it is not so, a great thickness of grey or greenish breccias underlying similar lava-sheets in other parts of the Kapanga district.

No. 10/2760.

M.C.—Whitish fine-grained rock, with ochreous stains.

U.M.—Consists of quartz mosaics varying in fineness, but never very coarse, and patches of sericite felt, also varying in fineness, usually very fine and irregular, but sometimes coarser and with the scales arranged radiately about a centre. Quartz grains and sericite occur mixed together, the sericite being interstitial to the quartz. Ochreous patches of ferric hydrate and some pyrites, from which mineral the ferric hydrate has probably been derived, are present. Some of the areas of sericite felt present a more or less definite rectilinear boundary, and show parallel striations between *x.n.*; they may represent pseudomorphs of some mineral such as felspar.

The origin of this rock is indeterminate.

Quartz Muscovite Rock.

Locality.—Left branch of Cadman's Creek, Tiki-Tokatea district.
Formation.—Te Anau series.
Remarks.—This rock is characteristic of the Te Anau series, and is strongly developed in the locality of the specimen, whence it may be traced in both directions to the limits of the district. On the road from Coromandel to Kuaotunu and on Tiki Spur it has usually been regarded as weathered and decomposed slate, and the fine grain of the material may have to be considered a sufficient excuse for the mistake.

No. 11/2788.

M.C.—Pinkish-grey rock, similar to 2760.

U.M.—This is similar to 2760, but presents fewer quartz mosaics and more isolated irregular grains of quartz.

There is a good deal of scattered leucoxene and some ferric hydrate. Some of the quartz grains look rhyolitic, and some of the sericite areas resemble pseudomorphs after felspar.

Quartz Sericite Rock.

Locality.—Right or north branch of Cadman's Creek, Tiki-Tokatea district.
Formation.—Te Anau series.
Remarks.—This and Specimen 2760 were taken at places about a quarter of a mile distant from each other, not in the hope that they would prove different rocks, but, on the contrary, believing that they would prove identical. This method has been followed to trace this rock to Tokatea Hill on the one hand and the Tiki Spur on the other.

The volcanic character of the material forming the Te Anau series between Tokatea and the Tiki may be considered as established beyond doubt. Except an obscure hint by Mr. Cox having reference to the rocks of Tokatea Hill and Mine, the true nature of these rocks was not suspected prior to the collection of the series of rock-specimens begun in 1896, and of which a selection is now under description. "Grauwacke" has been mentioned in reports previous to the date mentioned, but the term can hardly be said to have been used in the sense in which it is employed ordinarily, and generally understood.

No. 12/2790.*

M.C.—Dark-purple andesite, with minute irregular cavities lined with a lilac powder.

* Originally described as 100A/3601.

U.M.—MATRIX transparent brown glass, ultra-microscopic granular, crowded with felspar laths and rectangles, prisms of greyish-green and brown pyroxene, grains of magnetite; well-marked stream-lines.

PHENOCRYSTS.—*Plagioclase,* abundant large crystals, usually in groups; various twinning, often coarse and irregular. Ext. 30°/34°. Zonal. Inclusions, submarginal, central and general, consisting of brown glass often in negative crystals, and pyroxene; abundant. Some crystals broken in place. Some glomerulo porphyritic clusters occur with associated hypersthene and augite.

Augite in greenish-grey crystals, single and in clusters. Some show a slight pleochroism similar to that of hypersthene; straw-yellow / grey-green. These have usually a low extinction.

Hypersthene in greenish-grey almost colourless crystals, quite fresh; yellowish / greenish-blue; in one instance a crystal of hypersthene surrounded almost completely by a margin of augite; it exts. at 41°. Liquid cavities with bubbles occur in both pyroxenes.

Hornblende: A single instance of a resorption pseudomorph occurs in one slice.

Magnetite: A few large grains.

Hyalopilitic Hypersthene Andesite, with very little hornblende.

Locality.—Matarangi volcanic neck, Matarangi district.
Formation.—Beeson's Island group.
Remarks.—Matarangi Hill and volcanic neck is about three miles and a half from Kuaotunu and a little north of the road to Coromandel. The south side of the hill has been removed by slips, and after denudation has clearly exposed the agglomerate choking the old volcanic vent. It was from a mass of this agglomerate between the road-line and the hill that Specimen 2790 was taken.

No. 13/2792.

M.C.—Cream-coloured rock, stained with ochre.

This resembles 2760. It contains a good deal of scattered leucoxene and a few crystals of zircon.

Quartz Sericite Rock.

It is tempting to think of these rocks as altered rhyolites.

Locality.—Tiki Creek above the Pukewhau junction, Tiki-Tokatea district.
Formation.—Te Anau series.
Remarks.—This is a characteristic rock, and is found also in the Pukewhau

branch of the main creek. It is identical with 2760 and 2788, and is found also on Tokatea Saddle and Hill, and seemingly in position overlying the definitely ascertained rhyolites of the east slope of Tokatea Hill and farther east on the road to Kennedy's Bay. These quartz-sericite rocks are the "felsites" and "felsite tuffs" of previous writers, hitherto described as occurring only at Rocky Point, near the Thames. By an oversight no sample from Rocky Point was sent to England. It is unlikely, however, that any difference of opinion will arise as to the identity of the rocks, and, in any case, Professor Hutton's description of the Rocky Point rock may be referred to in proof of the close resemblance to it, if not the actual identity of the Rocky Point deposit with similar rock from the Tiki or Tokatea Hill.

No. 14/2808.

M.C.—Light-grey compact rock, with small but evident crystals of plagioclase and decomposed ferro-magnesian minerals.

U.M.—Groundmass dirty-looking owing to the irregular dispersion of grains of magnetite of very different size, and also to effects of alteration. Pilotaxitic, felspar laths running in lines of flow. Irregular grains of quartz are abundant in places, and are sometimes in optical continuity with the interstitial quartz of pilotaxitic areas. Scattered iron-ores and leucoxene.

Phenocrysts.—*Plagioclase* in well-formed crystals and in fragments. Crystals traversed by cracks; parallel curvilineal system of cracks traverse adjacent crystals without affecting the intervening matrix. Ext. of albitic twinning, 20° / 23°.

Pyroxene represented by pseudomorphs in chlorite and epidote.

Hornblende not uncommon, fresh, but corroded by magma; sometimes bordered by large grains of ilmenite with leucoxene border.

Large grains of *quartz* are absent, but patches of minute mosaics occur here and there. There is primary quartz in the rock, enough to make it a dacite.

It may be called either a

Quartz(?) Hornblende Pyroxene, or a Porphyrite Pilotaxitic Hornblende Dacite.

Illustration.—The slice shows fair contrasts of different parts.

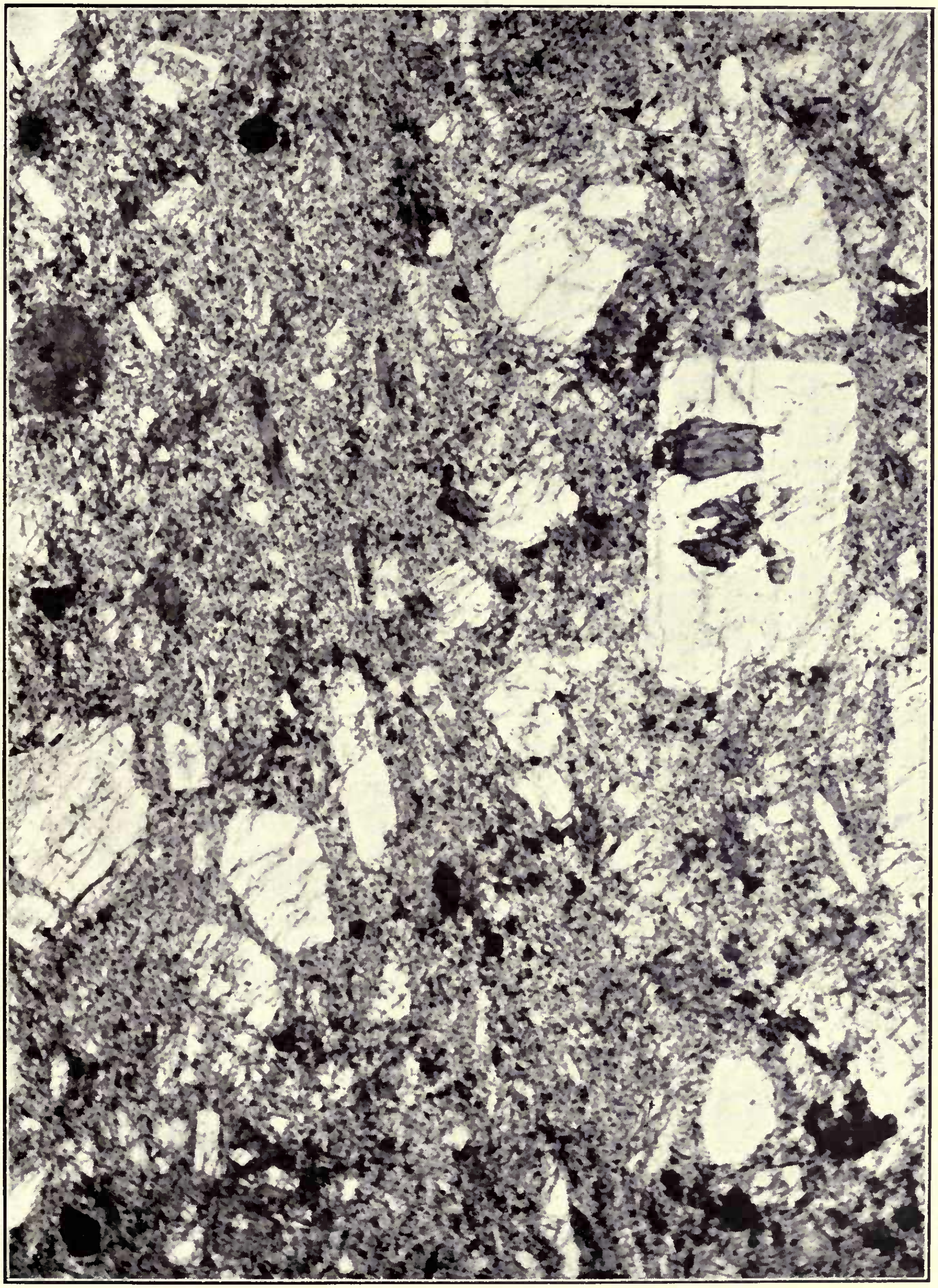
Photographed by ordinary light; magnification, 50 diameters; area photographed, lower middle, which is fairly characteristic of the whole of the slice.

Locality.—Right or main branch of Tiki Creek, Tiki-Tokatea district.

Formation.—A dyke in Te Anau series.

Remarks.—One of a series of nineteen dykes collected from in the valley of Tiki Creek.

The creek was followed to the upper fork, and the left-hand branch a short distance further; but it was found that further progress would be slow, and the various rocks passed had to be collected on the return journey. Without question



No. 14/2808. HORNBLENDE PYROXENE PORPHYRITE.

[*To face p.* 138.

many dykes lay higher up the creek, but these had to be left till a further opportunity, which never occurred, and at the time it was hoped that Cadman's Creek would supply what was missing. To some extent this was the case, but not as fully as was hoped.

The dykes in Tiki Creek are of the same age and class with those of both branches of Cadman's Creek and several of those on Tokatea Hill.

No. 15/2817.

M.C.—Dark bluish-grey compact rock, with evident small crystals of felspar.

U.M.—GROUNDMASS consists largely of multiple twinned plagioclase crystals. Quartz is obvious and interstitial. There is a good deal of scattered chlorite, hornblende, magnetite, and leucoxene.

PHENOCRYSTS. — *Plagioclase* numerous large fresh crystals variously twinned; *r.i.*, above balsam. Ext. 21° / 22°, 22° / 28°.

Pyroxene represented by pseudomorphs in carbonates, chlorite, and epidote, with magnetite. Not common.

Hornblende pale-green, reedy, more or less altered. Pleochroism pale yellowish-green/pale bluish-green. Transverse sections have the form of augite.

Magnetite grains and associated leucoxene.

Quartz occurs in somewhat large grains with jagged margins, not resembling rhyolite quartz. It contains liquid cavities with bubbles.

Apatite: Some comparatively large crystals are present.

This may be called a quartz uralite porphyrite or a uralite dacite; the former name is the more appropriate, judging from the liquid cavities in the quartz.

Quartz Uralite Porphyrite.

Locality.—Right or main branch of Tiki Creek, Tiki-Tokatea district.

Formation.—A dyke in Te Anau series.

Remarks.—This is from the fifth dyke below Fraser's Dam. All these dykes seem to run through the spur range intervening, and again occur in the valley of the left branch of Cadman's Creek.

No. 16/2827.

M.C.—Dark-grey felsitic-looking rock, with crystals of felspar.

U.M.—GROUNDMASS abundant, almost colourless; dirty-looking owing to disseminated magnetite grains of unequal size. Felspar laths once or twice twinned, often arranged in flow-lines; quartz in minute jagged grains, in limited areas abundant, but then associated with chlorite, and may be secondary. Scattered carbonates, chlorite and leucoxene granules. The matrix is not pilotaxitic, but a minutely crystalline admixture.

Phenocrysts.—*Plagioclase* fairly fresh; crystals often broken; some very irregular intergrowths. Albitic twinning generally very irregular. Ext. up to 24°/32°. Sometimes zonal structure, with marginal zone of inclusions. The felspar seems to have had a troubled history, as shown by its fragmentary character and its corrosion by the groundmass.

Pyroxene represented by pseudomorphs formed of carbonates and pennine; both hypersthene and augite may have been present.

Hornblende was fairly abundant, as shown by numerous pseudomorphs consisting of chlorite, carbonates, dust of iron-ore, and leucoxene.

It is difficult to say whether this rock was originally an andesite or a dacite; it would be strictly true to call it an

Altered Hornblende Andesite, containing quartz in the groundmass.

Illustration.—The slice shows in several cases the crystal outlines dark or with a dark border, and there is thus sufficient contrast of the different constituents. Photographed by ordinary light; magnification, 40 diameters; area photographed, upper right. The slice is varied, and it can hardly be said that the illustration represents other than the part photographed. It would require the whole to be photographed to fairly represent the slice.

Locality.—The Kathleen Crown Mine, Kapanga district.

Formation.—Kapanga group.

Remarks.—This rock was passed through in sinking the shaft of the mine. At the time it was thought to be a dyke rock, and a northern continuation of Castle Rock. There are no distinct proofs of these statements, and it seems fully as likely that we have to do with a lava-stream. The specimen is disappointing, as from its megascopic character a bolder photograph might have been expected.

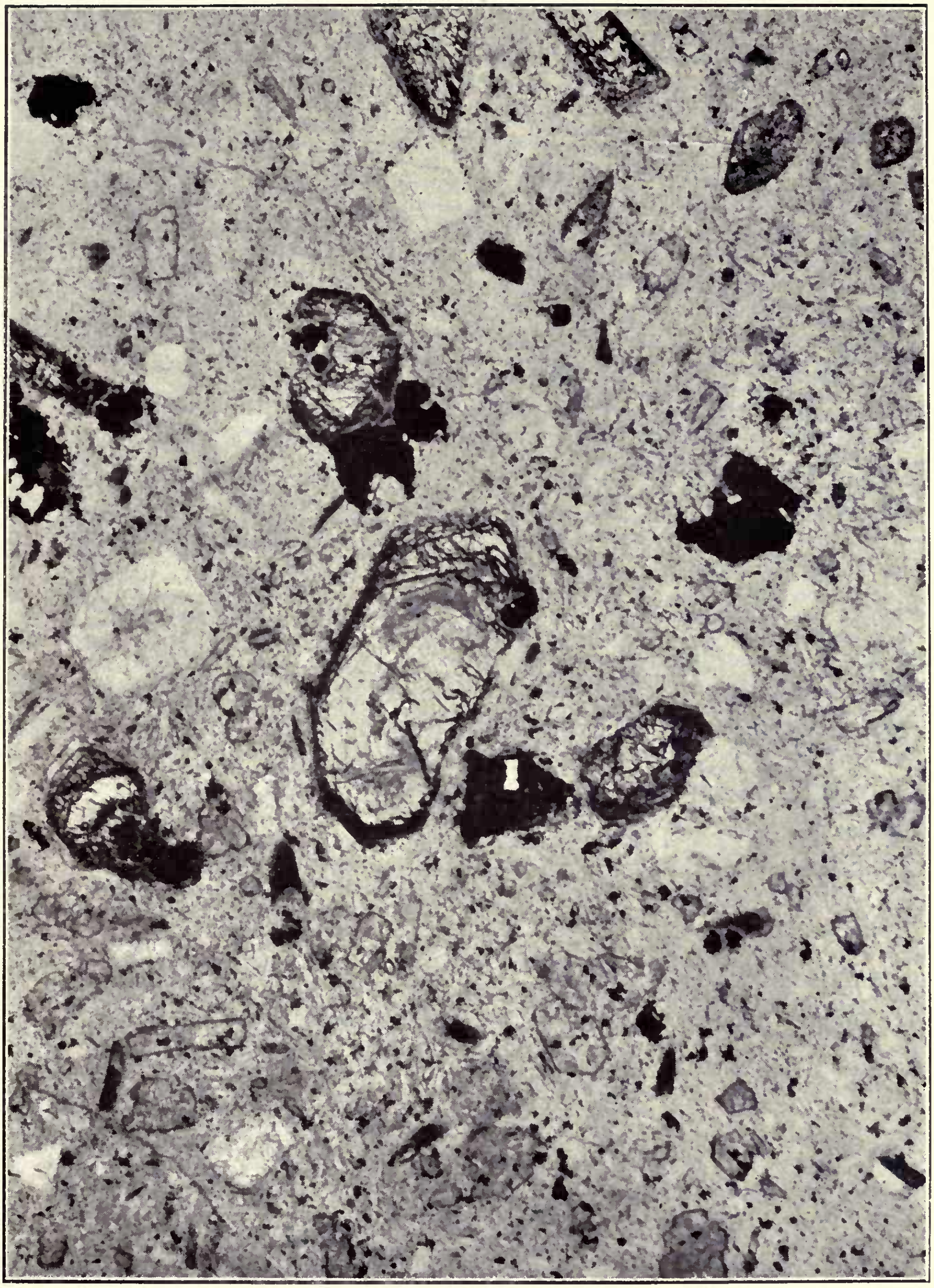
No. 17/2833.

M.C.—Grey to black basaltic-looking rock, with large crystals of felspar scattered porphyritically. Effervesces with hydrochloric acid.

U.M.—Groundmass minutely crystalline, not pilotaxitic; consists of felspar laths and rectangles, with traces of fluxional arrangement, minute jagged granules of quartz, chlorite scales, carbonates, titaniferous magnetite grains, and leucoxene.

Phenocrysts.—*Plagioclase,* simple and large complex crystals well formed, rarely rounded; marginal or submarginal zone of included matrix (or felsitic material). Ext. up to 35°/35°. Replaced to a variable extent by carbonates and chlorite; also by muscovite.

Pyroxene represented by pseudomorphs in chlorite and carbonates; both hypersthene and augite may have been present.



No. 16/2827. ALTERED HORNBLENDE ANDESITE CONTAINING QUARTZ IN THE GROUND-MASS.

[*To face p. 140.*

Hornblende represented by pseudomorphs in chlorite, carbonates, and scattered magnetic grains, which are titaniferous, as shown by leucoxene margins.

A large complicated pseudomorph apparently after pyroxene occurs in one slice; it includes some felspar, and for the rest consists of carbonates, chlorite, sphene, magnetite, and biotite, which includes apatite. The biotite is highly pleochroic, deep russet-red / faint straw-yellow, and is partly replaced by chlorite. It shows sections both parallel and at right angles to the *C* axis.

Pyrites in small quantity, in some instances associated with quartz. Very small crystals of pyrites are scattered less sparingly.

Quartz occurs here and there in irregular forms, containing vapour cavities; it is rare, but seems to be primary.

Altered Hornblende Dacite, or Dacite Porphyrite.

Locality.—Hauraki Mine, Kapanga district.

Formation.—Kapanga group.

Remarks.—This at the time of collecting was the darkest rock that could be found on the tip-head; its actual position in the mine was not ascertained.

No. 18/2836.

M.C. — An obviously decomposed rock; matrix felsitic-looking, with phenocrysts of opaque white felspar and dark ferro-magnesian minerals.

U.M.—Matrix abundant; minutely crystalline; composed of seriticised felspar laths and rectangles, jagged quartz grains (almost micropegmatitic), chlorite pseudomorphs, carbonates, and magnetite grains of various size, with associated leucoxene. No evident fluxional structure.

Phenocrysts.—*Plagioclase* with good crystal outlines, largely replaced by carbonates and muscovite; some have rounded outlines with a marginal zone of inclusions; traces of zonal structure persist, and of zonal inclusions. The extinction is now generally low; sometimes the *r.i.* is above balsam and the ext. 16°/ 16°, sometimes about equal to that of balsam, and then the extinction is parallel.

Pyroxene represented by pseudomorphs in pennine and carbonates; hypersthene was probably present, as well as augite.

Hornblende: Resorption pseudomorphs are numerous, some with sharp crystal outlines, some rounded.

Quartz: An isolated instance of a coarse mozaic surrounded by carbonates, but invaded by matrix, so that it was present before final consolidation.

Magnetite and associated *apatite* are present.

An altered hornblende dacite, or dacite porphyrite. Traces of liquid cavities with bubbles as well as stone cavities are seen in the quartz. According to Zirkel, this is a character foreign to the quartz of dacites.

Altered Hornblende Dacite, or Dacite Porphyrite.

Locality.—Kathleen Mine, Kapanga district.
Formation.—Kapanga group.
Remarks.—The Kathleen Mine, on the flat between Trig. Hill and the Wynyardton Hills, passed through a considerable thickness of estuarine deposits before touching solid rock. When reached the rock resembles more the rocks towards the east than those lying to the westward in the hills towards Coromandel wharf.

No. 19/2840.

M.C.—Greenish-grey decomposed rock, porphyritic with opaque white felspar, with included xenoliths.

U.M.—Matrix minutely crystalline; felspar laths and rectangles, with traces of fluxional arrangement; irregular granules of quartz, chlorite, and abundant leucoxene.

Phenocrysts.—*Plagioclase* variously twinned; low angle of extinction, frequently 6° or less, more or less attacked by carbonates. Some with marginal zone of inclusions.

Orthoclase: Some of the felspar extinguishes parallel, and in sections parallel to (010) at about 21° with the *C* axis. The *r.i.* in this case is low, not above balsam, though I cannot satisfy myself that it is below.

Pyroxene is represented by pseudomorphs in chlorite and carbonates with leucoxene.

Hornblende rare pseudomorphs, represented by chlorite and carbonates.

Quartz: Large grains with rounded outlines present, but rare.

Ilmenite plates are represented by leucoxene.

Some *apatite* is present.

The rock is an altered dacite containing xenoliths, but as the section has not passed through any of the latter I cannot state their nature.

Altered Dacite.

Locality.—Kathleen Mine, Kapanga district.
Formation.—Kapanga group.
Remarks.—The conditions under which this rock was obtained are the same as those of No. 2836. In both cases the specimens came from the shaft some 50 ft. to 100 ft. after having touched hard rock. Breccias were the chief output at the time of collection, and solid rocks were scarce.

No. 20/2853.

M.C.—Very much altered light-grey rock, containing opaque white felspar crystals and scattered pyrites.

U.M.—Matrix jagged interlocking grains of quartz; allotriomorphic plagioclase, in some places lath-like and rectangular; chlorite scales; abundant muscovite, often radio-fibrous, epidote, leucoxene.

Phenocrysts.—*Plagioclase:* Large crystals not numerous; broad albitic twinning. Ext. 14° / 12°; contain epidote and muscovite; some invaded by quartz; *r.i.* difficult to ascertain, not much above balsam.

Pyroxene represented by fairly numerous pseudomorphs, some of large size, consisting of a yellowish serpentinous mineral which in some instances retains the interrupted fibrous structure so common in pseudomorphs after hypersthene. In many cases epidote contributes largely to the pseudomorphic mineral, frequently in radiate aggregations; muscovite also is sometimes present.

Hornblende: Some of the pseudomorphs into which epidote enters largely present the transverse section characteristic of hornblende.

Leucoxene and *ochreous granules* are disseminated.

The rock is probably an

Altered Dacite.

Locality.—Right branch of Cadman's Creek, Tiki-Tokatea district.

Formation.—A dyke in Te Anau series.

Remarks.—Shows strongly on the right bank at the first turn in the creek on entering the hills. No matter how deeply this rock was broken into, in boulders or in the solid, it invariably showed a highly altered and decomposed appearance, and there seemed to be no good reason why it should be in a greatly different condition from numbers of dykes in the same district.

No. 21/2865.

M.C.—Lightish-grey diorite-like rock.

U.M.—Matrix comparatively small in amount; obvious quartz grains, which include small felspar rectangles and are interstitial to larger crystals. Epidote, chlorite, magnetite, and leucoxene are also present.

Phenocrysts.—*Plagioclase* abundant large crystals and complex growths, some broken and re-grown; often highly zonal; twinning various. Ext. 28°/ 28°. The core sometimes contains a muscovite-like network having a common optical orientation.

Augite: Some large almost colourless crystals, usually twinned. Ext. up to 44°, having sometimes a core consisting of some chloritic mineral and epidote, the chlorite sometimes passing into amphibole where it meets the unaltered augite.

Hornblende: Numerous pseudomorphs occur as a very dichroic chlorite, green / faint brownish-yellow ; epidote is frequently present also, and actinolitic fibres. Judging from rock No. 2817, I am inclined to think this may represent transformed uralite.

Quartz occurs in rounded and irregular grains, with liquid cavities containing bubbles.

Pyrites: A few cubes here and there.

Apatite: Some occurs.

The rock may be called a

Uralite Dacite Porphyrite.

Locality.—From one mile up the valley of the right-hand branch of Cadman's Creek, Tiki-Tokatea district.

Formation.—As a dyke in Carboniferous strata.

Remarks.—This is a massive and well-preserved dyke rock, good specimens being obtainable anywhere at the surface.

This dyke is so unyielding in character that if it does not form a gorge at the point where it crosses the creek it is because its breadth and direction is not such as to favour the formation of a gorge of any length. However, at the point where it crosses the creek the channel of the stream is narrowed and confined between opposing rocks.

The direction of the dyke northward is towards the lower part of the Success Claim, and in the opposite direction the dyke is hardly traceable beyond the banks of the creek, and has not been identified on the Coromandel–Whangapoua Road.

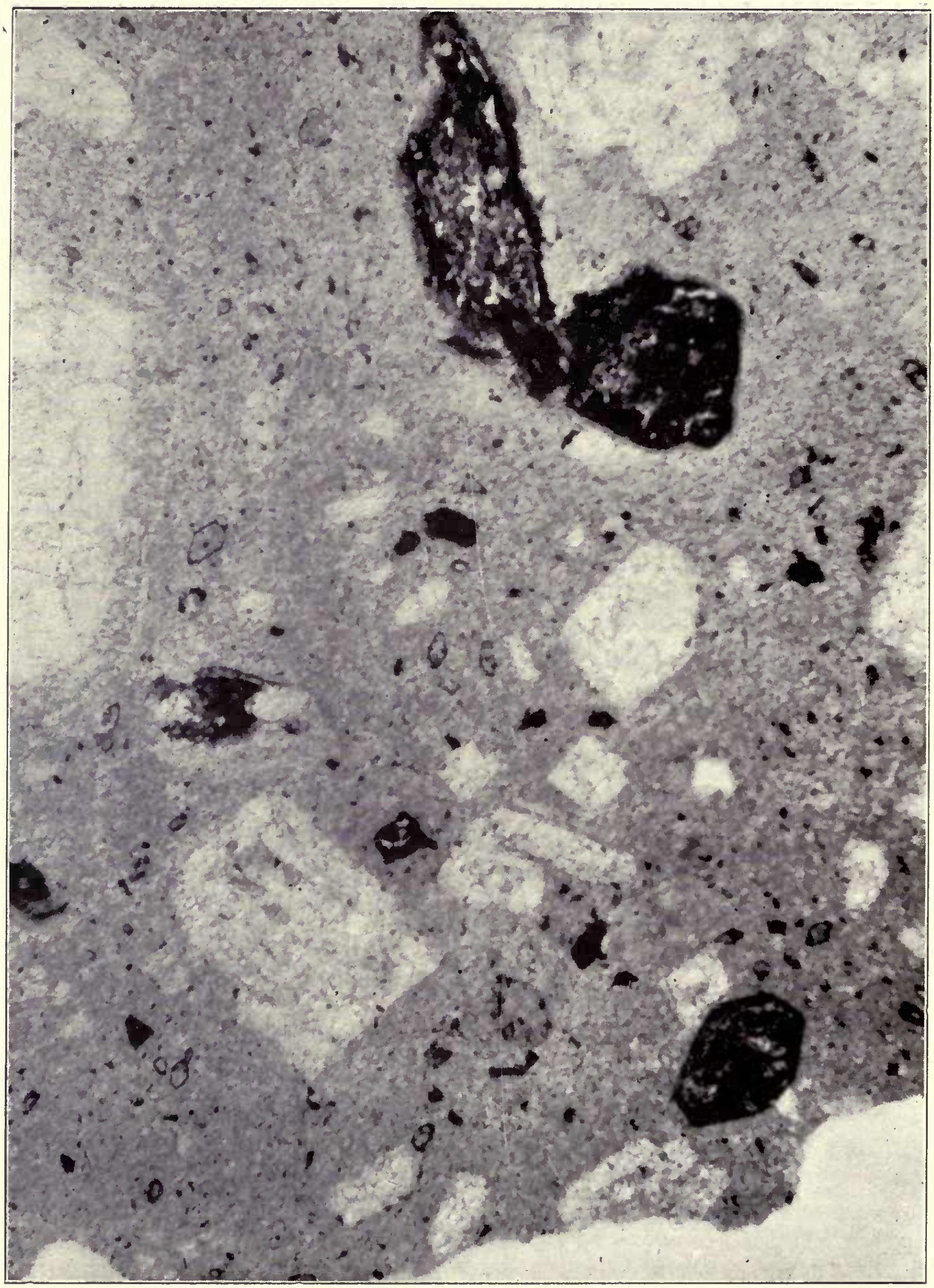
No. 22/2868.

M.C.—Light-grey rock, porphyritic with felspar and dark ferro-magnesian mineral.

U.M.—Matrix abundant, minutely crystalline, small grains of quartz, minute rectangular sections of plagioclase, chlorite scales, and scattered magnetite and leucoxene.

Phenocrysts.—*Plagioclase* fairly numerous large crystals and complex growths ; variously twinned. Extinction varies from 15°, when the *r.i.* approaches that of balsam, to 32°, when it is obviously higher. Crystals often fractured ; cracks filled with quartz ; sometimes a narrow marginal band of intergrown plagioclase and quartz may be seen. Liquid and vapour cavities are present in the felspar, some of large size and tubular and branching.

Pyroxene represented by pseudomorphs in green chlorite, which often forms radiating tufts proceeding from the cracks and sides of the original



No. 22/2868. ALTERED HORNBLENDE DACITE.

To face p. 145.

crystal. Some of the larger pseudomorphs consist of chlorite and quartz. Both augite and hypersthene may have been present.

Hornblende is abundantly represented by resorption products, now consisting of chlorite, opacite, and carbonates in various proportion. A good deal of leucoxene is also often present.

Apatite occurs here and there in large crystals.

Altered Hornblende Dacite.

Illustration.—Slice shows fair contrasts, but the felspar phenocrysts do not stand up well from the matrix, and the dark crystal pseudomorphs with one exception are irregular in outline.

Photographed by ordinary light; magnification, 50 diameters; area photographed, the upper right.

The reproduction print shows well the general character of the slice. The character of the matrix is not clearly defined, but this is usual in the dyke rocks of the district, except under a higher power than was employed.

Locality.—Shore-line south side of Kikowhakarere Bay, Kapanga district.

Formation.—Kapanga group.

Remarks.—In the locality of the specimen there are two very strong and well-marked ribs of rock of dark and lighter colour that side by side pass into the hill and trend in the direction of Coromandel Township. The samples from these are numbered respectively 2868 (above described) and 2869 (next to be described), which is the darker rock. The dyke-like character of the outcrop of these rocks is very apparent, and in this case, the rock being specifically the same as Castle Rock, it has been thought that the two may form part of the same intrusion. This, however, is unlikely.

No. 23/2869.

M.C.—Compact basalt-like rock, glistening with felspar.

U.M.—Matrix abundant, pilotaxitic, crowded with minute magnetite grains; patchy coloration, some patches colourless and unusually rich in magnetite, others yellowish and less rich in magnetite. Fluxion arrangement present. Rectangular felspar and microliths of pyroxene, which sink to almost ultra-microscopic dimensions, and sometimes form globules, are present; when very small they do not produce any evident effect on polarised light, when larger and rod-like extinction is generally parallel.

Phenocrysts.—*Plagioclase* mostly good crystal outlines—some simple, some complex, some fragmentary. Inclusions abundant, variable, sometimes sub-marginal, sometimes extend throughout the crystal from centre to margin, sometimes almost absent. Twinning various, albitic, coarse, and irregular. Ext. 25°/25°. Zonal structure is sometimes very perfect; when best developed twinning is not so coarse, and crystals usually simpler.

Pyroxene represented by abundant small pseudomorphs of green fibrous serpentinous matter, a few larger ones are also present, in a few cases a core of unaltered material remains; it is colourless, extinguishes parallel, and has a low double refraction, and hence may be regarded as hypersthene or enstatite; probably the latter, since pleochroism is absent.

Hornblende is fresh in abundant crystals bordered by resorption products; it is green, with usual pleochroism, and is sometimes twinned two or three times.

Pilotaxitic Hornblende Enstatite(?) Andesite.

Locality.—Shore of Hauraki Gulf, south side of Kikowhakarere Bay, Kapanga district.

Formation.—Kapanga group.

Remarks.—This rock is in contact with that whence was taken specimen No. 2868, one or other of which is supposed to be a north-west continuation of Castle Rock dyke. Both rocks are very remarkable, and form a bold reef on the coast-line under the higher part of Dacre's Hill. As these rocks are of easy access and are splendidly exposed on the sea-beach, they are likely to be made a frequent subject of study.

No. 24/2872.

M.C.—Dark basalt-like rock, glistening with felspar crystals.

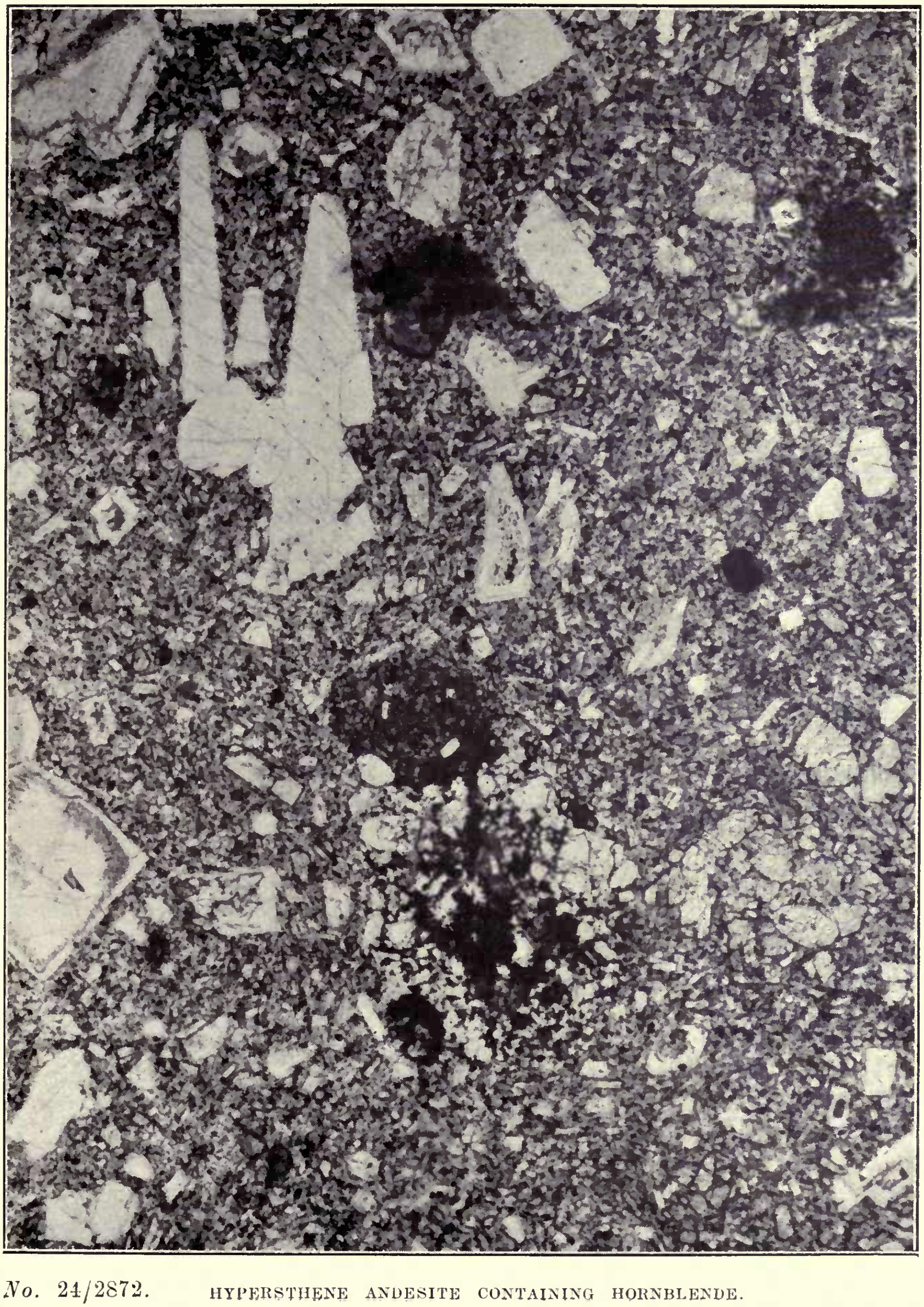
U.M.—Matrix a colourless cryptocrystalline basis crowded with laths and rectangular sections of plagioclase; microliths and small prisms of pyroxene; magnetite grains and dust, with only occasional signs of fluxional arrangement.

Phenocrysts.—*Plagioclase* very clear, well-defined crystals, simple and complex growths, whole or fragmentary, often fractured *in situ;* zonal; various inclusions, sometimes of matrix, which may form a coarse irregular network, or liquid cavities with bubbles, which follow the outlines of the zones; a close fringe of tubular cavities sometimes running at right angles to the margin of a zone. Twinning generally coarse and irregular. Ext. from 15° / 15° to 32° / 32°.

Augite in colourless crystals, single or clustered, whole or fractured; twinned, sometimes repeatedly. Usually quite fresh; occasionally transformed into serpentinous mineral; sometimes from irregular intergrowths with hypersthene.

Hypersthene well-formed crystals, almost colourless, faintly pleochroic; bluish / pinkish, passing into green serpentinous mineral having a wide double refraction.

Hornblende sage-green / faint straw-yellow. Ext. 20°, with a reaction border of completely individualised faintly green augite and hypersthene with plagioclase and magnetite grains. Inclusions of felspar not uncommon.



No. 24/2872. HYPERSTHENE ANDESITE CONTAINING HORNBLENDE.

[*To face p.* 146.

Biotite occurs in two or three instances, forming clusters of a reddish-brown colour. These occur in areas from which hornblende has disappeared, leaving only reaction products.

Magnetite : Some large grains.

Hypersthene Andesite, containing hornblende.

Illustration.—Slice shows good contrast between the different minerals present.

Photographed by ordinary light; magnification, 33 diameters; area photograhed, lower left.

The margined zonal and fissured character of the felspars can be readily traced. The part photographed indicates the character of the whole slice.

Locality.—Union Beach, Kapanga district.

Formation.—The Kapanga group.

Remarks.—The specimen is from an outcrop of dark basalt-like rock that occurs at high-water mark and within Bunker's Hill Claim. This rock is remarkable as being the only apparently fresh rock in the neighbourhood, most of the others having assumed the appearance of miner's sandstone.

The crown of the exposure (which is small) has been quarried for road-metal, and thus an opportunity was afforded for securing specimens in a fairly well-preserved state.

No. 25/2874.

M.C.—Grey diorite-looking rock, with abundant small crystals of felspar.

U.M.—Matrix comparatively coarse-grained. Plagioclase usually in rectangles, green decomposition products, scattered carbonates, and quartz in jagged interstitial grains, in some cases micropegmatitic growths.

Phenocrysts.—*Plagioclase,* in not very large idiomorphic to hypidiomorphic crystals, forms the greater part of the rock. Coarse albitic twinning. Ext. $30°/30°$. Sometimes zonal. Frequently a clear margin to a clouded interior, which contains carbonates.

Pyroxene completely transformed into green chlorite and carbonates; fairly abundant well-formed crystals; both augite and hypersthene may have been present originally. The chlorite gives yellow polarisation colours; its pleochroism is green / pale-yellow.

Hornblende not abundant, but often quite fresh; sometimes ophitic with felspar, surrounded by a reaction border. Pleochroism yellowish-brown / straw-yellow.

Magnetite occurs in scattered grains, and some large crystals of *apatite* are present.

The rock might be called a

Dacite, or Dacite Porphyrite.

Locality.—Shore-line between Coromandel Harbour and Kikowhakarere Bay, Kapanga district.

Formation.—Kapanga group.

Remarks.—This is probably a dyke rock, and, as the outcrop indicates a trend in the direction of Coromandel wharf and the Wynyardton Hills, it is probably represented in these localities.

This specimen has already been referred to under the description of No. 2727, with which this agrees in character, and with which it is in all probability continuous.

As one of the two specimens mentioned by Professor Sollas as closely corresponding to propylite, the position of the rock may be more particularly indicated. In passing from Kikowhakarere Bay south to Coromandel Harbour, before reaching the neck of the peninsula forming the north shore of the harbour, there is a stretch of sandy beach without solid rocks showing in the tide-way, or landward for some distance. The last rock outcropping on the beach before coming to the sandy beach is that from which Specimen 2874 was taken.

No. 26/2877.

M.C.—Dark-grey rock, porphyritic with glassy felspar and large crystals of hornblende. The hornblende shows a white resorption border, visible without a lens.

U.M.—MATRIX very minutely crystalline; felspar laths and zeolites, and scattered magnetic grains. Matrix constitutes about half the rock.

PHENOCRYSTS.—*Plagioclase* in single crystals and clusters; coarse albitic twinning. Ext. 23°/26°, 28°/34°; *r.i.*, above balsam. Zonal. Zeolitisation is marked in many of the crystals; the zeolite fills cracks in the felspar, and sometimes replaces the whole of the core, leaving the marginal area fresh and unaffected. The plagioclase is, on the whole, remarkably free from inclusions, but some crystals contain pyroxene and a little magnetite. The pyroxene has frequently passed into green serpentine.

Augite: A few small crystals and fragments of colourless augite, as well as some which are faintly pleochroic, like hypersthene; these are passing into green serpentine.

Hypersthene more obvious among the separated grains than in the thin slice. Pleochroism bluish-green / pinkish-brown; some quite fresh, others passing into green serpentine. Several small pseudomorphs of serpentine occur without any core of hypersthene.

Hornblende more abundant than pyroxene; green. Pleochroism straw-yellow / bright-green. Resorption borders not obvious; but the crystals have been attacked by the matrix, and are passing into green and colourless chlorite. The extinction angle of the hornblende, 17°.

Ilmenite, with included *apatite* and *magnetite*, sparingly distributed.

Apatite: A few large colourless striated crystals.

Zeolites: Cavities of irregular form occur in the rock, which are filled with radiating growths of a colourless transparent zeolite. Its specific gravity is about 2·198; its refractive index, 1·498; its double refraction slightly above that of the andesine of the rock. It does not gelatinise with hydrochloric acid, but decomposes, leaving a residue unchanged in shape. The solution contains aluminium and calcium. Heated in a closed tube it gives off water. Its angles of extinction, measured from the axis of elongation, is 0°, and its optic sign negative. It should therefore be heulandite. It is possible a little stilbite may also be present. The felspars of the rock are partly converted into heulandite.

The matrix of the rock has undergone a curious change, so that it now presents, in addition to slender rectangular felspar laths, a multitude of small rounded areas, which behave either wholly as isotropic material or give only a faint reaction with polarised light; these are framed in a very narrow border of crystalline material, which sometimes has a rectangular outline, and at others polygonal or rounded, but never clearly hexagonal. The central portion stains deeply after treatment with hydrochloric acid, or even without such treatment. On isolation the matrix is found to have a specific gravity ranging on each side of 2·57, and to present a faint green colour, due no doubt to the inclusion of minute scales of chlorite. For, when heated to redness, dark-brown or black granules are produced in it, giving it a black colour when seen with the unaided eye. This treatment also causes intumescence of some of its colourless constituents, and water is given off, as may be perceived in the closed tube. If now the margin of one of the areas occupied by the heulandite be examined under the microscope it will be found to be fringed by a second species of zeolite of a different habit to the first, not growing out in long radiate crystals, but forming more nearly equi-dimensional plates of hexagonal, square, rectangular, lozenge-shaped, and other outlines. The hexagonal plates appear to be traversed by a single optic axis at right angles to their extension, the lozenge-shaped extinguish parallel to the long diagonal, the rectangles parallel to one side. The long rectangles show no tendency to extend with their long axis at right angles to the surface on which they are seated. Their optic sign is —. Precisely similar plates can be traced into the matrix, which evidently largely consists of them. They are distinguished from heulandite not only by their form and habit, but by their *r.i.*, which is much higher, lying between 1·52 and 1·529; while their double refraction does not show a corresponding increase, though its precise value is difficult to estimate owing to the small size of the crystals. A little carbonate is present in the slice.

The extensive zeolitisation which the rock has suffered naturally leads one to suspect the presence of nepheline, but this, though carefully searched for, does not appear to be present. The nature of the second zeolite is very doubtful. I am inclined to think it belongs to the hexagonal system, but have not succeeded in isolating it. Its specific gravity is also unascertained; evidently the matrix is a complex mixture, and affords no clue to the specific gravity of the zeolite; all that can be said is that it is higher than that of the first zeolite.

A rough separation of the constituents of the rock gave—

Heulandite	4·0
Matrix	54·0
Andesine	21·0
Ferro-magnesian constituents and felspar, heavier than andesine, together with magnetite and apatite ...	21·0
	100·0

The interesting zeolitisation of the plagioclase phenocrysts suggests the question whether the thin veins in the similar phenocrysts of the rocks that I have suggested are filled with quartz, or a second felspar, may not also in some cases be filled with a zeolite.

There does not seem to be any quartz in the rock, which appears to be of a very unusual type. So far as our knowledge extends, it appears to be a

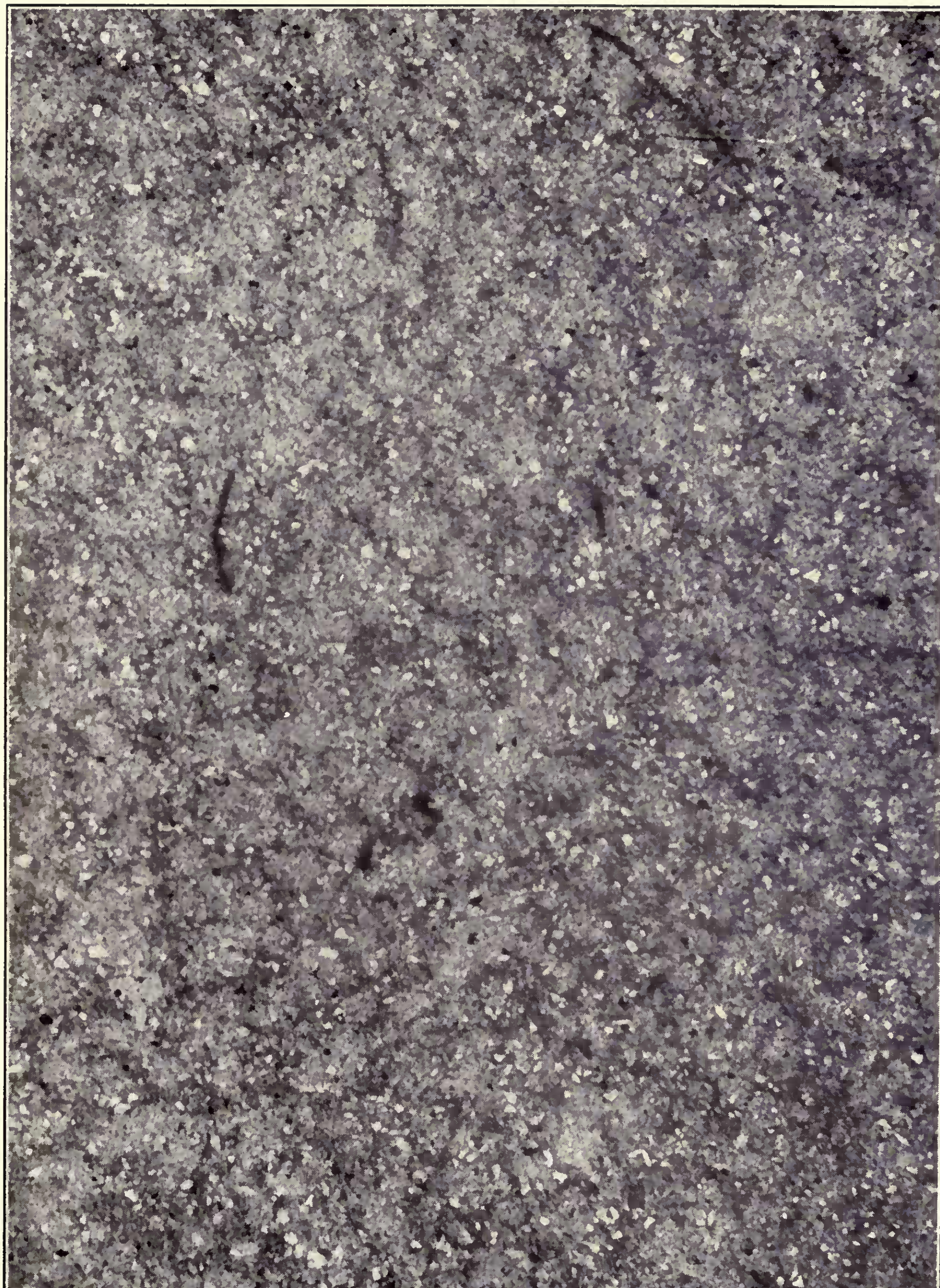
Hornblende Hypersthene Andesite, much altered by hydration.

Locality.—Junction of the Matawai with the Waiau Valley, &c., district.
Formation.—Thames-Tokatea group(?).
Remarks.—The specimen was taken at the place mentioned under the belief that the rock corresponded with that forming Castle Rock, on the main range at the source of the Matawai. It has already been explained that good specimens could not be obtained from Castle Rock itself, and such as were taken had to be supplemented by specimens from the valleys of streams draining from Castle Rock. This specimen and those obtained from Castle Rock differ, on sight, no more than fresh and partly decomposed specimens of the same rock might be expected to do. Castle Rock proves to be a hypersthene hornblende dacite (see 400/1331), and the specimen now being dealt with has been named hornblende hypersthene andesite. Castle Rock forms a considerable mass, which, as appears, is repeated by similar intrusive outcrops further south, and along the main water-divide to the saddle on the Tiki-Mercury Bay Road. This rock is probably closely connected with that forming Castle Rock itself.

No. 27/2900.

M.C.—Leek-green or grey rock, very fine-grained, compact.

U.M.—Matrix extremely fine-grained with patchy extinction between *x.n.*, recalling in some degree the pilotaxitic structure of an andesite. The structure is unusually well developed along one edge of the slice. The spots that give



No. 27/2900. SPOTTED ADINOLE OR GRAUWACKE.

[To face p. 150

most evident reaction with polarised light are clearer and freer from granules than the rest of the slice.

Quartz in small angular rounded or irregular grains and splinters is scattered through the matrix, also clear fragments of plagioclase extinguishing at 15° / 15°; sometimes one-half a felspar fragment is converted into carbonate. Carbonates are scattered in patches which have about the same size as the fragments of quartz and felspar; they appear to be pseudomorphs after plagioclase or pyroxene, and sometimes retain the form of the original mineral.

The fragmentary character of the quartz grains points to a clastic origin; the spotty character in this case would be the result of secondary changes by which some new mineral was sporadically developed through the matrix. This mineral occurs in a number of similar rocks in the collection; it has a fibrous structure to which in most cases it extinguishes parallel; its *r.i.* is fairly high, as also its double refraction.

The rock resembles an adinole, but is not so fusible as an adinole should be. Whether it contains sufficient soda to place it in this class can only be determined by chemical analysis. If not an adinole, it might perhaps be termed a grauwacke, though I scarcely think this is a quite appropriate name.

Spotted Adinole, or Grauwacke.

Illustration.—Slice uniform in grain, and showing but little contrast of the different constituents.

Photographed by ordinary light; magnification, 50 diameters; area photographed, the lower left.

The reproduction is characteristic of the whole slice, as the slice is of the specimen and rock itself.

Locality.—Tiki Creek, Tiki-Tokatea district, Coromandel County.

Formation.—Te Anau series.

Remarks.—This rock is from a little below the junction of the Pukewhau branch coming from the Pukewhau Saddle, and just below the crossing of the nineteenth dyke from the south to the north side of the valley. The rock is finely exposed in the sharp bend of the stream, and, being rapidly denuded by the stream setting on to it during floods, or the driving of timber, specimens are easily obtained in a fresh condition.

Whether a sedimentary rock or no, this lies between sandstones belonging to the Te Anau series and in a position higher in the series than the light-grey so-called felsite rock that appears in the main creek at and above the junction of the Pukewhau branch.

No. 28/2913.

M.C.—Hard dark-grey fine-grained rock.

U.M.—Matrix: There is scarcely any matrix; the rock consists almost wholly of adpressed grains, and the interstitial matter is indeterminable. The grains consist of angular fragments of quartz, in which vapour cavities are not common; cleavage fragments and irregularly broken crystals of felspar, some having the characters of orthoclase, some of plagioclase. Ext. angle of some, 22°/22°. Grains of volcanic rocks of various character, some of which once possessed a glassy matrix in which fairly fresh felspar laths running in lines of flow can still be seen; an occasional zircon sometimes occurs, and there are some streaks of brown biotite. Quartz occurs also in arabesque mosaics with associated pyrites, and in coarse angular mosaics with included epidote. Carbonates are present here and there.

This is an evident grit to which unworn igneous material has largely contributed. It may be termed a

Fine-grained Grauwacke.

Locality.—Pukewhau branch of Tiki Creek, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—This is an example of the sandstones associated with the quartz sericite rock and spotted adinole or grauwackes of the Te Anau series, and in its ordinary and visible characteristics it does not differ from the Carboniferous and Trias sandstones of the northern part of Cape Colville Peninsula. However, its intimate structure seems to be different, as of it, in conclusion, Professor Sollas remarks, "This is an evident grit to which unworn igneous material has largely contributed." No example of Trias sandstone was sent for description, but the conglomerates on the range between Coromandel and Manaia Harbours are described as consisting almost entirely of worn and fragmentary material with scarcely any interstitial cement. Pebbles of very various kinds and of all sizes occur, from those visible without a lens down to others of microscopic dimensions. The interstices between the larger are filled with the smaller, and those between the smaller by others smaller still, and so on (see under 87/3443).

So much for the rock itself. One of the constituents of this triassic conglomerate is a grauwacke of Carboniferous or Devonian age, clearly a rock very similar to 28/2913, above described. Of this included grauwacke Professor Sollas remarks that "it consists of a finely granular brown matrix in which small angular grains and splinters of quartz are richly scattered; banded plagioclase extinguishing at low angles, orthoclase, worn flakes of muscovite, chlorite flakes after biotite, and small andesite-like fragments are also present." This grauwacke in the description given of it corresponds exactly with that of the present specimen, and the other igneous material of the conglomerate, it is evident, could have also been derived from the Te Anau series within the Tiki-Tokatea district.

No. 29/2914.

M.C.—Bluish-grey crystalline rock, with fairly large abundant crystals of plagioclase and hornblende.

U.M.—MATRIX a dusty mosaic of small grains of quartz, with rectangles of plagioclase, chlorite pseudomorphs, magnetite, and leucoxene.

No. 29/2914. HORNBLENDE DACITE PORPHYRITE.

[*To face p.* 153.

PHENOCRYSTS.—*Plagioclase :* Large crystals and clusters; various twinning; albite twinning often coarse and irregular. Ext. 26°/27°. Some zonal, frequently fractured.

Pyroxene represented by pseudomorphs in chlorite (polarising in blue colours), epidote, and carbonates.

Hornblende fresh, with resorption borders; pleochroism honey to brownish-yellow / olive-green; often of considerable size.

Quartz rare; in isolated large grains, with various inclusions, among which liquid cavities with bubbles are to be noted.

Magnetite in grains of various sizes; titaniferous, as shown by associated leucoxene. The larger grains usually accompany the pseudomorphs after pyroxene.

Hornblende Dacite Porphyrite.

Illustration.—The slice shows fair contrasts between some of the larger crystals, but between the felspar crystals and the matrix there is but little contrast.

Photographed by ordinary light; magnification, 50 diameters.

The large crystal showing inclusions is much fissured, as is commonly the case in the dyke rocks of the Te Anau series.

Locality.—Junction of the Pukewhau with the main stream of Tiki Creek, Tiki-Tokatea district.

Formation.—Dyke in Te Anau series.

Remarks.—This is the most westerly of the series of nineteen dykes collected from along the upper part of Tiki Creek. It is of massive proportions, and has been thought to be a northern continuation of Castle Rock. This, however, for various reasons, cannot be considered probable.

No. 30/2918.

M.C.—Grey medium-grained rock, with obvious felspar.

U.M.—MATRIX colorless glass crowded with felspar microliths, laths, and rectangles, also crystallites, and magnetite grains.

PHENOCRYSTS.—*Plagioclase* of usual andesitic character, sometimes rich in glass inclusions. Ext. 20°/20°.

Augite colorless, subordinate. Ext. 40°, sometimes intergrown with hypersthene.

Hypersthene fairly abundant; usual pleochroism, generally fresh.

Hornblende : Numerous crystals with obvious reaction margin; pleochroism faint yellow / greenish.

Magnetite : Fairly numerous large grains, not weathered.

Hyalopilitic Hypersthene Hornblende Andesite.

Illustration.—The slice shows good contrast between the larger felspar crystals and the matrix.

Photographed by ordinary light; magnification, 40 diameters; area photographed, middle area, which fairly represents the whole of the slice.

A portion of a very large felspar crystal is shown in the illustration. Had the whole of this been shown the illustration would not have fairly represented the slice; what is shown besides this is thoroughly characteristic of the whole slice.

Locality.—Hill between Kapanga Mine and Kikowhakarere Bay, Kapanga district.

Formation.—Kapanga group.

Remarks.—This specimen was obtained from the eastern face of the hill, where it overlooks a tributary of Paul's Creek. The rock overlies all those met with in the Kapanga Mine or present in Scotty's Hill. It dips to the westward, and, much decomposed, is met with in the road-cuttings on the descent to Kikowhakarere Bay. As a lava-stream its light-grey colour distinguishes it from the others of the neighbourhood to the east, these being mostly dark basaltic-looking rocks.

No. 31/2930.

M.C.—Fine-grained grey decomposed rock, invaded with menilite. (Miner's sandstone.)

U.M.—Matrix finely granular; numerous irregular cavities occur in it filled with green chloritic material.

Phenocrysts. — *Plagioclase* largely converted into carbonates, but the original outline is well preserved, in single crystals and clusters. The exterior often more completely transformed than the interior, which seems to be less affected by carbonates, more by chloritic decomposition products. Extinction of surviving felspar, 15°/15°.

Pyroxene represented by numerous pseudomorphs of a green chlorite, with very low double refraction, seemingly isotropic; many of the forms suggestive of hypersthene.

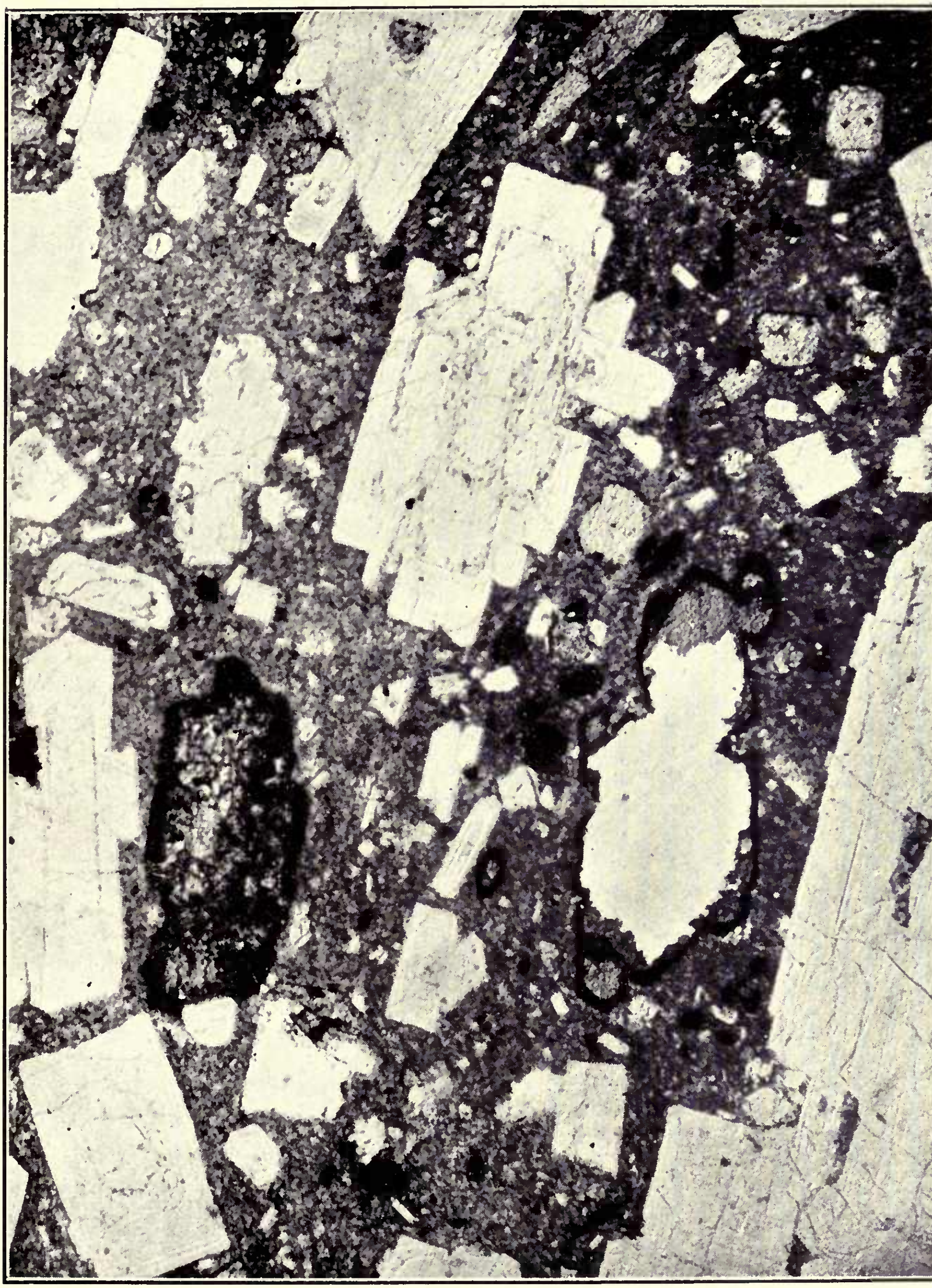
Leucoxene is fairly abundant, and *pyrites* is disseminated.

Highly Altered Andesite.

Locality.—Kapanga Mine, Kapanga district.

Formation.—The Kapanga group.

Remarks.—This rock is a good example of "miner's sandstone," but was selected chiefly on account of its containing curiously shaped concretions(?) or inclusions of a more felspathic-looking rock. The specimen is from the 940 ft. level of the mine, or about 700 ft. below sea-level. All the rocks in the Kapanga Mine at and below this level are of the nature of fine-grained breccias or ash-beds, and associated with them are clear evidences of the terrestrial conditions under which they were erupted and accumulated, not the least convincing of which is a band of impure coal abounding in iron-pyrites. This is by no means the lowest rock reached in this mine, borings having been carried to 1,200 ft. from the surface still in volcanic rock of the brecciated character referred to.



No. 30/2918. HYALOPILITIC HYPERSTHENE HORNBLENDE ANDESITE.

[*To face p. 154.*

No. 32/2933.

M.C.—A brecciated rock consisting of angular light greenish-grey fragments set in a darker greenish matrix.

U.M.—The slice is seen to be composed of two parts separated by a distinct line of demarcation.

In the larger of these the characters are as follows :—

Matrix composed of minute jagged grains of quartz which sometimes attain comparatively large dimensions, transformed felspar, chlorite, and granules of leucoxene.

Phenocrysts.—*Felspar* completely transformed into carbonates, muscovite, sometimes radio-fibrous, and chlorite.

Pyroxene also wholly changed into chlorite, colourless muscovite-like mineral, carbonates, and sphene.

Ilmenite, *leucoxene*, and *pyrites* are present.

In the smaller part :—

Matrix similar, but more abundant and perhaps finer-grained, clearer in general appearance.

Phenocrysts rare, and then chiefly as minute quartz mosaics. Some rare grains of quartz are included.

It is difficult to say certainly whether this rock has been internally brecciated, or whether the fragments were formed before the consolidation of the rock. The predominant rock was originally a

Dacite, or Andesite.

Locality.—Britannia Mine, western base of Tokatea Hill, Kapanga district.
Formation.—The Kapanga group.
Remarks.—This rock, as a greenish calcareous breccia, is prone to decomposition, and, though a hard rock when first excavated, on exposure to the atmosphere it soon crumbles to an incoherent grit or powder. Pyrites are very common in this rock, and these seem to be the agent and the cause of the rapid change that takes place.

This rock occurs near the eastern boundary of the Kapanga group. Higher up the slope towards Tokatea Saddle, and, indeed, till nearing the big reef, it is hard to say whether the much-decomposed rocks seen in the road-cuttings should be referred to the Kapanga group or to the Te Anau series.

No. 33/2941.

M.C.—Greyish rock spotted with white felspar and containing minute crystals of pyrites.

U.M.—More than one rock is present in the slice.

No. 1. Matrix consists of fairly even-sized grains of quartz, often jagged and interlocking, often isolated in green minutely granular material. Felspar in laths and rectangles altered into carbonates, sericite, and sometimes partly into quartz. Some of the quartz is in quite round or oval granules. Leucoxene granules present.

PHENOCRYSTS.—*Felspar* of various size, some very large pseudomorphs, converted into carbonates and minutely granular brownish material, which is milky-white by reflected light. The decomposition of the felspar is not complete, so that the original character of the twinning, which was after more than one law, can still be observed. The extinction may still reach 15°/11°, but no conclusion can be drawn from this. The felspar was evidently plagioclase.

Pyroxene is represented by pseudomorphs of chlorite.

Hornblende: A few resorption pseudomorphs now converted into quartz and chlorite, the reaction border now converted into leucoxene and chlorite. Some of the pseudomorphs are replaced by carbonates.

Biotite, with pleochroism faint straw-yellow / deep russet-brown, occurs in association with quartz and chlorite in one instance.

Ilmenite represented by leucoxene.

No. 2. MATRIX finer-grained and without the scattered isolated quartz grains of No. 1, or with far fewer.

PHENOCRYSTS.—Fragmentary felspar much altered, but some felspar material remaining; carbonates present, impregnated with chlorite.

Pyroxene in chloritic pseudomorphs.

Hornblende only slightly changed; good transverse sections showing invasion by the matrix.

Quartz: A large rounded grain.

Leucoxene and *pyrites* present.

Altered Quartz Pyroxene Hornblende Rock, of more than one variety.

Locality.—Scotty's Mine, Driving Creek, Kapanga district.
Formation.—The Kapanga group.
Remarks.—This in position should be a higher rock than No. 2933, from the Britannia Mine, but both are fragmental rocks that probably belong to the same eruptive disturbance, as they certainly are of the Kapanga group.

No. 34/2945.

M.C.—Fragmental rock, fragments variously coloured—some green, some red, and others purple with white decomposed felspar.

U.M.—More than one kind of rock is seen to be present.

No. 1. MATRIX consists of minute jagged grains, chlorite and sericitised felspar, and leucoxene granules.

PHENOCRYSTS.—*Felspar* in pseudomorphs of various size, consisting of sericite, chlorite, and carbonates; in some cases the chlorite presents the chenille-like form. A little surviving plagioclase is met with which extinguishes at 15°/11°; some gives parallel extinction.

Pyroxene: A few pseudomorphs in quartz and chlorite.

Hornblende pseudomorphs with black borders, indicating original presence of reaction margins.

Leucoxene and black iron-ores.

No. 2 resembles No. 1, but pyroxene pseudomorphs occur as carbonates; outlines recall hypersthene.

In No. 3 the matrix is deeply coloured reddish-brown by ferric hydrate, probably originally glassy, containing minute laths originally felspar, but now converted into colourless transparent material of uncertain nature. Some larger pseudomorphs are present, consisting of sericite and chlorite. Certain areas with curved sides now filled with chlorite resemble infilled vesicles. This looks like a lapillus.

No. 4. Similar to No. 1, but with a clearer matrix, and distinguished by numerous pseudomorphs after pyroxene and hornblende, which are bounded by a black or ochreous margin. Some may have been hypersthene.

No. 5. Black groundmass half filled with minute felspar laths or their pseudomorphs in fluxional arrangement.

Fragmental Volcanic Rock, composed chiefly of a **Pyroxene Andesite** containing hornblende.

Locality.—Hauraki North Mine, Kapanga district.

Formation.—The Kapanga group.

Remarks.—This breccia or tuff bed may correspond to one or other of similar beds of grey colour in the Kapanga Mine. Like rocks, but not so varied in colour, also occur in the hills on the left bank of the creek farther down stream, and, without question, this underlies the dark rock that constitutes the higher part of Scotty's Hill.

No. 35/2948.

An unlabelled specimen of black rhyolite glass with grey spherulites. I think No. 2948.

Black Rhyolite Glass, with grey spherulites.

Remarks.—There is doubt as to the identity of this specimen.

No. 36/2952.

M.C.—Black fine-grained basalt-like rock, with small phenocrysts of felspar and ferro-magnesian mineral.

U.M.—Matrix fine-grained pilotaxitic, rich in minute felspar laths. Magnetite in minute octahedra evenly and abundantly dispersed. Pyroxene absent. Matrix abundant.

Phenocrysts.—*Plagioclase* in every gradation of size, from minute rectangles to large crystals. Extended parallel to (010). Comparatively simple twinning after albite law. Ext. 20°/25°, 20°/34°. Slightly attacked by carbonates.

Pyroxene not abundant, subordinate, altered into a green serpentinous mineral and carbonates.

Hornblende rare, one or two instances with resorption borders.

Pilotaxitic Andesite, containing very little hornblende.

Locality.—Road-metal quarries at the western base of Tokatea Hill, Kapanga district.

Formation.—The Kapanga group.

Remarks.—This rock is exposed where the creek separates into two branches, one coming from the north along the eastern base of Scotty's Hill, the other from the Tokatea Saddle. This rock should occur, and appears to be present, in the Britannia Mine, also in the Hauraki North Mine, on the western bank of the creek below the junction of the two source-branches. It should also be present in both Scotty's and the Kapanga Mines, and corresponds to dark-lava rocks met with in the latter. The dark rock on the higher part of Scotty's Hill, though similar, cannot be part of the same lava-stream.

No. 37/2957.

M.C.—Light-grey much-decomposed rock, with white earthy felspar and scattered pyrites.

U.M.—Matrix: Quartz in small irregular grains scattered amidst granular polarising colourless material; some sericite, chlorite, and scattered leucoxene grains. Matrix abundant.

Phenocrysts.—*Plagioclase* represented by pseudomorphs in carbonates and sericite, with some chlorite. Twinning comparatively simple, also complex.

Ferro-magnesian minerals probably hornblende, now represented by pseudomorphs in quartz. The quartz forms a mosaic of grains, which are elongated parallel to the axis *C*, and are striated in the same direction by included rods and granules; some of the granules are leucoxene, some rutile, others zircon. Some remains of fibrous serpentine run parallel with the quartz. In some cases pyrites is associated with these pseudomorphs.

Pyroxene is represented by pseudomorphs of chlorite or serpentine, often bounded by a leucoxene rim, and sometimes included in the hornblende pseudomorphs.

Quartz is present in rhyolite-like grains, and in bi-pyramids much corroded by matrix.

Rutile (after ilmenite) is scattered through the slice as well as leucoxene.

Apatite is also present, often associated with pyrites and quartz.

The rock is an

Altered Dacite, with hornblende.

Locality.—Scotty's Mine, Driving Creek, Kapanga district.

Formation.—The Kapanga group.

Remarks.—This specimen is a fair example of "miner's sandstone" as it appears within a short period after being mined and brought to the surface.

There is no appearance in Scotty's Mine of the darker rocks in the low grounds further to the east, and it has to be assumed that the workings are being carried on between the dark rock 2952 and that occupying the top of Scotty's Hill.

No. 38/2969.

M.C.—Bluish-grey felstone-looking rock, with obvious felspar crystals.

U.M.—Matrix: Minute jagged grains of quartz, felspar laths and rectangles, scattered magnetite and leucoxene, chlorite, and a little carbonate. Matrix abundant.

Phenocrysts.—*Plagioclase* crystals, clusters and fragments, coarsely twinned. Ext. $23°/27°$; *r.i.*, about that of balsam, fresh on the whole, a little carbonate in some; cracks lined by sericite; zonal structure.

Augite represented by pseudomorphs in pennine and carbonates, including magnetite. In some cases a core of unaltered brownish-yellow augite is preserved.

Hypersthene: None remains even as a core, but it is probably represented by numerous pseudomorphs in pennine which still preserves the fibrous character of bastite; magnetite and leucoxene associated.

Hornblende: Complex pseudomorphs occur in which a core of fresh material remains unchanged; pleochroism deep olive-green / light yellowish-green / faint straw-yellow. The reaction margin is represented by carbonates, magnetite, and sphene.

Magnetite grains; titaniferous, bordered by leucoxene.

Apatite: Some large crystals with included rods running parallel to *C* axis.

Quartz: One large rhyolite-like grain observed.

Altered Dacite, with some hornblende.

Locality.—Britannia Mine, western foot of Tokatea Hill, Kapanga district.
Formation.—Kapanga group.
Remarks.—This rock resembles that of the road-metal quarries at the forks of the creek (No. 2952), to be certain of which it was sent for description, with the result that this is a dacite, the other an andesite.

Nos. 2957 and 2974, as altered dacites, are probably from the same lava-stream.

No. 39/2974.

M.C.—Bluish-grey felstone-like rock, porphyritic with small crystals of felspar.

U.M.—MATRIX: Felspar laths, minute quartz grains, and sericite, forming a minutely crystalline mixture; magnetite and leucoxene disseminated. In some places clusters of numerous granules of pyrites; small patches of carbonates. Matrix very abundant.

PHENOCRYSTS.—*Felspar* partly altered into sericite and carbonates; traces of albitic twinning. Ext. angle now low.

Pyroxene pseudomorphs in almost isotropic green material; carbonates and magnetite. Some of the chlorite grass-green / honey-yellow.

Hornblende(?).

Quartz: A few areas of very jagged quartz grains.

Altered Dacite.

Locality.—Scotty's Mine, Driving Creek, Kapanga district.
Formation.—Kapanga group.
Remarks.—This rock comes from a depth of 250 ft. in the mine, and consequently occurs at about sea-level. Whether volcanic rocks of the Kapanga group could be followed to the same depth they have been proved at in the Kapanga Mine (1,200 ft.) may be doubted, but it is clear that a peculiar depression of the surface of the underlying rocks occurs between the Upper Township (of Coromandel) and Paul's Creek, north of Kapanga Hill, where Palæozoic rocks are above sea-level, and on the east side of the depression the older rocks reach 1,100 ft. above the sea. Towards the south-west no slate barrier has been proved, so that in this direction the deep ground may, and seemingly does, extend to the shores of Coromandel Harbour.

No. 40/2981.

M.C.—Light-grey fine-grained rock, sparkling with pyrites, and containing fragments of different texture.

U.M.—MATRIX: Quartz in irregular grains, often forming filigree mosaics; sericites abundant. No obvious remains of felspar laths, or few only.

Phenocrysts. — *Plagioclase* represented by abundant pseudomorphs of sericite and carbonates; imperfect fluxional arrangement.

Pyroxene fairly common, represented by pseudomorphs in carbonates. Some probably hypersthene. Apatite occurs in some of the pseudomorphs.

Hornblende(?).

Leucoxene represents ilmenite; apatite is associated with it.

Pyrites disseminated.

No rhyolitic quartz grains.

Altered Dacite, or Andesite.

If some of the quartz is secondary, as appears probable, the rock would be an altered andesite.

Locality.—Britannia Mine, western base of Tokatea Hill, Kapanga district.

Formation.—The Kapanga group.

Remarks.—Taken as an example of the grey pyritous sandstone of the miner.

No. 41/2992.

M.C.—Greenish-grey fine-grained rock, with minute green spots like those of 3178.

Minute angular fragments of quartz and plagioclase are scattered through a matrix of minute interlocking grains of quartz, scales of sericite, and chlorite. Certain bands or streaks poorer in fragments than others. Veins of secondary quartz mosaic run through the slice. The fragments of plagioclase are frequently fresh, and occur as flat angular flakes, splinters, and rounded grains. There may be some orthoclase, and worn flakes of muscovite are present. Pyrites is scattered here and there.

Grauwacke.

Locality.—Courthouse Creek, above Buffalo's Mine, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—The specimen was taken from the bank of the creek at a height of 950 ft. above sea-level, and there was appearance that the rock reached considerably higher on to the range. The sedimentary rocks of the Te Anau series in Courthouse Creek are divided by a strong band of igneous rock resembling miner's sandstone, within which is situated the Buffalo Mine.

No. 42/2995.

M.C.—Greenish-grey decomposed rock, with white earthy felspar crystals.

U.M.—MATRIX abundant, fine-grained, consisting of lath-shaped felspar, greenish sericite scales, jagged quartz grains irregularly distributed, and a little leucoxene.

PHENOCRYSTS.—*Plagioclase* numerous pseudomorphs; now usually extinguishing parallel, largely replaced by sericite. Some chlorite.

Ferro-magnesian minerals only as pseudomorphs; some outlined by leucoxene, and consisting of pennine and other kinds of chlorite, may have been hornblende; others of small size, not outlined by leucoxene, may have been pyroxene.

Ilmenite in large plates now converted into leucoxene, with obvious twinning.

Apatite in comparatively large crystals, violet-brown in colour, slightly pleochroic, striated parallel to the long axis; contain irregular vapour cavities and negative crystals. Occur in association with ferro-magnesian pseudomorphs and leucoxene.

Pyrites: A few cubes.

Altered Orthoclase(?) Plagioclase Pyroxene Rock.

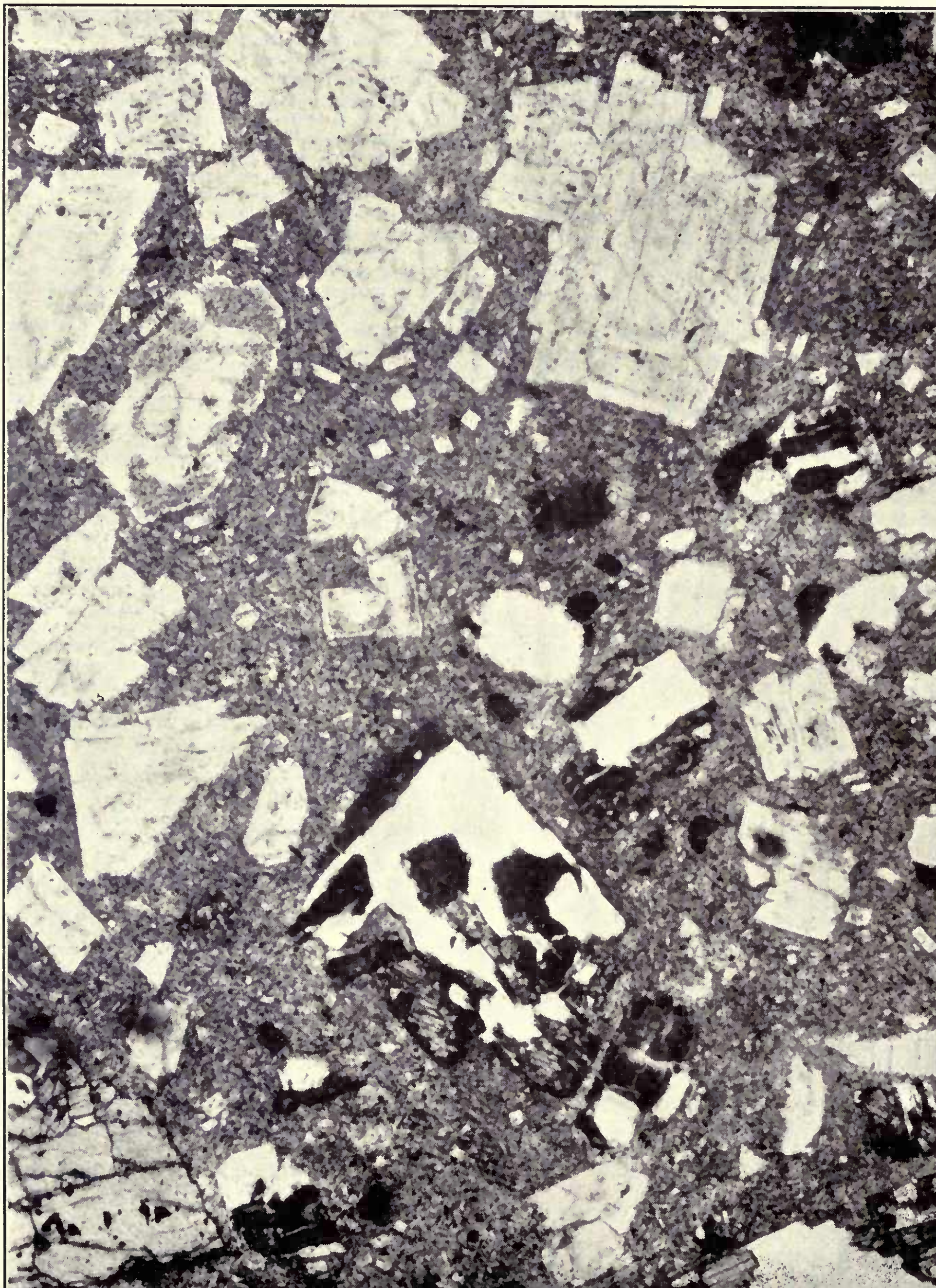
Locality.—Buffalo Mine, Success Range, Tiki-Tokatea district.
Formation.—(?). (Regarded as a dyke in Te Anau rocks.)
Remarks.—The great breadth of its development in Courthouse Creek is the chief reason for doubting that this rock is a dyke penetrating beds of the Te Anau series. Such, however, from the description of the slice it seems to be, and if so it is by far the largest of all the dykes that are met with on the west slope of the main range between Tokatea Hill and the Tiki.

No. 43/3010.

M.C.—Black compact basaltic-looking rock, with glistening felspar and scattered ferro-magnesian minerals.

U.M.—MATRIX colourless glass, residual between the crystalline elements of which the matrix chiefly consists. In places the glass is represented by pilotaxitic material. The crystals are minute felspar laths and rectangles, green granular pseudomorphs after pyroxene, and magnetite grains, which are not very abundant. Fluxional structure is present, but is not pronounced, except locally.

PHENOCRYSTS.—*Plagioclase* abundant, fresh, of the usual andesitic character. Ext. 25°/25°, 24°/30°. The inclusions are various; among them a little ophitic pyroxene.



No. 44/3012. HYPERSTHENE ANDESITE.

[*To face p.* 163.

Augite faint bluish-green, sometimes pleochroic, with the same tints as hypersthene. Ext. 42°.

Hypersthene in well formed crystals, with usual pleochroism; both this and the augite are fairly and equally abundant. Both are passing into a green biotite, the pleochroism of which is green / faint greenish-yellow to almost colourless. There is no gradual passage, however, but a sudden and abrupt transition.

Hornblende is absent.

Hyalopilitic Hypersthene Andesite.

Locality.—South side of Cabbage Bay, Cabbage Bay district.

Formation.—Beeson's Island group.

Remarks.—The specimen is from the south-east end of the road-cutting, in which the Carboniferous slates and sandstones are seen to pass under a coarse volcanic breccia or agglomerate. Large blocks occur in this latter, and from one of these the specimen was taken. This breccia may be considered the same as that forming the south headland of Cabbage Bay, where, however, the rocks are of a grey colour, largely due to exposure and weathering.

No. 44/3012.

M.C.—Black basaltic-looking rock, infiltrated with opal, and showing incipient brecciation.

U.M.—Matrix in places pilotaxitic, but very little basis is present; lath-like felspars, pseudomorphs after pyroxene, magnetite dust and grains form the mass of the matrix.

Phenocrysts.—*Plagioclase* as in 3010.

Pyroxene also as in 3010; transformed into fibrous serpentine and green biotite.

Apatite rare; a large crystal or so seen.

Leucoxene after ilmenite.

Hypersthene Andesite.

Illustration.—The slice shows good contrasts between the phenocrysts and the matrix.

Photographed by ordinary light; magnification, 33 diameters; area photographed, upper middle, which, other than not showing veins that are present in other parts, is characteristic of the slice.

Locality.—Road-cutting south side of Cabbage Bay, Cabbage Bay district.

Formation.—Beeson's Island group.

Remarks.—The specimen is from the western end of the road-cutting, in which, towards the south-east, the Carboniferous rocks disappear under those of the

Beeson's Island group, and from which Specimen 3010 was taken. This breccia has an extensive development on the south-eastern inner slopes of the Cabbage Bay coast-range, the high-level surface rocks being of various colours, due to surface-decomposition. Opal and chalcedony and other siliceous secretions are common on the beach, where these rocks are washed by the tide, and much petrified wood is also to be met with north-west of the road-cutting referred to in connection with these rocks. The stumps and branching roots of trees from which the old soil has been partly washed away are often met with within tide-way on the road to the South Head, and at one place several old soils are seen separated by beds of fine or coarser breccia. Firmly rooted in these old soils, and buried in the overlying breccias, examples of the tree-stumps referred to can be seen at several horizons, and it is evident that here the volcanic rocks did not accumulate at a rapid rate, and that the fragmental material of this part was deposited on a land-surface covered with forest growth and trees of considerable size.

No. 45/3023.

M.C.—Light-grey compact rock, with numerous glassy clear felspar crystals and black hornblende.

U.M.—Matrix abundant. Fine-grained crystalline matrix of equi-dimensioned quartz granules, plagioclase microliths and rectangles, a little magnetite, and some leucoxene.

Phenocrysts.—*Plagioclase :* Large crystals, fresh, zonal, coarsely twinned; *r.i.*, above balsam. Ext. up to 20°/20°.

Pyroxene represented by pseudomorphs in green serpentinous material, with associated iron-ores.

Hornblende abundant, well-defined forms, with narrow reaction borders; pleochroism pale straw-yellow / dark red-brown.

Ilmenite with leucoxene fairly common.

Apatite : Numerous crystals, associated with hornblende and ilmenite.

Quartz rare, one or two rounded grains observed.

Hornblende Dacite.

Illustration.—The slice shows good contrasts between the larger crystals and the matrix.

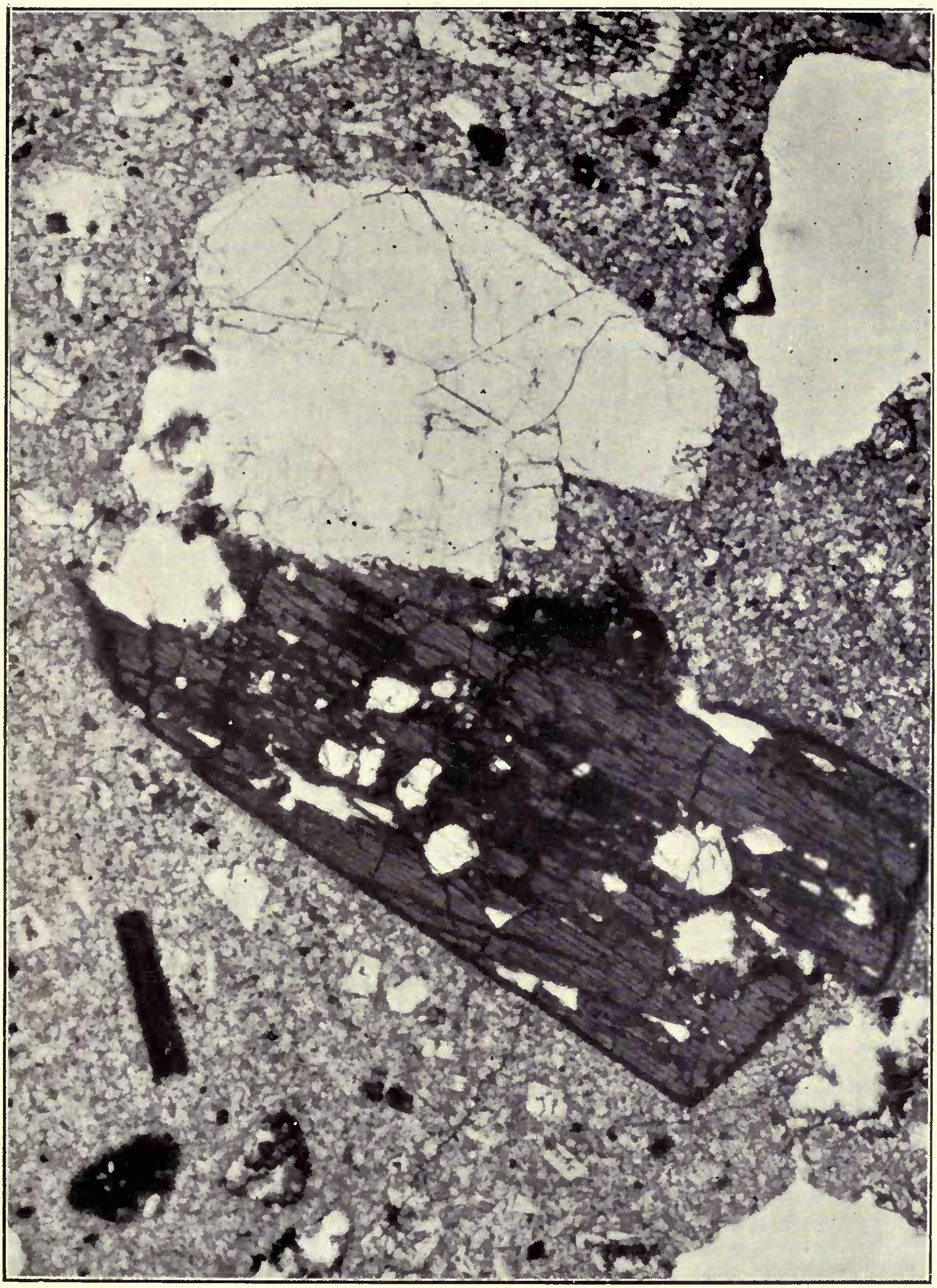
Photographed by ordinary light; magnification, 50 diameters; area photographed, middle left.

The slice is varied, more especially as regards the size and mode of the larger plagioclase phenocrysts, and it would require several such plates as the illustration to convey a correct idea of the whole slice. So far as concerns the area photographed, the general character of this is shown excellently well.

Locality.—South side of Cabbage Bay, Cabbage Bay district.

Formation.—Beeson's Island group.

Remarks.—The specimen is from the road-cutting showing junction of the Carboniferous and volcanic rocks, and the remarks under Nos. 3012 and 3010 apply here also.



No. 45/3023. HORNBLENDE DACITE.

[*To face p.* 164.

No. 46/3024. INDETERMINATE.

[*To face p.* 165.

No. 46/3024.

After trying various methods and spending much time I can make nothing of this.

Illustration.—The slice shows fair contrasts between the dark and lighter material of which it is composed.

Photographed by ordinary light; magnification, 25 diameters; area photographed, nearly the whole slice, and as the photograph is a fairly good one it is thus characteristic of the slice.

Locality.—South side of Cabbage Bay, Cabbage Bay district.

Formation.—Beeson's Island group.

Remarks.—However puzzling this rock might be as represented by a hand-specimen only, in the field there is no doubt whatever about it. It is simply screenings down a steep slope into a marshy pond of what is chiefly broken felspar crystals, which, rudely stratified, has associated with and in it small branches and twigs of shrubs or small trees that grew on the hill-slope or on the borders of the pond in which the material was deposited.

No. 47/3032.

M.C.—Light-grey rock, with obvious felspar.

U.M.—Matrix minutely crystalline, minute felspar laths lying in lines of flow, jagged granules of quartz, scales of sericite, scattered leucoxene, some carbonates.

Phenocrysts. — *Plagioclase* abundant; large well-defined crystals, with coarse irregular twinning. Ext. 11°/12°, 13°/14°; *r.i.*, about the same as balsam. Replaced by carbonates and sericite.

Pyroxene: Well-preserved outlines, but no original material remaining; usually defined by rows of leucoxene granules, replaced by carbonates, quartz, and radio-fibrous serpentine. Much apatite and leucoxene in some of the pseudomorphs. The outlines of some suggest hypersthene.

Ilmenite: Beautiful examples of its conversion into leucoxene. In some cases intercrystalline spaces filled with radio-fibrous muscovite.

Except in the matrix the quartz is secondary.

Altered Pyroxene Andesite, or Dacite.

Locality.—Kapanga Mine, Kapanga district.

Formation.—Kapanga group.

Remarks.—This specimen, as part of a diamond-drill core, is from 1,200 ft. from the surface at the mine, or 950 ft. below sea-level.

The extraordinary depth to which the volcanic rocks, breccias, &c., poured out on a land-surface descend has already been noticed and commented upon under descriptions of No. 2974.

No. 48/3036.

M.C.—A breccia or ash containing a fragment of the older sedimentary rocks of the Success Range and Tokatea Hill. Greenish-grey fragmental rock.

U.M.—Matrix minutely crystalline, quartz granules, altered felspar, sericite, chloritic staining.

Phenocrysts.—*Plagioclase:* Numerous large crystals converted into sericite and carbonates.

Pyroxene: Abundant pseudomorphs in green serpentine with associated apatite. Hypersthene probably originally present.

Hornblende: A few pseudomorphs in carbonates with reaction borders; sometimes include pseudomorphs of pyroxene.

Pyrites in small disseminated crystals.

A fragmental rock largely composed of andesite, now much decomposed.

Fragmental Andesite Rock.

Locality.—Kapanga Mine, Kapanga district.

Formation.—Kapanga group.

Remarks.—The specimen is part of a core from a depth of 1,000 ft. from the surface. The core brought up from this depth enclosed a fragment of slate in what was otherwise an andesic breccia, which might have been considered indication of soon reaching the solid slate in continuing the bore; but 200 ft. further boring failed to pass through the volcanic rock, and it is quite uncertain at what depth the whole thickness would be penetrated and the fundamental slate be reached.

No. 49/3042.

M.C.—Fine-grained grey rock, with greenish spots.

U.M.—Matrix microgranitic; quartz in jagged grains or approaching bi-pyramidal form, with obvious liquid cavities and bubbles; felspar in allotrimorphic grains and ragged rectangles, *r.i.* below balsam, some extinguishes parallel.

Phenocrysts.—*Felspar* fairly numerous, but quite subordinate to the matrix. Not fresh; kaolinisation is commencing, and epidote is present in many cases. Some with albitic twinning, some not twinned at all. Ext. 8°/8° to 16°/17°; in latter case *r.i.* equal to balsam. Possibly both orthoclase and albite occur. Some large grains of quartz are present.

Pyroxene pseudomorphs in pennine, usually with vague outlines, but in some cases resembling those of pyroxene, occur sparingly. Epidote, leucoxene, and sometimes quartz contribute to form these pseudomorphs.

Ilmenite; A very little, passing into leucoxene.

A vein of quartz with associated epidote traverses the slice.

Evidently a very acid rock, composed chiefly of quartz and felspar, with a little augite probably.

Augite Microgranite; or, perhaps, Microgranitic Dacite.

Locality.—Collected at the mouth of Waiaro Creek, Moehau district.

Formation.—Dyke in the Maitai series.

Remarks.—There is a great accumulation of similar rocks on the beach at the mouth of Waiaro Creek. These have been drifted along the shore from the north and lodged in the little bay at Waiaro.

The rocks themselves occur in the west spur of Moehau, and reach down to and are exposed along the shore of this part of Hauraki Gulf. Circumstances prevented the collecting of these rocks *in situ*, and the only thing that could be done was to collect the different varieties from the drift along the shore-line where this could be done. The manner in which this collection was made, and how it was ascertained that no igneous rocks other than the dykes are present in the collection made, has been described elsewhere, and it has only to be added in further proof that Professor Sollas does not indicate one specimen as exhibiting the characteristics of an eruptive rock or lava-stream.

No. 50/3053.

M.C.—Blackish-grey basalt-like rock, with small rectangular sections of plagioclase and phenocrysts of pyroxene.

U.M.—Matrix: Felspar laths and rectangles and fragments, pseudomorphs in carbonate after pyroxene, magnetite grains and obscure interstitial matter, sometimes pilotaxitic. Traces of fluxional arrangement.

Phenocrysts.—*Plagioclase* variously twinned, zonal; the central area may extinguish at 30°, the marginal at 27°; *r.i.*, about that of balsam. Specific gravity, 2·71; hence labrador felspar. Inclusions of glass and other material in the core, sometimes both in core and margin.

Augite crystals and rounded fragments, greyish-green almost colourless, multiple twins.

Hypersthene similar, but pleochroic honey-yellow / ferrous-green / warm brownish-yellow, or may be darker, up to reddish-brown. Sign — ! Optic axial angle, 72°, varying a little above and below. Specific gravity above 3·428.

The felspar and groundmass below 2·71 in specific gravity constitute 85% of the rock; the pyroxene and other material above 2·71 constitute remaining 15%.

Hypersthene Andesite.

Locality.—Mouth of Waiaro Creek, Moehau district.
Formation.—Dyke in the Maitai series.
Remarks.—The same as for No. 3042, but it must be added that the rock was obtained beyond the reach of the tide, and as a flat slab of hard rock it may have been brought by Maoris to where it was found.

No. 51/3064.

M.C —Bluish-grey rock, diabase-looking, a few phenocrysts of felspar and hornblende.

U.M.— MATRIX: Long felspar laths, simple and twinned, in flow-lines arranged in trachytic fashion; *r.i.*, above balsam. Interstitial chlorite and actinolite needles, and irregular quartz, magnetite in well-defined crystals and grains, with associated leucoxene; hence titaniferous.

PHENOCRYSTS.—Not numerous. *Plagioclase* in complex groups, forming a mosaic sometimes; some highly zonal; *r.i.*, above balsam. Ext. from 9°/14° to 27°/34°. In some a small quantity of epidote.

Pyroxene very rare; some fragmentary pseudomorphs in chlorite.

Hornblende in pseudomorphs, sometimes with a core of unaltered material: yellowish-green / faint straw-yellow. Ext. 17°, striated by rods and rows of opacite granules. Passes into actinolite.

Quartz: Some of the jagged grains of the matrix attain a size comparable to that of the phenocrysts.

Apatite is present, especially in association with the ferro-magnesian pseudomorphs.

Hornblende Dacite, with a trachytic habit, and composed chiefly of felspar.

Locality.—Mouth of Waiaro Creek, Moehau district.
Formation.—Dyke in the Maitai series.
Remarks.—The same as for No. 3042.

No. 52/3077.

M.C.—Dark-grey fine-grained rock, crowded with minute crystals of felspar.

U.M.—MATRIX: Large elongated sections of plagioclase, with intervening green granules, which appear to be alteration products after pyroxene; some interstitial quartz is also present.

PHENOCRYSTS.—*Plagioclase:* Numerous crystals of usual habit.
Hornblende curiously transformed, fairly common.

Hornblende Andesite.

No. 53/3083. QUARTZ DIORITE APPROACHING A DIORITE PORPHYRITE.

[*To face p. 169.*

Locality.—Mouth of Waiaro Creek, Moehau district.
Formation.—Dyke in the Maitai series.
Remarks.—The same as for No. 3042.

No. 53/3083.

M.C.—Light-grey holocrystalline rock, showing white felspar and greenish ferro-magnesian crystals.

Plagioclase: Large crystals in rectangular and hexagonal sections, also complicated growths, often zonal, sometimes broken and dislocated *in situ,* internal fractures injected with quartz; epidote and viridite also developed in some of the cracks. Inclusions general or submarginal. Ext. 14° / 14°; *r.i.,* above balsam.

Hornblende, green; pleochroism light straw-yellow / ferrous-green / brownish-yellow; passes into epidote, actinolite, and chlorite. Varies from idio- to hypidio-morphic; sometimes presents its own form, at others that of pyroxene (uralite).

Ilmenite occurs in numerous hexagonal plates with associated leucoxene.

Quartz interstitial and in large grains, containing liquid cavities with moving bubbles.

Quartz Diorite, approaching a Diorite Porphyrite.

Illustration.—The slice shows in fair contrast the different individual crystals of which it is composed.

Photographed by ordinary light; magnification, 50 diameters; area photographed, lower left, which, with the exception of some large felspars in other parts, represents fairly the whole of the slice; and the reproduction shows well the character of the part photographed.
Locality.—Mouth of Waiaro Creek, Moehau district.
Formation.—Dyke in the Maitai series.
Remarks.—The same as for No. 3042.

No. 54/3084.

M.C.—Resembles 3083, but more coarsely crystalline.

U.M.—*Plagioclase:* Large rectangular sections are the commonest; albitic twinning sometimes very regular. Ext. up to 30°. Various inclusions; most important is augite, sometimes occurring in globules, sometimes with definite crystal outlines; ext. up to 40°; a grain of magnetite often attached to it.

Hornblende greenish, less idiomorphic than the felspar; aqua-marine green / faint topaz-yellow. Ext. at 19°/19°. Some is evidently uralite, and retains synthetic twinning parallel to (100). Partly actinolitised.

Quartz largely interstitial, with micrographic intergrowths.

Ilmenite is present, and gives rise to leucoxene and red spherules.

Apatite occurs occasionally in large dusty colourless crystals.

Epidote chiefly occurs in the altered hornblende.

Quartz Diorite.

Illustration.—The slice shows in good contrast the individuals of which it is composed.

Photographed by ordinary light; magnification, 50 diameters; area photographed, lower right, which represents fairly the whole of the slice.

Locality.—Mouth of Waiaro Creek, Moehau district.

Formation.—Dyke in the Maitai series.

Remarks.—The same as for No. 3042.

No. 55/3093.

M.C.—Similar to 3084, with a vein of finer grain.

U.M.—Coarser part quartz biotite diorite.

Plagioclase in large crystals; ext. up to 23°/28°; *r.i.*, above balsam. Some very fresh, some dusty with sericite.

Quartz in large grains, containing liquid cavities and bubbles.

Biotite: Pleochroism rich brown / pale straw-yellow, decomposing into green chloritic products.

Hornblende replaced by chlorite and quartz.

Ilmenite and *zircons* present.

Finer part very dirty looking, composed to a large extent of fragmentary crystals such as might have been derived from the coarser quartz diorite. It is what is sometimes illogically called a contemporaneous vein. There are no constituents, however, recognisably different from those of the quartz diorite.

Quartz Biotite Diorite Porphyrite.

Illustration.—The coarser half of the slice shows good contrasts.

Photographed by ordinary light; magnification, 50 diameters; area photographed, lower left, which is representative of the coarser part.

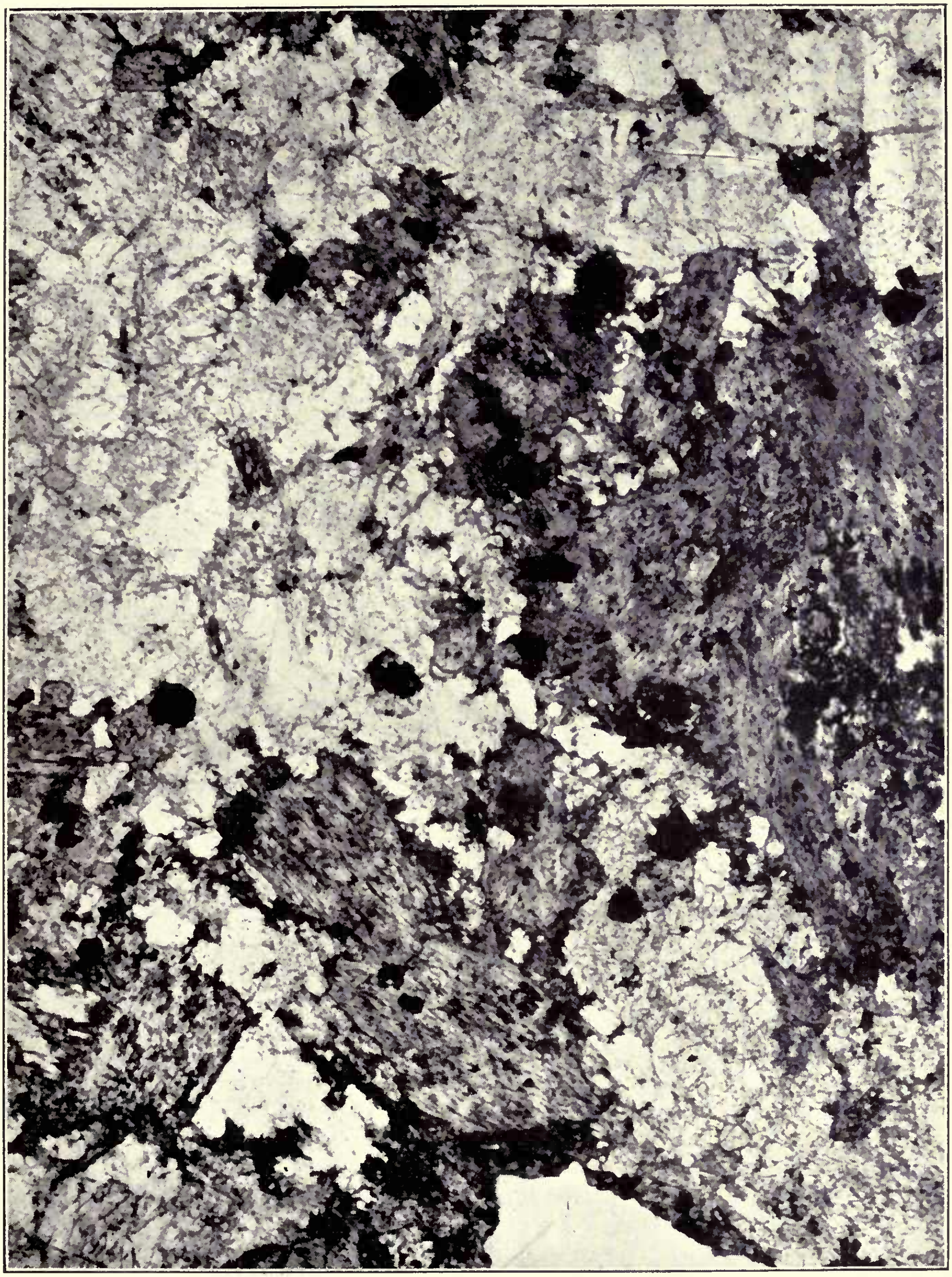
Locality.—Mouth of Waiaro Creek, Moehau district.

Formation.—Dyke in the Maitai series.

Remarks.—The same as for No. 3042.

No. 56/3102.

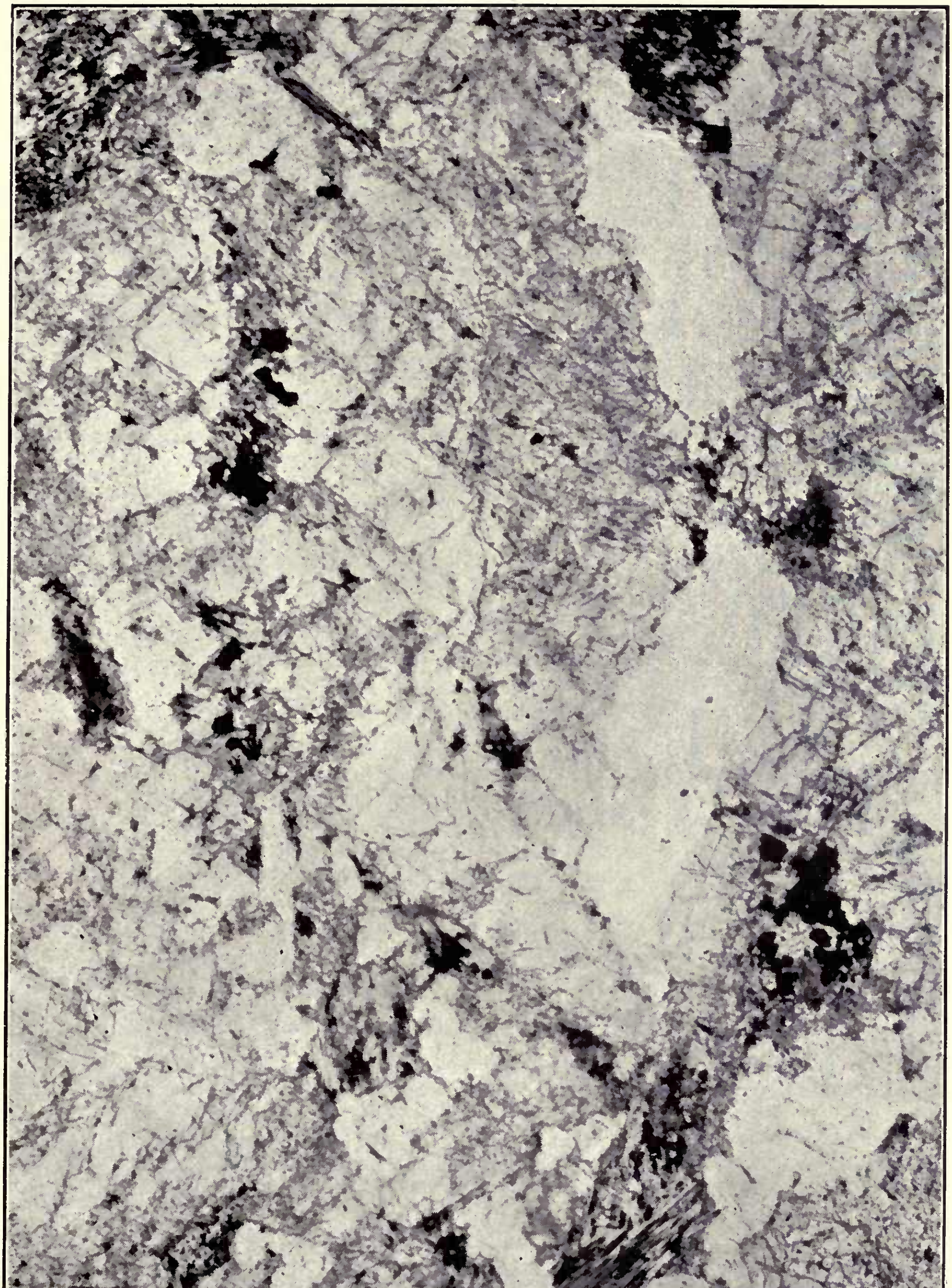
M.C.—White coarse crystalline rock, porphyritic with large greenish-black crystals of hornblende.



No. 54/3084. QUARTZ DIORITE.

[To face p. 170.

i.



No. 55/3093. QUARTZ BIOTITE DIORITE PORPHYRITE.

[*To face p.* 170.

ii.

U.M.—Matrix abundant, dusty appearance, with clear areas and scattered viridite scales. Composed chiefly of small mostly equi-dimensional grains of quartz, irregular in outline, but often approximating to square and hexagonal sections. A granular material is interspersed; this may be felspar. Against this matrix the phenocrysts, which are abundant, are sharply defined.

Phenocrysts.—*Plagioclase* predominates, mostly in well-formed crystals and clusters; fragments are not common. Some are zonal; albite twinning irregular, and frequently not extending right across the crystal. Ext. up to 27° / 38°. Many crystals much fractured internally. On the whole the felspar is fresh.

Hornblende quite fresh, sometimes closely associated with pseudomorphs after pyroxene. Pleochroism grass-green / yellowish-green ; faint straw-yellow / olive-green. No reaction border is present. Sometimes twinned. Ext. 19°.

Pyroxene: Fairly numerous pseudomorphs in pennine and other species of chlorite, along with epidote, leucoxene, and apatite. A border of epidote surrounds some of the pseudomorphs. Some of the sections of these pseudomorphs recall hypersthene.

Quartz occurs in large rounded angular and irregular grains, and contains liquid cavities with bubbles.

Ilmenite forms large plates, usually adjacent to the pyroxene pseudomorphs. A good deal of *apatite* is present.

Quartz Augite Diorite Porphyrite.

Locality.—Mouth of Waiaro Creek, Moehau district.
Formation.—Dyke in the Maitai series.
Remarks.—The same as under No. 3042.

No. 57/3103.

M.C.—Grey coarsely porphyritic rock.

U.M.—Matrix micropœcilitic to granitic, various. Felspar chiefly in comparatively large rectangular sections impressed by quartz; some may be orthoclase, as suggested by low refraction index and parallel extinction. There is a good deal of disseminated chlorite, epidote, and apatite.

Phenocrysts.—*Plagioclase* in large crystals and complexes, with coarse albitic twinning; *r.i.*, above balsam; much cracked, various inclusions; fairly fresh, some altered into carbonates and epidote.

Hornblende fresh, green, fragmentary, including magnetite grains, apatite, zircon, and chloritic pseudomorphs after pyroxene.

Pyroxene represented by pseudomorphs in pennine, with some epidote; amphibole fibres occur in some.

Quartz : Numerous large grains, rounded and in optical continuity with the quartz of micropœcillitic areas; or in bi-pyramids, sometimes with fortification outlines. Liquid cavities with large bubbles are present.

Magnetite grains of fairly large size.

Apatite abundant.

Hornblende Dacite Porphyrite.

Illustration.—The slice has moderate contrasts.

Photographed by ordinary light; magnification, 50 diameters; area photographed, upper right, which fairly represents the whole of the slice. The much-jointed character of the larger crystals is very evident in the photograph and the reproduction from it.

Locality.—Mouth of Waiaro Creek, Moehau district.

Formation.—Dyke in the Maitai series.

No. 58/3119.

M.C.—Black basaltic-looking rock, with glassy felspar.

U.M.—Matrix abundant; laths of plagioclase in flow-lines; pyroxene represented by pseudomorphs in green material, with a high double refraction like carbonates; magnetite grains and leucoxene are present. The matrix is not pilotaxitic, but may be hyalopilitic. There seem to be traces of residual glass.

Phenocrysts.—*Plagioclase* abundant, fresh, in definite crystal forms, simple and complex, of usual andesitic character. Ext. 22° / 30°.

Augite : A little colourless augite is present. Ext. up to 32°; double refraction low.

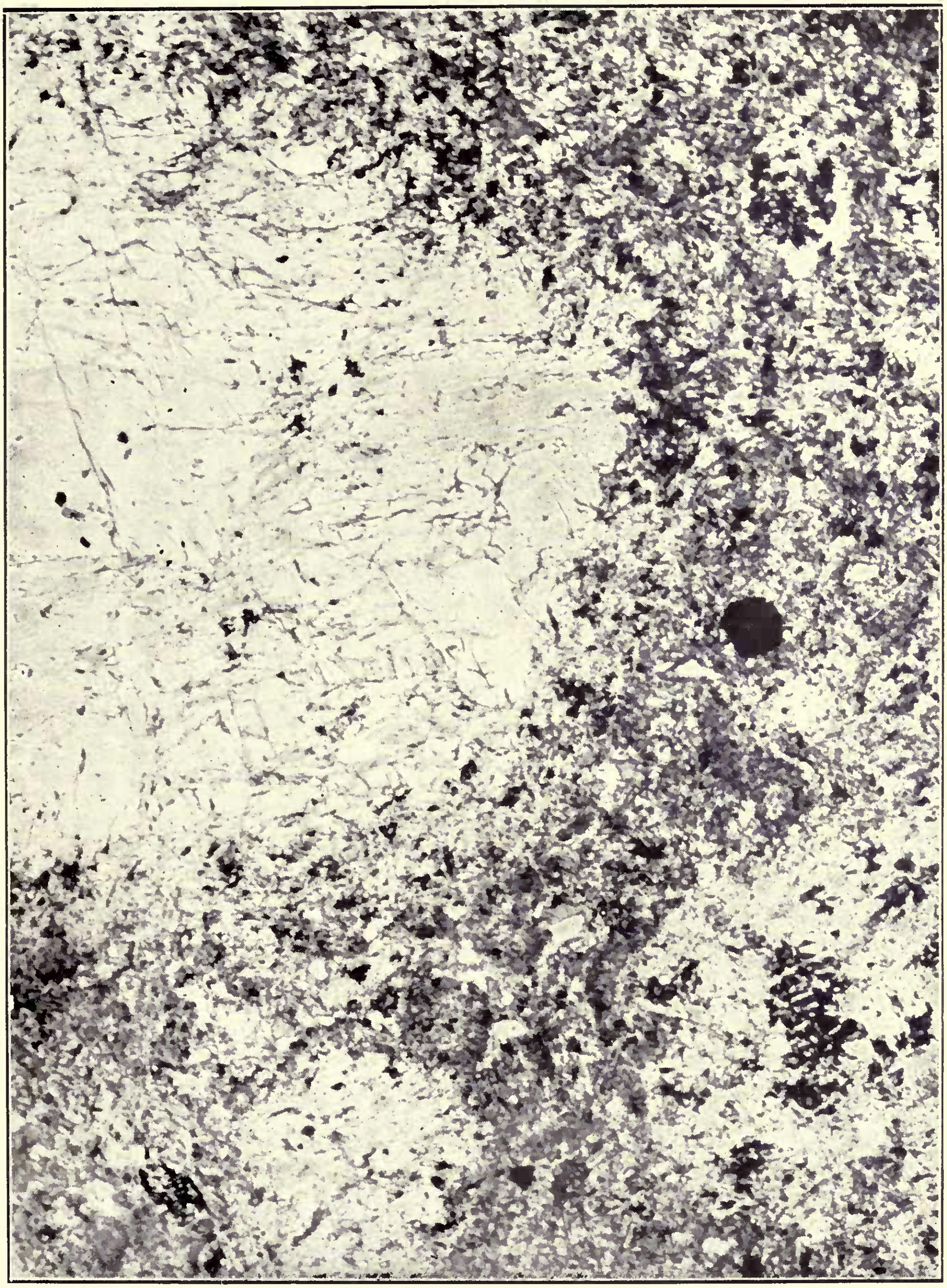
Hypersthene abundant, colourless as preserved in cores to alteration products. If this were its original character it should be termed enstatite.

The alteration, which often extends throughout the whole crystal, is into a serpentine with wide double refraction and positive optical sign. This is not bastite (so-called), and the double refraction is rather high for chrysotile. The serpentine is passing into chlorite.

Hornblende : A few large crystals, bronze-yellow in colour, with faint pleochroism, and marked by reaction borders. Magnetite in fine dust and rods running parallel with the axis *C;* a pseudomorph in serpentine after hypersthene is included in one crystal of hornblende. The reaction border consists of magnetite and pyroxene.

Ilmenite occurs in large plates.

Hypersthene or Enstatite Andesite, containing some hornblende.



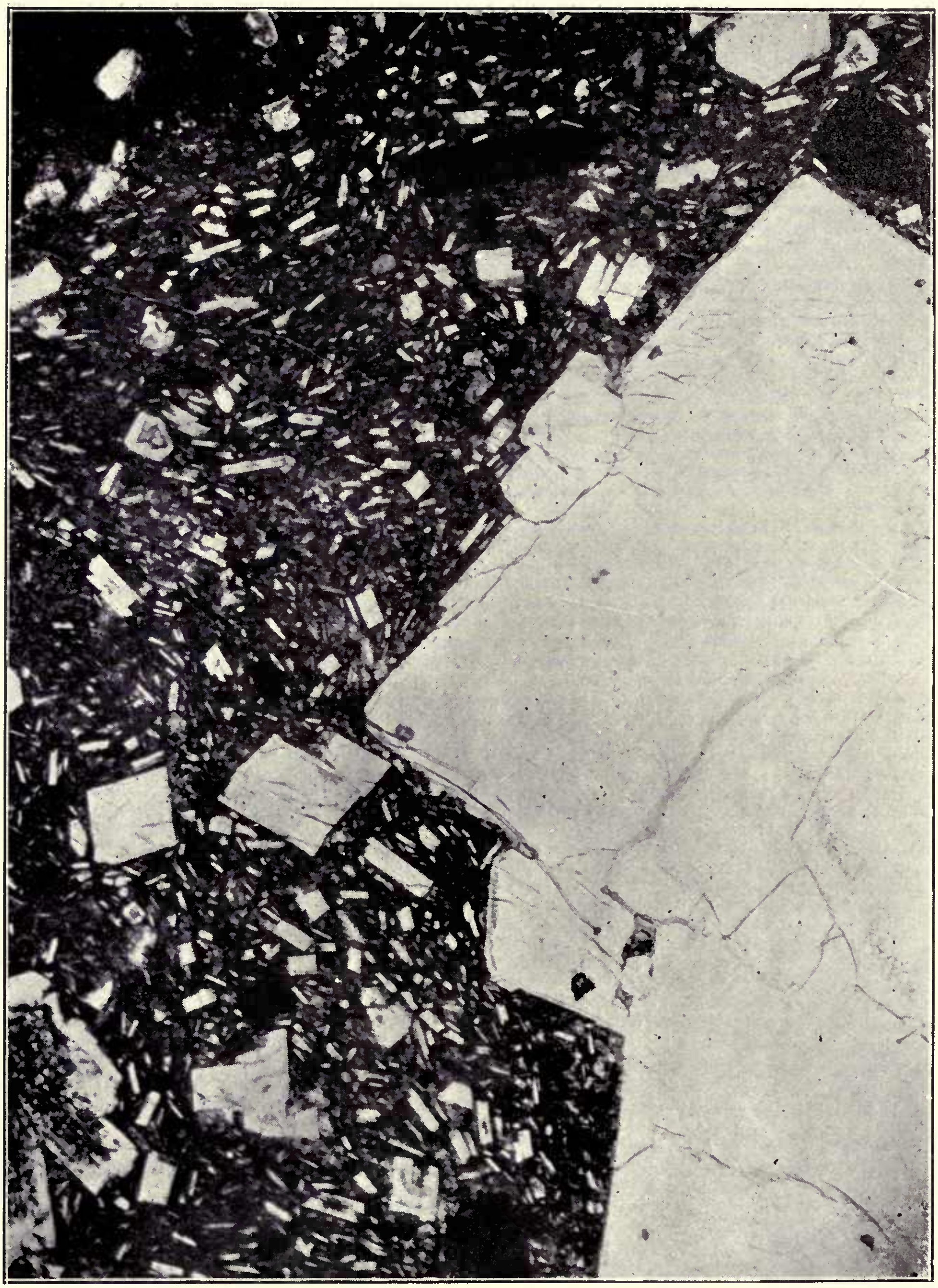
No. 57/3103. HORNBLENDE DACITE PORPHYRITE.

[*To face p.* 172.

No. 58/3119. HYPERSTHENE OR ENSTATITE ANDESITE CONTAINING SOME HORNBLENDE.

[*To face p.* 173.

i.



No. 59/3125. HYPERSTHENE ANDESITE.

[*To face p. 173.*
ii.

Illustration.—The slice has good contrast of the different minerals present.

Photographed by ordinary light; magnification, 50 diameters; area photographed, upper right, where a very large crystal occupies the left of the area and most of the part photographed. The illustration is therefore not representative of the whole of the slice.

Locality.—Austral Hill, Cabbage Bay district.

Formation.—Kapanga group.

Remarks.—The great bulk of the Kapanga rocks forming the northern end of the Tokatea Range consist of light-grey breccias of coarse or finer grain underlain by grey or yellowish tufaceous beds, slaty in character and fine in grain, which split along the bedding-planes with facility. Impressions of marsh-planes abound in these sediments. The Specimen 3119 is from one of the harder bands underlying the breccias and overlying the plant-beds.

No. 59/3125.

M.C.—Dark-grey andesite-like rock, with phenocrysts of felspar and ferromagnesian minerals.

U.M.—Matrix colourless interstitial glass with needle-like transparent crystallites; plagioclase laths and rectangular sections showing marked fluxional arrangement; augite in crystalline grains and magnetite granules.

Phenocrysts.—*Plagioclase* in large well-formed crystals and fragments and complex growths, usual andesitic character. The central parts of zoned sections have often a lower refraction index and a smaller angle of extinction than the margin; thus the marginal portion may extinguish at 25° and the central at 14°.

Augite rare, faint green colour, well-formed crystals.

Hypersthene is the predominant pyroxene, mostly quite fresh; pleochroism bluish-green / faint yellow / brownish-yellow.

Hornblende chiefly represented by resorption products, which are fairly common; apatite and leucoxene are associated with them.

Titaniferous magnetite and iron-stained *leucoxene* are present, but not in large quantity.

Hypersthene Andesite, containing hornblende.

Illustration.—Slice shows good contrasts.

Photographed by ordinary light; magnification, 36 diameters; area photographed, middle part. One large crystal occupies nearly half the print; the remainder is characteristic of the slice where large phenocrysts do not appear.

Locality.—Upper part of left branch of Umangawha River, Cabbage Bay.

Formation.—Beeson's Island group.

Remarks.—The specimen is from a dyke-like outcrop of hard rock in association with tuff-beds containing coaly matter.

No. 60/3126.

M.C.—Bluish-grey porphyritic rock, with large crystals of milky-white felspar.

U.M.—MATRIX micropœcillitic, with fluxional structure, very abundant; large felspar laths and rectangles, quartz, chlorite scales, magnetite grains, and leucoxene.

PHENOCRYSTS.—*Plagioclase:* Large well-formed crystals, with submarginal zone of inclusions. Ext. 29° / 32°; contain epidote.

Pyroxene represented by large pseudomorphs of carbonates, or of quartz, chlorite, leucoxene; and carbonates. A pseudomorph in carbonate forming a mosaic may be traversed by numerous veins of chlorite.

Hornblende may have been present, but no outlines are preserved by which it can be identified.

Ilmenite and *leucoxene* sparsely scattered.

Quartz: Some irregular grains and mosaic are certainly primary, or at least were formed during consolidation; others may have been secondary.

Dacite Porphyrite.

Locality.—Mouth of Waiaro Creek, Moehau district.
Formation.—As a dyke in Carboniferous strata.
Remarks.—The same as under No. 3042.

No. 61/3138.

M.C.—Dark fine-grained andesite-like rock, with small crystals of felspar and ferro-magnesian minerals.

U.M.—MATRIX hyalopilitic, usual felspar laths, long small prisms of augite faint-green in colour, grains of magnetite, obscure fluxional arrangement.

PHENOCRYSTS.—*Plagioclase:* Ordinary andesitic character. Inclusions various; sometimes a submarginal zone, sometimes the crystal is filled with a perfect network of glass. Ext. in central area, where no inclusions occur, 30°/32°; in external region where inclusions appear, 41°/42°.

Augite: Pale sage-green. Ext. 39°. A few small crystals are fresh; others converted into carbonates. In one case ophitic with carbonates.

Hypersthene: Small regular crystals more frequent than augite, but not numerous.

Hornblende abundant, chiefly represented by resorption products; in the case of a large individual a little almost fresh hornblende may remain as a core, associated with brown biotite which has been produced as an alteration product.

Magnetite: A few large irregular grains.

Apatite associated with hornblende pseudomorphs.

Hyperstene Hornblende Andesite.

Locality.—The coast-line south of the mouth of Tawheterangi Creek, Cabbage Bay district.

Formation.—As a dyke in Carboniferous strata.

Remarks.—There is a probability that this and another dyke of the same character, which occurs on the point north of the mouth of the creek, belong to a later period than the dykes on Moehau. As dyke No. 3125 occurs in this part of the district, and with some other bodies of igneous rock, presumed to be dykes, break through rocks belonging to the Beeson's Island group, the inference is that the two dykes above referred to, though breaking through rocks of Carboniferous age, are not necessarily older than the period of the Beeson's Island group.

No. 62/3168.

M.C.—Compact grey felsitic-looking rock, spotted with dark arborescent patches.

U.M.—Dusty granular matrix, with angular, irregular, and rarely rounded grains and shreds of quartz, and fragments of felspar scattered through it. The felspar is sometimes banded, ext. at 15°/15°; sometimes not, and extinguishing parallel. Carbonates are abundantly dispersed, and there is a little chlorite. The clearer patches corresponding to the dark spotting in the hand specimen, are rich in muscovite, and freer from minute granules or dust than the rest of the rock, but otherwise they are similar; the muscovite is probably secondary, and possibly an alteration product after some metamorphic mineral developed by contact. Grains of opacite and pyrites.

Spotted Adinole or Grauwacke.

Locality.—No. 7 level, Tokatea Mine, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—This rock prevails through all but the two highest levels of the Royal Oak and Tokatea Mines. It is readily recognised in Nos. 7, 6, 5, and 3 levels of these mines, and reaches on Tokatea Hill to at least 1,200 ft. above the sea, and is found in the deepest levels of the mines.

No. 63/3178.

M.C.—Grey fine-grained rock, mottled with darker spots.

U.M.—A minutely crystalline groundmass of sericite and minute quartz granules, scattered through which are angular splinters and fragments of quartz, granules of leucoxene, minute patches of carbonates, and cubes of pyrites about which quartz has grown.

The dark spots are due to secondary deposition of an undetermined mineral, and remind one of the andalusite growths in a spotted schist. The mineral is transparent and colourless, with parallel-sided outlines, rectangular lozenge-shaped and hexagonal, with a parallel fibrous structure; a refraction index above that of quartz, and a double refraction wider than that of quartz; it extinguishes parallel to the length of the fibres, which is also the direction of one pair of sides of the rectangular outlines. The presence of this mineral renders the slice clearer when it occurs.

I have called this rock a spotted adinole; it may be, but chemical analysis is required to show whether it contains enough soda to rank as a true adinole. Its fusibility is not quite so easy as I should expect in an adinole.

Spotted Adinole.

Illustration.—The slice shows fair contrasts, and displays the spotted character of the specimen and the rock.

Photographed by ordinary light; magnification, 50 diameters; area photographed, lower left, which is characteristic of the whole slice.

Locality.—No. 5 level, Tokatea Mine, Tiki-Tokatea district.

Formation.—Te Anau series.

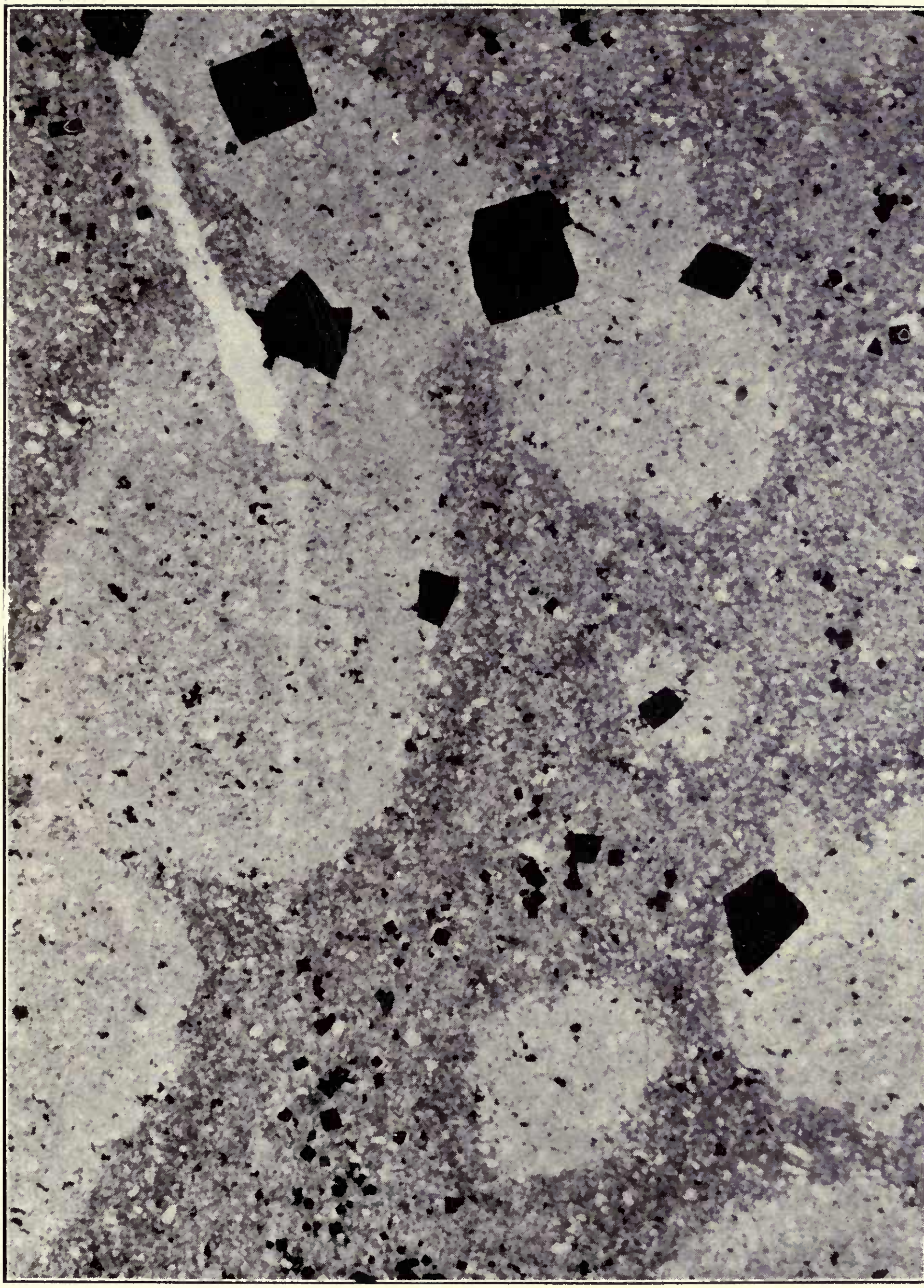
Remarks.—Collected from the tip-head of the mine; the rock is common, and attracts notice owing to its spotted appearance. The rock outcrops on the surface between No. 5 and No. 6 levels, but the specimen was taken from the tip-head of No. 5 level.

No. 64/3186.

M.C.—Coarse crystalline rock, porphyritic with white felspar and hornblende.

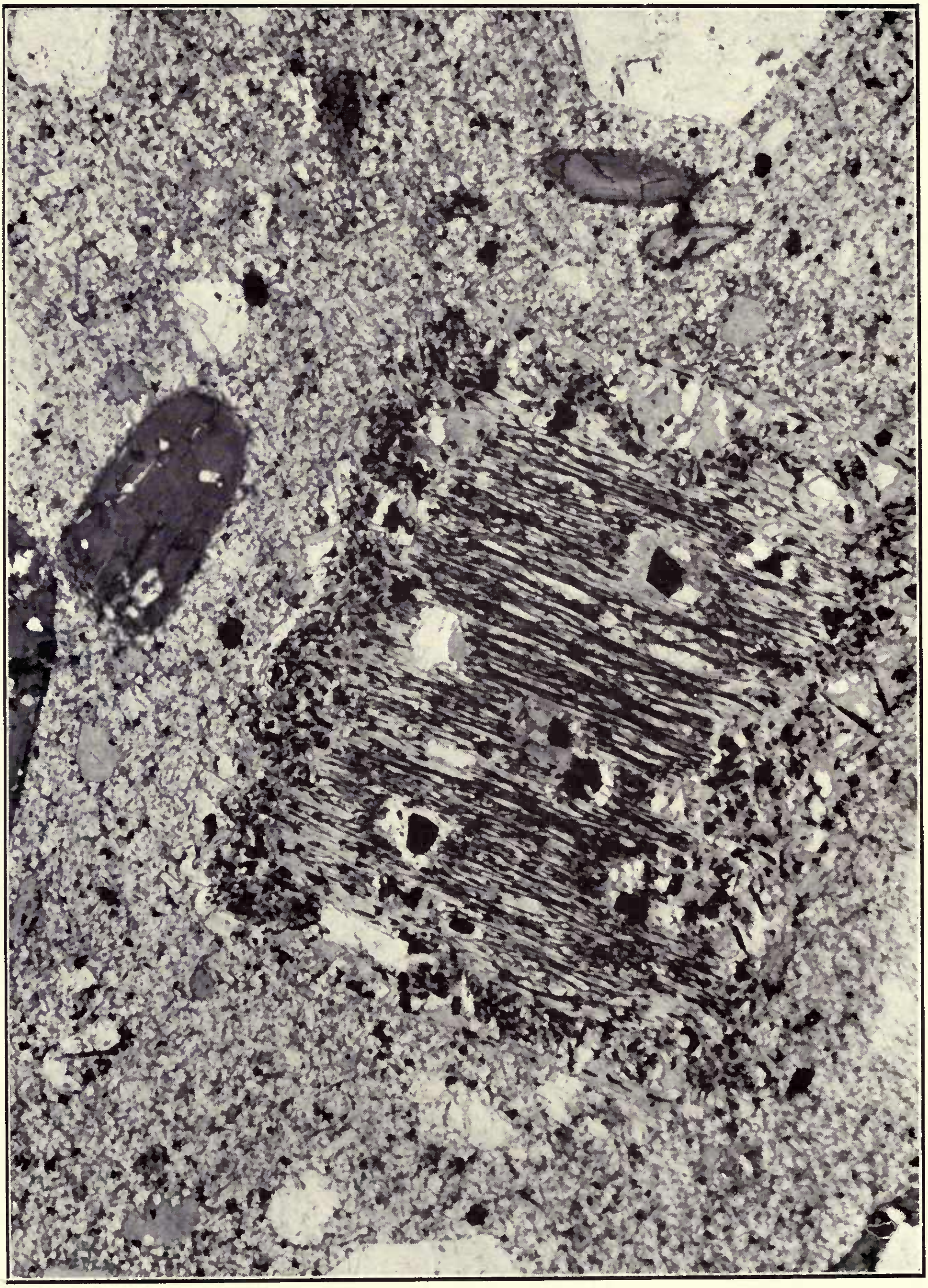
U.M.—Very similar to 3102. Matrix fairly even-sized grains of quartz approaching bi-pyramids in form; laths and rectangles of plagioclase, and perhaps some orthoclase; chlorite and sericite scales, and leucoxene pseudomorphic after titaniferous magnetite.

Phenocrysts.—*Plagioclase:* Large crystals, often tabular from development of 010; various twinning, some much corroded by matrix; zonal. Fractured, cracks filled with quartz or another felspar. Ext. 10°/10° to 20°/28°.



No. 63/3178. SPOTTED ADINOLE.

[*To face p.* 176.



No. 64/3186 HORNBLENDE DACITE PORPHYRITE.

[*To face p.* 177.

Hornblende: Green crystals and rounded fragments, sometimes twinned. Pleochroism olive-green / straw to brown-yellow; in some no reaction border, in others a broad margin consisting of a somewhat coarse mixture of chlorite, quartz, and leucoxene, with epidote and associated apatite.

Pyroxene occurs as pseudomorphs in pennine, with carbonates sometimes occupying the central area. Ilmenite and leucoxene frequently included in these pseudomorphs.

Pyrites is present in some quantity, as cubes of fairly large size. No doubt a secondary product.

Ilmenite occurs in plates passing into leucoxene.

Apatite is associated with the ilmenite.

Zircons are present, but rare.

Hornblende Dacite Porphyrite.

Illustration.—The slice shows good contrasts between the phenocrysts and the matrix.

Photographed by ordinary light; magnification, 33 diameters; area photographed, upper right. One large crystal surrounded by a broad border of various minerals forms the principal object, and the illustration cannot, therefore, be said to represent the whole of the slice.

Locality.—First waterfall on the road from Tokatea Saddle to Kennedy's Bay, Tiki-Tokatea district.

Formation.—Dyke in the Te Anau series.

Remarks.—This rock forms a massive dyke, which is exposed on the roadside, and is one of the most marked on the east slope of Tokatea Hill.

No. 65/3188.

M.C.—Grey-mottled much-jointed rock containing pyrites; similar to No. 3178, but with parallel banding.

U.M.—Minutely crystalline GROUNDMASS of sericite, chlorite, and quartz, through which are scattered angular grains and splinters of a seriticised felspar (orthoclase), some plagioclase showing albitic twinning and extinguishing at 22°/ 2°, granules of leucoxene. The spotting resembles that of No. 3178, but two sets of fibres are sometimes visible crossing at right angles, and in one instance signs of twinning are visible, the striæ of adjacent individuals meeting at 127°. The rock has been much fractured internally; the cracks are filled with quartz, and in the case of the larger veins by a coarse mosaic of quartz in the middle and chlorite chiefly at the sides; some pyrites has been deposited in these fissures.

Provisionally a

Spotted Adinole.

Locality.—No. 6 level, Tokatea Mine, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—This rock closely resembles No. 3178, but comes from the next lower level in the mine, in which the lode-stuff is characterised by a greater abundance of calcite. This calcite, apparently derived from the adjacent country rock, is itself sometimes auriferous to a degree which warrants its being sent to the mill and treated for the contained gold.

No. 66/3189.

M.C.—Cream-coloured rock with fine grey bands suggesting fluxional structure.

U.M.—Arabesque mosaics of quartz in streaks of different degrees of coarseness; felted sericite in patches, pseudomorphic after some other mineral. Grains of quartz showing signs of previous corrosion and reminding one of rhyolitic quartz grains are present; others distinguished by the presence of fine opaque dust in accumulations having circular outlines, and suggesting positive spherulitic structure. In some cases this dust is replaced by transparent highly refringent rods and granules.

Black dust arranged in bands independent of the outlines of the grains also occurs.

This rock was originally a rhyolite. It now consists almost entirely of quartz.

Altered Rhyolite.

Illustration.—Fair contrasts appear in different parts of the slice.

Photographed by ordinary light; magnification, 160 diameters; area photographed, lower left. Though the magnification was considerable, the photograph is yet fairly representative of the whole slice, and the tendency to spherulitic structure seen under the microscope in the part photographed can be readily traced in the print and reproduction.

Locality.—Left bank of the Harataunga, half a mile above the compressor, on the road from Tokatea Saddle to Kennedy's Bay, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—The specimen is from the middle part of one great exposure, or the middle one of three independent outcrops of rhyolite, through which the Waikorimika (in its lower course called the Harataunga) cuts a deep gorge on its way to the sea in Kennedy's Bay. The lower rib or outcrop is seen at the Royal Oak Compressor, the excavations for the site of which have been made in this rock, which here has a somewhat porphyritic structure. The westerly rib forms the western wall of the upper part of the gorge referred to and is a much brecciated rock. The middle rib, of a more earthy description than the others, shows distinct indications of flow-structure, and on this account, in the selection that had to be made, was preferred to the others, but a sample (No. 3200) from the western rib was also forwarded for description.

Collectively the rhyolites on the east slope of the Tokatea Range and in the hilly country farther to the east have a considerable thickness. They appear in two

No. 66/3189. RHYOLITE REPLACED BY QUARTZ.

[*To face p. 178.*

different localities, that which has already been described and another more to the west, which, trending north and south at right angles to the direction of the first mentioned, forms the western limit of the productive part of the Tokatea Goldfield, as in like manner the other—its strike being east and west—does for the northern part of the field. The relation of the rhyolites in the gorge of the Harataunga to the neighbouring andesic rocks is not very clearly displayed, but there can be no doubt that they underlie the more basic rocks. This has recently been shown by work now in progress in the Four-in-hand Mine, situated some distance south-south-east of the Harataunga Gorge. The upper workings of this mine are in andesite, but the lowest level is now being driven in a decidedly acid rock, resembling that at the Royal Oak Compressor on the road to Kennedy's Bay, and it may reasonably be inferred that the same rock is continuous between the localities mentioned.

No. 67/3199.

M.C.—Hard siliceous compact bluish-grey rock, traversed by numerous thin veins, weathering brownish, and in weathered portion showing signs of oblique lamination.

U.M.—Matrix of sericite and quartz with scattered fragments and shreds of quartz; a good deal of muscovite, often in curvilinear forms suggestive of seriticised volcanic glass, but more probably produced by adaptation to the outlines of quartz grains; carbonates in patches as if replacing some other mineral, such as felspar. Opaque whitish granules and an occasional zircon present. Threads of pyrites and cubes of this mineral.

Fine-grained Siliceous Grit.

Locality.—The middle part of the gorge of Tapu Creek, nearly opposite the bridge, Thames County.

Formation.—Maitai series (?).

Remarks. — This rock resembles the felsite tuff of Rocky Point, near the Thames, and also the adinole of Tokatea Range, and these are referred, the first to the Maitai series of Carboniferous age, the last to the Te Anau series of Devonian age. There is thus uncertainty as to what in this case the reference should be. However, it is more than probable that in the three localities the rocks are of the same age, probably Devonian, and here the reference to Maitai series is in deference to previous determinations.

No. 68/3200.

M.C.—White porous rock with scattered grains of quartz and drusy cavities coloured with patches of ferric hydrate.

U.M.—Very finely granular microcrystalline groundmass consisting of quartz and sericite with scattered ochreous granules.

Phenocrysts.—*Quartz* in irregular corroded grains, such as commonly occur in rhyolite, sometimes presenting the form of bi-pyramids surrounded by a secondary growth of quartz.

Felspar : Certain areas rich in sericite and an undetermined granular fibrous material may possibly represent this mineral.

The quartz grains contain large rounded and irregular liquid and vapour cavities, but this is not inconsistent with a rhyolitic nature. Many of the grains seem to be angular fragments, but the manner in which some are invaded by the matrix is very suggestive. The iron-stained areas do not throw any light on the origin of the rock; they are marked by radio-fibrous aggregates of muscovite.

The rock is a

Rhyolite replaced by Quartz.

Illustration.—Slice in places stained red, but otherwise shows but little contrast as seen by the unaided eye or under low powers of the microscope.

Photographed by ordinary light; magnification, 160 diameters; area photographed, the middle part, which fairly represents the rest of the slice. Fragmentary crystals and distinct evidences of the former presence of spherulites are traceable in the reproduction.

Locality.—About a mile upstream from the Royal Oak Compressor, at the lower end of the Harataunga Gorge, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—The specimen was taken from the eastern end of the road-cutting at the upper end of the gorge, and from the northern side of the brecciated mass in which the road has been made. The brecciated character of the rock is remarkable, and in this respect it is distinguished from the rhyolitic outcrops farther down the gorge.

No. 69/3208.

M.C.—Greyish-white rock strewn with grains of quartz.

U.M.—A mosaic of interlocking grains of quartz dusty with sericite and opaque white granules form the GROUNDMASS, in which grains of quartz are scattered like phenocrysts. Some of these are rounded and others bi-pyramids; they contain large liquid cavities with bubbles and vapour cavities; some include islets of matrix.

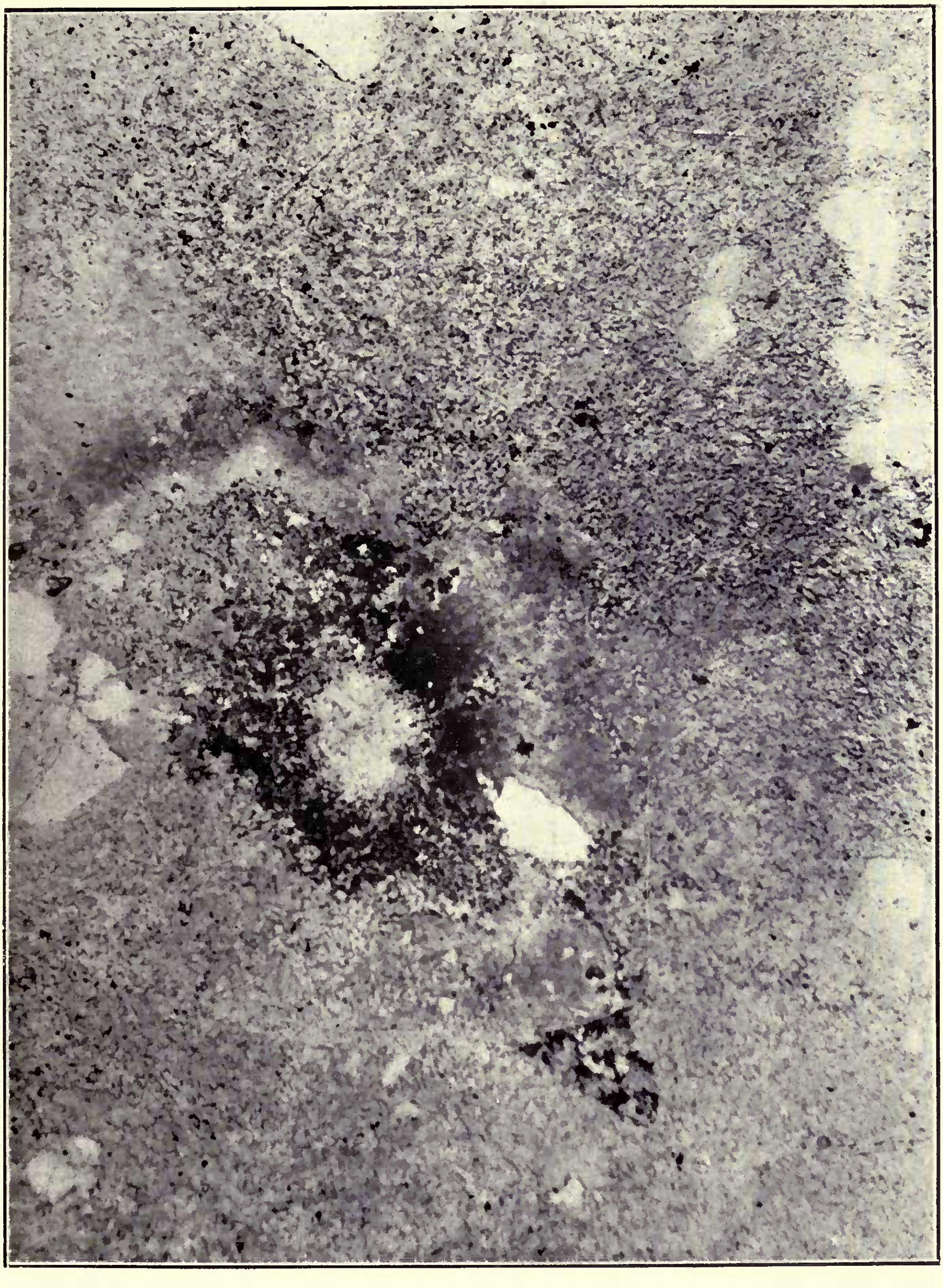
Aggregates of muscovite with rectilinear boundaries are clearly pseudomorphous after some other mineral, and the outlines in some cases suggest felspar.

This is now a

Quartz Mica Rock,

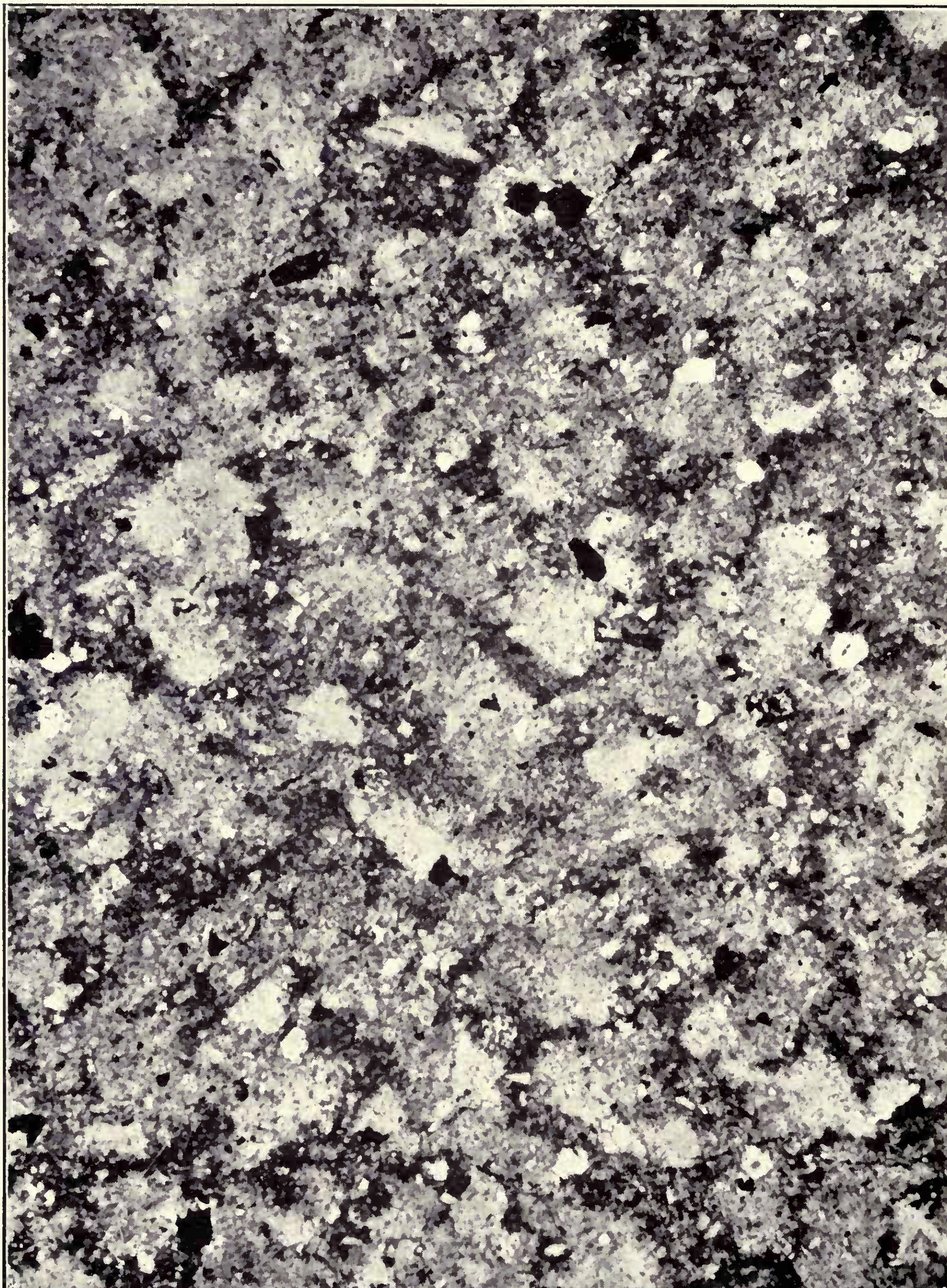
but was originally a rhyolite. It closely resembles No. 3200.

Locality.—The sharp ridge of white rock that from the manager's house on the Tokatea Claim strikes south across the Kennedy's Bay road at the second waterfall in the creek coming from Tokatea Saddle, and is thence continued in the same



No. 68/3200. RHYOLITE REPLACED BY QUARTZ.

[*To face p. 180.*



No. 70/3216. SPOTTED ADINOLE,

[To face p. 181.

direction till reaching within 4 chains of the Upper Waikorimika Road, where the ridge attains its highest elevation, from which highest part of the ridge the specimen was taken.

Formation.—Te Anau series.

Remarks.—The exposure of this rock does not exceed 3 to 4 chains at most in width, and it might with propriety be considered as intrusive. Along the line of outcrop its characteristics vary; towards the north it is an earthy chalk-like rock abounding in small cavities where once were lodged cubes of pyrites or small octhedræa of magnetite or bi-pyramids of quartz; on the south side of the creek the rock is columnar, the columns dipping at high angles to the westward. Near the highest point of the ridge the rock looks like a lava-flow, fluxional structure on a large scale being very pronounced in this part; and, finally, farther south, where it disappears under the Thames-Tokatea rocks, it is again of the earthy character first described.

This rock seems to limit towards the east the productive part of the Tokatea Goldfield, and it is therefore of importance in connection with prospecting and the development of the auriferous resources of this part of the Tiki-Tokatea district.

No. 70/3216.

M.C.—Very fine-grained greenish-grey rock faintly spotted, containing small cubes of pyrites with platy jointing.

U.M.—Matrix rich in chlorite and sericite. Scattered through it are (i.) angular grains and sometimes minute bi-pyramids of quartz, sometimes invaded by matrix; (ii.) pseudomorphs after felspar in chlorite, carbonates, and quartz; (iii.) ilmenite altering into leucoxene; (iv.) last and most abundant, patches and pseudomorph-like areas occupied by a problematical mineral which sometimes forms mosaics: its *r.i.* is greater than that of quartz; its double refraction varies greatly in different specimens and different parts of the same area, but is above quartz, and sometimes almost equal to that of muscovite; its extinction is parallel with the fibres of which it is composed. Its outline is frequently polygonal, rectangular, or hexagonal, suggesting a replacement product after felspar or pyroxene; it sometimes occurs associated with felspar residues, and in one case a patch with pyroxene-like outline was observed within an altered felspar crystal: at other times the outline is quite irregular, but this might be due to an extension of the pseudomorph beyond the boundary of the original mineral. This problematical material is very abundant; at present I can throw no further light on it.

Irregular grains of pyrites are scattered about.

Spotted Adinole.

Illustration.—In the slice there s fair contrast between the different minerals present.

Photographed by ordinary light; magnification, 50 diameters; area photographed, lower left, which is representative of the slice, with the exception of some very fine lines formed of an opaque mineral (pyrites?) that traverse the right side of the slice. The reproduction shows well the general character of the slice as seen under magnification.

Locality.—Upper level of the Hauraki Associated Mine, Tokatea Saddle, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—The presence of this rock near the saddle and on the higher part of the Tokatea Range proves the absence generally, and shows that nowhere can there be any considerable thickness of Tertiary volcanic rock on or near the saddle. Both to the north and the south of the saddle these Palæozoic rocks rise to yet greater heights, but hitherto have been identified as belonging to the younger series of igneous outpourings; and, speaking of the Tokatea Reef, Professor Park says, "At the No. 5 level it passes from propylite into blue slaty shales,"* which slaty shales have to be considered the same, or the equivalents, of the grauwackes and adinoles of the present descriptions.

No. 71/3222.

M.C.—Light greenish-grey compact rock porphyritic with white felspar and dark ferro-magnesian minerals.

U.M.—MATRIX pilotaxitic; felspar in laths and rectangles, in flow-lines; chlorite in green scales, scattered carbonates, obvious interstitial quartz, disseminated leucoxene and some magnetite. The felspar is a plagioclase with *r.i.* above balsam.

PHENOCRYSTS.—*Plagioclase:* Numerous crystals and fragments much fractured, cracks numerous and close, more or less parallel, filled with quartz or a differently orientated felspar or a different species of felspar; probably a result of pressure; *r.i.*, above balsam; ext., 22°/ 25° up to 30°/ 30°. Carbonates and epidote are present as alteration products.

Pyroxene completely altered into chlorite and carbonates; residual cores very rare; in one instance some colourless augite, ext. at 40°, was observed.

Hornblende: The remains of large crystals with resorption borders converted into chlorite, leucoxene and carbonates are met with, but they are not very numerous. A residue of unaltered hornblende is preserved; the pleochroism is sage-green / straw-yellow.

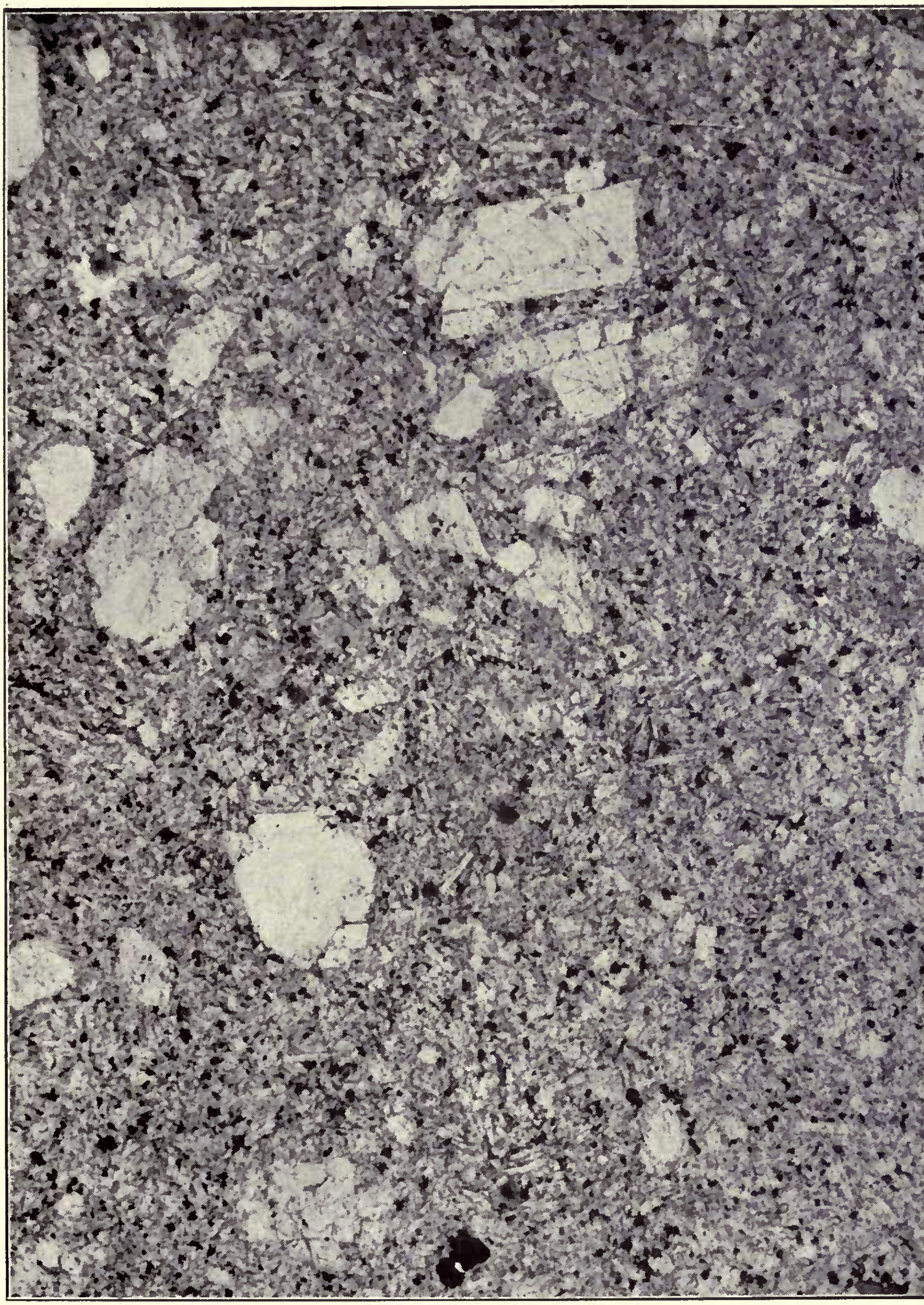
Quartz: Irregular grains like the interstitial quartz of the matrix, but of larger size are met with. There are also quartz mosaics which look like pseudomorphs.

Ilmenite in a few large plates; also *apatite* and *pyrites.*

Pilotaxitic Dacite Porphyrite.

Illustration.—There is fair contrast within and between different parts of the slice.

* "Geology and Veins of the Hauraki Goldfields." (Trans. N.Z. Inst. of Mining Engineers, 1897, p. 74.)



No. 71/3222. PILOTAXITIC DACITE PORPHYRITE.

[*To face p. 182.*

Photographed by ordinary light; magnification, 50 diameters; area photographed, the upper middle part. The reproduction, although perhaps not showing the presence of all the minerals mentioned in the descriptions, nor exhibiting clearly the disposition of the felspar laths in flow-lines, and therefore not, strictly speaking, characteristic of the whole slice, is yet a clear delineation of the part represented.

Locality.—Low-level or No. 7 tunnel of the Tokatea Mine, Tiki-Tokatea district.

Formation.—Dyke in the Te Anau series.

Remarks.—The rock is very distinct from the adinole and sedimentary deposits elsewhere showing in the low-level workings of the mine. It occurs 1,600 ft. from the mouth of the tunnel on the east side of the range, and is vertically under the highest part of Tokatea Hill. The strike is nearly north and south, the dip is at high angles to the east, and hence at the surface it should appear along the highest part of the Hauraki Associated Claim and the eastern slope of Tokatea Hill to the north of the saddle; but the dykes outcropping along this part of the range are of a more hornblendic character than the specimens taken from the low level of the Tokatea Mine.

No. 72/3223.

M.C.—Dark-grey compact rock, very fine-grained and felsitic-looking.

U.M.—Numerous angular clastic small grains of quartz irregularly scattered, chloritic scales, opaque white granules, small patches of carbonates and sericite(?) spots; these spots have sometimes regular rectilinear boundaries suggesting pseudomorphs, at others they are quite irregular; since they contain angular quartz grains like those generally scattered through the rock, the presumption is that they are metamorphic products. Movement has taken place and shear-planes seem to have been produced.

Spotted Adinole, or Fine-grained Grit.

Locality.—Upper level of the Pevril Mine at the north end of the Success Range, Tiki-Tokatea district.

Formation.—Te Anaŭ series.

Remarks.—The specimen has the appearance of a sedimentary rock, and at higher levels on the range and along the track from Tokatea Saddle to the Success Mine stratified rocks occur within the boundaries of the Pevril Claim at and higher than 1,100 ft. above sea-level. At higher levels and more to the south at lower levels the Success Range is formed of Tertiary volcanic rock belonging to the older auriferous andesites or Tokatea group, with which this and like rocks have been identified in previous reports dealing with this part of the Coromandel Goldfields.

No. 73/3241.

M.C. — Dark-bluish felsitic-looking rock with dark-green patches and pyrites. The green patches have a nodular form, and vary from microscopic dimensions up to 1½ in. diameter.

U.M.—Fine-grained MATRIX of quartz and scales of sericite and chlorite, with leucoxene granules; not unlike the altered matrix of an igneous rock. Numerous areas rich in chlorite and sericite suggest pseudomorphs after phenocrysts of felspar; some rectangular or parallel-sided sections of altered felspar are undoubtedly present; some rectangles in pennine are probably after some ferro-magnesian mineral; some areas of quartz mosaic suggest pseudomorphs. A little apatite is present.

Carbonates and epidote, together with pyrites, ilmenite, leucoxene and chlorite, form the green patches mentioned as visible to the unaided eye.

The rock is *indeterminate*; it might be an altered flow or it might be fragmental.

Locality.—The Hauraki Associated Mine, Tokatea Saddle, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—The specimen is from the upper level of the mine, a little below Tokatea Saddle, on the western side of which similar rock is met with in Harbour View Claim.

No. 74/3260.

M.C.—Greenish-grey rock with evident fragments spotted with a greenish mineral, and glistening with pyrites.

U.M.—Pseudomorphs in quartz mosaic; rhyolitic quartz grains; rounded quartz grains rarely; pseudomorphs in radio-fibrous sericite and pennine; patches rich in minute bi-pyramids of quartz; fragments of irregular quartz mosaics of various degrees of fineness; leucoxene and pyrites. A very heterogeneous rock, and evidently fragmental.

Fragmental Rock.

Illustration.—Good contrast is afforded by different parts of the slice.

Photographed by ordinary light; magnification, 50 diameters; area photographed, lower-left, which is fairly characteristic of the whole of the slice.

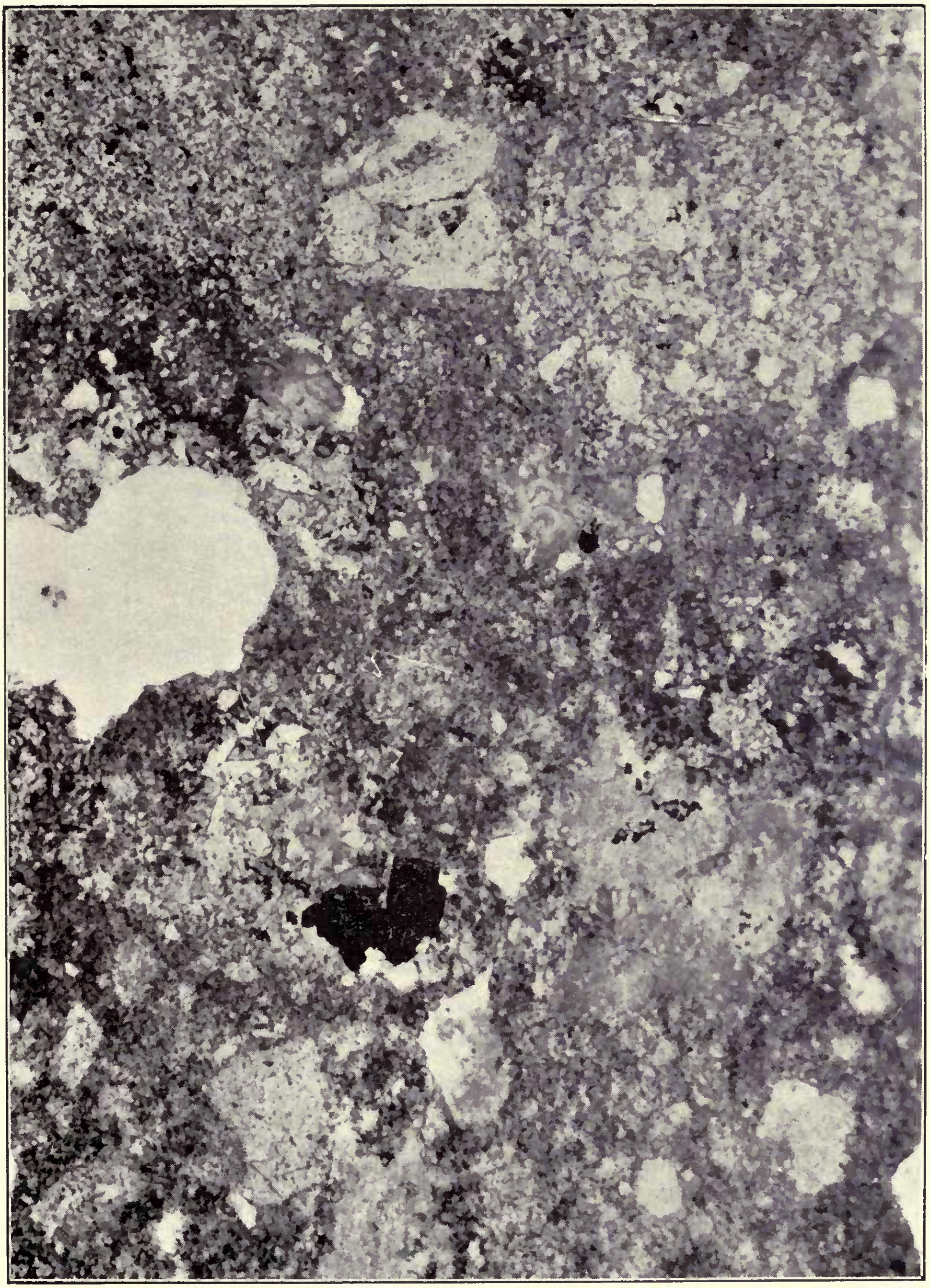
Locality.—Harbour View Mine on the west side of Tokatea Saddle, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—This rock bears some resemblance to "miners' sandstone," but it is a resemblance only, and on close inspection the difference is easily detected, except in cases in which the "sandstone" results from the decomposition of fine-grained breccias, which are not infrequent between the foot of Tokatea Hill and Coromandel.

No. 75/3277.

M.C.—Very similar to 3260.



No. 74/3260. FRAGMENTAL ROCK.

[*To face p. 184.*

U.M.—Matrix very fine-grained mixture of quartz and sericite, containing angular fragments of volcanic rock showing flow structure, trachyte-like in appearance; the felspar-laths completely transformed into an indeterminate mineral.

Pseudomorphs in quartz mosaic; angular fragments of irregular quartz mosaic; pseudomorphs in muscovite.

Cubes of *pyrites* often in clusters.

Fragmental Rock.

Locality.—Upper level of the Hauraki Associated Mine, east side of Tokatea Saddle, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—This is a common rock on the higher part and west side of Tokatea Saddle, within Harbour View, and adjacent claims east of the big reef. A comparison of this with specimen No. 3260 shows that the same rock is found on both sides of Tokatea Saddle—not, however, the same stratum, since the rocks dip at high angles and to the westward.

No. 76/3290.

M.C.—Black, irregularly banded, very fine-grained rock crossed by white quartz grains.

U.M.—Small but numerous angular fragments and shreds of quartz; worn flakes of muscovite; pseudomorphs in carbonates of about the same size as the quartz grains; numerous irregular black granules and others opaque white, flakes of chlorite; fragments of felspar.

A fine Quartz Felspar Grit, or Grauwacke.

Locality.—No. 7 level, Tokatea Mine, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—This was forwarded as a sedimentary rock and described as a "grey sandy-shale." This and specimen No. 2913 were thought sufficient to represent fairly the rocks of this kind met with in the mine-workings of Tokatea Hill. Similar rocks were collected from different parts of the district, but this sample had a special interest in that it comes from the inner end of the tunnel, about 3,000 ft. from the entrance, on the east side of the range. It is consequently a rock of the western slope, close up to where the line of the big reef crosses that of the tunnel. The specimen was collected from the tip-head at the mouth of the tunnel, the inner face of which can no longer be reached.

No. 77/3312.

M.C.—Greyish-white compact rock with green spots, some approximately circular with a white margin, and rounded lumps of compact rock.

U.M.—Microcrystalline MATRIX of quartz granules, sericite, minute rod-like felspar laths, and small bi-pyramids of quartz, with pseudomorphs in carbonates after large felspar phenocrysts. This forms the greater part of the slice, but includes fragments of a different nature. Some (i.) fairly large, consisting of altered felspar laths with trachytic habit in flow-lines, spotted with patches of carbonates; (ii.) others composed of large isolated grains of quartz and large sericite pseudomorphs after felspar. Pyrites is present. The coarse fragmentary material (ii.) is opposed to the notion that this is a flow rock with included xenoliths, and leads to the conclusion that it is fragmental, but largely composed of fragments of flow rock.

Altered Fragmental Rock, containing large fragments of a volcanic flow.

Locality.—No. 5 level, Royal Oak and Tokatea Mine, Tiki-Tokatea district.
Formation.—Te Anau series.
Remarks.—The specimen contains some calcite and crystals of pyrites. A common rock in most mines on this field. Being "largely composed of fragments of flow rock," and undoubtedly belonging to the Te Anau series, this rock is important as proof that volcanic action took place within the area of the Tiki-Tokatea district in Palæozoic times.

No. 78/3334.—No slice.

Locality.—Low-level tunnel, Pevril Mine, north end of Success Range, Tiki-Tokatea district.
Formation.—Te Anau series.
Remarks.—The specimen as numbered formed part of the collection sent to England, but in some way has been overlooked. It was a solid and highly crystalline rock, showing felspar phenocrysts of considerable size. The material of the tip-head of this lower level of the mine showed that this rock formed a dyke mass of considerable thickness, and perhaps the largest to be met with in a traverse of the range across Tokatea Saddle or immediately north or south of the saddle.

No. 79/3350.

M.C.—Bluish-grey crystalline rock, evident crystals of white felspar, with a singular bluish opalescent appearance.

U.M.—MATRIX granular, dusty-looking, constituting about one-half of the rock, consisting of irregular grains of micropœcillitic quartz enclosing plagioclase laths; felspar laths and rectangles, running in stream-lines in some places; opacite grains and leucoxene, chlorite scales, and carbonates dispersed through the matrix.

PHENOCRYSTS.—*Plagioclase:* Numerous large crystals, complexes and some fragments. Crystals often shattered internally; most of them are traversed by curved cracks running close together. The sides of these cracks are converted into indeterminate fine granular brown material, to which opalescent appearance may be due. Twinning various; ext., 12°/14°; *r.i.*, above balsam. Alteration commencing; inclusions generally transformed into chlorite and carbonates.

Pyroxene: Only as pseudomorphs in pennine, or in pennine and carbonates; sometimes some quartz, ilmenite, and leucoxene associated. All these substances may occur together in one pseudomorph; or chlorite, or carbonates may occur alone; in one case one half consists of chlorite and the other of quartz with longitudinal striation.

Apatite is sometimes present in these pseudomorphs.

Biotite: A few scales; faint straw-yellow / warm-brown, contains ilmenite and leucoxene.

Ilmenite: A few large hexagonal plates with leucoxene margin and associated *apatite*.

Dacite Porphyrite.

Locality.—The junction of the two main branches of the Manaia River, Waiau, &c., district.

Formation.—A dyke in the Maitai series.

Remarks.—It is possible that this dyke occurs in rocks of Triassic age; but, as on the coast-line farther south a series of dykes occur penetrating rocks that are thought to be of Carboniferous age, here also it is most probable that the sedimentaries are of and belonging to the Maitai series.

No. 80/3352.

M.C.—Light-grey rock porphyritic with moderately large crystals of felspar and smaller darker crystals.

U.M.—MATRIX abundant; very dirty-looking with ordinary light, owing to numerous dispersed granules of very various size, somewhat opaque; some are black. Rich in felspar in laths and small crystals. Quartz not common. Carbonates abundantly dispersed.

PHENOCRYSTS.—*Plagioclase* in well-formed crystals, but not fresh; much sericitised, and inclusions converted into chlorite. Some carbonates present.

Pyroxene: Some obscure pseudomorphs in chlorite may represent pyroxene, but the evidence is not very clear.

Hornblende: Abundant pseudomorphs presenting distinctive transverse sections and reaction borders. The material of the pseudomorph is a fine granular material which has a brown colour by transmitted light, but is milky-white by reflected light. Some green chlorite and carbonates may be associated with this. Granules of opacite and white opaque grains are included.

Ilmenite is present in large hexagonal tables, often reduced to a grill of parallel bars and associated leucoxene, which is generally iron-stained.

Apatite : A few colourless crystals.

This is a much-decomposed and somewhat puzzling rock, but it would appear to have been originally a hornblende andesite. The pseudomorphs after hornblende recall the mineral which occurs as spots in some of the adinoles.

Hornblende Andesite, much altered.

Locality.—Junction of the two main branches of the Manaia River, Waiau, &c., district, Coromandel County.

Formation.—As a dyke in Carboniferous(?) strata; possibly in Trias.

Remarks.—The age of the sedimentary rocks containing this dyke, and from which specimen No. 3350 also comes, is doubtful. Triassic rocks occur not more than two miles distant, and the rocks further up the valley more resemble the Trias than the Carboniferous rocks of the adjacent district to the north-east. Of the two dykes occurring in the near vicinity of each other this one is much more decomposed than No. 3350, and, besides, shows evidence of stress and movement, the joints of the rock being often slickensided, thus contrasting strongly with the other adjacent dyke.

The occurrence of this is as a natural exposure, while that of No. 3350, in a deep artificial cutting, may in part account for the greater decomposition of this.

No. 81/3354.

M.C.—Dark greenish-grey felstone-like rock with crystals of felspar and a little pyrites.

U.M.—Matrix, rather large laths and rectangles of plagioclase running in flow-lines, interstitial quartz, pyroxene passing into carbonates, granules of leucoxene. Matrix very abundant.

Phenocrysts.—*Plagioclase* crystals u ually with rounded outlines, zonal; a submarginal zone of magma inclusions parallel to rounded periphery; central core extinguishing at a markedly different angle to exterior part, sometimes 14° less; exterior ext., 28°/30°. Fairly fresh; carbonates present more or less.

Augite almost colourless, fairly abundant in well-defined crystals, often twinned and repeatedly; sometimes corroded by matrix. Much is fresh, and extinguishes up to 40°, but a good deal is converted into colourless serpentine. Pseudomorphs after pyroxene in chlorites and carbonates occur commonly, and may represent hypersthene. No hornblende is visible.

Quartz : The interstitial quartz sometimes forms larger irregular veins.

Pyrites occurs sometimes within felspar.

Dacite.

Locality.—The upper level of the Success Mine, Success Range, Tiki-Tokatea district.

Formation.—Thames-Tokatea group.

Remarks.—In some respects this resembles the dark compact rocks found along the east side of the Kapanga district. The specimen, however, is from near the base of the Thames-Tokatea group, which also contains dark basalt-like rocks. These, however, are distinguished from the like rocks of the Kapanga group by a difference in the character of the matrix.

No. 82/3356.

M.C.—Greenish-grey compact rock, with dark ferro-magnesian phenocrysts sparkling with pyrites and greenish-white felspar with obscure margins. Cracks lined with chlorite and rich in pyrites.

U.M.—Matrix fine angular quartz grains and seriticised remains of felspar laths, chlorite, and leucoxene grains. In places the matrix is much clearer than in others, especially when rich in secondary quartz; this gives it a deceptive appearance suggestive of xenoliths.

Phenocrysts.—*Plagioclase:* Numerous large crystals, much altered; some with a generally dull appearance between *x.n.* are seriticised; others more abundant are converted wholly or partly into carbonates.

Pyroxene: Some pseudomorphs of chlorite and quartz devoid of opaque granules may represent pyroxene, but I have not seen any characteristic transverse sections.

Hornblende was originally present in large and often complicated crystals, and in considerable quantity. It is now represented by pseudomorphs, often margined by rows of pyrites crystals, and consisting of a feebly double-refracting chlorite traversed by a network of more brilliantly polarising material (chrysotile?) which is accompanied by minute opaque white granules of leucoxene. Quartz sometimes contributes to these pseudomorphs, and apatite is generally present.

Ilmenite in plates passing into leucoxene.

Apatite fairly abundant in clear colourless crystals, as well as others containing fine granules.

A much **Altered Hornblende Dacite or Andesite.**

Locality.—Lower level of the Success Mine, Tiki-Tokatea district.

Formation.—The Thames-Tokatea group.

Remarks.—This underlies the darker rocks of the higher part of the Success Range, and also overlies a considerable thickness of volcanic rock belonging to the same group. Towards the south end of the Success Range the rocks of the Thames-Tokatea group appear to have accumulated in a depression, now filled with angular breccias and rudely stratified tuff, rocks that do not show towards the northern end of the range, nor to the south along the Coromandel–Whangapoua Road are there any of the coarse breccias met with on the road to the Success Mine.

No. 83/3390.

M.C.—Heavy black compact rock with small obvious felspar and ferro-magnesian minerals.

U.M.—MATRIX brown glass crowded with linear microliths of felspar and some pyroxene; magnetite granules generally disseminated; marked flow structure.

PHENOCRYSTS.—*Plagioclase* very abundant, well-defined crystals of usual andesitic character; ext., 23°/25°.

Augite: Simple well-defined crystals and clusters, twinned; nearly colourless to faint grey-green; extinction up to 44°; fairly numerous.

Hypersthene: Fresh and unaltered, as abundant as the augite, same colour; pleochroism feeble, faint bluish-green / faint straw-yellow.

Hornblende: Fresh, with reaction borders; not very common.

Magnetite: Numerous fairly large crystals.

Hyalopilitic Hypersthene Andesite, containing some hornblende.

Illustration.—The slice shows strong contrasts between the matrix and the contained phenocrysts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, lower middle, which is characteristic of the rest of the slice. The reproduction shows abundance of matrix, in which float crystals ranging from very minute up to what appears an inch in length or more. The brown glass was evidently non-actinic, and consequently this is represented black.

Locality.—The west or outer third of the peninsula on the north side of Coromandel Harbour, Coromandel, Te Kouma, and Manaia district.

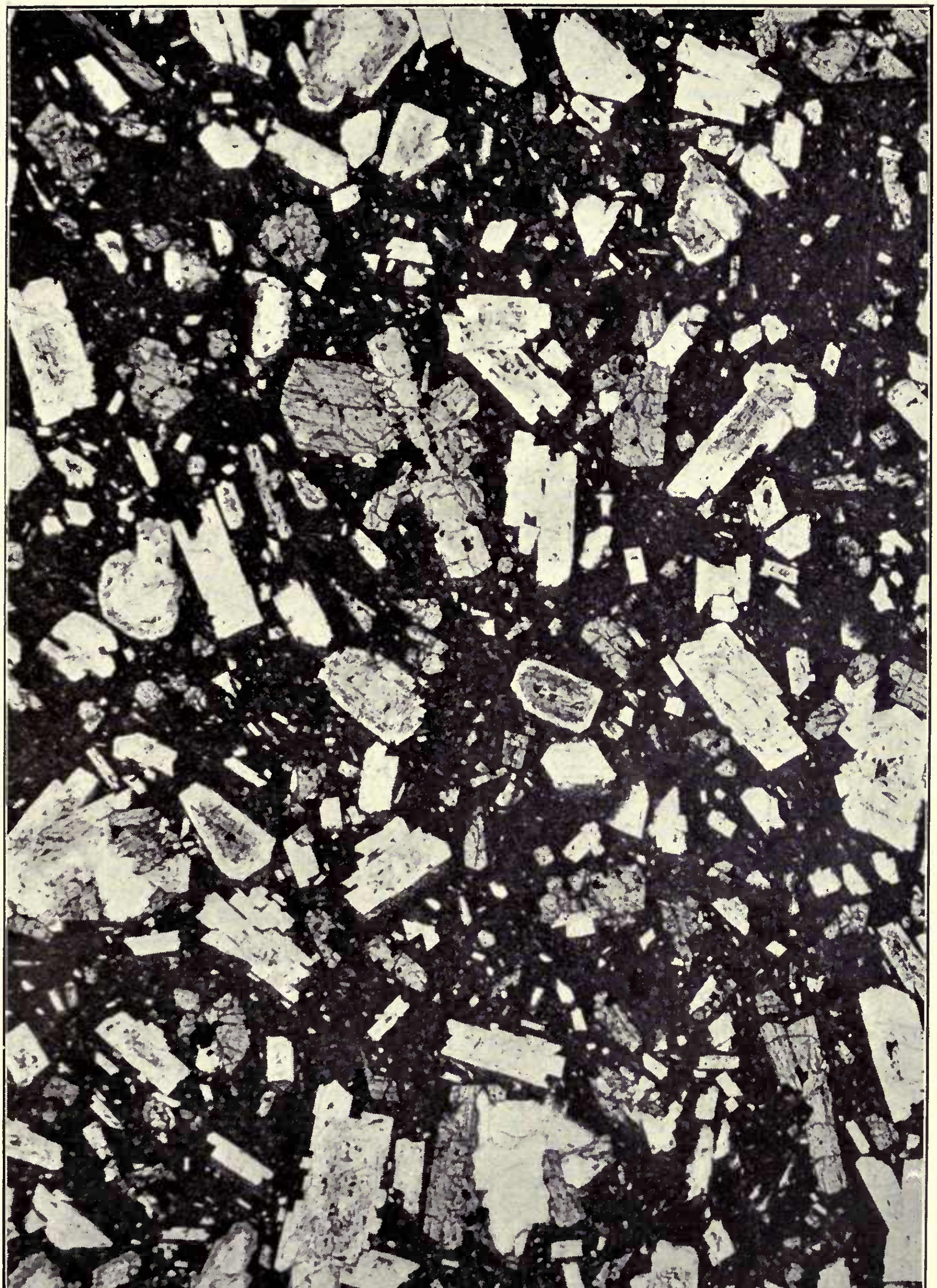
Formation.—Beeson's Island group.

Remarks.—As seen in the sea-cliffs of the peninsula the rocks are generally of a lighter colour than the specimen selected. The formation in the cliffs consists mainly of a very coarse breccia agglomerate, and neither lava-streams nor dyke-rocks are met with till the extremity of the peninsula is reached, where solid rocks are reported on both sides of the channel separating the peninsula from Beeson's Island.

The light-grey appearance of the weathered rock, its coarse texture, and harshness to the touch must be considered responsible for this rock being for many years regarded as trachytic in character, not on the shores of Coromandel Harbour only, but south along the coast to Kirita Bay.

No. 84/3411.

M.C.—Compact greyish-white rock, easily scratched, somewhat steatitic appearance. Pyrites is present.



No. 83/3390. HYALOPILITIC HYPERSTHENE ANDESITE CONTAINING SOME HORNBLENDE.

[*To face p. 190.*

U.M.—Minute grains of quartz and scales of a sericite-like mineral, in which are set rhyolitic quartz grains showing characteristic invasions of the matrix, and numerous very small bi-pyramids of quartz, some of which show secondary growth. The mineral which occurs in the spotted adinoles, such as 70/3216, is abundantly developed; it is not destroyed by heating to redness, and it survives boiling in concentrated hydrochloric acid. The rhyolitic quartz grains strongly suggest an altered igneous rock; splinters fuse at the edge before the blowpipe.

Adinole(?).

Locality.—No. 3 level, Royal Oak Mine, Tokatea Hill, Tiki-Tokatea district.

Formation.—Te Anau series.

Remarks.—The rocks in this and the higher levels of this and adjacent mines have hitherto been regarded as belonging to the Tertiary group of volcanic rocks. The description of the specimen is in agreement with the most recent examination of the geology of the district, and is not at variance with the conclusion that the rocks of even the higher part of Tokatea Hill are, even the dyke intrusions, of Palæozoic age.

No. 3 level has been driven right through the range, and it was from material brought to the western tip-head that the sample under description was taken. The same rock nearly midway in the tunnel shows as thick-bedded masses in a nearly horizontal position, and should be closely associated with the rock-masses from which specimens Nos. 3260 and 3277 were taken.

No. 85/3424.

M.C.—Black glassy rock closely spotted with opaque white felspar.

U.M.—Matrix brown glass densely crowded with opaque granules and charged with rod-like felspar microliths. Fluxional structure present.

Phenocrysts.—*Plagioclase* abundant in well-formed crystals; ext., 28° / 32°. The central portion decomposed, and consequently torn out in grinding; the marginal zone well preserved; in some cases a central core of the glassy magma now crypto-crystalline; the submarginal inclusion zone also in some cases glassy. The felspar appears to have been attacked by the magma.

Augite: A good deal, faint greenish-grey crystals and clusters, quite fresh, extinguishing up to 40°. Twinned.

Hypersthene also abundant in single crystals and clusters; pleochroism salmon-pink / bluish-green.

Magnetite: Numerous grains.

Many branching cavities occur in the slide, now filled with clear almost colourless glass, but crystalline in the centre, and so giving aggregate polarisation effects.

Hyalopilitic Hypersthene Andesite.

Illustration.—The slice shows good contrast between the glass of the base and the more prominent phenocrysts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, the middle part, which indicates the general character of the slice.

The reproduction closely resembles the illustration of specimen No. 3390, the only difference being the greater size of the phenocrysts and the fewer number of small and minute crystals. The material from which the two specimens were collected is similar, and might very well be the product of the same eruption.

Locality.—Cliffs on the north side of the upper part of Manaia Harbour, Coromandel, Te Kouma, and Manaia district.

Formation.—Beeson's Island group.

Remarks.—This rock is from a coarse breccia, largely developed between Te Kouma and Manaia Harbours, where it forms hills, in which a rude stratification of the material composing them is easily made out if viewed from a distance; but this character disappears on closer inspection. The breccias forming the cliffs from which the specimen was taken show no variety of rock, and the description of the megascopic character as given above would apply to almost the whole of the material forming the hills bounding on the north Manaia Harbour and thence extending to the southern shores of Coromandel Harbour.

No. 86/3433.

M.C.—Glassy black rock with small phenocrysts of felspar.

U.M.—Matrix colourless glass crowded with microliths and opaque dust; flow structure. In interstices between phenocrysts a minutely granular brown glass without microliths.

Phenocrysts.—*Plagioclase,* with usual andesitic character, fresh; ext., 20° / 22°, 25° / 28°.

Augite: A few small, often fragmentary, crystals of a greenish-grey tint.

Hypersthene is the dominant pyroxene. It occurs in numerous well-formed crystals, with the usual pleochroism, and is quite fresh. Sometimes intergrown with plagioclase.

Hornblende in ochreous-yellow or rarely green crystals in various stages of resorption.

Magnetite: Fairly numerous grains.

Sometimes a coarsely grained product consisting of evident augite crystals and magnetite is present.

Hyalopilitic Hypersthene Andesite, containing hornblende.

Illustration.—The slice shows good contrast between the glassy base and the crystals immersed therein.

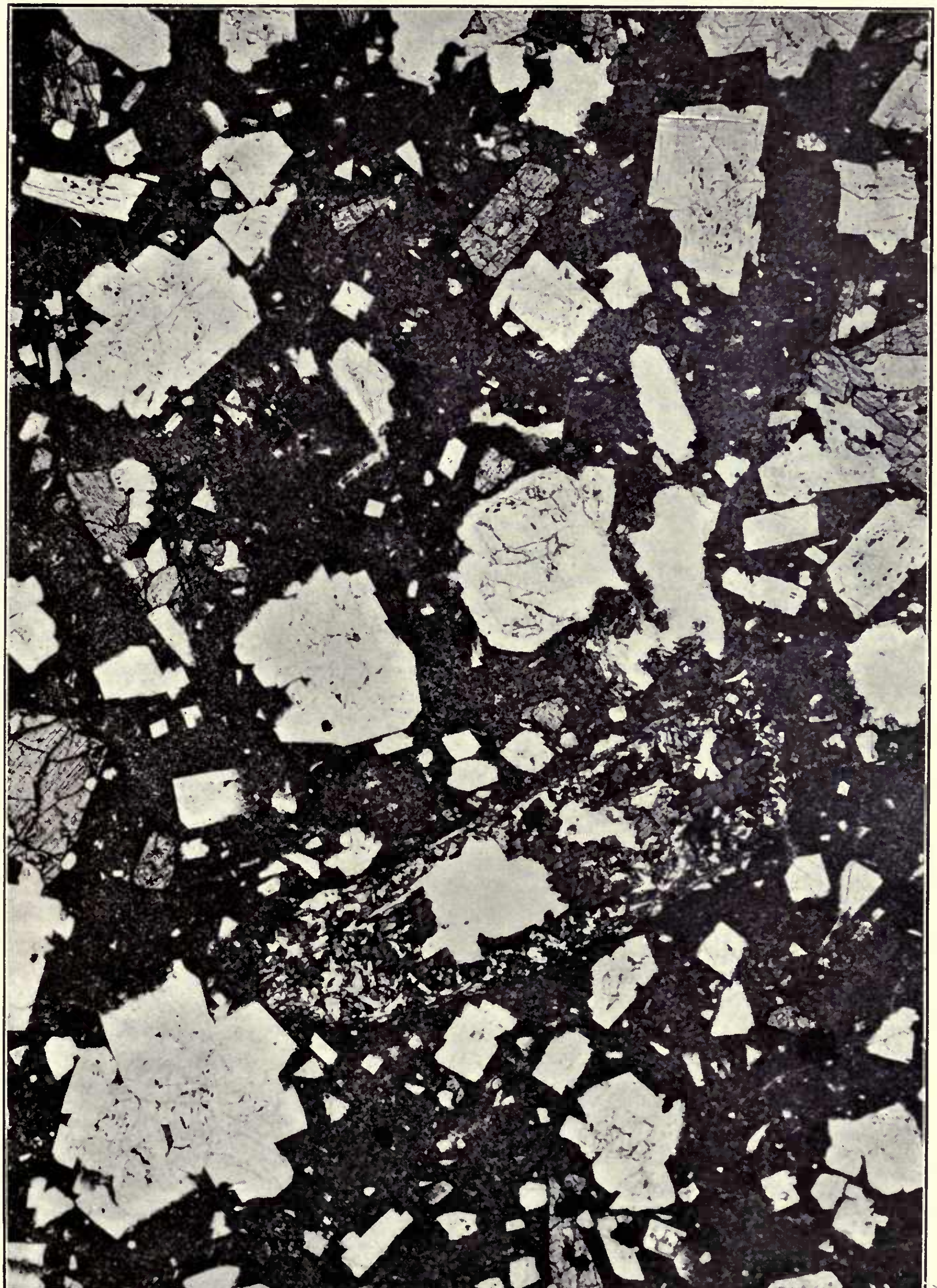
Photographed by ordinary light; magnification, 33 diameters; area photographed, lower right, which is fairly characteristic of the other parts of the slice.

There is striking agreement between the illustration of this specimen and of Nos 3424 and 3390. The present specimen, however, unlike the two former, was

No. 85/3424. HYALOPILITIC HYPERSTHENE ANDESITE.

[*To face p. 192.*

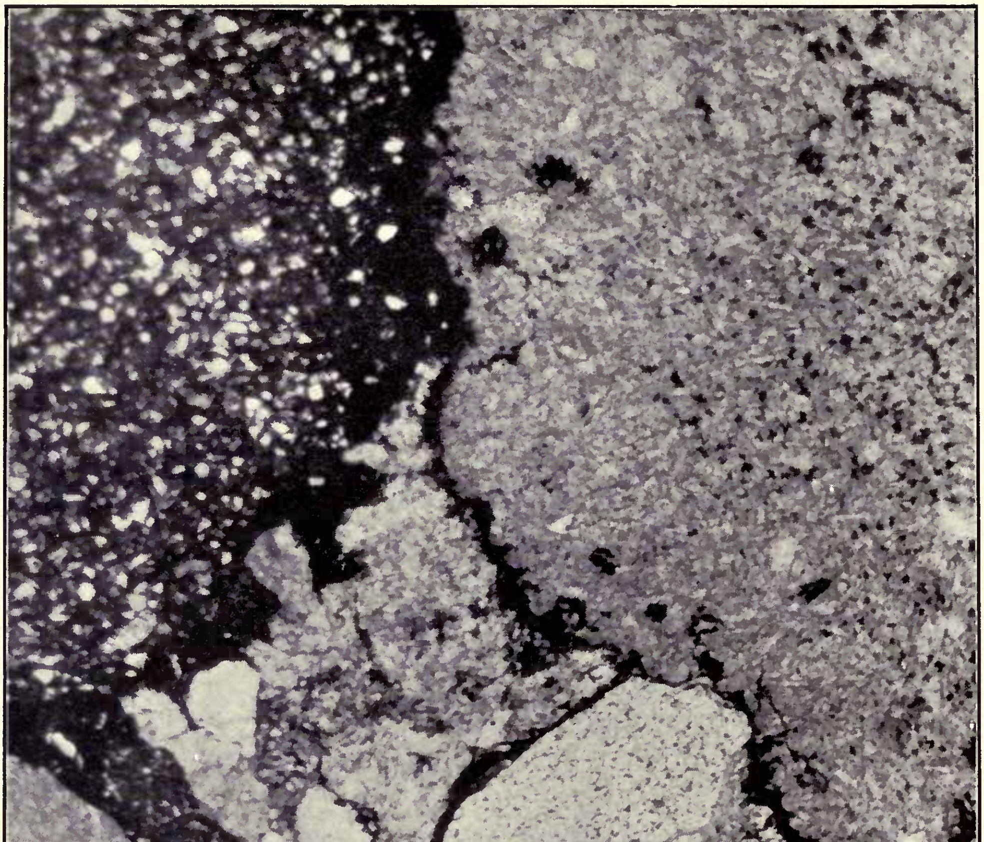
i.



No. 86/3433. HYALOPILITIC HYPERSTHENE ANDESITE CONTAINING HORNBLENDE.

[*To face p. 192.*

ii.



No. 87/3443. CONGLOMERATE CHIEFLY FORMED OF PEBBLES OF IGNEOUS ROCKS.

[*To face p. 193.*

taken from a solid floe of dark and apparently well-preserved andesite; while the others come from breccias exposed in high cliffs, and apparently altered by weathering.

Locality.—The road-line on the top of the range between Coromandel and Manaia Harbours.

Formation.—Beeson's Island group.

Remarks.—This rock lies at the base of the volcanic part of the section in which it appears, near, if not in actual contact with, Trias rocks. Its fresh appearance is remarkable, considering that all the volcanic rocks in the immediate vicinity are much decomposed, and that close to where the specimen was taken there is strong evidence of thermal action in an abundance of siliceous sinter in solid masses or as loose boulders down the northern slope of the range to the low grounds at the head of Manaia Harbour.

No. 87/3443.

M.C.—Conglomerate with rounded pebbles of igneous rocks.

U.M.—The rock consists almost entirely of worn and fragmentary material, with scarcely any interstitial cement. Pebbles of very various kinds and of all sizes occur, from those visible without a lens down to others of microscopic dimensions. The interstices between the larger are filled with the smaller, and those between the smaller by others smaller still, and so on. Interstices unoccupied by fragments are thus rare, secondarily deposited material, such as carbonates and chlorite, occurring only in very insignificant quantity. The pebbles consist—

(i.) Of a dark-brown fine-grained grit or grauwacke, derived from older sedimentary rocks. It presents a finely granular brown matrix, in which small angular grains and splinters of quartz are richly scattered. Banded plagioclase extinguishing at low angles, turbid orthoclase, worn flakes of muscovite, chlorite flakes after biotite, and small andesite-like fragments are also present. An occasional zircon may be noted. In some places material similar to this grauwacke forms a matrix in which the other constituents of the conglomerate are immersed.

(ii.) Of various forms of andesite, both pilotaxitic and hyalopilitic with altered glassy base; of dacite, and of the groundmass of flow rocks without phenocrysts composed of ragged felspar laths with interstitial quartz. Most of these pebbles show marked fluxional structure. Silicified rhyolites are also present.

(iii.) The smaller fragments consist of large grains of quartz, often containing liquid cavities; broken crystals of plagioclase, with twinning lamella bent or broken as a result of pressure posterior to accumulation; and other material. The materials are such as might have been derived from Carboniferous rocks.

Conglomerate chiefly formed of Pebbles of Igneous Rocks.

Illustration.—The slice shows good contrast between the different fragments and pebbles that compose it. Photographed by ordinary light; magnification, 50 diameters; areas photographed—(*a*) the middle right, and (*b*) the lower left, which show a variety of rocks of which the reproductions give a fair rendering.

Locality.—The south slope of the ranges between Coromandel and Manaia Harbours, in a cutting of the Thames–Coromandel Road.

Formation.—Trias.

Remarks.—Conglomerates of igneous rocks are to be found on both the north and south slopes of the range, but chiefly on the latter. Volcanic material was first found in gritty sandstone on the south shore of Coromandel Harbour, but this proved nothing beyond the fact that, as in Tiki Creek and the mines of Tokatea Hill, igneous matter of rhyolitic character occurs in beds resembling those of the Te Anau series in other parts of the Coromandel district.

The coarser conglomerates on the south slope of the range at once indicated a close correspondence, if not complete identity, between the igneous rocks of the conglomerates and the flow-rocks and dyke intrusions of the Tiki-Tokatea district, belonging to the Te Anau series, and at the same time a probable connection with the dykes of Moehau that appear in rocks of the Maitai series of Carboniferous age.

The conglomerates now under consideration, having resulted from previously existing igneous rocks of Carboniferous and Devonian age that can still be traced in the northern part of the Cape Colville Peninsula, must be regarded as of Permian or of Secondary age not younger than the Jurassic period, and there being some slight evidence of the Triassic age of the conglomerates themselves, until distinct proofs to the contrary are obtained tentatively they may be considered as of that age.

The great importance that attaches to the nature and identity of the igneous rocks forming the bulk of these conglomerates and the impossibility of otherwise representing fairly the rock-slices of the specimens described warranted the production of more than one photograph of each slice, and this has accordingly been done: four photographs of different parts of this were taken, of which two have been reproduced, the selections being fairly characteristic of the slice.

No. 88/3450.

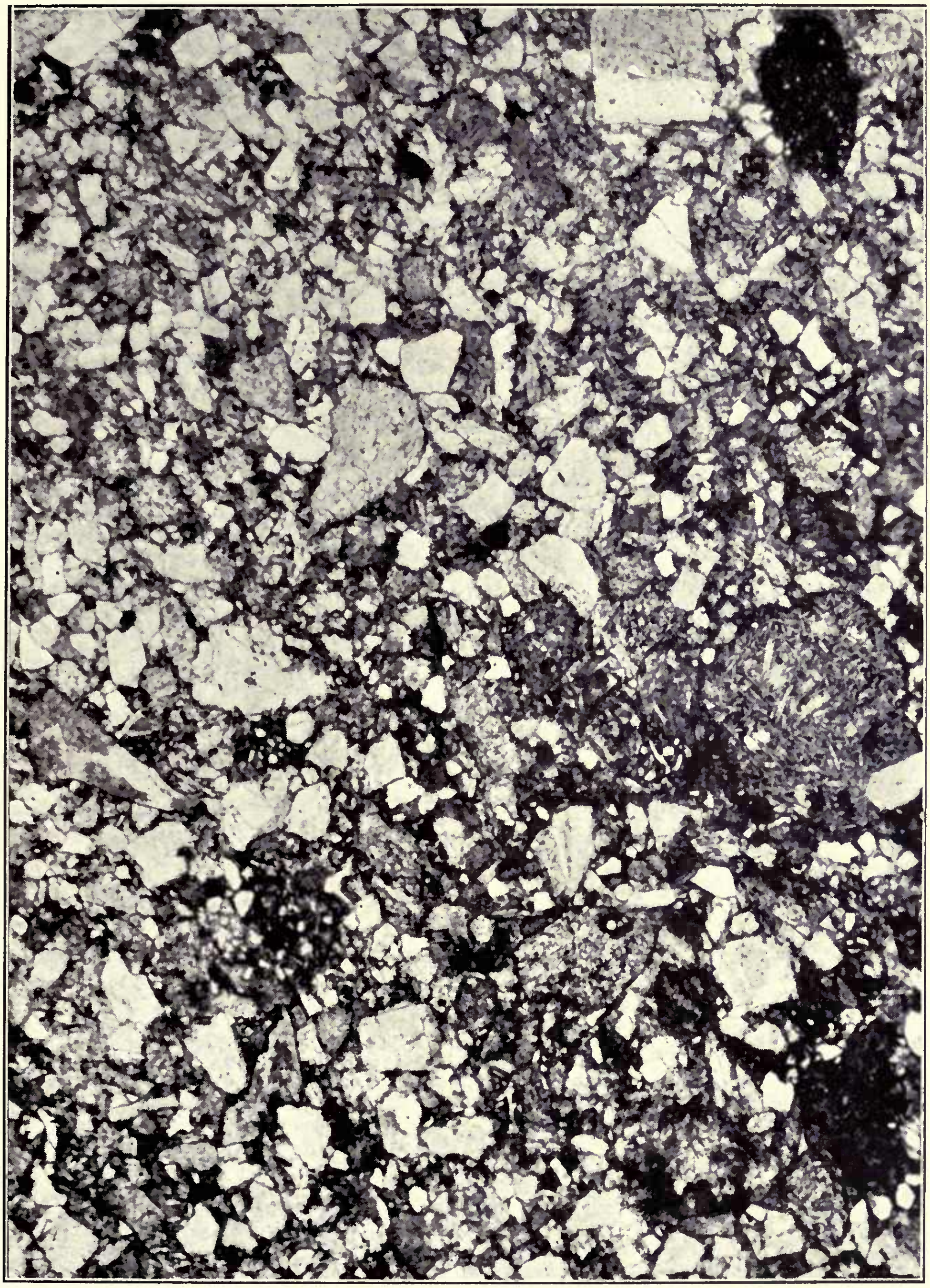
M.C.—A conglomerate similar to No. 3443.

U.M.—Very similar to No. 3443, but differs in the presence of a fairly large pebble having carbonate of lime for its matrix. In addition to the carbonates of the matrix, numerous pseudomorphs of calcite after some other mineral occur in the slice, but no signs remain of organic structure if this were ever present. The fragments in this calcareous pebble are very various; quartz grains predominate, but there are also pellets of grauwacke, grains of altered felspar sometimes with included epidote, and bits of the groundmass of andesite, and possibly of rhyolite. Many of the quartz grains seem to have come from rhyolite.

Congolmerate chiefly formed of Pebbles of Igneous Rocks.

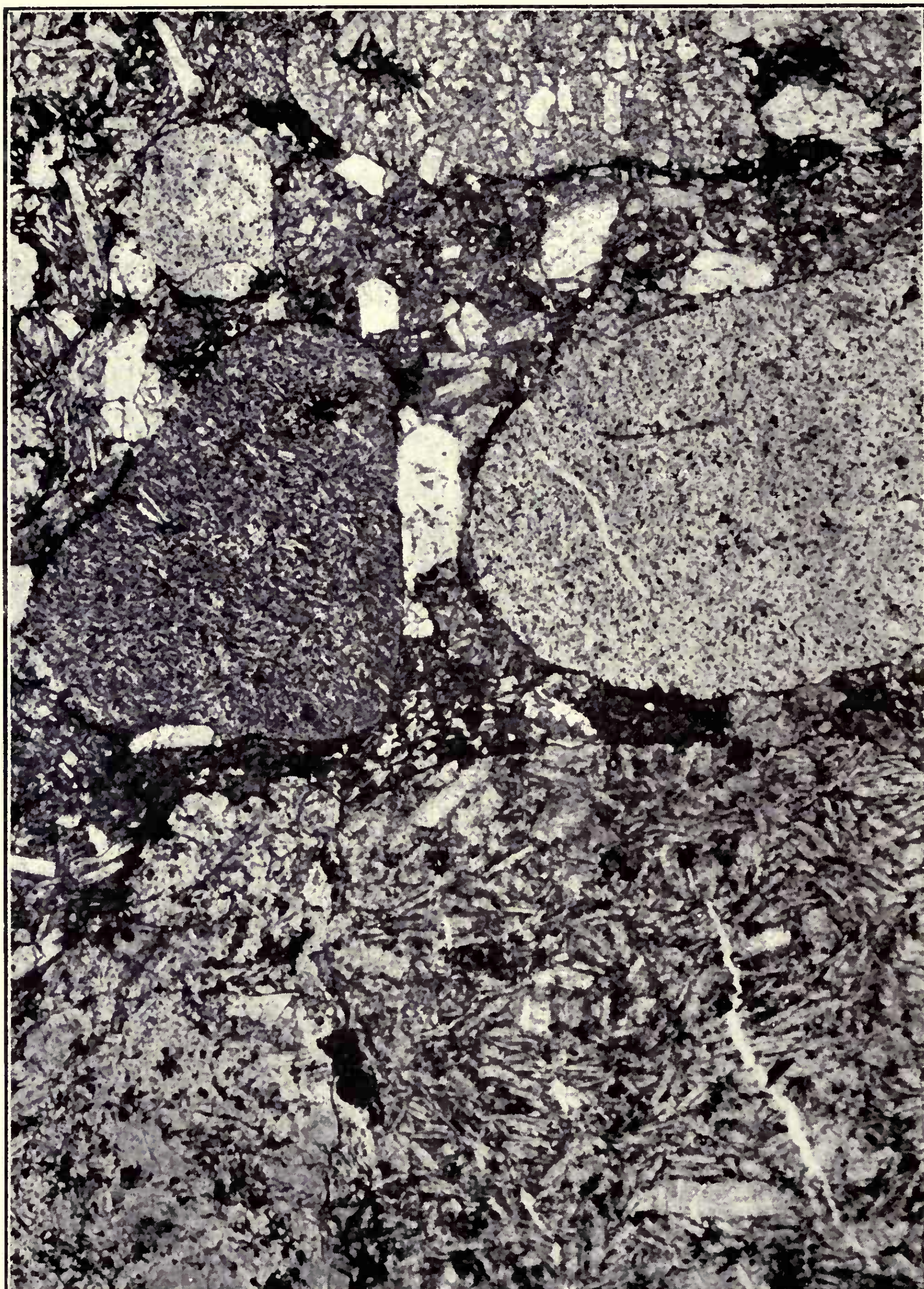
Illustration.—The slice shows fair contrasts.

Photographed by ordinary light; magnification, 50 diameters; area photographed, upper middle part, the result of which, although a good representation



No. 88/3450. CONGLOMERATE CHIEFLY FORMED OF PEBBLES OF IGNEOUS ROCKS.

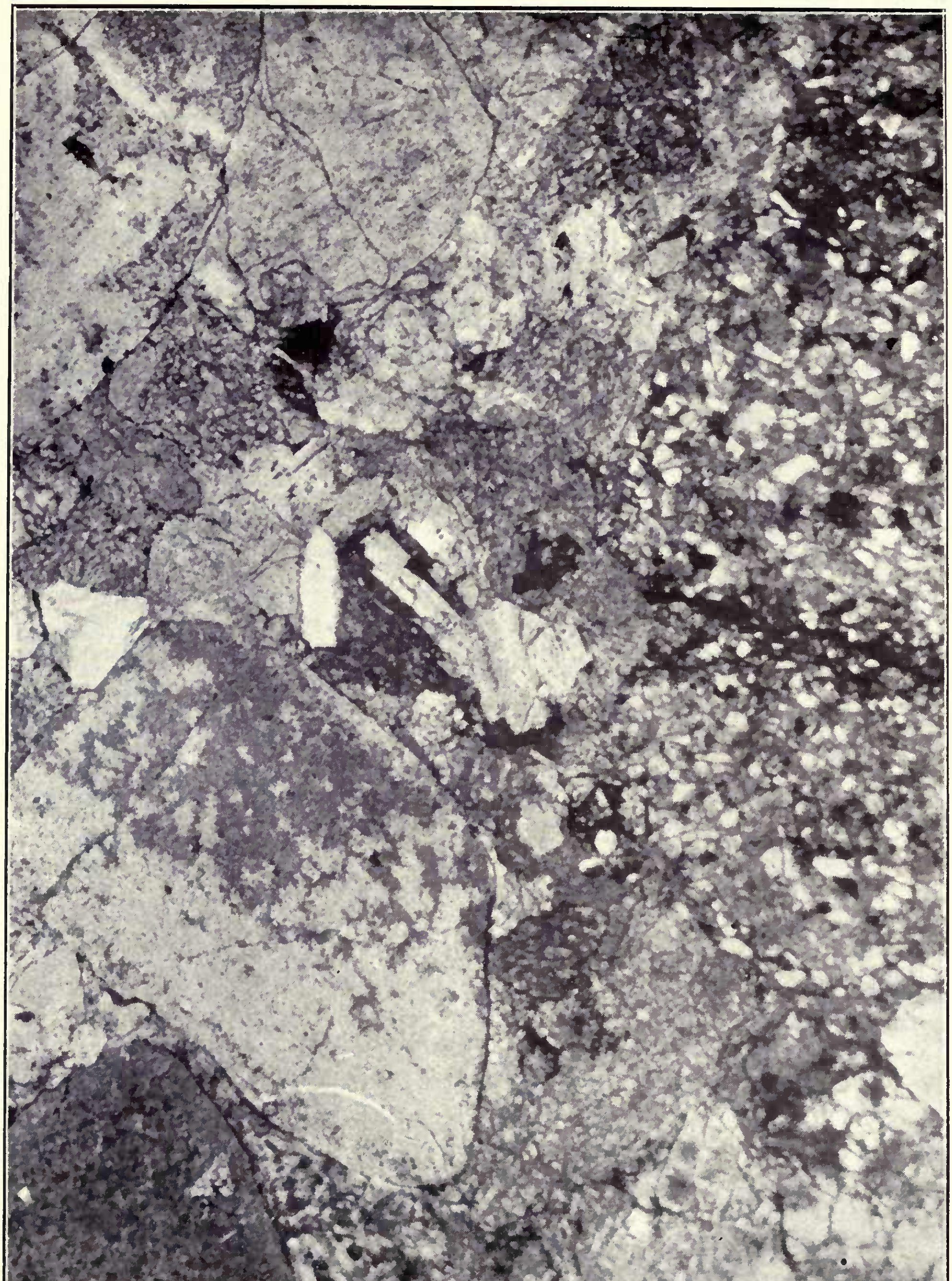
[*To face p.* 194.



No. 90A/3453. CONGLOMERATE CHIEFLY FORMED OF PEBBLES OF IGNEOUS ROCKS.

[*To face p. 195.*

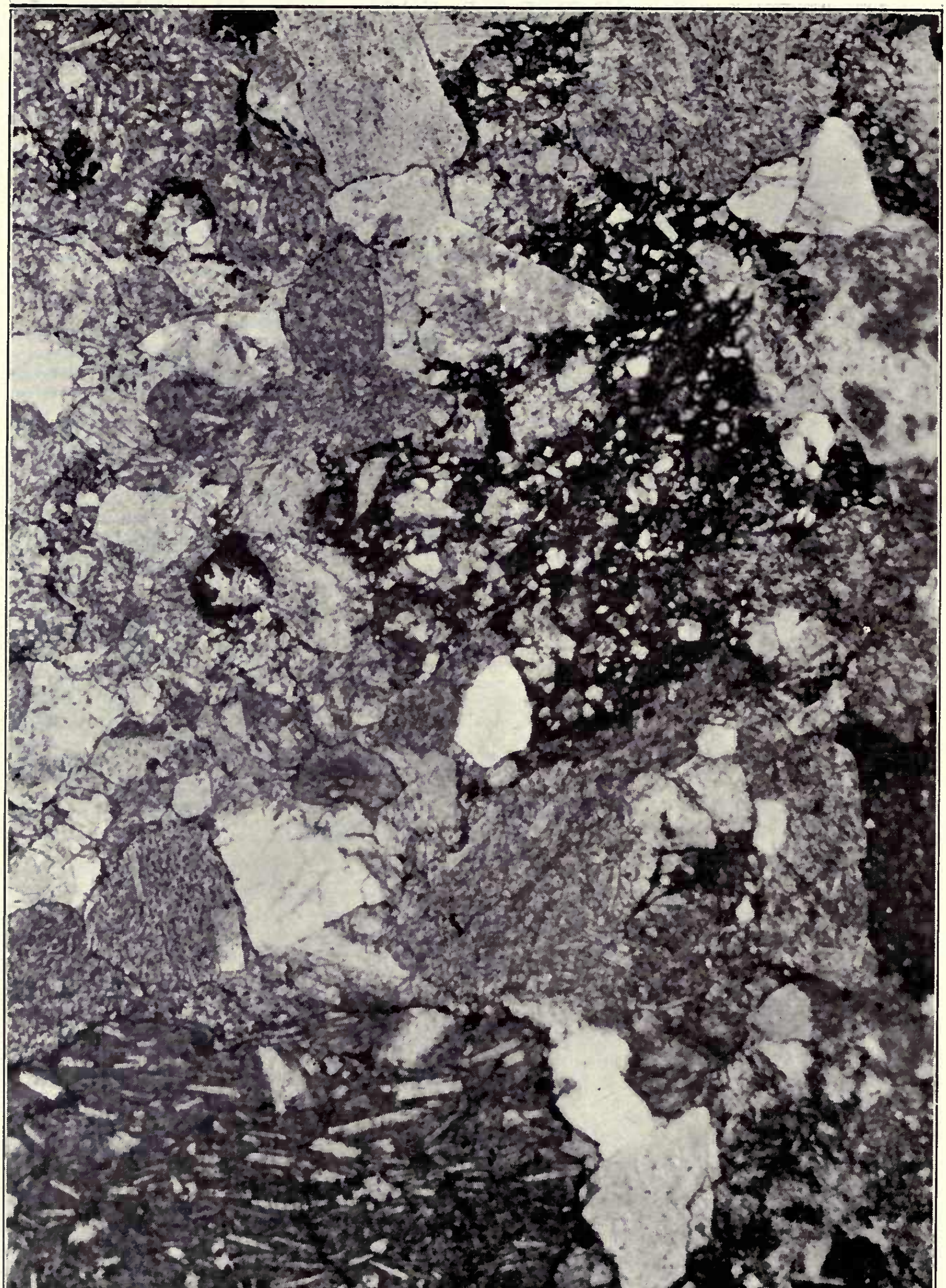
i.



No. 90B/3453. CONGLOMERATE CHIEFLY FORMED OF PEBBLES OF IGNEOUS ROCKS.

[*To face p.* 195.

ii.



No. 90c/3453. CONGLOMERATE CHIEFLY FORMED OF PEBBLES OF IGNEOUS ROCKS.

[*To face p. 195.*

iii.

of the part concerned, cannot be considered as characteristic of a slice in which such variety appears as would under the same power necessitate the taking of five or six photographs in order to give a fair idea of the slice.

Locality.—Southern slope of the range between Coromandel and Manaia Harbours, in a cutting of the Thames–Coromandel Road.

Formation.—Trias.

Remarks.—Generally the same as under No. 3443. Three photographs were taken of different parts of this slice, and, while each of the others showed larger inclusions, the upper middle part was selected as differing somewhat from the others, from the slice (No. 3443) and from those that are yet to be described.

No. 8-3463.

M.C.—Conglomerate similar to preceding.

U.M.—The pebbles and fragments consist of andesite, rhyolite, fine-grained grauwacke, quartz sometimes in bi-pyramids, bits of micro-pegmatite, chips of plagioclase felspar, &c.

Conglomerate chiefly formed of Pebbles of Igneous Rocks.

Locality.—The same as No. 3443.

Formation.—The same as No. 3443.

Remarks.—The same as under No. 3443.

No. 90/3453.

M.C.—A conglomerate similar to the preceding.

U.M.—The pebbles consist of pilotaxitic andesite, silicified rhyolite with traces of axiolitic structure in some cases, in others micropœcillitic with clouded sanidine as a Carlsbad twin, and residues of positive spherulitic structure; some biotite also is present in some of the rhyolites. There is also altered hyalopilitic andesite with flow structure. The grains are small fragments as before. Amongst the pebbles one with a calcareous matrix must not be overlooked; it might be called a calcareous grit or a calcareous grauwacke.

Conglomerate chiefly formed of Pebbles of Igneous Rocks.

Illustrations.—The slice shows good contrasts.

Four or five photographs of different parts were taken—of these, three have been reproduced: First (90A), photographed by ordinary light; magnification, 50 diameters; area photographed, upper right, in which there is a variety of igneous pebbles of varying sizes, but little or no grauwacke. Second (90B), a reproduction of a photograph less distinct than 90A, taken by ordinary light, under 50 diameters magnification, the part photographed being the lower middle part. Third (90C), a photograph and reproduction of greater vigour, which, taken under the same conditions of light and magnification, represents the middle part of the slice, and exhibits a variety of rocks of the kinds mentioned in the description of the rock and slice.

Locality.—Southern slope of the range between Coromandel and Manaia Harbours, in a cutting of the Thames–Coromandel Road.

Formation.—Trias.

Remarks.—The same as under No. 3443.

No. 91/3464.

M.C.—A conglomerate.

U.M.—Pebbles of banded rhyolite with mosaic groundmass and pilotaxitic andesite; also altered hyalopilitic andesite, grauwacke consisting of angular grains of quartz, orthoclase, plagioclase, chlorite, sericite, brown biotite, leucoxene granules, and zircons.

Conglomerate chiefly formed of Pebbles of Igneous Rocks.

Illustration.—The slice shows good contrasts, and of the different photographs taken two have been reproduced: First (91A), photographed by ordinary light, magnification 50 diameters; area photographed, upper middle part. Second (91B), photographed under the same conditions of light and magnification as 91A, the area photographed being also the upper middle part a little to the right of 91A, which shows a junction of the coarser conglomerates with the grauwacke of the adjacent area.

Locality.—Southern slope of the range between Coromandel and Manaia Harbours, in a cutting of the Thames–Coromandel Road.

Formation.—Trias.

Remarks.—The same as under No. 3443.

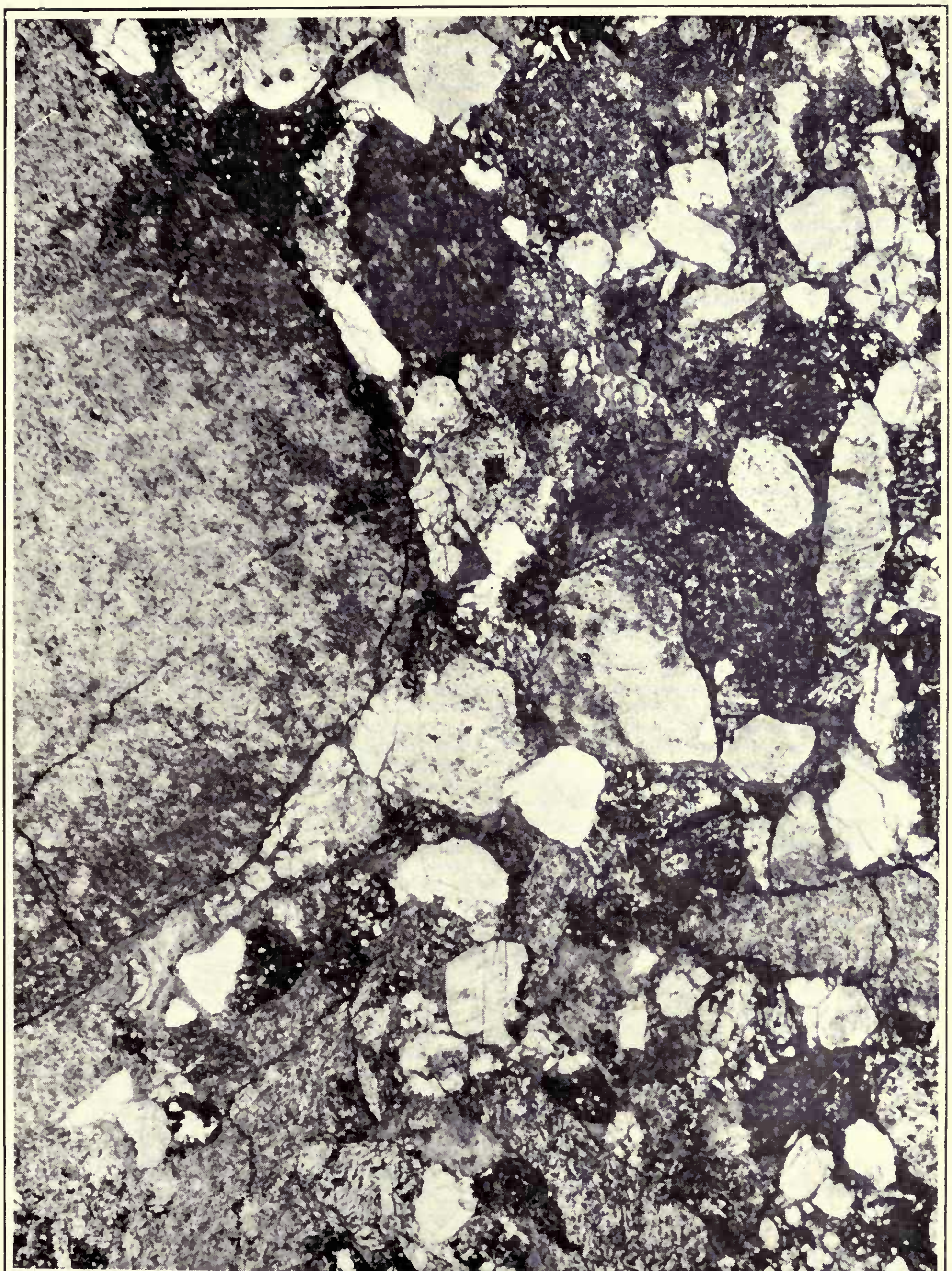
No. 92/3469.

M.C.—Porous grey rock with phenocrysts of felspar and some dull black mineral.

U.M.—MATRIX dirty-looking, owing to irregular distribution of leucoxene granules and black opacite rods. With *x.n.* minutely or even crypto-crystalline groundmass with immersed felspar microliths in flow-lines; jagged grains of quartz of very various dimensions, often very small. Occasionally micropœcillitic areas. Leucoxene granules. Black rods which may be resorption remains of hornblende. Some orthoclase may be present.

PHENOCRYSTS. — *Plagioclase* fairly fresh; carbonates locally developed; abundant large crystals, variously twinned, zonal; *r.i.*, above balsam; ext., 20°/20°.

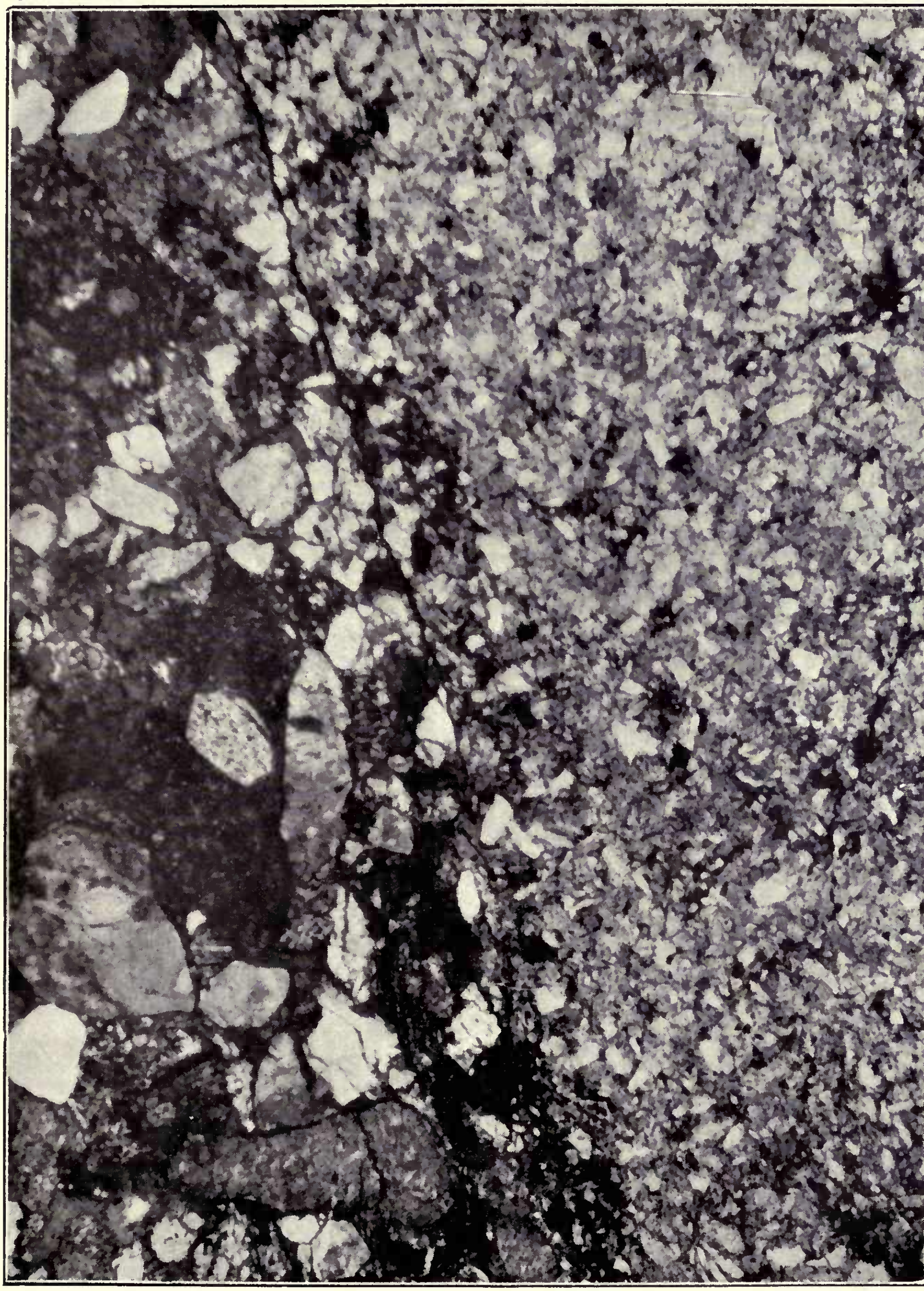
Augite: Large regular crystals almost wholly transformed into carbonates, and some mineral which has disappeared, leaving a vacant space. Margined by a black rim of opacite.



No 91A/3464. CONGLOMERATE CHIEFLY FORMED OF PEBBLES OF IGNEOUS ROCKS.

[*To face p. 196.*

i.



No. 91B/3464. CONGLOMERATE CHIEFLY FORMED OF PEBBLES OF IGNEOUS ROCKS.

[*To face p. 196.*
ii.

No. 92/3469. HORNBLENDE DACITE

[*To face p.* 197.

Hypersthene: The outlines of some pseudomorphs in carbonates and serpentine, in some cases with a quartz core, suggest the presence of pyroxene.

Hornblende: Abundant pseudomorphs showing strong resorption; consisting chiefly of carbonates and magnetite, the latter arranged in linear rows of dots. Some almost entirely represented by magnetite.

Apatite: Numerous large crystals of a yellow colour, pleochroism faint canary-yellow / brownish-yellow.

Quartz: Some rounded grains with stone cavities.

Hornblende Dacite.

Illustration.—The slice shows good contrasts in all the parts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, the upper right, in which lies the largest crystal contained in the slice.

Locality.—Tunnel in Murphy's Hill, Matarangi district.

Formation.—Beeson's Island group.

Remarks.—The partial destruction of the large crystal in grinding the slice could not, perhaps, be avoided. What remains—the other crystal outlines and the general character of the reproduction—is a fair rendering of the part of the slice concerned. Murphy's Hill is on the western border of the Matarangi district, and is not to be confounded with Murphy's Hill in the Kapanga district.

No. 93/3476.

M.C.—Black basalt-like rock with phenocrysts of felspar and ferro-magnesian minerals.

U.M.—Matrix colourless glass with abundant microliths of felspar and some faint-green prisms of pyroxene, minute granules of magnetite. Traces of flow structure. The felspar microliths are plagioclase with a *r.i.* above balsam.

Phenocrysts.—*Plagioclase:* Numerous very large crystals, with usual andesite characters; ext., 25°/25°. Often include network of green serpentine.

Augite: Faint greyish-green crystals and clusters, also fragments. Some remarkable intergrowths with hypersthene.

Hypersthene: Usual pleochroism bluish-green / pinkish; passing into green serpentine.

Hornblende: A few resorption pseudomorphs.

Magnetite grains, and colourless *apatite*.

Hyalopilitic Hypersthene Andesite, containing hornblende.

Illustration.—The slice shows good contrasts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, the middle part, which is characteristic of the rest of the slice otherwise than as containing the largest crystal in the slice. The large crystal contains numerous small areas, rendered black in the reproduction. These are green in the slice.

Locality.—The east side of the east spur of Matarangi Hill, ending in Matarangi Bluff.

Formation.—Beeson's Island group.

Remarks.—The specimen is from the road-cutting round the bluff.

No. 94/3482.

M.C. — Black basalt-like rock sprinkled with phenocrysts of white felspar.

U.M. — Matrix colourless glass crowded with microliths of felspar, and more rarely pyroxene and granules of magnetite. Matrix uniform and abundant.

Phenocrysts.—*Plagioclase:* Usual andesitic character; ext., 20°/ 20°.

Augite not very abundant. Faint greenish-grey crystals, sometimes in micrographic growth with plagioclase.

Hypersthene: More numerous crystals, fresh, with usual pleochroism.

Magnetite: Fairly numerous large grains.

Chlorophæite in patches.

Hornblende in crystals having pleochroism deep brassy-yellow / straw-yellow; marked reaction border, often surrounded by a cluster of pyroxene, felspar, magnetite and glass. The hornblende resorption areas resemble those of No. 3433.

Hyalopilitic Hypersthene Andesite, containing hornblende.

Illustration.—The slice shows strong contrasts, and, possibly owing to an under-exposure of the photographic plate, the details of the matrix charged with microliths have not been rendered.

Photographed by ordinary light; magnification, 33 diameters; area photographed, the upper right, which indicates the general character of the slice.

Locality.—The east side of the east spur on the road round the sea-face of Matarangi Bluff, Matarangi district.

Formation.—Beeson's Island group.

Remarks.—Part probably of a lava-stream from Matarangi Hill.

No. 95/3527.

M.C.—Basalt-like rock with phenocrysts of felspar and ferro-magnesian minerals.

U.M.—Matrix pilotaxitic, felspar microliths in flow-lines; granules of magnetite; occasional streaks of greenish chlorophæite.

No. 93/3476. HYALOPILITIC HYPERSTHENE ANDESITE CONTAINING HORNBLENDE.

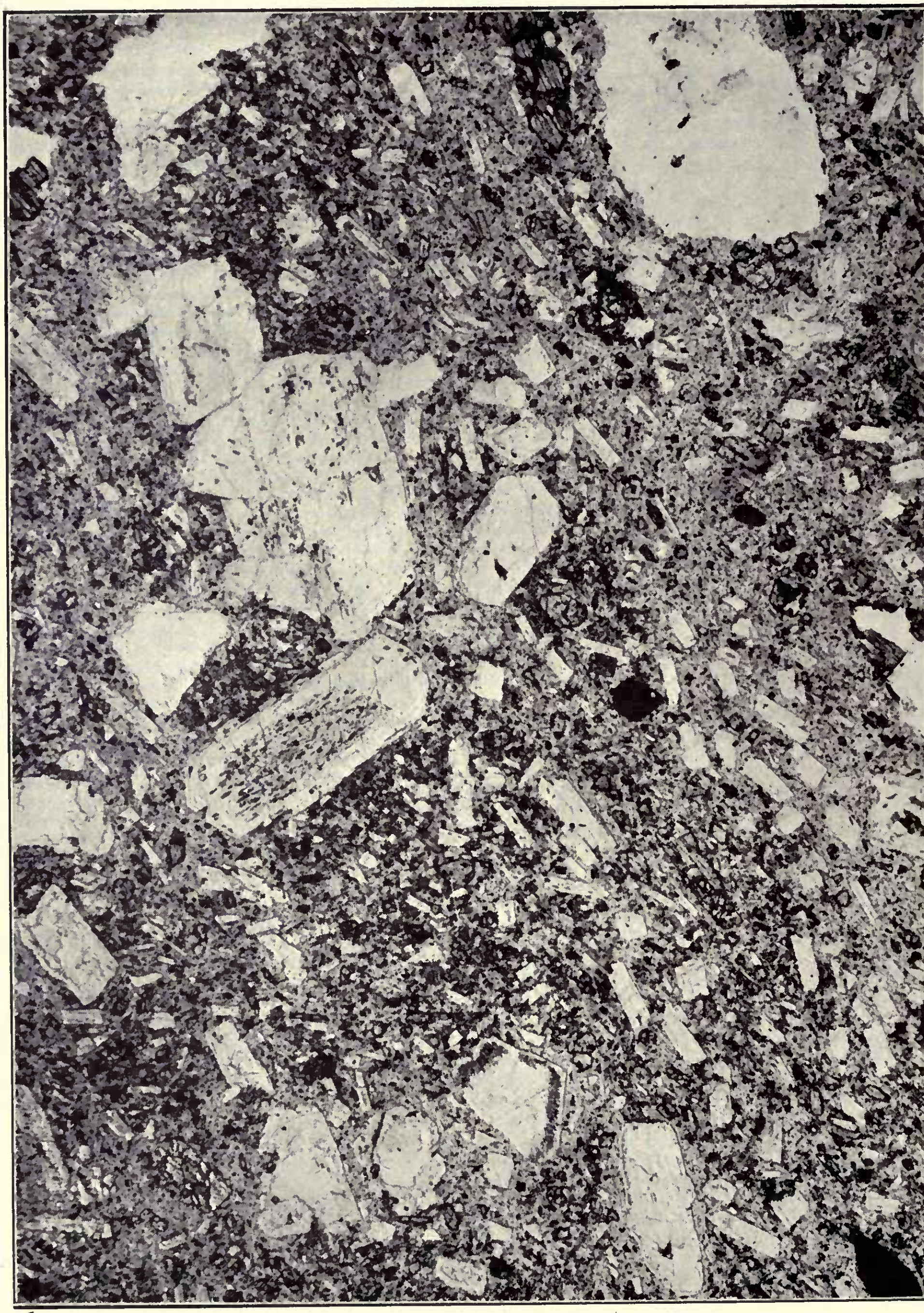
[*To face p. 198.*

i.

No. 94/3482. HYALOPILITIC HYPERSTHENE ANDESITE CONTAINING HORNBLENDE.

[*To face p. 198.*

ii.



No. 95/3527. PILOTAXITIC HYPERSTHENE ANDESITE WITH HORNBLENDE.

[*To face p.* 199.

PHENOCRYSTS.—*Plagioclase :* Usual andesitic character ; extinction up to 20°/ 25°.

Augite not very abundant ; crystals with synthetic twinning, some intergrown with hypersthene ; extinction up to 41°. Colour faint greenish-grey, almost colourless, mostly fresh.

Hypersthene faint-greenish, usual pleochroism altering into greenish serpentine ; distinctly lamellar, but not so-called bastite.

Hornblende : Occasional resorption pseudomorphs, which include hypersthene, suggestive of ophitic intergrowth.

Magnetite grains, when large, usually secondary.

Apatite : Some large crystals associated with hornblende resorption products.

Pilotaxitic Hypersthene Andesite, with hornblende.

Illustration.—The slice shows fair contrasts between the matrix and the phenocrysts.

Photographed by ordinary light ; magnification, 33 diameters ; area photographed, the lower left, which fairly represents the whole of the slice.

Locality.—Middle part of the west spur of Matarangi Bluff, on the road round the coast, Matarangi district.

Formation.—Beeson's Island group.

Remarks.— Comparing this specimen with the two previous (Nos. 3482 and 3476), in which the base is glassy and, as shown in the photographs, without felspar laths or microliths of any kind, in decided contrast with these the pilotaxitic matrix of No. 3527 is clearly shown crowded with minute crystals. All three specimens are megascopically described as " basalt-like rocks with phenocrysts of felspar," and all contain ferro-magnesian minerals and differ in nothing except the character of the matrix ; but this scarcely accounts for the absence of the felspar microliths in the photographs illustrating Nos. 3476 and 3482, light conditions and magnification being the same in each case.

No. 96/3543.

M.C.—Greyish-black basalt-like rock, weathering brown, sprinkled with felspar crystals and dark-red grains.

U.M.—MATRIX fairly abundant, pilotaxitic, plagioclase felspar laths in flow-lines, no visible pyroxene, magnetite grains minute, but very little magnetite dust. Here and there a red ferric hydrate replaces the pilotaxitic material and fills cracks in the felspar phenocrysts ; it is this which gives the appearance of red grains in the hand-specimen.

PHENOCRYSTS.—*Plagioclase :* Usual andesitic character ; extinction up to 25°/ 25°. Decomposition is commencing, and has produced carbonates and green material in some crystals.

Ferro-magnesian minerals completely decomposed, chiefly into carbonates, but also into serpentine, with formation of leucoxene and sphene. The outlines strongly suggest the original presence of hypersthene as well as augite. Hornblende may or may not have been present; if present, quite subordinate.

The iron-ores are chiefly magnetite, but an occasional ilmenite plate may be seen.

Pilotaxitic Hypersthene Andesite, weathered.

Locality.—Brown's Camp, on the Kuaotunu-Mercury Bay Road, Kuaotunu district.

Formation.—Beeson's Island group.

Remarks.—This rock at the surface and in the deeper road-cuttings is very much decomposed, and it is only from isolated kernels of harder rock that moderately good specimens can be obtained.

No. 97/3551.

M.C.—Basalt-like rock with phenocrysts of felspar and ferro-magnesian minerals, much jointed; joint-surfaces covered with a black film.

U.M.—Matrix rather dirty-looking, pilotaxitic, felspar microliths and small rectangular sections; magnetite grains and green decomposed products disseminated.

Phenocrysts. — *Plagioclase:* Usual andesitic characters; ext., 22°/24°. Some crystals a mere shell enclosing green decomposition products.

Augite much altered; a few colourless cores remain within a serpentinous pseudomorph; these extinguish up to 45°.

Hypersthene entirely transformed into green serpentine and carbonates.

Hornblende: Numerous resorption pseudomorphs.

Magnetite: A fair number of large grains, some with leucoxene borders; occasionally epidote associated.

Apatite in association with ferro-magnesian pseudomorphs.

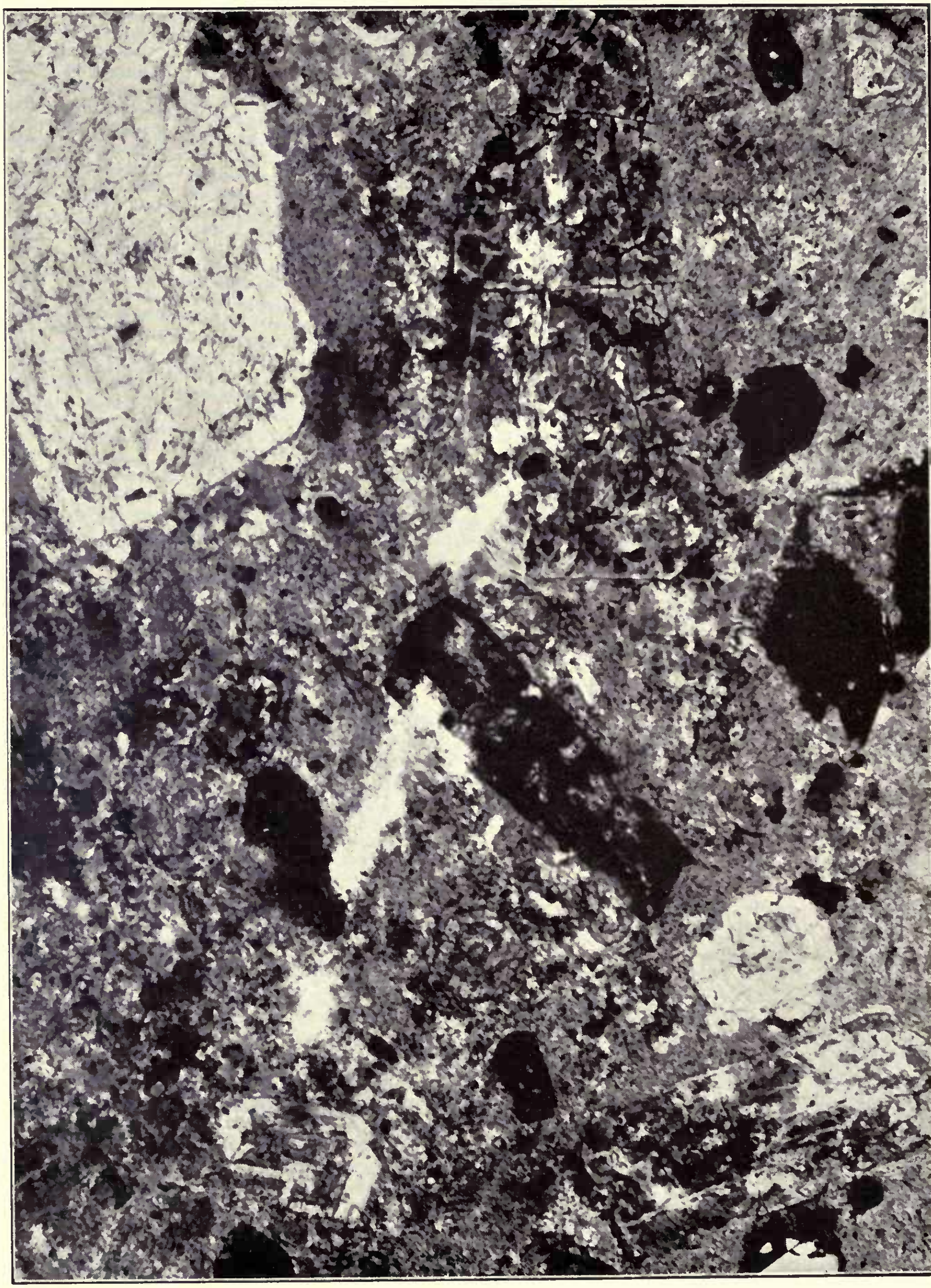
Quartz occurs in mosaics, but may be secondary.

Pilotaxitic Hypersthene Hornblende Andesite.

Locality.—Quarry at the big bend beyond Brown's Camp, on the Kuaotunu-Mercury Bay Road, Kuaotunu district.

Formation.—Beeson's Island group.

Remarks.—The rock as seen in the quarry and adjacent cliffs is shattered, the joints and fractures running in various directions.



No. 98/3557. HORNBLENDE DACITE.

[*To face p. 201.*

No. 98/3557.

M.C.—Greenish-grey rock with darker streaks or bands and phenocrysts of felspar and ferro-magnesian minerals. A very fragmental appearance.

U.M. — Matrix colourless, dirty-looking, heterogeneous. In places pilotaxitic, elsewhere minute jagged quartz grains in a sericite felt. Magnetite irregularly distributed.

Phenocrysts.—*Plagioclase* crystals, complexes, and fragments; abundant; variously twinned; ext., 10°/10° to 15°/15°; *r.i.*, above balsam. Submarginal inclusions of matrix; these peculiarly liable to decomposition; frequently converted into carbonates along the submarginal zones.

Pyroxene represented by pseudomorphs in carbonates, chlorite, and quartz; some nearly all quartz, which occurs in interlocking grains immersed in granular chlorite; some nearly all chlorite. A good deal of pyroxene was originally present.

Hornblende: Numerous resorption pseudomorphs, some of large size, now consisting of chlorite, magnetite, and inclusions among which apatite may be mentioned.

Quartz: A few rounded grains corroded by the matrix.

Apatite: Fairly numerous large crystals in short prisms of brown colour, striated longitudinally.

Some vesicular fragments, cavities filled with chlorite.

Hornblende Dacite Tuff.

Illustration.—Different parts of the slice are in strong contrast, opaque matter abundant and sometimes ill-defined.

Photographed by ordinary light; magnification, 33 diameters; area photographed, the upper middle part, which is that most characteristic of the whole.

Locality.—The west spur of Matarangi Bluff; from the road-cutting on the coast-line, Matarangi district.

Formation.—Beeson's Island group.

Remarks.—The light-grey appearance of the high cliffs formed of this rock distinguishes this from the central and eastern parts of the bluff, in which there are heavy bands of much darker rocks; also a rude stratification appears in the cliffs, and at places the rock has a brecciated character.

No. 99/3558.

M.C.—Greyish stony rock, variegated with red and green spots and streaks, and white veins of calcite.

U M.—Matrix pilotaxitic, abundant laths of plagioclase in flow-lines, spots of carbonates, magnetite grains and leucoxene.

Phenocrysts.—*Plagioclase* of the usual andesitic habit, much altered, replaced by carbonates, serpentine, and sometimes a little quartz. In a coarsely twinned example less decomposed than usual an extinction of 13° / 17° was measured.

Pyroxene completely transformed into green chlorite, colourless serpentine, and carbonates, sometimes also quartz is present. Some of the pseudomorphs show previous corrosion by matrix. Hypersthene was probably present, as well as augite.

Hornblende not observed.

Magnetite: A few large grains *Apatite* also is present.

The rock shows signs of internal shearing.

Pilotaxitic Andesite.

Locality.—Quarry at the big bend, beyond Brown's Camp, on the Kuaotunu-Mercury Bay Road, Kuaotunu district.

Formation.—Beeson's Island group.

Remarks.—The same as under No. 3551.

No. 100/3586.

M.C.—Greenish-white decomposed fragmental rock.

U.M.—Matrix of two kinds, one granular, minutely crystalline, difficult to analyse, charged with irregular angular pseudomorphs in chlorite and carbonates, and occasional quartz mosaics: it is rich in leucoxene granules, and has a dirty appearance; along a sharp line of demarcation it bounds irregular areas, perhaps representing fragments of another kind of rock, the matrix of which is clearer, freer from leucoxene, and very transparent; presents with ordinary light a fibrous appearance, but almost isotropic with *x.n.* The obvious fibres of which it chiefly consists show that it is not glass, and I conclude that it is probably a chlorite with very low double refraction. It is impossible to say what material it has replaced. In this matrix we have the following phenocrysts:—

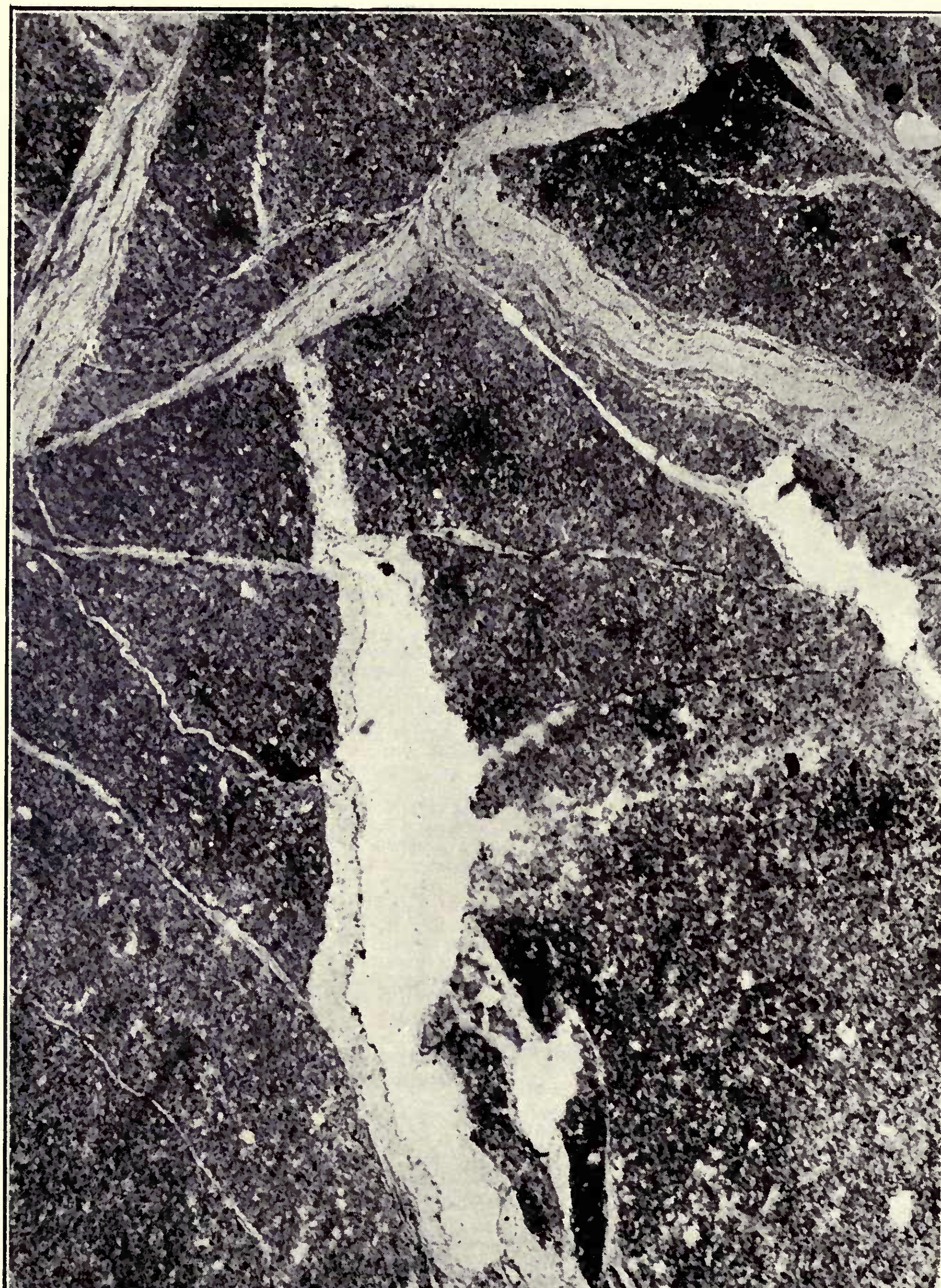
Plagioclase represented by pseudomorphs in carbonates.

Pyroxene represented by pseudomorphs in pennine and sometimes carbonates.

In the matrix which forms the greater part of the rock we have similar phenocrysts, and as well fragments which resemble the rock characterized by the second matrix. In the second slice there is also a fragment of pilotaxitic andesite containing an incompletely altered phenocryst of plagioclase which extinguishes at 12° / 18°, and showing felspar laths in the matrix with fluxional arrangement.

The rock does not afford any of the characteristic signs of an ash, but it is evidently fragmental, and chiefly composed of andesitic material.

Fragmental Andesitic Rock.



No. 101/3626. FINE-GRAINED SANDSTONE MUCH FISSURED AND FISSURES FILLED WITH THERMAL DEPOSIT.

[*To face p. 203.*

Locality.—Upper workings of the Kapai-Vermont Claim, Kuaotunu district.
Formation.—Beeson's Island group.
Remarks.—This rock forms a deposit of some thickness, resting on slates and sandstones of Carboniferous age. In it outcropping reefs were found, which were traced into the underlying sedimentary rocks, in which they have been worked to a considerable depth.

No. 101/3626.

M.C.—A very compact fine-grained rock showing obvious signs of pressure deformation.

A GROUNDMASS of colourless granular material which gives no reaction with *x.n.* Scattered through it are numerous small angular fragments of quartz, opaque whitish granules and in places grains of iron-rust probably pseudomorphic after pyrites. It is traversed by numerous quartz veins, and has clearly been subject to considerable movement and earth-pressures, which have rendered it phacoidal. The isotropic material is probably a decomposition product.

Rock, Problematical.

Illustration.—The slice shows fair contrasts of the different parts, more especially in the part represented.

Photographed by ordinary light; magnification, 33 diameters; area photographed, lower left. The photograph and reproduction from it shows well the manner of the thin veins of siliceous deposit that are found in every part of the slice; otherwise the specimen is a fine-grained sandstone.
Locality.—North-west base of Black Jack, at the north end of the Waitaia Range, Kuaotunu district.
Formation.—Maitai series.
Remarks.—The rock is a fine-grained sandstone, with coarser sandstones containing small inclusions of slate, and sandy shales with traces of coal from the northern lower slopes of Black Jack to sea-level. The finer-grained rock was selected on account of the numerous thin veins of thermal siliceous deposit which traverse it. Its association with the coarser grits and coaly sandy shales of the Maitai series cannot be doubted.

No. 102/3630.

M.C.—Black compact rock with white and yellow spots and obvious xenoliths.

U.M.—MATRIX transparent colourless and brown glass with ultra-microscopic granules, laths and rectangles of plagioclase in obvious flow-lines, prismatic microliths of pyroxene, and octahedra of magnetite. Patches occur of clear-yellow glass and chlorophæite, converted into fibrous serpentine at margin and along cracks. Pyroxene occurs immersed in this; it also, and black material derived from it, forms a network or other inclusions in plagioclase and pyroxene crystals.

PHENOCRYSTS. — *Plagioclase:* Usual andesitic character; ext., 24°/28°; abundant.

Augite in single crystals and large complicated clusters of augite and hypersthene, faint greenish-grey in colour; extinguishes up to 42°.

Hypersthene quite fresh and abundant, with usual characters.

No hornblende pseudomorphs are present. Scarcely any large grains of magnetite are present, but a remarkable intergrowth is seen within the inked circle on the slice. It surrounds a fibrous serpentinous pseudomorph which may be after olivine. The included core of augite is not the residue of the mineral which produced the secondary product.

Hyalopilitic Hypersthene Andesite.

Locality.—Te Tuku or Matarangi Hill, Matarangi district.

Formation.—Beeson's Island group.

Remarks.—The specimen is from the agglomerate filling the volcanic pipe seen in the section of the southern face of the hill, a general view of which is given at page 84. This is a rare example of the kind on Cape Colville Peninsula. It is, indeed, very remarkable that so few crateral vents are traceable in a country where sectional exposures are by no means rare. The agglomerate filling the old pipe or vent has been exposed by the slipping-away of the south side of the hill. The decomposed walls of the pipe is thus seen as a somewhat solid decomposed or tufaceous rock of fine grain, which is but little in evidence on the lower slopes of the disturbed southern face of the hill. Nearer the road-line the slipped ground is strewn with great masses of the agglomerate from which the present specimen and No. 2790 were taken.

No. 103/3632.

M.C.—Blackish-grey basalt-like rock sprinkled with small phenocrysts of felspar and ferro-magnesian minerals.

U.M.—MATRIX pilotaxitic, laths and rectangles of plagioclase in flow-lines, scattered patches of carbonates, magnetite grains, and leucoxene. Some irregular growths of quartz.

PHENOCRYSTS.—*Plagioclase:* Usual andesitic character, but extinguishing up to 30°/32°; generally fresh, rarely containing carbonates.

Augite: Faint greyish-green; extinguishes up to 42°; much is decomposed passing into pennine, unless, as seems probable, the pennine has proceeded from hypersthene enclosed within the augite.

Hypersthene: Abundantly represented by pseudomorphs in pennine, but no fresh material, not even cores; carbonates associated.

There are no hornblende resorption products and no large grains of magnetite, except as secondary products from replacement of hypersthene.

Altered Pilotaxitic Hypersthene Andesite.

No. 103/3632. ALTERED PILOTAXITIC HYPERSTHENE ANDESITE.

[*To face p. 204.*

Illustration.—The slice shows good contrasts generally, and more especially in the part which has been photographed.

Photographed by ordinary light; magnification, 33 diameters; area photographed, lower left, which, with the addition of a thin vein of transparent material bordered on each side with opaque matter, is characteristic of the whole slice. This thin vein, not mentioned in the description of the slice, is a characteristic feature of the reproduction, as it intersects a number of crystals and crystal complexes, and where it passes through matrix the pilotaxitic character of this (elsewhere well shown) is completely altered and a glassy is substituted in place thereof.

Locality.—Blackstone Creek, on the east slope of the main range on the road from Coromandel to Whangapoua, Coromandel County.

Formation.—Thames-Tokatea group.

Remarks.—This is rather a remarkable rock, considerable blocks of which lie in the creek-bed at the point where the road crosses it. Its position on the range to the east has not been ascertained, but this may be determined without much trouble.

No. 104/3635.

M.C.—Compact basalt-like rock glistening with felspar.

U.M.—Matrix pilotaxitic, with felspar laths in flow-lines, prisms of pyroxene, and scattered magnetite grains and leucoxene.

Phenocrysts.—*Plagioclase* of usual andesitic character; ext., 18°/ 22°, 21°/ 25°; fresh, a little carbonate in some, abundant crystals and fragments.

Augite: A small quantity of fresh augite in pale greenish-grey crystals, often synthetic twins; ext., 40°/ 44°.

Hypersthene numerous pseudomorphs with almost colourless cores, converted for most part into serpentine, chlorite, and carbonates.

Magnetite: A few large grains. Hornblende absent.

Pilotaxitic Hypersthene Andesite.

Locality.—Opitinui Creek, second crossing below the township, Opitinui district.

Formation.—Thames-Tokatea group.

Remarks.—Generally speaking, the rocks of this part of the district are much and deeply decomposed, so that it is not easy to get a good specimen; but this rock stands out in remarkable contrast with the crumbling highly decomposed rocks that are met with on the spurs and hill slopes.

No. 105/3636.

M.C.—Leek-green compact rock with a curious uneven fracture, minute phenocrysts of felspar, and speckled with minute white spots.

U.M.—Matrix pilotaxitic, with small felspar laths in flow-lines, and minute green chlorite scales and prisms, disseminated carbonates, and dendritic growths of snow-white leucoxene.

PHENOCRYSTS.—*Plagioclase* of usual andesitic character; ext., 35°/ 38°, 36°/ 40°; evidently very basic. Contains patches of carbonates, leucoxene, and strings of green chlorite.

Pyroxene not abundant, now represented by carbonates, chlorite or serpentine, leucoxene, and radio-fibrous brown material of wide double refraction.

Hornblende is absent.

Pilotaxitic Andesite.

Illustration.—The slice shows medium contrasts, and is of an even character of matrix and included phenocrysts throughout.

Photographed by ordinary light; magnification, 33 diameters; area photographed, lower left, which is characteristic of the rest of the slice. The reproduction shows well the character of the matrix and the included "laths and rectangles," also the shattered and much-jointed condition of the larger phenocrysts.

Locality.—Last crossing of the Waitekauri River, on the road from Coromandel to Whangapoua, Opitinui district.

Formation.—Thames-Tokatea group.

Remarks.—The sample was taken from the river-bed at the road-crossing, but as the whole watershed of this stream is contained within the area of the Thames-Tokatea group, between Castle Rock and Tokatea Hill, there can be but one opinion as to what group the specimen should be referred to.

No. 106/3638.

M.C.—Greenish-grey, porphyritic with white felspar and some ferro-magnesian mineral; specks of pyrites are visible.

U.M.—MATRIX micropœcillitic, with rather large laths of plagioclase, sometimes in flow-lines; but in places the quartz becomes interstitial in character rather than micropœcillitic; pyroxene and its decomposition products, grains of magnetite and leucoxene are also present.

PHENOCRYSTS. — *Plagioclase:* Large but not very numerous crystals, clusters, and fragments, variously twinned; ext., 30°/ 30°; submarginal inclusions, fissured with a network of cracks filled with quartz. Carbonates present to a slight extent, and sometimes a little epidote.

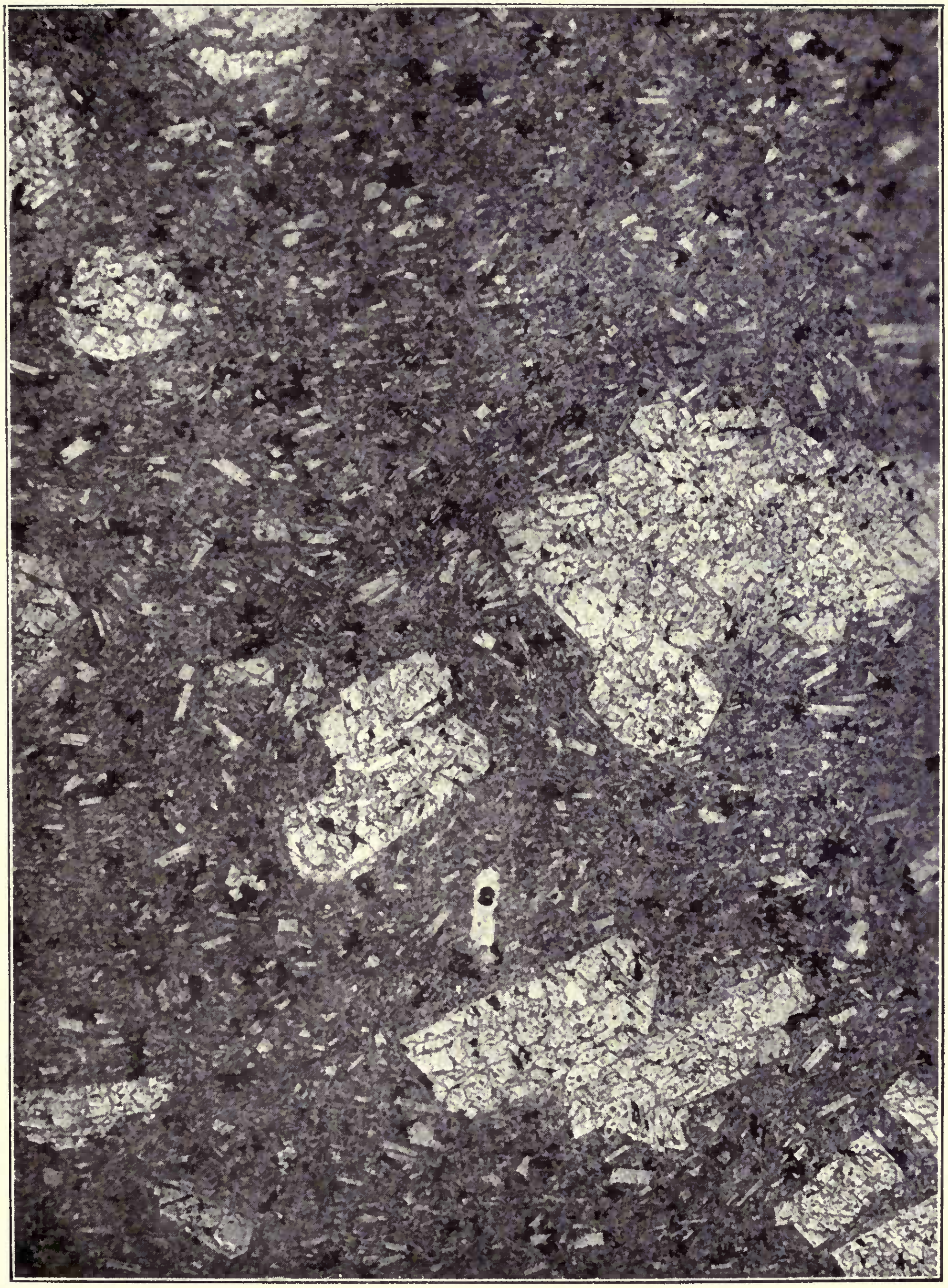
Augite: Nearly colourless, extinguishing up to 40°, is met with, fairly fresh; many pseudomorphs in chlorite and carbonates with magnetite and leucoxene occur, and represent probably both augite and hypersthene.

Hornblende occurs in comparatively numerous large resorption pseudomorphs; in a few cases the original hornblende is preserved, its pleochroism then is faint-yellow / brown-yellow, and ext. 8°.

Spongy masses of *pyrites* associated with quartz and radio-fibrous colourless chlorite occur.

Quartz is present in irregular grains and small patches of mosaic.

Hornblende Dacite Porphyrite.



No. 105/3636. PILOTAXITIC ANDESITE.

[*To face p.* 206.

Locality.—The Maiden Mine, Opitinui district.
Formation.—Thames-Tokatea group.
Remarks.—This rock is from the workings of the mine named, but taken from the tip-head, so that its exact position in the mine was not determined. No similar rock is met with on the surface at or near the mouth of the mine, deep decomposition of the surface-rocks having taken place.

No. 107/3643.

M.C.—Black basalt-like rock porphyritic with small crystals of felspar.

U.M.—Matrix very obscurely pilotaxitic, crowded with opacite (magnetite ?) dust and minute microliths, mostly felspar, but some pyroxene. Larger granules of magnetite fairly uniform in size and distribution passing into leucoxene.

Phenocrysts.—*Plagioclase:* Numerous crystals, complexes, and fragments; some corroded by matrix; fairly rich in evenly distributed inclusions; zonal; variously and irregularly twinned; ext., 20°/ 20°.

Augite in crystals and fragments from colourless to faint greenish-grey, colourless, extinguishing at 40°; occurs as an outer shell filled with alteration products after hypersthene in some cases. Synthetic twins occur.

Hypersthene: Fairly abundant; well-formed crystals now represented by green serpentine and carbonates.

Hornblende absent.

Obscurely Pilotaxitic Hypersthene Andesite.

Locality.—The Maiden Mine, Opitinui district.
Formation.—Thames-Tokatea group.
Remarks.—This rock, taken from the tip-head of the mine, occurred manifestly in close association with fine and coarser grained breccia-beds which do not show well at the surface.

No. 108/3664

M.C.—Bluish-grey compact rock with crystals of felspar, decomposed.

U.M.—Matrix abundant, obscurely pilotaxitic, felspar microliths in flow-lines, magnetite granules and leucoxene, scattered decomposition products after pyroxene.

Phenocrysts.—*Plagioclase:* Abundant well-formed crystals and fragments; crystals much fractured internally, coarsely twinned; ext., 33°/33° to 42°/47°. Zoisite and radio-fibrous muscovite developed in the internal fissures; green decomposition products derived from inclusions also present.

Pyroxene not abundant; completely transformed into serpentine and magnetite.

Magnetite grains sometimes as fairly large crystals whitened internally by leucoxene.

No signs of hornblende.

Obscurely Pilotaxitic Andesite.

Illustration.—The slice shows moderate contrasts only.

Photographed by ordinary light; magnification, 33 diameters; area photographed, the middle right, which is characteristic of the rest of the slice.

Locality.—Road-cutting where the road from Coromandel to Whangapoua first reaches the Wharekuri River, Opitinui district.

Formation.—Thames-Tokatea group.

Remarks.—This rock resembles in its megascopic characters No. 3424, but the description of the slice as seen under the microscope shows it to be a somewhat different rock, the pilotaxitic matrix not being common to the Beeson's Island rocks.

No. 109/3665.

M.C.—Pale-grey or violet-grey earthy rock with scattered white patches.

U.M.—Matrix a mosaic of quartz of various degrees of fineness, with interstitial sericite, and patches of sericite and chlorite, closely dotted with crystals of pyrites, varying in size from mere dust upwards.

Phenocrysts represented wholly by pseudomorphs.

Felspar is represented by patches of rectangular and other outlines rich in muscovite, or consisting of a quartz mosaic bounded by a zone rich in muscovite.

Pyroxene is probably represented by patches of quartz mosaic and associated chlorite and muscovite.

A **volcanic rock** replaced by quartz, sericite, and pyrites.

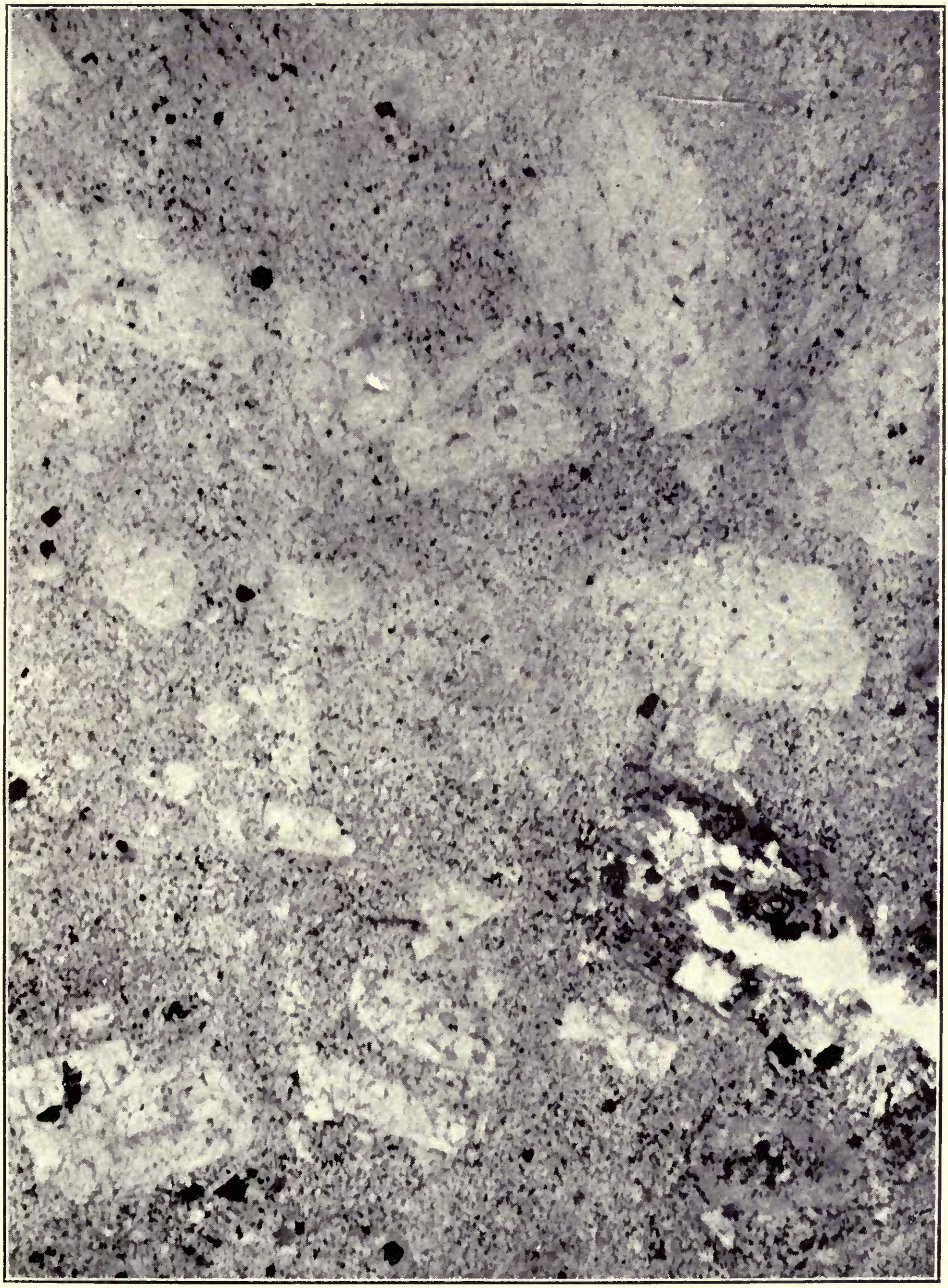
Locality.—The Maiden Mine, Opitinui district.

Formation.—Thames-Tokatea group.

Remarks.—This rock was taken as an example of "miners' sandstone" or the propylite of some writers on the geology of the Hauraki Goldfields. From the depths of the mine this is an altered rock, and where it occurs at or near the surface further atmospheric decomposition has also to be taken into consideration.

No. 110/3668

M.C.—Vivid (chlorite-like) green earthy rock with white earthy patches; scratches readily with the knife.



No. 108/3664. OBSCURELY PILOTAXITIC ANDESITE.

[To face p. 208.

No. 110/3668. ALTERED FLOW ROCK WITH RHYOLITE.

[*To face p.* 209.

U.M.—Matrix with ordinary light suggests a somewhat dusty colourless glass with abundant thin green streaks drawn out in contorted flow-lines, and sometimes enclosing oval areas which look like vesicles. With *x.n.*, however, the vesicular appearance is found to be deceptive, the colourless material which forms the greater part of the slice proves to be minutely crystalline, except in certain places when it forms an irregular or arabesque mosaic of quartz, while the green streaks consist of some kind of chlorite. Where the quartz declares itself in mosaics the granules of the matrix disappear, and the inference seems clear that its less obvious appearance in the remainder of the slice is due to its obscuration by the dispersed granules. An angular fragment showing spherulitic structure is seen in one slice, as well as a rounded fragment with minute felspar laths running in flow-lines, but replaced by quartz.

Phenocrysts are occasionally represented by pseudomorphs in quartz mosaic or by vacant spaces.

Pyrites is present in small crystals scattered about.

Unless the field evidence points in another direction I should conclude that this is a flow rock which has caught up and entangled in itself fragments of a previously consolidated rhyolite, and which, further, has undergone replacement to a greater or less extent by quartz.

Illustration.—There is fair contrast of the different constituents of the slice.

Photographed by ordinary light; magnification, 40 diameters; area photographed, upper middle part. The reproduction represents fairly the general character of the slice, and a flow-rock, probably rhyolite, is plainly indicated.

The specimen coming from a thermal locality is almost necessarily altered and liable to include xenoliths.

Locality.—Hot-water Beach, on the coast south of Mercury Bay, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—There are no floes of andesite in the near neighbourhood of whence the specimen was taken, but the pumiceous agglomerate, which forms an important division of the acid rocks, and which frequently contains semi-basic inclusions, is abundant over the area between the Whitianga River and the coast-line as far south as Hot-water Beach.

No. 111/3672.

M.C.—Compact brittle black rock porphyritic with small phenocrysts of felspar weathering light-grey and showing fluxional structure on weathered surface.

U.M.—Matrix streaky fluxional structure, lighter streaks more quartzose than darker, often micropœcillitic, sometimes forming a quartz mosaic, contain granules of magnetite, microliths of pyroxene in form of faint-greenish prisms, which usually extinguish parallel; in the darker areas a felt of felspar and other crystallites, and a few scattered rectangles of felspar which extinguish parallel.

PHENOCRYSTS.—*Plagioclase:* Well-formed zonal crystals and fragments, some with *r.i.* equal to that of balsam, and extinguishing at 12°; others with *r.i.* above balsam, and extinguishing at 17°/20°. Includes brown glass and augite, and in one case the rod-like magnetite crystallites arranged in parallel order which are so characteristic of labradorite.

Augite in well-formed crystals, few in number, small and corroded; pleochroic, extinguishing at 10°; straw-yellow / yellowish-green; large negative crystal containing bubbles included; magnetite associated.

Hypersthene with the usual pleochroism, and sometimes in fine interlamellar twins with augite; in some cases transverse fractures widely open and filled with colourless apparently isotropic material (can this be glass? I think not). Negative crystals with bubbles in some cases.

Quartz: Occasional grains.

Biotite: A few brown scales in association with quartz.

Magnetite: A few large grains.

Apatite: Numerous crystals.

Judging from the phenocrysts alone I should unhesitatingly set this rock down as a dacite, but the large quantity of quartz in the matrix suggests a rhyolite. Chemical analysis alone can decide this question.

Locality.—Track from Gumtown to Upper Rangihau Valley, Gumtown district.

Formation.—Acid group of Pliocene age.

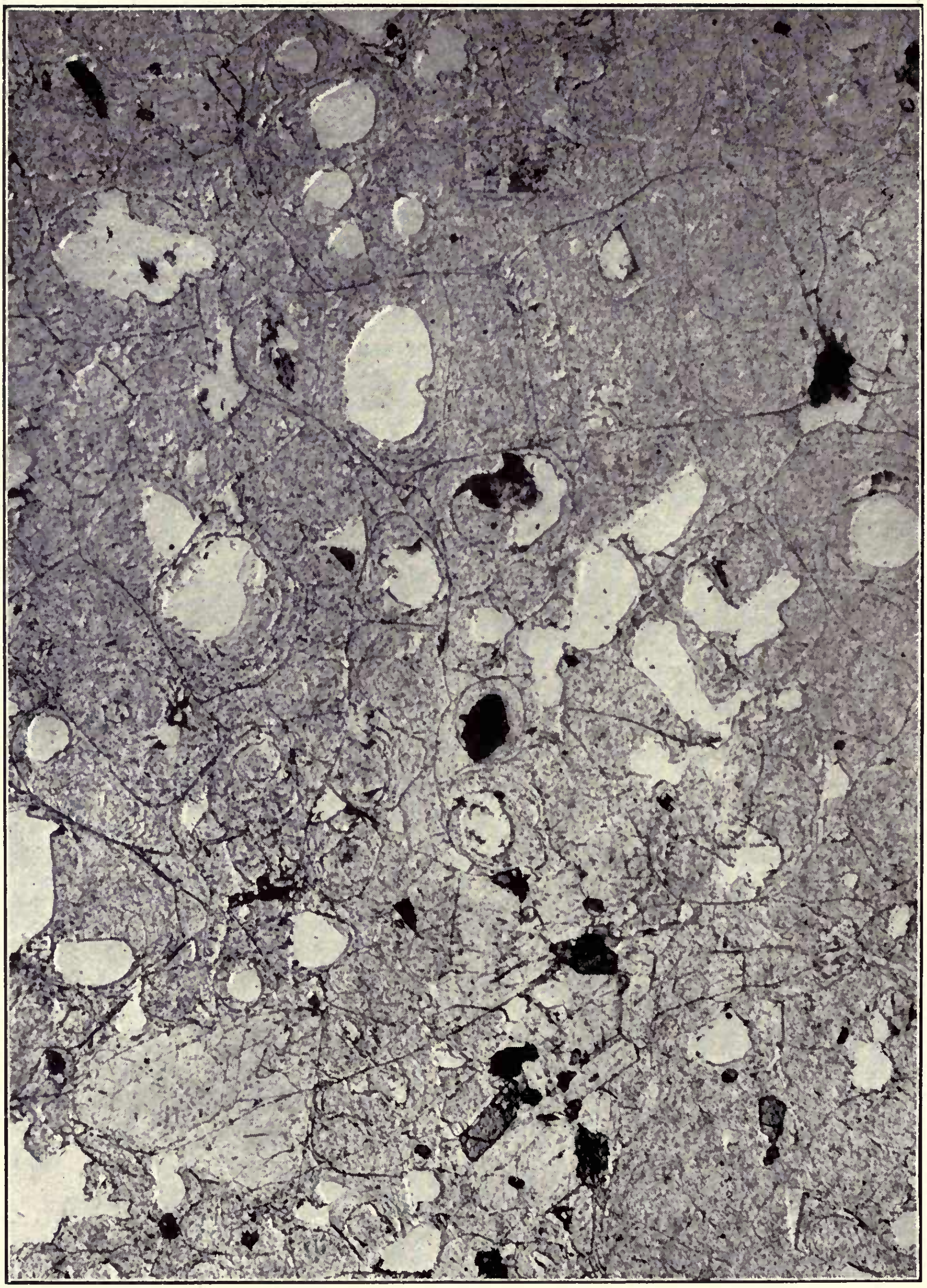
Remarks.—As an inclusion in pumiceous agglomerate, and also from its general appearance, this rock might be considered a rhyolite, but it would appear that the examination of the slice favours the idea that the rock is dacite. Inclusions of a more basic character, however, abound in the pumiceous agglomerates of the vicinity of and north of Gumtown and in the direction of Mercury Bay, and practically wherever the pumiceous agglomerate is present.*

No. 112/3680.

M.C.—Lustrous glassy rock porphyritic with felspar and ferro-magnesian minerals.

U.M.—MATRIX clear, almost colourless, faintly yellow glass, with perlitic cracks, crowded with linear crystallites in fluxional arrangement, globulites, margarites, cumulites, curved trichites, and belonites richly scattered. Perlitic cracks occupied by doubly refracting material, sometimes by magnetite or

* The analysis of this and other rocks of a doubtful character will appear in an appendix to these descriptions in Volume II. of this report.



No. 112/3680. THE PHENOCRYSTS POINT TO A BASIC GLASS.

[*To face p. 211.*

opacite, which sometimes forms a network within them. Here and there positive spherulites occur, proceeding from a phenocryst of felspar as a nucleus.

PHENOCRYSTS.—*Plagioclase* in crystals, fragments, and mosaics, some beautiful zonal growths and inclusions, large negative crystal cavities with liquid(?) and bubble. Some brown glass. Ext., 23° / 26°.

Augite: Not much, greenish-grey, magnetite associated.

Hypersthene rather abundant, markedly pleochroic, often well-formed crystals, some very long and slender, include apatite; pleochroism ferrous-green / brown-yellow.

Hornblende: A small quantity, highly pleochroic very dark-brown / straw-yellow.

Magnetite: A few large grains.

The phenocrysts point to a basic glass, but they cannot perhaps be trusted.

Illustration.—The slice shows poor or but moderate contrasts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, middle left, which fairly represents the whole of the slice, though of the phenocrysts present in the reproduction these are not better seen than might have been expected.

Locality.—New slip, Rangihau Valley, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks.—This specimen is from the *débris* of a recent and very large slip, which, as an avalanche, was precipitated from a height of some 800 ft., filling the valley of Slip Creek and of the Rangihau to a depth of 40 ft. over an area of 10 acres, and forming a lake not yet completely drained.

No. 113/3691.

M.C.—White porous rock, soils the fingers.

U.M.—MATRIX tridymite and decomposition residue of felspar.

PHENOCRYSTS.—Pseudomorphs after *felspar* and *pyroxene*. The felspar pseudomorphs are isotropic, and hence in similar cases have been taken for glass by Vogelsang and Rutley, and considered evidences of re-fusion. This is an error. The pseudomorphs are composed of a porous colourless material which readily absorbs aniline dyes, and it has a refractive index not far removed from that of balsam, and hence is invisible. The rock has been much altered, I should think by solfatara action.

Rhyolite.

Locality.—New slip, Slip Creek, Rangihau Valley, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks.—Collected from the surface of a large slip, the material of which fills the lower part of the valley of Slip Creek and the main valley at the junction of Slip Creek with the Rangihau.

The slip is of recent occurrence, and from the material composing it fairly fresh specimens, as was expected, can be obtained. The specimen, however, is considerably altered. This alteration, it is suggested, may be due to solfatara action. The evidences of hot springs are plentiful further up the Rangihau Valley and may exist in the neighbourhood, but were not noticed near to where the specimen had position *in situ.*

No. 114/3692.

M.C.—Black lustrous rock porphyritic with felspar and ferro-magnesian minerals.

U.M.—Matrix abundant, a violet-brown glass with ultra-microscopic granulation crowded with microliths, laths of felspar, pyroxene, and somewhat sparingly magnetite grains. The glass, when included in phenocrysts of felspar, contains crystallites and cumulites instead of microliths, though a few pyroxene rods may occur.

Phenocrysts.—*Plagioclase:* Not very abundant crystals, numerous fragments, and some complex growths, corroded by glass; zonal; very various inclusions; ext., 4°/8° to 26°/27°; *r.i.*, above balsam.

Augite: Faint-green rounded crystals.

Hypersthene more abundant than augite. Pleochroism ferrous-green and yellow-brown, shows as interlamellar twins with augite. Some large crystals include magnetite, and this in turn apatite, magnetite or ilmenite, or both; several large sections.

Hyalopilitic Hypersthene Andesite.

Locality.—East side of the Rangihau Valley, about six miles from Gumtown, Gumtown district.

Formation.—As a dyke breaking through acid rocks of Pliocene age.

Remarks.—This specimen, although obtained some seven miles away from its source, is clearly a sample of the great dyke which forms Table Mountain. Many huge boulders of this rock occur even at high levels along the valley of the Rangihau River, and until their source has been discovered are very perplexing in a country otherwise exclusively formed of acid rocks. These boulders are found fully 1,000 ft. above the bed of the Rangihau, and are an evidence of the rapid rate at which the valley is being cut down by the action of the river alone. The block from which the specimen was taken lies on the track from Gumtown where this first descends into the Rangihau River, and at about 400 ft. above the river-bed.

No. 115/3697.

M.C.—Violet-grey rock with fluxional white bands, slightly porous, with few phenocrysts.

U.M.—Matrix (i.) faintly-brownish almost colourless glass with incipient crystallization, chiefly expressed by negative spherulitic structure, the microliths of the spherulites being so small as to produce but little effect on polarised light. In some cases the spherulites are arranged in axiolitic fashion. (ii.) Streaks of this alternate with others in which spherulitic structure is absent, and the crystallization is minutely granular. (iii.) There are also streaks either devoid of substance or filled with isotropic material in which nests of tridymite occur, and pseudomorphs after minute felspar crystals. (iv.) Over some parts of the slice vermiform areas of a clear colourless substance giving very minutely granular polarisation includes negative spherulites with well-developed structure clearly affecting polarised light. In No. iv. positive spherulitic growths occur. The somewhat brownish glass and spherulitic substance which forms the mass of the rock is crowded with crystallites of various kinds running parallel with the flow-lines; they are chiefly black rods and granules; very minute felspar microliths are also abundant. (v.) Very granular dark isotropic streaks also occur sparingly.

Phenocrysts not very numerous. *Plagioclase* with straight extinction, but *r.i.* above balsam, or extinguishing up to 7°/7°, in crystals and fragments, usually transformed in part into isotropic material (so-called re-fusion effects); sometimes invaded by matrix in gulfs like corroded quartz.

Pyroxene: Some large pseudomorphs as well as small, transformed into almost colourless structureless material which is isotropic, but along cracks a fibrous mineral of rather high double refraction occurs; it appear to be serpentine; in some cases the serpentine is more abundant.

Magnetite: Grains of fair size occur very sparingly. A little *apatite* is also present.

The phenocrysts are not those of an ordinary rhyolite, but this is the case with most of the true rhyolites of this district. In this rock, however, negative spherulitic structure is so abundant as to suggest a very felspathic character for the glass; chemical analysis is required to precisely determine the position of this rock in classification. I should on the present evidence regard it as a

Dacite Rhyolite.

Locality.—New slip, Slip Creek, Rangihau Valley, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks.—This is originally from a mountain on the right or east side of the valley, which for 200 ft. or 300 ft. above the bottom of the valley is formed of fine pumice sand, and the higher part of thick floes of rhyolite and other acid rocks. Along Slip Creek, up to the great slip itself, these pumice sands are seen to underlie the rhyolite floes that form the mass of the mountains to the east and south.

New slip covers about 10 acres, to a depth varying from 20 ft. to 40 ft. or more It is of quite recent occurrence, and forms an excellent field for the collection of specimens.

No. 116/3703.

M.C.—Black slightly scoriaceous glass.

U.M.—Matrix clear-brown glass with perlitic cracks, some of which are lined by doubly refracting material. Flow-lines are indicated by faint-white streaks and the parallel arrangement of the crystallites. These are partly globulites, sometimes produced into a minute tail, partly belonites with double outline and truncated ends, partly stillate growths of belonites. They vary in abundance; some streaks of the glass are richer, others poorer in them. Microliths are very rare, almost absent; the most obvious appear to be apatite(?) and pyroxene.

Phenocrysts.—*Plagioclase* in well-formed crystals, clusters, and fragments; some with a core of brown glass; inclusions of augite, globules of brown glass, and negative crystals not uncommon. Highly zonal. Twinning various; ext., 22°/ 28°; *r.i.*, above that of balsam.

Augite: A few crystals more or less attacked by matrix, faint-greenish in colour, extinction often 10°, sometimes with outer lamellar hypersthene.

Hypersthene: Pleochroism bluish-green / brownish-yellow.

Magnetite: Several large crystals with associated *apatite,* sometimes corroded by glass.

Clusters of plagioclase, pyroxene, and magnetite associated together, with broken margins, are not uncommon.

Perlitic Pitchstone, with plagioclase, augite, and hypersthene.

This may be an andesitic glass.

Locality.—New slip, Slip Creek, Rangihau Valley, Gumtown district.
Formation.—Acid group of Pliocene age.
Remarks.—Resembles specimen No. 3680, but contains a number of visible crystals. Irrespective of its andesic character this rock probably originated in connection with the acid rocks of the district in which it was found. It, however, is possible that it may have been derived from the vicinity of the great dyke forming Table Mountain, *débris* from which is scattered all over the Rangihau Valley, but it is more likely to have come from a dyke of less prominence penetrating the acid lava-floes further to the east.

No. 117/3708.

M.C.—Violet-grey stony rock interlaced with a red vermiform network.

U.M.—Matrix (*a*) an irregular network of negative spherulites, the meshes filled with (*b*) crystal complexes.

(*a.*) The negative spherulites are small, and vary in fineness of the radio-crystalline structure according as they are more or less completely formed.

The coarsest are composed of (i.) radiating crystals of felspar, probably sanidine, which are continued beyond the periphery, and then present definite crystalline outlines; and (ii.) a clear colourless material which fills up the spaces between the felspar wedges and continues beyond the periphery, to contribute, along with the felspar crystals, to the formation of the crystal complexes (*b*). This material has a low *r.i.* and very low double refraction, and in some cases resembles tridymite. The negative spherulites with finer radio-fibrous structure are chiefly found in the redder veins of the rock, which they appear to characterize. They possess a negative optical sign, and thus agree with the more obviously crystalline spherulites.

(*b.*) The crystal complexes: These consist of crystals of sanidine immersed in a material much resembling tridymite.

PHENOCRYSTS.—*Orthoclase*(?) is represented by numerous pseudomorphs with crystal outlines; the material of the pseudomorph is some finely granular brown substance (milky-white by reflected light) and muscovite, the parallel arrangement of which has been determined by the cleavage of the original felspar, and which is in some cases so disposed as to indicate Carlsbad twinning.

Apatite is present in some of the pseudomorphs.

Magnetite: A few grains with a rusty border.

Microspherulitic Rhyolite.

Locality.—New slip, Slip Creek, Rangihau Valley, Gumtown district.
Formation.—Acid group of Pliocene age.
Remarks.—This rock comes from the southern margin of the intrusive belt of acid rocks that can be traced from the west side of Stony Creek across the Kapowai and along the upper Rangihau Valleys almost to Table Mountain. New slip is constituted of the material of a rock avalanche which was precipitated from a height of 800 ft. into the valley of the creek at and near its junction with the Rangihau. New slip, though of considerable dimensions (covering an area of from 7 to 10 acres), is of limited extent and bulk compared with others that have taken place in the same valley, all of them occasioned by the removal or the yielding character of the soft pumice sands that underlie a vast accumulation of acid lava-streams that piled up on the more yielding rock, attain a thickness of 1,000 ft. to 1,500 ft.

No. 118/3709.

M.C.—Porous grey banded rock.

U.M.—The greater part is minutely spherulitic with irregular interspherulitic areas, sometimes empty, sometimes filled with sanidine and tridymite; or empty except for nest, or a lining of tridymite.

The microspherulitic portion is of a faint-brownish tint, and contains numerous crystallites in somewhat disturbed lines of flow; they include short abruptly truncated colourless belonites, long transparent colourless needles, and opaque white rods; some minute microliths of felspar and magnetite granules are also present. The spherulites are negative, and frequently only partially or confusedly developed.

PHENOCRYSTS.—*Plagioclase* in crystals and fragments, few and small, partly transformed into milky-white granular material; some with definite albitic twinning, extinguishing at 13°/ 17°; others are not twinned, and extinguish parallel, yet these have a *r.i.* above balsam, and are therefore oligoclase to andesine.

Microspherulitic Rhyolite, containing phenocrysts of plagioclase.

Locality.—New slip, Slip Creek, Rangihau Valley, Gumtown district.
Formation.—Acid group of Pliocene age.
Remarks.—The same generally as under No. 3708, the specimen being collected from the *débris* of new slip.

No. 119/3711.

M.C.—Violet-brown rock with a stony matrix and traces of flow structure; numerous xenoliths of various sizes, but small, and crystals of felspar.

U.M.—MATRIX a streaky glass, crypto-crystalline in places; some is almost colourless, and contains crystalline particles and magnetite grains; in places it exchanges its glassy character for a crypto-crystalline one; but the greater part is ochreous-yellow, generally glassy and granular, with ferric dust. The streaks are undulating and contorted by flow. Positive spherulitic growths present.

PHENOCRYSTS.—These are probably *xenocrysts*, as follows:—

Plagioclase: Some well-formed crystals, as well as fragments. Some beautifully zoned; *r.i.* of all above balsam; ext., 15°/ 15°, 30°/ 35°. Some not twinned, and extinguish parallel, but still have *r.i.* above balsam. Mural cleavage not uncommon. In one interesting case a lattice-work of granular isotropic material. Some highly corroded by the matrix.

Pyroxene in pseudomorphs of yellow serpentine, not numerous, often fragmentary or rounded.

Ilmenite: Several hexagonal plates with lobate processes.

Xenoliths: Various forms of rhyolites, some banded with flow-lines and largely composed of negative microspherulites, some wholly crystalline, consisting of felspar laths and jagged insterstitial quartz. Some of the xenoliths may be andesite, such, for instance, as those which consist almost entirely of long rectangular felspars with only a little interstitial quartz and scattered grains of magnetite. The xenoliths contrast with the enclosing rock by their want of colour.

Rhyolite, crowded with xenoliths.

No. 120/3713. WHITE SPHERULITIC ROCK WITH VIOLET-GREY INTERSPHERULITIC RESIDUE.

[*To face p.* 217.

Locality.—Crossing of the Kapowai, on the road from Gumtown to Stony Creek, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks.—Although the hills to the east are composed of rhyolite resting on pumice sands and breccias, and the specimen could have come from the solid rocks in these hills, it is yet more probable that it has been brought down the Kapowai from the higher mountains near the source of that stream. In any case the specimen belongs to the Kapowai Valley, and is thus as closely located as many described rocks of New Zealand have been. In this case, as in others described in this work, the peculiarities of the specimen recommended its collection, and it was beyond the power of the collector to more closely locate its original position and source.

No. 120/3713.

M.C.—White spherulitic rock with violet-grey interspherulitic residue.

U.M.—MATRIX : The substance between the obvious spherulites consists of a material which in ordinary light looks like a faintly-brownish glass with rod-like crystallites running in flow-lines, except where negative microspherulitic structure abounds. Within each microspherulite the crystallites are diminished in number, and the glass-like material is clearer; but between adjacent microspherulites the crystallites remain in unchanged numbers, and so form a darker granular margin around the microspherulites. Between *x.n.* the microspherulitic character is revealed; its sign is negative, and we have the usual transition from very fine-rayed glassy-looking spherulites to the coarser and more obviously crystalline. In addition to the simple belonites, margarites, moniliform belonites, and microliths of felspar occur.

Between the microspherulites streaks of crystal complexes, formed of felspar and tridymite, occur.

Spherulites : Large positive spherulites with completely differentiated rays, consisting of felspar with its axis in the direction of the fibres and intervening tridymite. The flow-lines as shown by crystallites have completely vanished within these spherulites. Scales of biotite occur within the spherulite.

PHENOCRYSTS.—A few small crystals of *plagioclase*; ext., 17°/20°; *r.i.*, above balsam; invaded by glass. No pyroxene seen.

Magnetite : A few small grains.

Spherulitic Rhyolite.

Illustration.—Slice shows but moderate contrast of the material present.

Photographed by ordinary light; magnification, 40 diameters; area photographed, upper middle part, which is fairly characteristic of the whole of the slice.

Two photographs of this slice were taken. With the exception of the Triassic conglomerates (Nos. 3443–3464), it was not the practice to prepare more than one illustration, as the number of these had to be limited, and it was desired to spread them over as many specimens as possible. Usually but one negative was taken, but in this case the rule was departed from, and (*a*), which has not been reproduced, is from the upper margin of the slice and shows a very large spherulite, the middle part of which, now empty, was probably once occupied by a crystal of some kind. The interior of the solid part is a mixture of black and white material with crystal outlines. The peripherical area, about one-fifth of the semi-diameter, is of a lighter colour, and at places shows a radiate structure. The extreme of the border is again of a darker tint. In the photograph which is here reproduced the outlines of the larger spherulite are easily traced, but radiate structure, even in the peripherical part, is obscure or scarcely indicated. In a lesser, lobate irregularly shaped spherulite, having also a crystal outline at the centre, radiate structure is very evident, also crystals of felspar, the presence of which led to the selection of this in preference to the other photographs.

Locality.—Crossing of the Kapowai, on the road from Gumtown to Stony Creek, Gumtown district.

Formation.—From the alluvial of the creek-bed, but derived from solid floes of rhyolite forming the upper part of the acid group of Pliocene age.

Remarks.—The Kapowai Stream in its lower course has but little fall, and for some distance above the crossing its valley is low and swampy, being excavated in the pumice sands that underlie the solid rhyolites. The specimen here described must therefore have reached into the valley from the hills to the west or from the mountains of rhyolite that lie round the source of the creek.

No. 121/3735.

M.C.—White, uniformly fine-grained, porous, hard rock.

U.M.—Composed almost entirely of quartz mosaics of various degrees of fineness, with scattered ochreous grains and granules, and white opaque cubical grains, probably leucoxene after titaniferous magnetite.

Notwithstanding the complete replacement that the rock has undergone, the outlines of once-existing phenocrysts may still be discerned; they can be plainly perceived either by ordinary transmitted or reflected light, but not between *x.n.* The outlines are indicated by lines of opaque white granules, and resemble those of felspar, both rectangular and hexagonal sections of the latter parallel to (010) being represented; the material they now include is quartz mosaic with ochreous granules. It is possible that other minerals besides felspar were originally present, but there are no rhyolitic quartz grains.

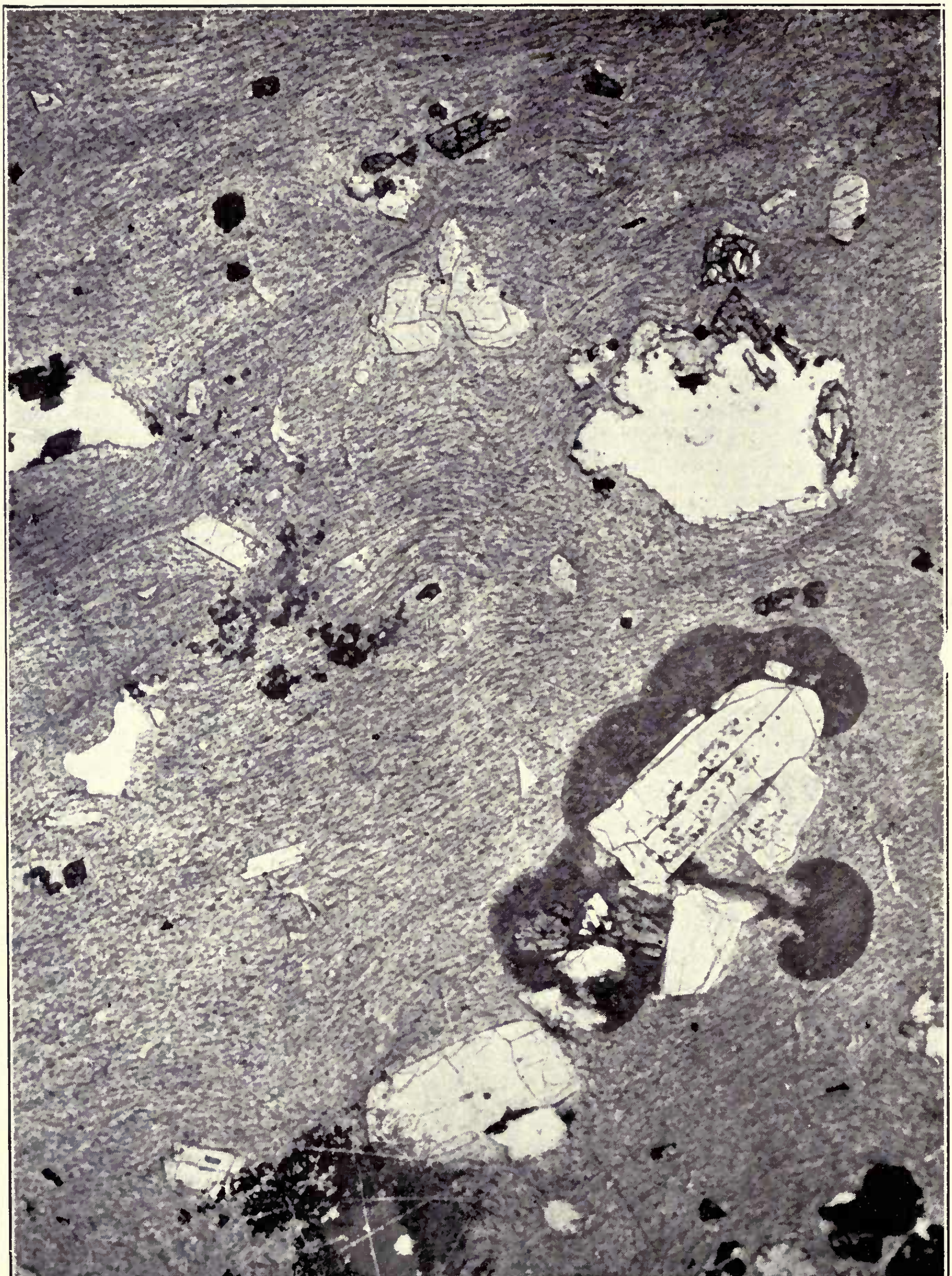
A quartzose pseudomorph after an igneous rock, probably a

Rhyolite.

Locality.—The big slip at the source of Slip Creek, Rangihau Valley, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks.—The specimen was collected not far from and nearly in line with the trend of the workings on the Kapowai No. 2 Claim, which workings are not on a defined reef, but along a band of altered rhyolite.



No. 122/3739. GLASS RARELY SPHERULITIC WITH PLAGIOCLASE, HYPERSTHENE, AND AUGITE, AND RARELY HORNBLENDE.

[*To face p. 219.*

No. 122/3739.

M.C.—Black glassy rock with phenocrysts of felspar.

U.M.—Matrix forms the mass of this rock. Colourless glass crowded with crystallites streaming in lines of flow. The crystallites are transparent, colourless or faintly-green globulites, margarites, belonites, and trichites. The glass is very homogeneous; perlitic cracks are present, and show no fibrous crystalline structure at their edges. Positive spherulitic growths are present in places, seated on a phenocryst of felspar or pyroxene, the crystallites stream through them without suffering deviation from their line of flow. The spherulites are darker and less transparent than the surrounding glass and are seen to be slightly stained with ochreous material when viewed by reflected light; the ochreous streaks run parallel with the crystallites, and may result from the oxidation of some of them. Some minute rod-like microliths of augite are sparingly present. Granules of magnetite are also dispersed.

Phenocrysts.—*Plagioclase:* Broken and corroded crystals, sometimes include glass and augite; ext., $14^\circ/19^\circ$, $20^\circ/22^\circ$; *r.i.*, above balsam. Plagioclase, hypersthene, and augite sometimes associated in a cluster. Zonal structure.

Augite: Small fragmentary crystals often undergoing corrosion by magma; faint-greenish colour.

Hypersthene: Small crystals; pleochroism faint-green / warm-brownish-yellow; quite fresh.

Hornblende: One fragmentary crystal, deep brownish-green / faint yellowish-brown; quite fresh, and no absorption border.

Magnetite: Larger grains usually associated with pyroxene.

Glass, rarely spherulitic, containing phenocrysts of plagioclase, hypersthene, augite, and rarely hornblende.

Andesitic Glass.

Illustration.—The slice shows but moderate contrasts between the fluxional matrix and the contained phenocrysts and spherulites.

Photographed by ordinary light; magnification, 33 diameters; area photographed, the middle part, which is characteristic of the whole slice. The details of the glassy base in its contorted flow and the manner in which the spherulites are built up on the felspar phenocrysts are worthy of note.

Locality.—Crossing of the west branch of Slip Creek, Rangihau Valley, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks.—The same as under No. 3703. And, in further remark, as the specimen was obtained in the creek-bed at the crossing of the track leading to Kapowai No. 2 Claim, it is possible it might have come into the creek from the westward. This, however, is but a possibility, and the greater likelihood is that it came from the opposite direction, and from the range between this branch of Slip Creek and the source of the Kapowai.

No. 123/3747.

M.C.—Alternating bands of violet-grey and cream to ochreous-white, with evident quartz grains.

U.M.—Matrix grey, stained in places yellow, containing in others patches of a network of brilliant red ferric hydrate. Micropœcillitic quartz, no evident felspar, numerous opaque rods and granules.

Phenocrysts.—*Plagioclase:* A very few rounded crystals, fragments, and clusters; *r.i.*, above balsam; ext., 4°/8°, 10°/10°; some zonal.

Biotite: A few corroded crystals, dark green-brown, almost black / straw-yellow.

Quartz: Numerous bi-pyramids, some fractured in place, often corroded by matrix; negative crystals with bubbles present. Cracked, and fissures filled with films of ferric hydrate. Corrosion cavities sometimes filled with radio-fibrous chlorite.

Pyroxene: A few pseudomorphs in yellowish chlorites may possibly represent pyroxenes.

Magnetite with a leucoxene border; a few zircons included in quartz, and associated with magnetite.

Rhyolite, containing phenocrysts of plagioclase.

Locality.—West branch of Slip Creek, Rangihau Valley, Gumtown district.
Formation.—Acid group of Pliocene age.
Remarks.—This specimen was also taken from the creek-bed a little lower down than abreast of the Big Beetle Claim, and the remarks under the previous specimen (No. 3739) apply here also.

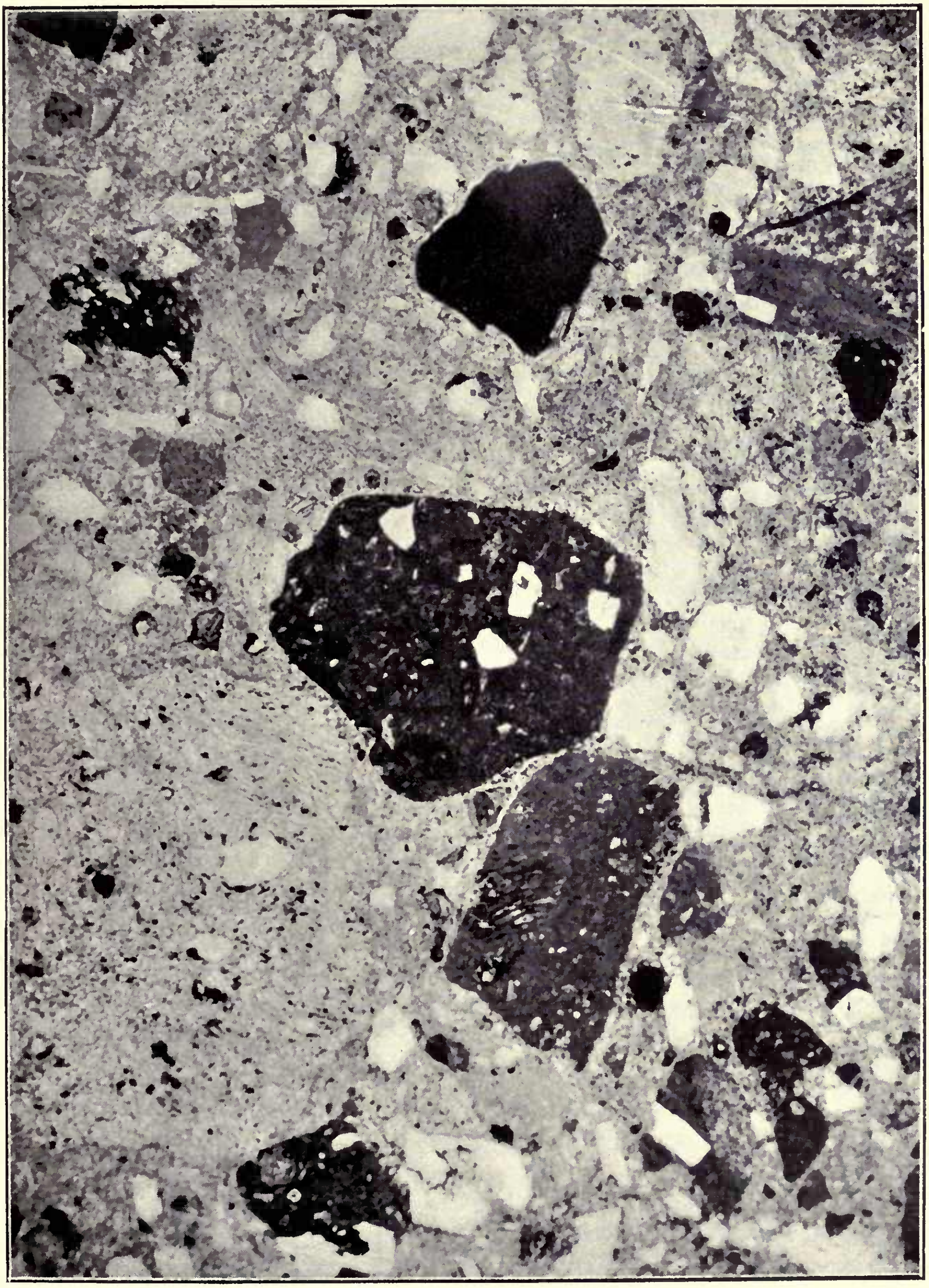
No. 124/3749.

M.C.—Volcanic ash or agglomerate.

U.M.—Matrix of fragments of pumiceous colourless glass and greenish granular material.

Included fragments: *Pumice* chiefly of colourless glass; *microspherulitic rhyolite*, spherulites with negative sign; positive spherulitic fragments; glass rendered black by opacite dust and granules (reddish-brown by reflected light); a flow rock composed of ragged *felspar laths* and *tridymite; magnetite* grains, ochreous dust, and phenocrysts of plagioclase; colourless glass crowded with opaque linear crystallites, and containing a few small felspar rectangles; a solitary fragment of laminated *grauwacke;* various crystals more or less broken. *Hypersthene* pleochroism bluish-green / brownish-yellow; *hornblende* green / straw-yellow; *augite; plagioclase.*

A **Pumiceous** fine-grained **Agglomerate.**



No. 124/3749. PUMICEOUS FINE-GRAINED AGGLOMERATE.

[To face p. 220.

Illustration.—Slice shows good contrast between the different fragments forming the part represented.

Photographed by ordinary light; magnification, 20 diameters; area photographed, upper part, which is fairly representative of the whole slice.

Locality.—Track from Gumtown to the Upper Rangihau Valley, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks.—This is a fair example of the pumiceous breccia or agglomerate that is extensively developed over a large part of the east side of the peninsula south of Mercury Bay. Largely consisting of pumice and much rhyolite, this agglomerate or breccia at places contains much andesite and other semi-basic rocks mixed in such manner as would seem to indicate that the whole has resulted from explosions involving the breaking-up of a variety of rocks. This assumption necessarily supposes the prior existence of acid and pumiceous rocks within or contiguous to the districts over which the breccias are found. If it be not over the coastal area south of Mercury Bay that such older acid rocks occur it cannot be proved that such exist, as elsewhere it appears that the agglomerates usually rest on andesite rocks or occur in connection with rhyolites that have been intruded into them.

No. 125/3751.

M.C.—Violet-grey stony-looking rhyolite with small sanidine-like crystals.

U.M.—Matrix, felspar laths mostly minute, and very irregular quartz grains concentrated here and there into mosaics. Fluxional arrangement of felspar evident. The felspar has a lower *r.i.* than quartz; is probably sanidine. Magnetite grains and alteration products after ferro-magnesian microliths.

Phenocrysts.—*Plagioclase* in crystals, clusters, and fragments; zonal; variously twinned; extinguishing from 7° / 8° to 25° / 25°; *r.i.*, above balsam. Not very abundant.

Pyroxene absent.

Quartz: No large grains.

Magnetite: A few large grains.

Zircon: An occasional crystal.

If the phenocrysts could be taken as a guide, we might conclude that this rock was not far removed from dacite, but the matrix contains so much quartz that it is safer to call it a rhyolite with plagioclase phenocrysts. The phenocrysts do not look as if they were borrowed from another rock.

Rhyolite, with plagioclase.

Locality.—Right bank of the Rangihau, six miles from Gumtown, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks. — The mountain from the base of which the specimen was taken appears as one of a line of rhyolite peaks, that stretch along the southern boundary of the pumiceous agglomerate in the Gumtown district, which are distinguished from the acid lava-flows that form the bulk of the mountains more to the south, by not resting on but breaking through the pumiceous agglomerate formation and the finer sands containing Pliocene fossils and beds of lignite that overlie. In the Rangihau this rock is seen forming the base of the mountain at the level of the river, while to the north and south the pumiceous agglomerate rises 400 ft. to 500 ft. above the level of the stream and abuts against or flanks on to the middle slopes of these intrusive rocks, while further south the sandy beds are overlain by acid lava-floes, as seen along Slip Creek and on Bull's Run, within the Upper Rangihau, towards Table Mountain, and on the higher hills north towards Gumtown. East of the Kapowai acid lava-streams also cover the pumiceous agglomerates.

The tendency towards basic conditions will not warrant the exclusion of this rock from the acid group of Pliocene age, even if this should be considered premonitory of the more basic rocks that finally appeared in Table Mountain and in the Omahu district, on the southern boundary of Thames County.

No. 126/3758.

M.C.—Spherulitic rhyolite with crystals of felspar, quartz, and biotite.

U.M.—Matrix almost entirely composed of positive spherulites, mostly with the fibrous structure so well developed as to be plainly visible in ordinary light; but in places not so obvious, and replaced by brown finely granular material with crystallites, and looking like glass; even this, however, is found to be radio-fibrous like the rest, and passes into the coarser and more obvious structure. The periphery of the spherulites is circular, or by apposition rectilinear, when a mosaic is suggested, but never perfected; in some cases the outline is lobate. When the spherulites are not in apposition the intervening space is filled with an arabesque mosaic of quartz, including thin tabular crystals of felspar and scales of biotite. Some of the spherulites show interrupted growth; a mosaic of quartz takes the place of the spherulitic matter, and from this quartz a fresh spherulitic growth proceeds.

Phenocrysts.—*Plagioclase* in not numerous well-formed crystals; *r.i.*, equal to or greater than that of balsam; ext., 5° / 6° to 15° / 20°; even those which are not twinned and extinguish parallel have a *r.i.* above balsam.

Biotite: Some well-formed crystals, highly pleochroic, deep-brown, almost black / straw-colour.

Quartz: Numerous large grains, often bi-pyramids, corroded by matrix, in one or two instances with a perlitic crack.

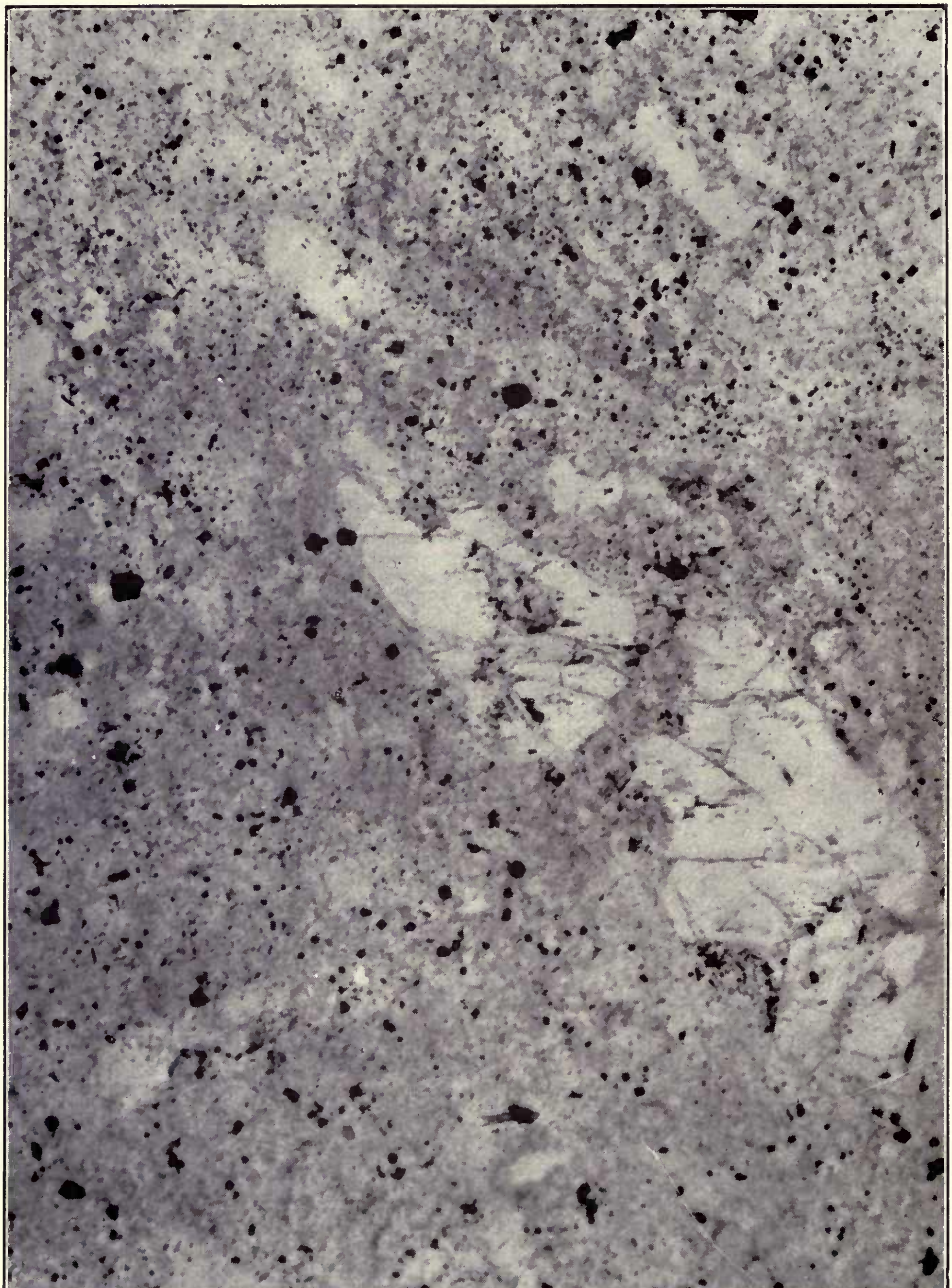
Ilmenite converted into a leucoxene net.

Zircons: A few crystals.

Positive Spherulitic Rhyolite, containing plagioclase.

Locality.—Top of the range, south of the Big Slip, and north of the Welcome Jack Mine, between the Kapowai and Rangihau Valleys, Gumtown district.

Formation.—The acid group of Pliocene age.



No. 127/3759. RHYOLITE.

[*To face p.* 223.

Remarks.—The specimen was taken on the top of the range where this is reached by the track from the Kapowai No. 2 to the Welcome Jack Mine, and at a height of between 1,900 ft. and 2,000 ft. above the sea. This and other rocks of the same group enclose the auriferous reefs or lodes that are worked in the Welcome Jack, Kapowai No. 2, and Big Beetle Mines, and it was for the purpose of determining the nature of the rocks in which these auriferous deposits occur that this part of the district was visited and collected from.

Previously some acquaintance with the district had beeu acquired, and the nature of the rocks in the lower grounds of the Rangihau Valley was already determined. Subsequently, on the gold discoveries being made, the miners reported the country as similar to that at the Thames, and this was also the expressed opinion of some geologists. It therefore became my duty to visit the district a second time, and the result, as seen in these descriptions, is a complete vindication of the conclusions that had in the first instance been arrived at.

No. 127/3759.

M.C.—White porous rock with pronounced fluxion structure.

U.M.—MATRIX alternating bands or streaks consisting of (i.) quartz mosaics; (ii.) granular bands rich in felspar microliths arranged parallel with flow-lines, and containing disseminated opaque white granules of leucoxene; (iii.) quartz mosaics containing spherules of glass with faint radial striation, which look like incipient microspherulites.

Small cubes of pyrites are disseminated chiefly in the quartziferous bands.

PHENOCRYSTS.—*Orthoclase:* A few well-formed crystals, some with Carlsbad twinning; *r.i.,* below balsam; extinguishing on 010 at 5°, on 001 at 0°; some show a curious patchy appearance suggestive of microperthite.

Ferro-magnesian minerals absent.

Pyrites in larger as well as minute cubes.

A transverse vein of quartz mosaic accompanied by pyrites crosses the banding. No large grains of *quartz*.

Rhyolite.

Illustration.—Slice shows moderate contrasts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, middle part, but this does not show well the flow-structure seen in the slice and rock, which is very apparent to the unassisted eye. More than one attempt was made to get a satisfactory negative, but failed.

Locality.—Welcome Jack Mine, in the range between the Kapowai and Rangihau Valleys, Gumtown district.

Formation.—The acid group of Pliocene age.

Remarks.—This specimen is from the walls of the reef in the Welcome Jack, but was taken from the material excavated while yet the mine was in the prospecting stage. The general remarks under No. 3758 apply in this case; also, a greater alteration might have been expected than the description of this rock indicates.

No. 128/3768.

M.C.—White spherules set in a rusty quartzose matrix, minute druses lined with minute quartz crystals.

U.M.—MATRIX: Original matrix has been entirely replaced by quartz, and the spherulites lie immersed in quartz mosaics. The quartz crystals are not equally developed in all directions, but present elongated forms, and they do not everywhere fill the whole space, but leave interstitial cavities which are filled with iron-ochre. Sometimes definite hexagonal prisms may be observed terminated by pyramidal faces, which may project freely into a vacant cavity. Occasionally a radial striation may be observed in the quartz similar to that of a microspherulite, and suggesting the previous existence and replacement of such a structure.

Ferro-magnesian alteration products occur in places, and remains of phenocrysts, such as plagioclase felspar extinguishing at 22°/ 22°, and quite fresh, though fragmentary; in other cases quartz pseudomorphs after felspar are seen, perhaps also after ferro-magnesian minerals.

The spherulites present evident but rarely coarse fibres with a positive sign, in addition to the colourless or nearly colourless fibres; others are sparingly present which are reddish-brown to yellow in colour, and transparent. They appear to be some species of ferric hydrate, and correspond probably to the dark branching rays of undetermined nature generally to be found in positive spherulites, which in this case have undergone hydration.

The periphery of the spherulites is usually well defined, and sometimes emphasized by a marginal deposit of ochreous matter.

Radial, concentric, and irregular cracks traverse the spherulites, and are filled with quartz mosaic; a few are eviscerated and the empty space remaining lined by quartz mosaics, the termination of the constituent crystals projecting freely into the central cavity.

The spherulites are sometimes crossed by crystallites running in lines of flow; the crystallites are slender trichite-like threads, now consisting of iron-ochre.

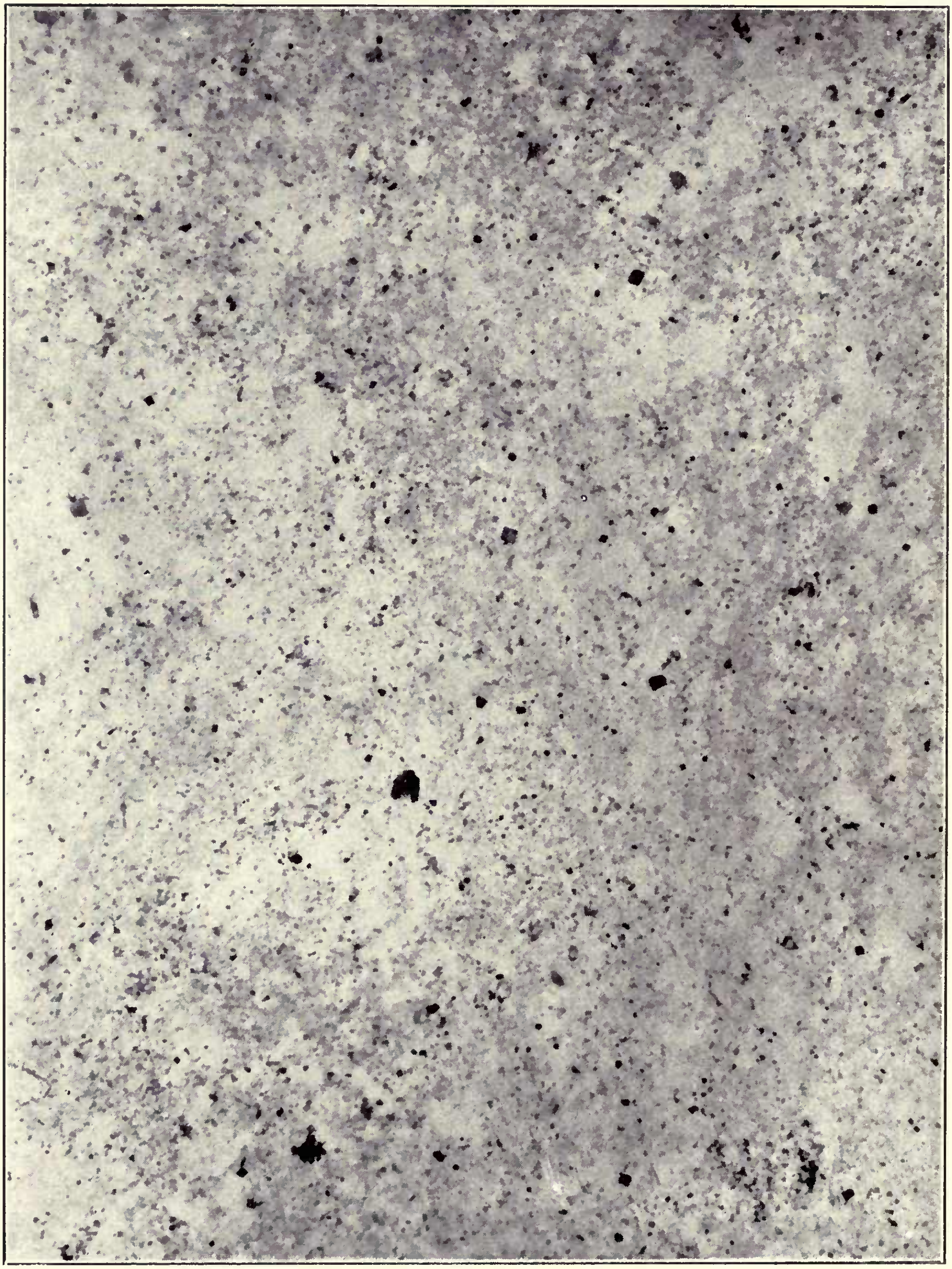
Spherulitic Rhyolite, the matrix of which has been replaced by a quartz mosaic.

Locality.—Big Beetle Mine, Rangihaū Valley, Gumtown district.

Formation.—The acid group of Pliocene age.

Remarks.—The specimen shows the nature of the rock-walls of the principal lode on this claim and the manner in which the sides of the fissure are covered with minute crystals or quartz, carrying gold entangled between the points of the quartz crystals. The spherulitic character of the rock is most obvious.

The remains of thermal-spring deposits are traceable about a chain distant from the main lode, and hence the considerable alteration which the matrix carrying the spherulites has been subjected to.



No. 129/3772. RHYOLITE REPLACED BY QUARTZ.

[*To face p.* 225.

No. 129/3772.

M.C.—Grey iron-stained stony rock.

U.M.—Matrix consisting almost entirely of quartz mosaics of various degrees of fineness ; ordinary transmitted and reflected light must be used even more than polarised light in investigating this rock. The mass of the rock presents a finely granular appearance with irregular clear streaks, reminding one of microspherulitic areas with their interspherulitic clear crystal complexes ; with polarised light this appearance is lost, owing to complete replacement by quartz. Ochreous granules are scattered about, some of which are pseudomorphs after magnetite, others after pyrites. A few zircons occur in the matrix.

Phenocrysts.—These are wholly replaced by quartz, but their original outlines may be seen by ordinary, particularly by reflected, light. They include—

Felspar, of which an external shell may remain unreplaced while the interior is converted into sericite and quartz ; this is often torn out in the process of preparing the thin slice ;

Leucoxene after ilmenite, and some long rectangular sections with associated leucoxenes which remind one of pyroxene. They are sometimes fibrous longitudinally, and traversed by transverse cracks, but wholly replaced by *quartz*. There are no corroded quartz grains.

Rhyolite, replaced by quartz.

Illustration.—The slice shows but moderate contrasts.

Photographed by ordinary light ; magnification, 40 diameters ; area photographed, middle part, which is fairly characteristic of the other parts of the slice.

Locality.—Kapowai No. 2 Claim, Slip Creek, Rangihau Valley, Gumtown district.

Remarks.—This is from the auriferous band that constitutes the so-called lode in the Kapowai No. 2 Claim. The rock has been so much altered that no clear crystal outlines can be seen in the photograph or the reproduction from it, and this in spite of extra care in the production of the original negatives. Had reflected light been used possibly better results would have been obtained.

The gold in this rock is in nests and patches of limited extent, but of frequent occurrence along a line of fissure, and for a variable distance into the eastern wall. At the time the specimen was taken there was no sign of the presence of reef quartz in any part of the workings, and up to the time of writing none has been reported.

No. 130/3800.

M.C.—Banded rhyolite.

U.M.—Matrix alternating, undulating bands of quartz mosaic and microfelsite, iron-stained. Black belonite-like crystallites in flow-lines occur in some of the bands. Traces of negative microspherulites are found in some, others are distinguished by larger positive spherulites, but all are mosaicised by quartz.

Phenocrysts.—*Plagioclase* crystals and fragments, some zonal; fresh; sometimes partly replaced by quartz and chlorite.

Iron-ores: A few large grains.

Pyroxene: Some elongated rectangles filled with quartz, chlorite, and serpentine, and having magnetite associated, appear to be pseudomorphs after pyroxene.

Drusy cavity: (i.) Walls formed of mosaicised quartz replacing positive spherulitic fibres, suggesting that the whole druse, with its walls, corresponds to a spherulite which has been cavernous in the middle. (ii.) Next to the spherulitic matter follows a layer of quartz mosaic inclosing green delessite; (iii.) then a thin layer of delessite covering the quartz; (iv.) this is followed by a glassy-clear zeolite with radiate structure; and (v.) this again by another zeolite of much lower *r.i.*, and with a tendency to become fibrous. No. iv. may be wanting when No. v. rests on the delessite.

Highly Quartzose Rhyolite.

Locality.—The old slip in Slip Creek, Rangihau Valley, Gumtown district.

Formation.—Acid group of Pliocene age.

Remarks.—The specimen was obtained about a mile from the upper end of the slip, and about 250 yards above where the track to the Kapowai No. 2 crosses the east branch of the creek, along which the great slip travelled to the low grounds.

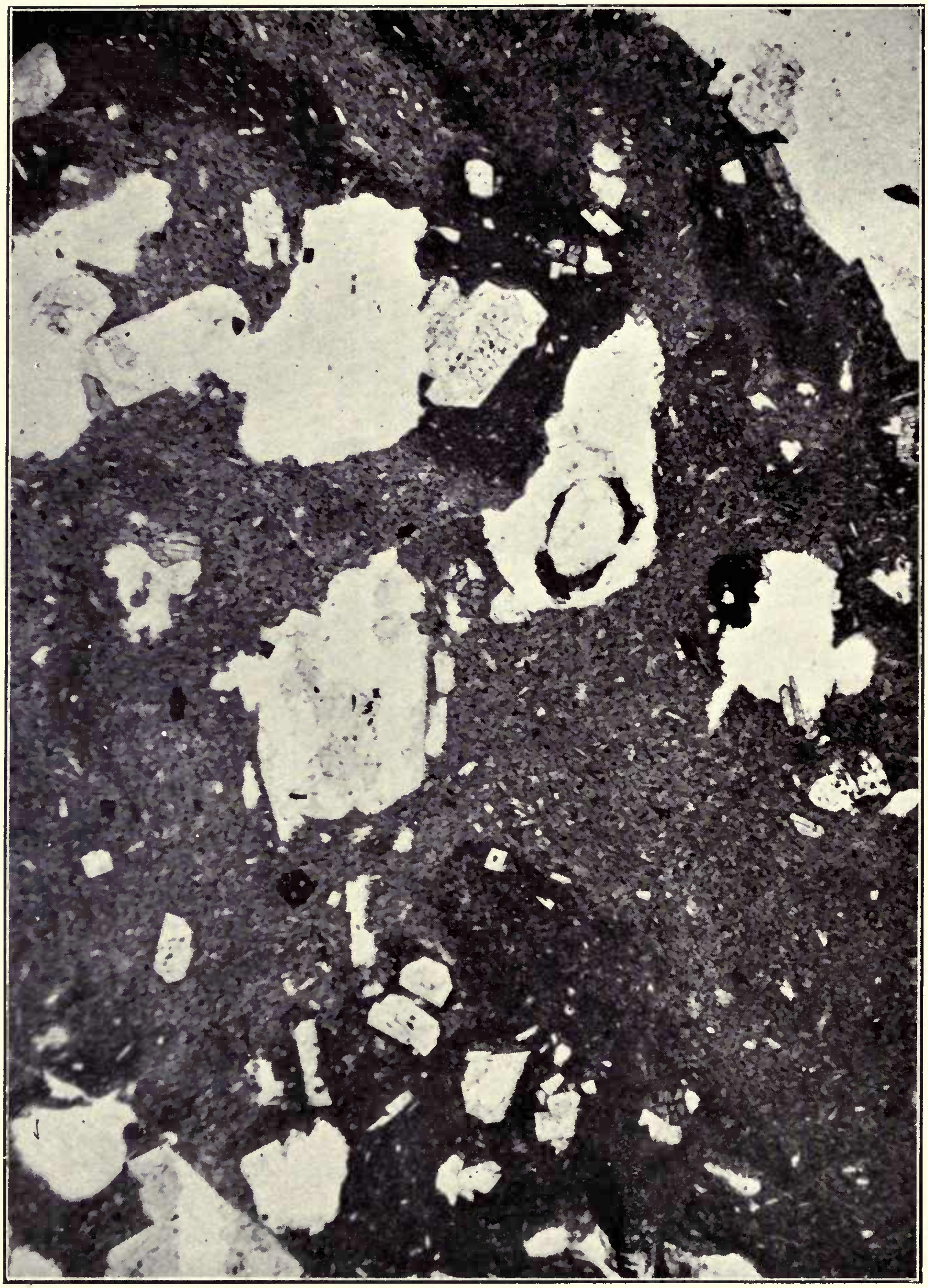
The rock is of a flaggy character, and easily splits into thick or thinner slabs. In the partings zeolites have formed, and are fairly plentiful. The rock seemed somewhat prone to decomposition, much more so than a similar flaggy rock further down the creek, which also contains zeolites and, in addition, much magnetite in the flaggy partings of the rock.

No. 131/3809.

M.C.—Banded rock, dark-reddish and blackish bands alternating with decomposed white and ochreous layers.

U.M.—Matrix once consisted of — microspherulitic layers and intervening crystal complexes, and of + spherulites; now almost wholly converted into quartz mosaics. The + spherulites have retained their structure, but in some cases have escaped to a certain extent the mosaicising process. With non-polarised light the flow-lines are still well indicated in limited areas by the parallel course of the crystallites, such as margarites and belonites.

Phenocrysts.—*Plagioclase* in well-formed crystals of moderate size; Carlsbad and albite twins; extinguishing from 0° to 33° / 40°, but in all cases *r.i.* higher than that of balsam.



No. 132/3818. HYALOPILITIC HYPERSTHENE ANDESITE.

[*To face p. 227.*

Pyroxene: A few sections now filled with quartz mosaic, chlorite, and a little leucoxene strongly recall pyroxene.

Ilmenite and *magnetite* converted into leucoxene.

Zircons: Minute colourless crystals, rather numerous.

Apatite: A little.

Spherulitic Rhyolite, largely replaced by quartz.

Locality.—Big slip, Slip Creek, Rangihau Valley, Gumtown district.
Formation.—Acid group of Pliocene age.
Remarks.—The rocks at the head of the slip *in situ* and the mounds of *débris* formed by the carrying-away of the slipped part being much decomposed, the present specimen was taken some little distance down the slip, at the first point where fresh material appeared in the bed of the stream that enters into and flows from the upper part of the slip.

No. 132/3818.

M.C.—Heavy black pitchstone-like rock, spotted with decomposed felspar phenocrysts, pitted with minute cavities.

U.M.—Matrix brownish glass crowded with microliths of felspar and pyroxene and granules of magnetite; some parts darker than others, owing to greater richness in microliths, especially opacite dust.

Flow structure only well expressed here and there.

Phenocrysts.—*Plagioclase:* Usual andesitic character; *r.i.*, above balsam; ext., 16° / 16°, 30 / 35°; rich in inclusions irregularly dispersed of brown glass containing black granules. In clusters of felspar the re-entrant angles between the crystals are often filled with a brown glass the microliths of which are smaller than elsewhere, and in the most enclosed spaces disappear, becoming replaced in some instances by crystallites.

Augite: Greenish crystals; synthetic twins; ext., 43°; corroded or fragmentary. Not abundant.

Hypersthene: Quite fresh, perhaps a little commoner than augite; pleochroism bluish-green / warm-yellow, both very faint.

Magnetite: Fair number of large grains, frequently associated with the pyroxene.

Hyalopilitic Hypersthene Andesite.

Illustration.—The slice shows strong contrasts between the matrix and the contained phenocrysts. There is also fair contrast between different parts of the matrix itself.

Photographed by ordinary light; magnification, 40 diameters; area photographed, middle part, which is characteristic of the rest of the slice.

Locality.—Main range at the source of the south branch of Omahu Creek, Omahu district.

Formation.—Post acidic intrusive andesites of Pliocene age.

Remarks.—This specimen was not collected *in situ*, but from the lower end of the deep gorge through which this branch of the creek from the higher part of the main range makes its way westward to the low grounds beyond the mountain region. The specimen when collected was considered pitchstone, and as such was forwarded for description. The description and the part of the slice photographed shows the rock is an andesite, and it has thus in all probability been derived from the intrusive mass that forms the highest part of the main range on the track from the Thames Valley to the east coast at Whangamata.

No. 133/3819.

M.C.—Dark somewhat basaltic-looking rock with phenocrysts of felspar.

U.M.—Matrix abundant felspar laths, grains of pyroxene, granules of magnetite, with colourless interstitial glass for the most part, but in some areas pilotaxitic.

Phenocrysts: Smaller quantity compared to the matrix. *Plagioclase* of usual andesitic character; ext., 28° / 35°. Some coarse clusters of associated plagioclase and pyroxene.

Augite: Faint greenish broken crystals, or coarsely ophitic with felspar.

Hypersthene: Some large crystals, more numerous than augite, fresh, but beginning to decompose, passing into green and olive-brown serpentine. Pleochroism faint bluish-green / faint topaz-yellow.

Ilmenite including aptite and small crystals of felspar.

Apatite: Some large crystals, including black rod-like bodies parallel to *c*.

Hypersthene Andesite, chiefly hyalopilitic, partly pilotaxitic.

Locality.—The main range east of Omahu Peak, Omahu district.

Formation.—Post acid intrusive andesites of Pliocene age.

Remarks.—This rock appears as though it had broken through the acid rocks of Pliocene age that are found immediately east and west of its exposure on the line of track to the Tairua Valley, and for this reason it was concluded that it was in time and mode of its appearance the same as Table Mountain dyke and other basic rocks breaking through the acid rocks of Pliocene age.

No. 134/3822.

M.C.—Fine alternating parallel bands of purple and ochreous-yellow with white spots.

U.M.—Matrix undulating, contorted, and broken streaks, microfelsite with dark globulites and belonites in flow-lines, passes into fibrous material like that of a spherulite, but without radiate arrangement; in clearer interspaces this structure becomes coarser, fibres wedge-like, but optic sign cannot be determined. From this we pass to clearer areas where quartz mosaic predominates; in this crystallites begin to disappear, and ferric hydrates occur. In some areas a regular spherical form is taken by an almost isotropic glass, the spherules having a radiating arrangement formed by rows of globulites.

PHENOCRYSTS.—*Plagioclase :* Few, small, often well-formed crystals; *r.i.*, above balsam; ext., 14°/ 14°.

Pyroxene : Pseudomorphs occasionally occur in quartz and serpentine.

Ilmenite : A few plates are present.

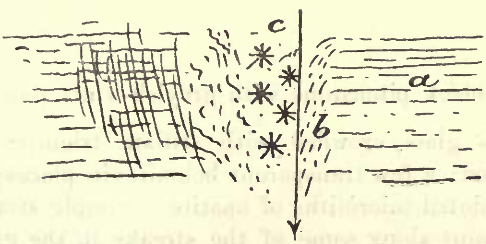
Rhyolite, containing plagioclase and a few pseudomorphs after pyroxene.

Locality.—North branch of Omahu Creek, Omahu district.
Formation.—Acid group of Pliocene age.
Remarks.—Collected from the bed of the creek which till passing Omahu Peak has its course over rocks of the Beeson's Island group, and as but little rhyolitic matter reaches the creek from the higher part of Omahu Peak the specimen is necessarily derived from the main range, on the western higher part of which, towards the Puriri, the acid group of Pliocene age has a great development.

No. 135/3823.

M.C.—Spherulitic rhyolite.

U.M.—MATRIX faintly-brown glass passing into microfelsite with flow-lines marked by innumerable crystallites—long thin black rods; the flow structure is very regular, but disturbed in places in various ways, the most interesting case being that in which the processes of microcrystalline structure cross the flow-lines and divert the crystallites into their own direction, a very remarkable phenomenon. The arrangement is shown in the following diagram :—



a. Microfelsite with flow-lines undisturbed.
b. Microfelsite with flow-lines bent parallel to the arrow.
c. Microspherulitic crystallization.

The microfelsite, which gives scarcely any reaction with polarised light, and thus resembles a glass, possesses, however, a distinct fibrous structure like that of a positive spherulite; the fibres may run with the flow-lines or across them. Examination under low magnification shows that the microfelsite is, in fact, the material of the positive spherulites which possess long branching processes. Blotches of micropœcillitic quartz are sporadic in the microfelsite.

The microcrystalline streaks consist of microspherulites which, though usually giving very faint reaction with polarised light, and thus affording no certain evidence of their optical sign, closely resemble negative microspherulites. They consist of felspar rays with inter-radial colourless material resembling tridymite. Sometimes they are replaced by irregular growths of quartz, and then the crystallites disappear and small grains of magnetite take their place. The microspherulitic structure passes in places into more coarsely crystallized complexes in which a little sanidine and much tridymite may be recognised.

PHENOCRYSTS.—*Plagioclase:* A few crystals often torn out, may have been more numerous than appears at first sight, often fragmentary; *r.i.*, above balsam; ext., 7°/7°.

Pyroxene: A few pseudomorphs in colourless minutely granular material with veins of fibrous serpentine(?). Ilmenite and leucoxene occur in association with these.

Ilmenite: Some large plates, converted to a large extent into leucoxene.

Spherulitic Rhyolite, with plagioclase and pseudomorphs after pyroxene.

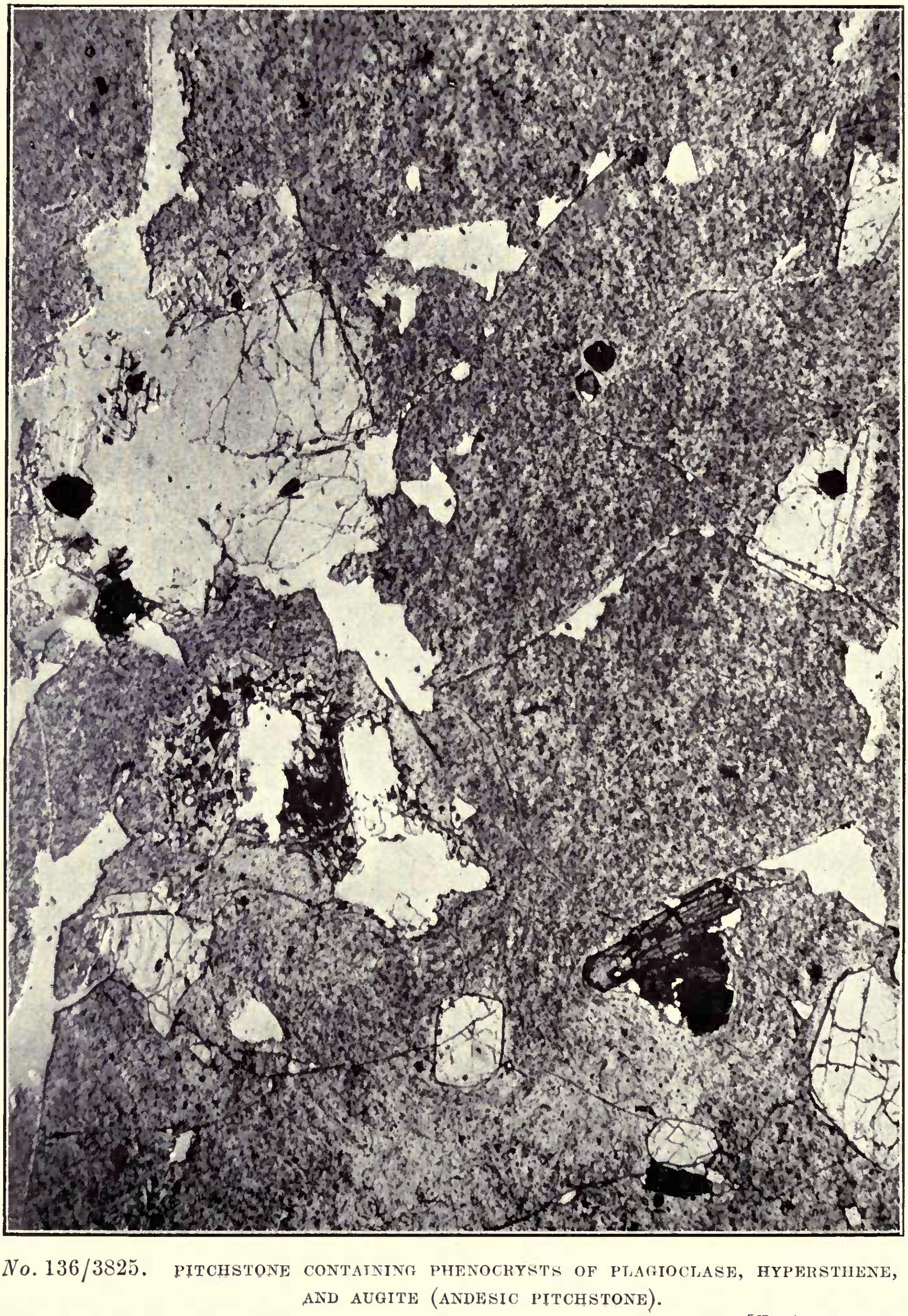
Locality.—Road-line round northern face of Omahu Peak, Omahu district.
Formation.—Acid group of Pliocene age.
Remarks.—This specimen was collected some 200 yards further east than where No. 3838 comes from. There is doubt as to the blocks of rock being *in situ*, and it is probable that the flow containing the spherulites above described must be looked for higher up the northern slope of the peak. There should be no difficulty in finding them, and this was so certain a matter that I made no effort to prove the occurrence of the rock at higher levels, this being to me a conclusion not admitting of doubt. Any one in search of further specimens should have no difficulty in securing them.

No. 136/3825.

M.C.—Brownish-black pitchstone with greyish-white phenocrysts.

U.M.—Colourless glass crowded with stillate trichites of very uniform size; rays short, curved; a few transparent belonites in places; also rarely transparent long slender-jointed microliths of apatite. Simple straight trichites and rows of magnetite grains along some of the streaks in the glass. Crystallites diminish in number around phenocrysts.

PHENOCRYSTS.—*Plagioclase:* Well-formed crystals and corroded fragments of microtine habit, associated occasionally with pyroxene; *r.i.*, above balsam; ext., 17°/22°. Sometimes highly zonal. Various inclusions.



No. 136/3825. PITCHSTONE CONTAINING PHENOCRYSTS OF PLAGIOCLASE, HYPERSTHENE, AND AUGITE (ANDESIC PITCHSTONE).

[*To face p. 231.*

Augite not abundant, in small, broken, and corroded crystals, sometimes faintly pleochroic, pale sherry-yellow / faint-green.

Hypersthene: Small broken crystals. Pleochroism faint bluish-green / faint brownish-yellow.

Magnetite: Large grains not numerous.

Pitchstone containing phenocrysts of plagioclase, hypersthene, and augite.

Andesitic Pitchstone.

Illustration.—The slice shows fair contrasts.

Photographed by ordinary light; magnification, 40 diameters; area photographed, lower left, which is representative of the whole of the slice.

Locality.—Right-hand branch of Omahu Creek, Omahu district.

Formation.—Acid group of Pliocene age.

Remarks.—The specimen has been derived from the higher part of the main range east of Omahu Peak. The lower slopes of Omahu Peak show a narrow rib of rhyolite, and the higher part of the peak is also rhyolite; but as from either of these sources there comes a limited supply, and far greater quantities of rhyolitic *débris* being translated from the main range along the bed of the creek, the main range is the more probable source of the specimen.

No. 137/3828.

M.C.—Grey rock with white decomposition products and fluctuation structure.

U.M.—Matrix microcrystalline indeterminate, with minute grains of quartz and patches of positive spherulitic structure, often limited by straight lines, somtimes becoming axiolitic. Some coarser crystalline patches rich in quartz, irregular or bi-pyramidal, with included matrix. The positive spherulitic structure often in irregular forms, tufts, and brushes; nucleus often afforded by a phenocryst. Flow-lines marked by crystallites.

Phenocrysts.—*Felspar* large and small well-defined crystals or fragments, rectangular and six-sided (after M), mostly converted into sericite and quartz; when fresh *r.i.* below balsam; ext., 21°, and thus sanidine.

Pyroxene: Numerous pseudomorphs occur in quartz mosaics, often outlined by leucoxene and containing leucoxene; some of these may be after pyroxene, others are certainly after felspar. Pyrites is frequently present within these pseudomorphs, and that in considerable quantity.

Ilmenite: A few large plates converted into leucoxene.

Quartz in large irregular grains and bi-pyramids, containing large vapour cavities and stone cavities. Some corroded by matrix.

Xenoliths: Rounded fragments of another rhyolite rich in felspar laths arranged in flow-lines occur in places; trachytic-looking.

Rhyolite, with Xenoliths of another Rhyolite.

This has been altered by the percolation of waters charged with silica and pyrites.

Locality.—Klondike Claim, on the old track south of Omahu Peak, Omahu district.

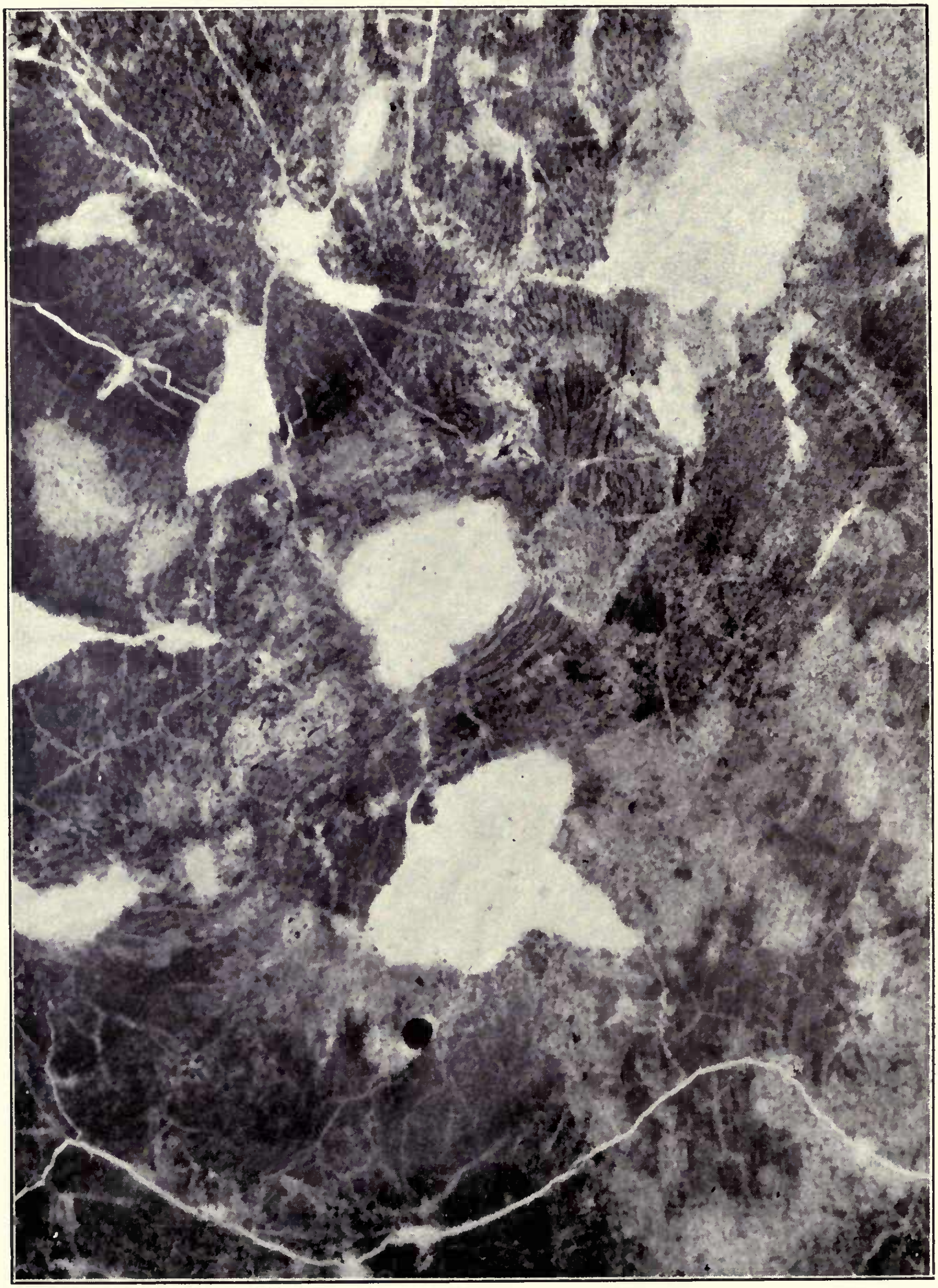
Formation.—Acid group of Pliocene age.

Remarks.—The rock is auriferous, and at the time the specimen was collected a mass of brecciated rhyolite was being worked for gold. As seen in mass this rock has the appearance of a finely brecciated rhyolite or rhyolitic tuff, and seems to lie at the base of a coarser and less dense variety of the same rock, which corresponds with the pumiceous agglomerate of the Mercury Bay district and the eastern part of the Hikutaia watershed.

No. 138/3833.

M.C.—Dark violet-grey rock full of white decomposed spherulites and cavernous lithophysæ.

U.M.—Matrix microfelsitic, positive spherulitic, crowded with dark rod-like crystallites in flow-lines which are much contorted in places, but traverse the positive spherulites undisturbed. The microfelsite is brown by transmitted, milky-white by reflected, light, and darker in concentric zones within the spherulites. The matrix is very patchy in appearance, owing to a large extent to the clearing-up of parts by the disappearance of the fine granules which give the milky appearance and of the crystallites. This clearing-up may take place over the whole or a part of a spherulite, between opposed spherulites, or quite irregularly, or in concentric zones of a spherulite, or along irregular cracks which traverse the slice. It is frequently accompanied by a change in the character of the spherulite due to crystallization in a coarser form and the appearance of tridymite in streaks or patches. Lithophysæ are also present, frequently as irregular cavities which seem to bear no relation to the form of the spherulites; sometimes, however, central. They are lined with tridymite, and the rays of the spherulites (when the cavity is central) appear to originate from the outer surface of the tridymite lining. This is so general a phenomenon that I can only conclude the tridymite to have been present before the spherulite, or, at least, something representing it. This might have been the wall of a cavity, and the tridymite might have been subsequently deposited within this vesicle. But I do not think so, because in one case the tridymite forms a cluster which is to a great extent bounded by straight lines and looks like a composite crystal, and it is from the margin of this that the spherulitic brushes arise.



No. 138/3833. POSITIVE SPHERULITIC RHYOLITE.

[*To face p.* 233.

PHENOCRYSTS.—*Plagioclase:* Small crystals and fragments, often twinned on albite plan, some no traces of twinning, but all with *r.i.* above balsam; extinction may be 18°/20°.

Pyroxene: In characteristic octagonal sections, represented by pseudomorphs in serpentine.

Ilmenite: Plates passing into leucoxene.

Zircons: A few small crystals. *Apatite* rare.

Positive Spherulitic Rhyolite, with plagioclase and pyroxene pseudomorphs, also lithophysal.

Illustration.—The slice shows good contrasts in the part photographed.

Photographed by ordinary light; magnification, 40 diameters; area photographed, upper right, which is characteristic of the rest of the slice. The spherulites are everywhere crossed by a network of lines, some of which are very transparent, whilst others are less so.

Locality.—The foot of the zigzag at the western base of Omahu Peak, Omahu district.

Formation.—Acid group of Pliocene age.

Remarks.—This specimen is from a narrow strip of rhyolite extending along the base of Omahu Peak, between the two main branches of Omahu Creek. This rhyolite is now held in a nearly vertical position between andesite to the east and west of it, which cannot have been its original position; and it is evident that faulting on a considerable scale has taken place.

No. 139/3838.

M.C.—Black glassy-looking rock containing fragments of glass, like Nos. 3828 and 3833, and other xenoliths.

U.M.—MATRIX alternating streaks of colourless and brownish glass with exquisite flow structure, sometimes contorted, damascene-like. In some streaks small, beautifully definite crystals of plagioclase, glassy-clear.

PHENOCRYSTS.—*Plagioclase:* Abundant crystals and fragments, often much corroded, zonal, various twining; *r.i.*, above balsam; ext., 4°/5° to 15°/20°. When immersed in brown glass surrounded by a film of colourless glass in many cases.

Augite: A few corroded crystals, some large, zonal.

Hypersthene: Also a few crystals, some large. Pleochroism bluish-green / brownish-yellow; contain in some cases liquid cavities with bubbles.

Magnetite and *ilmenite* passing into leucoxene; some *apatite* is associated with them.

Xenoliths numerous small rounded and angular fragments of (i.) various kinds of rhyolite, some positive spherulite, some glassy; (ii.) hypersthene andesite, both hyalopilitic and pilotaxitic; (iii.) one fragment of grauwacke. Considering the presence of these fragments, suspicion is aroused as to the true nature of the phenocrysts, many of which have the appearance of xenocrysts.

Pitchstone, containing plagioclase, augite, hypersthene, and various xenoliths.

Locality.—New road north side of Omahu Peak, Omahu district.

Formation.—Acid group of Pliocene age.

Remarks.—This seems to be a pitchstone dyke penetrating rocks belonging to the Beeson's Island group. The various igneous xenoliths may thus be accounted for, but it is more difficult to explain the presence of fragments of grauwake, as such rocks are not known at the surface nor in mines south of the Thames Goldfields, and the Beeson's Island group is here of very great thickness. The rock has been cut into in making the road, and in the bank it is seen to be formed of rubbly columnar masses, apparently nearly at right angles to the walls of the fissure which contains them; but this structure does not appear in the actual road-excavation, and the appearance noted may be deceptive. There is, however, no doubt that, where collected from, the dyke is just passing from the rocks of the Beeson's Island group into those of the acid group a little higher on the hill, and this circumstance will probably account for most of the peculiarities which have been determined concerning this rock.

No. 140/3840.

M.C.—Dark-grey compact rock with numerous small phenocrysts of felspar and ferro-magnesian minerals.

U.M.—Matrix violet-brown glass crowded with felspar rods and plates, pyroxene grains, and magnetite. Ultra-microscopic granules disseminated.

Phenocrysts.—*Plagioclase* abundant, usual andesitic character; some densely charged with inclusions of matrix; ext., 20°/20° to 32°/36°.

Augite fairly abundant, very faint-green, twinned, intergrown with hypersthene; ext., 41°; includes large liquid cavities with bubbles. Fresh, but corroded by matrix.

Hypersthene: Large crystals surround and enclose large crystals of augite, small globules of which are given off into the hypersthene. Plagioclase and magnetite also included.

Magnetite grains and *apatite* sparingly present.

Hyalopilitic Hypersthene Andesite.

Illustration.—The slice shows good contrasts.

No. 140/3840. HYALOPILITIC HYPERSTHENE ANDESITE.

[*To face p. 234.*

Photographed by polarised light;* magnification, 48 diameters; area photographed, upper middle part, which fairly represents the rest of the slice, and, but for the considerable magnification, the reproduction had done the same.

Locality.—The western lower slopes of Omahu Peak, Omahu district.

Formation.—Beeson's Island group.

Remarks.—The specimen may be from a dyke interposed between the coarse breccias of the zigzag and the rhyolites at the western base of Omahu Peak. The position of the rhyolites as a narrow belt of acid rock, with Beeson's Island rocks to the east and west, has already been referred to.

No. 141/3846.

M.C.—Resembles No. 140/3840, weathers whitish.

U.M.—Matrix mostly felspar laths and rectangles, pyroxene grains, and magnetite. Glass reduced to a minimum, merely interstitial.

Phenocrysts. — *Plagioclase* abundant, well-formed crystals and many fragments; ext., 24°/32° to 35°/45°. Zonal, and zonal inclusions. Glass inclusions very interesting. Long prisms of hypersthene are amongst the inclusions. Hypersthene and plagioclase phenocryts are associated in parallel growths.

Augite fairly common, intergrown with hypersthene, faint-green in colour, well-formed crystals and fragments.

Hypersthene abundant, fresh, sometimes presenting square sections showing traces of 100,010 only.

Magnetite, iron-ores, and *apatite* sparingly dispersed.

Hyalopilitic Hypersthene Andesite.

Locality.—Old road to Whangamata, where it follows the spur immediately south of Omahu Peak.

Formation.—Beeson's Island group.

Remarks.—The specimen was taken from the solid, some 300 yards up the spur from the south branch of Omahu Creek. This rock lies on the east side of the rib of rhyolite already mentioned as stretching along the western base of Omahu Peak.

* In connection with these descriptions, hitherto the illustrations have been from photographs taken by ordinary transmitted light, and others yet to come have been taken in the same way. It was, however, felt from the beginning that a variety of specimens would give better results if polarised light could be used in photographing the slice. This, however, with an ordinary apparatus could not be effected, if under low magnification it was purposed to take a full-plate negative (6½ in. by 8½ in.), and prisms large enough for the purpose not being obtainable, shifts had to be made to overcome the difficulty. A solution of the problem, after some experimenting, was found (though not without the necessity of a longer exposure of the sensitive plate) which enabled the taking of plates 10 in. square, the magnifying-power not being greater than 30 diameters. Having succeeded in this matter, 33 diameters was considered the most desirable magnification, the power used in the case of No. 3840 being 48 diameters, though not excessive, is as much as might well be applied where the phenocrysts chance to be of considerable size.

No. 142/3847.

M.C.—White cavernous spherulitic rhyolite.

U.M.—Matrix a mixture of brownish microfelsite and minutely crystalline material, the microfelsite with granules, transparent margarites and belonites, and forked felspar microliths in flow-lines, occasionally microspherulitic; within this are large positive spherulites of the usual character, but distinguished by cavernous character—*i.e.*, they are lithophysæ. The cavities are very irregular in form and distribution, and do not seem to bear any definite relation to the spherulites, extending from them into the surrounding matrix. They are lined with tridymite in well-formed crystals.

Phenocrysts.—*Plagioclase:* A few crystals; *r.i.*, above balsam; ext., 14°/15°.

Pyroxene: None.

Biotite: A few small scales.

Ilmenite: Hexagonal plates, rarely converted into leucoxene.

Lithophysal Rhyolite, with Plagioclase.

Locality.—Range at the source of the middle branch of Omahu Creek, Omahu district.

Formation.—Acid group of Pliocene age.

Remarks.—The greater mass of this part of the main watershed is formed of rhyolite, and this sample comes from the source of the middle branch of Omahu Creek, within which and to the north towards the Puriri Gorge on the higher part of the range there is a great development of acid rocks.

No. 143/3866.

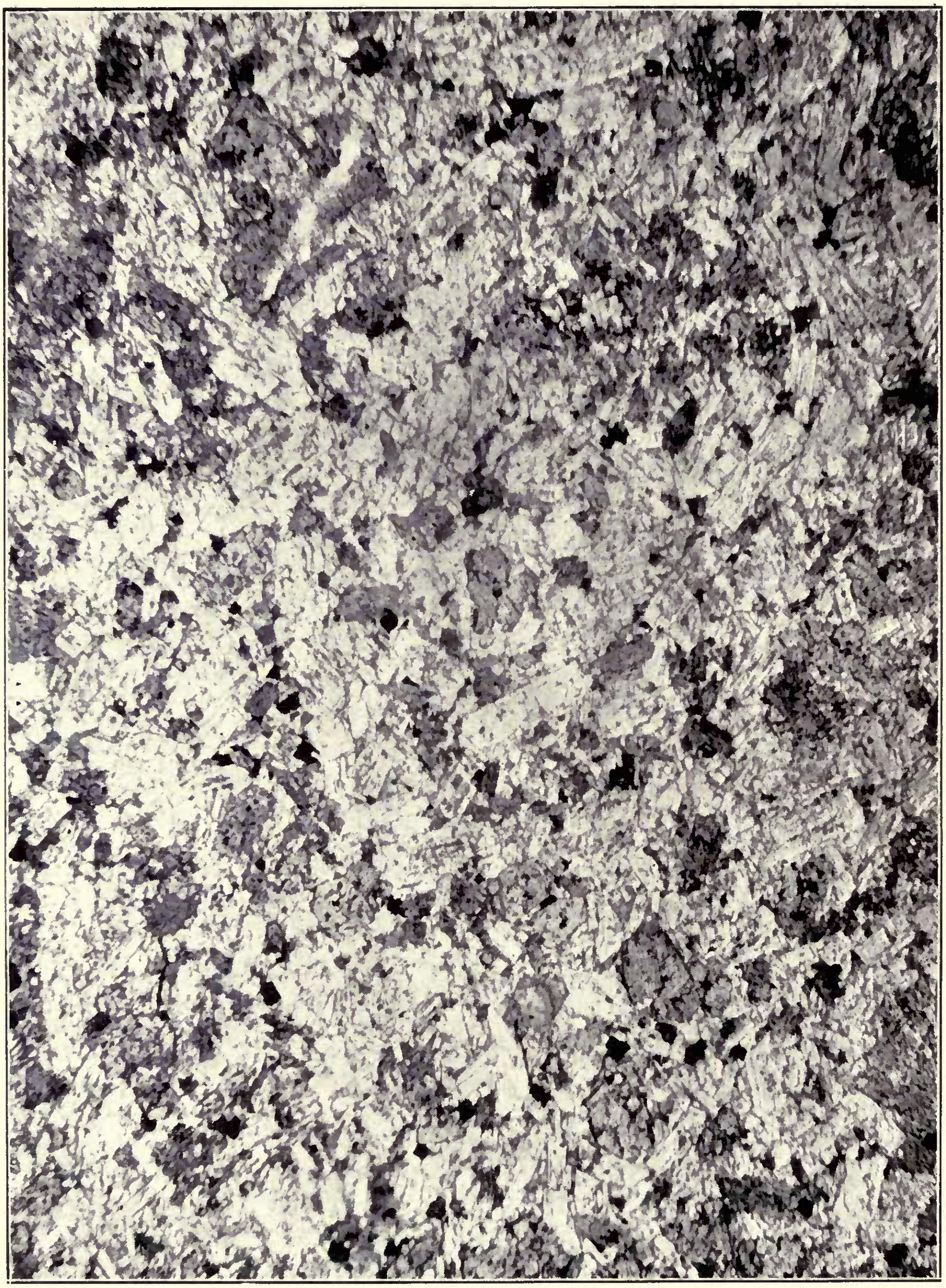
M.C.—Greenish-grey fine-grained rock.

U.M.—Holocrystalline hypidiomorphic.

Plagioclase predominant, hypidiomorphic crystals with marked albitic twinning, very fresh, glassy-clear; ext., from 18°/20° to 30°/30°. Sometimes zonal, the marginal zone rather uniform in thickness, with marked difference in extinction angle; in one case where extinction of interior was found to be 21°/24° that of the margin was 9° less. Inclusions of augite and pseudo-allotriomorphic morphs after hypersthene.

Augite: Single crystals and clusters allotriomorphic to idiomorphic, faint-greenish colour; ext., 39°; some twinned. In some cases a thick shell of fresh augite encloses a pseudomorph after pyroxene, which may have been augite or included hypersthene.

Hypersthene: Some fresh crystals associated with augite, but mostly completely transformed into a green fibrous mineral which looks like fibrous hornblende, and possesses a double refraction quite as high as hornblende, but extinguishes parallel. Its optic sign is negative.



No. 143/3866. AUGITE DIORITE WITH HYPERSTHENE AND A LITTLE QUARTZ AND ORTHOCLASE.

[*To face p. 237.*

Epidote also occurs.

Ilmenite and *magnetite* in considerable quantity.

Apatite : A few long colourless prisms.

Quartz and *orthoclase :* Very little, interstitial.

Augite Diorite, with hypersthene and a little quartz and orthoclase.

This is a very interesting rock, and provides us with the holocrystalline equivalent of the hypersthene andesites. A complete series thus exists in the district, extending from hypersthene augite diorite to andesitic glass.

Illustration.—The slice shows fair contrasts over the whole of its surface.

Photographed by ordinary light; magnification, 33 diameters; area photographed, lower left, which is characteristic of the slice, this being uniform in structure and the distribution of the different contained minerals.

Locality.—The shore of Hauraki Gulf, at second point north of the mouth of Waiomio Creek, Thames County.

Formation.—Thames-Tokatea group.

Remarks.—This rock is exposed on the side of the road along the foot of the cliffs fronting the beach at the place indicated, and the locality being accessible and not easily mistaken, further description of it is not necessary.

No. 144/3889.

M.C.—Compact black rock with plagioclase and pyroxene phenocrysts.

U.M.—MATRIX predominant, minutely crystallo-granular, colourless, with dispersed magnetite granules, minute felspar rods, quartz, a little pyroxene.

PHENOCRYSTS.—*Felspar. Plagioclase:* Single crystals and a few clusters irregularly twinned, highly zonal, core sometimes replaced by quartz; when fresh considerable difference in extinction angle of margin and core—thus, margin 27° / 26°, core 32° / 33°. The felspar is fairly abundant.

Hornblende: Olive-green crystals and fragments, some broken in place, all with reaction borders, and otherwise corroded by matrix; pleochroism faint olive-green / brownish-green / straw-yellow; ext., 23°; sometimes twinned.

Augite: Very little; some small greenish crystals.

Hypersthene: One single large pseudomorph in serpentine was observed.

Hornblende Andesite.

Locality.—Third dyke on coast-line north of the Mata River, Thames County.

Formation.—A dyke in Carboniferous rocks.

Remarks.—This specimen is from one of a series of dykes that make a great display on the coast-line between the Mata and Waikawau Rivers. The dykes appear in Carboniferous strata, but not far from the junction with volcanic rocks belonging to the Thames-Tokatea group, and it is possible may have been intruded subsequent to the accumulation of the Tertiary volcanic series or the earlier formed of that group of deposits.

No. 145/3898.

M.C.—Greenish-grey earthy rock sprinkled with opaque white and dark dots.

U.M.—MATRIX very finely granular, a mixture of quartz, chlorite scales, and opaque white granules.

PHENOCRYSTS represented only by pseudomorphs, some in carbonates, some in quartz mosaic, some in chlorite, carbonates, and opacite. *Felspar* and *pyroxene* may have been present.

Some large colourless crystals of *apatite;* minute *zircons* are present.

There is nothing to show that this rock is an ash, so far as microscopic evidence is concerned, and it is too much altered for definite determination.

Highly altered Igneous Rock.

Locality.—First bay south of the Mata River, Thames County.

Formation.—Thames-Tokatea group.

Remarks.—This rock outcrops on the beach under high-water mark, immediately above which slates and sandstones appear in the spurs that, rising abruptly inland, are capped by volcanic rock. Its resting hard on the slates and sandstones of the Maitai series may account for the higly altered condition of this rock.

No. 146/3901.

M.C.—Greenish-grey dacite-like rock with obvious phenocrysts.

U.M.—MATRIX not very minutely crystallo-granular, consisting of quartz, felspar, and chlorite after pyroxene.

PHENOCRYSTS.—*Plagioclase* abundant, large crystals; ext., 25°.

Augite not abundant, faint-greenish, fresh crystals.

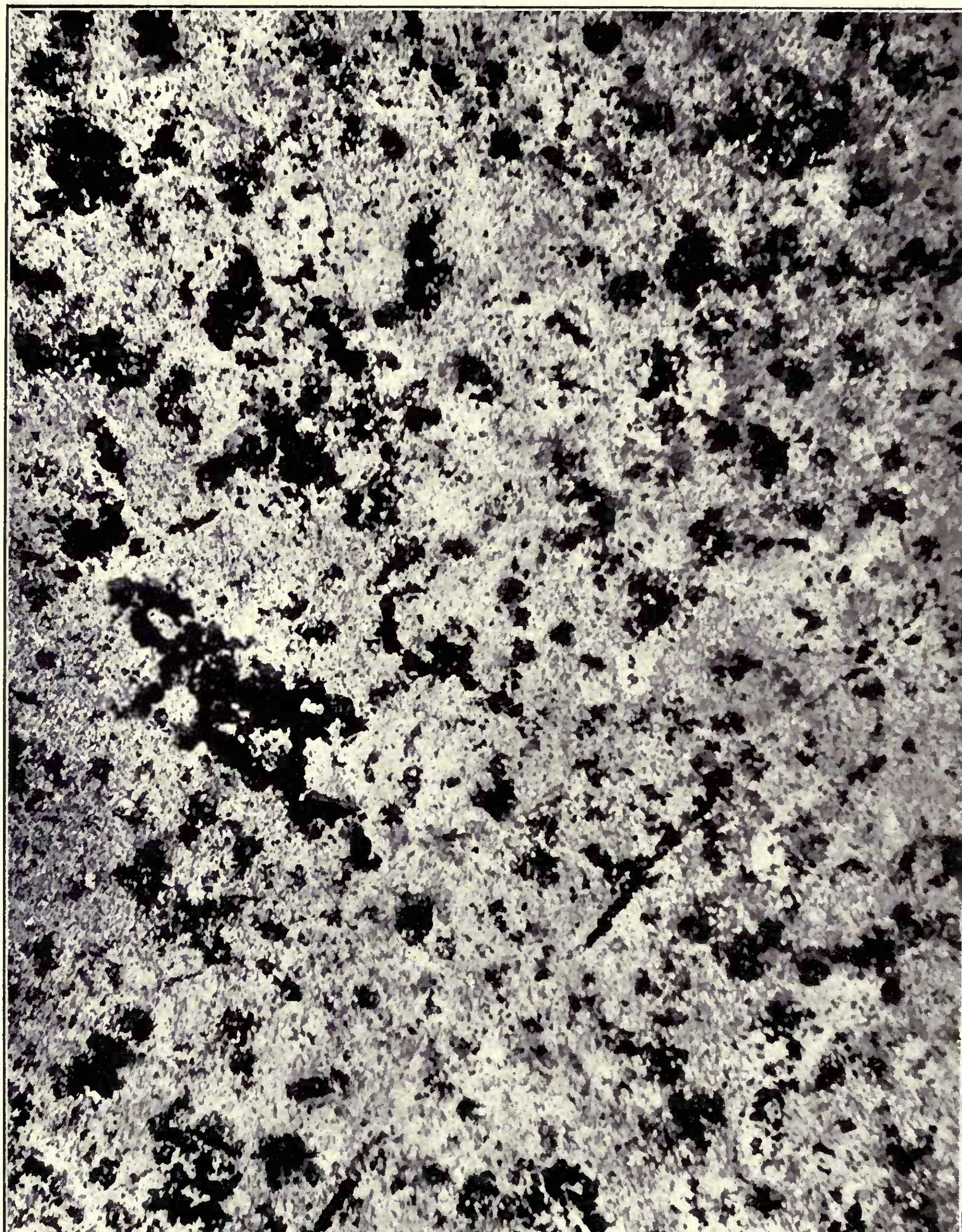
Hypersthene represented by pseudomorphs in green serpentine; a replacement by carbonates has also occurred. No unaltered hypersthene remains.

Hornblende: Green crystals and fragments, fresh, twinned; pleochroism green / straw-yellow, with and without reaction borders.

Magnetite grains fairly abundant. Some *pyrites.*

Quartz: A few grains large enough to be seen under low magnification.

Hornblende Hypersthene Andesite, with a little quartz or **Hypersthene Dacite.** The choice of terms is indifferent.



No. 147/3905. HIGHLY ALTERED IGNEOUS ROCK.

[*To face p.* 239.

Locality.—The most southerly of the series of dykes on the coast-line north of the Mata River, Thames County.

Formation.—A dyke in Carboniferous strata.

Remarks.—This dyke occurs close to the junction of the Maitai series with the lowest breccias belonging to the Thames-Tokatea group.

No. 147/3905.

M.C.—Greyish-white (earthy) rock, speckled green. Too hard to be scratched with the nail, easily scratched with a knife.

U.M.—Matrix: Mosaics of quartz of varying degrees of fineness and irregularity, some with interstitial or included sericite scales; in places more sericite than in others. Dendritic leucoxene scattered through the slide.

Phenocrysts indicated by various pseudomorphs, some formed of a milky-white granular material, brownish by transmitted light, such as frequently replaces pyroxene or felspar in highly decomposed rocks; some formed of chlorite. Patches of a fibrous green mineral resembling fibrous hornblende, but extinguishing parallel, such as are described as pseudomorphous after hypersthene in No. 143/3866, are not uncommon. Iron-ores common throughout the rock.

Highly altered Igneous Rock, not further determinable.

Illustration.—Slice shows fair contrasts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, lower left, which is characteristic of the whole of the slice.

Locality.—Monowai Claim, Waiomio Creek, Thames County.

Formation.—Thames-Tokatea group.

Remarks.—From the tip-head of the mine.

No. 148/3921.

M.C.—Greenish-grey compact rock, earthy to the touch, speckled white.

U.M.—Matrix dirty-looking, owing to disseminated granules of magnetite and leucoxene of various sizes. Not very abundant, about one-half the rock. Minutely crystalline, crowded with sericite replacing felspar laths, and irregular grains of quartz. Pseudomorphs in carbonates are also present.

Phenocrysts.—Abundant *felspar* with well-defined crystal outlines, but converted into carbonates and sericite; rarely a little quartz occurs in the pseudomorph.

Pyroxene represented by pseudomorphs in green pennine and carbonates, with sometimes a little quartz.

Magnetite very titaniferous, mostly converted into leucoxene and a colourless granular polarising mineral.

Quartz in isolated, scattered, irregular grains, whether primary or not it would be difficult to say. *Some* is secondary.

Much-decomposed Andesite or Dacite, with secondary quartz and carbonates.

Locality.—The first bluff on the coast south of Tapu Creek, Thames County.
Formation.—Thames-Tokatea group.
Remarks.—Taken as an example of the more decomposed rocks of the district as seen at the surface, and as also resembling "miners' sandstone."

No. 149/3932.

M.C.—White decomposed rock, soils the fingers.

U.M.—MATRIX almost colourless, with dispersed leucoxene dust and granules, consisting chiefly of small irregular grains of quartz, fine scales of sericite, and a little carbonate.

PHENOCRYSTS.—*Felspar:* Numerous pseudomorphs in carbonates, sericite, and pyrites are scattered through the slice, in too many cases torn out by grinding. The outlines are not well preserved; too often transgressed by the carbonates, which have extended their growth into the matrix.

Pyroxene: In a few cases definite octagonal outlines like those of pyroxene have been observed, and included leucoxene as well as pyrites.

Hornblende would seem to have been fairly abundant; numerous six-sided sections occur, containing carbonates, pyrites, and a white serpentinous mineral. The hornblende presents no reaction borders.

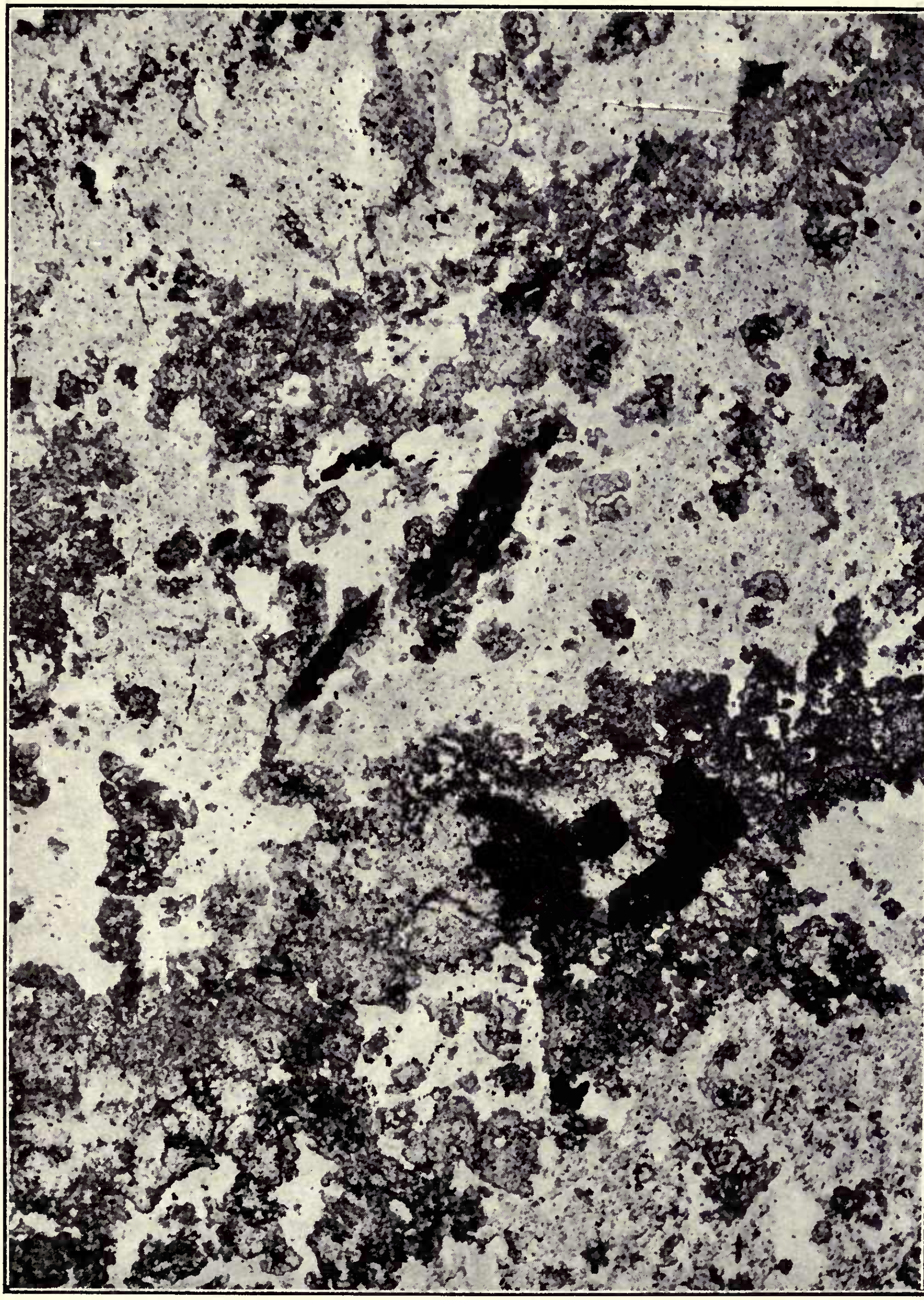
Pyrites is abundantly present throughout the slice.

Andesite or Dacite, much decomposed.

Illustration.—Slice shows fair contrasts without very definite outlines of the included crystals.

Photographed by ordinary light; magnification, 40 diameters; area photographed, middle left, which shows a tendency to banding more pronounced than is seen in other parts of the slice.

Locality.—First bay south of the mouth of the Mata River, Thames County.
Formation.—Thames-Tokatea group.
Remarks.—The rock collected from is exposed in the tideway. It resembles, and probably is the same as No. 3898, the remarks under which may have application here. While the rocks of the Thames-Tokatea group appear in the tideway Maitai slates and sandstones appear at the foot of the slopes immediately above high-water mark.



No. 149/3932. ANDESITE OR DACITE HIGHLY DECOMPOSED.

[*To face p. 240.*

No. 149A/3948.

M.C.—Violet-grey spherulitic rhyolite with phenocrysts of biotite; the spherulites weathering to an ochreous colour.

U.M.—Banding of original stream-lines still preserved in places, and indicated by parallel arrangement of biotite flakes in others. Bands which have consolidated early are of a yellowish-brown colour by transmitted light, and milky-white by reflected light, and therefore probably altered; they are traversed by positive spherulitic fibres, and positive spherulites start from their surface as origin. Lath-like microliths of sanidine are conspicuous, running in stream-lines; occasional flakes of corroded biotite are present, numerous grains of magnetite, and here and there black, dusty, rod-like forms which look like resorbed hornblende. The positive spherulites which arise from the limits of these bands extend their rays into it as well as outwards, in the latter direction attaining their full development, and extending their cervicorn processes into the adjoining irregular band, which is made up of more obviously crystallized coarser material, and even includes micropœcillitic inclusions of felspar in quartz. The positive spherulites seem frequently to be determined in their origin by a pre-existing solid body, such as a crystal of felspar or biotite; in the latter case they may grow in numerous tufts from each side, and so produce a very elongated axiolite-like form of spherulite. Some of the positive spherulites are very regular in their first stage of growth, approximately spherical or mushroom-shaped; they may never lose this regularity, but frequently after attaining a certain limit they suddenly branch out into cervicorn processes; but also their growth may be irregular from the first.

Some of the clearer spaces in the rock contain "quartz globulaire," and quartz mosaicises some of the positive spherulites.

Negative microspherulitic material occurs in small quantity; in some places it forms the usual border to the positive spherulite, but in others it has disappeared by subsequent alteration.

In the clearer coarser crystal complexes minute short green prisms of hornblende occur as microliths.

PHENOCRYSTS.—*Plagioclase* crystals with a *r.i.* above balsam, twinned on the albite plan, and extinguishing at 32°/ 32° occur. Other felspar is inclosed in the spherulites; this is

Sanidine: Its *r.i.* is below balsam, and its extinguishing is 21°, with the edge 010, 110.

Quartz occurs in corroded bi-pyramids.

Biotite in rather large crystals, with marked pleochroism, straw-yellow / deep-brown, almost black.

Spherulitic Rhyolite, containing plagioclase.

Illustration.—The slice shows fair contrasts, but on the screen most parts, except that photographed, appeared flat. In this case a complicated spherulite built up on a plate of biotite gave the necessary contrast.

Photographed by ordinary light; magnification, 48 diameters; area photographed, upper middle part.

Locality.—Hikutaia River bed, at first crossing above the township, Hikutaia district.

Formation.—Acid group of Pliocene age.

Remarks.—The specimen was possibly carried by the main stream from the upper valley. Possibly it could have come from the mountains on the north side of the valley, but the suggestion first made indicates the more likely locality.

No. 150/3949.

M.C.—Black pitchstone.

U.M.—Matrix: Transparent brown glass forms the greater part of the rock; colourless interrupted irregular streaks occur in it, and wherever magnetite grains occur the brown colour is discharged around them. The colourless streaks are distinguished by containing most of the black rods and granules of the glass. Perlitic cracks occur in some parts of the slice.

Phenocrysts.—*Plagioclase*: Chiefly in corroded fragments; contains inclusions of brown glass and pyroxene; *r.i.*, above balsam.

Pyroxene: Only a little and that chiefly hypersthene, which is fresh, and with the usual pleochroism.

Ilmenite: Several crystals already converted into leucoxene and sphene. *Apatite* occurs in association with it.

Biotite: One or two large crystals are present; pleochroism dark-brown / faint straw-yellow.

Pitchstone, containing plagioclase and hypersthene.

Locality.—Hikutaia River bed, at the first crossing above the township, Hikutaia district.

Formation.—Acid group of Pliocene age.

Remarks.—The same as for the previous specimen (No. 3948).

No. 151/3954.

M.C.—Violet-grey rhyolite with mica, evident quartz, and small cavities.

U.M.—Matrix by ordinary light faint-brownish, almost colourless, traversed by crystallites in stream-lines. The crystallites are usually long, black, and straight, sometimes curved or "knicked"—*i.e.*, suddenly bent trichites. With *x.n.* negative microspherulitic structure is seen to predominate. Positive spherulitic growths occur around many of the included

No. 149A/3948. SPHERULITIC RHYOLITE CONTAINING PLAGIOCLASE.

[*To face p. 242.*

phenocrysts, and proceed from streaks (corresponding to fissures originally) running with the flow-lines; in the latter case they take an axiolitic form. The middle of the streak now consists of tridymite, bordered first by a thin layer of negative microspherulitic material and then by the positive spherulitic growths; also, from the walls of various cavities in the slice, some of which may be artefact, produced during the grinding of the slice and the tearing-out of phenocrysts, but some appear to be original, an inner lining of tridymite occurs in these cases. Immediately outside the positive spherulitic growths mosaics occur, possibly of quartz.

PHENOCRYSTS.—Sanidine, often six-sided (010); *r.i.*, below balsam.

Quartz in corroded grains and bi-pyramids. The spherulitic material round these may be traversed by perlitic cracks concentric with the quartz.

Biotite: Well-defined crystals, straw-yellow / deep-brown or almost black. Minute scales generally present as well in the groundmass.

Magnetite: A few large grains.

Negative Microspherulitic Rhyolite, with positive spherulitic growths.

Locality.—Hikutaia River bed, at first crossing above the township.

Formation.—Acid group of Pliocene age.

Remarks.—Although the specimen was collected where stated, the rock was traced and collected from at 900 ft. above the Hikutaia, on the road to the "Wires" in the Upper Tairua Valley, where it occurs in considerable mass as a spongy rock containing scales of biotite.

No. 152/3966.

M.C.—Stony rock with scattered crystals.

U.M.—MATRIX with ordinary light has much the appearance of microspherulitic bands alternating with crystal complexes, but between *x.n.* transformed into an irregular mosaic of quartz of various degrees of coarseness. Those parts which originally corresponded to microspherulite are distinguished by abundance of granules, giving a dusty appearance. In rare places these granules retain the radiate arrangement of microspherulitic structures, so that with ordinary light one may fancy one is observing a microspherulite. With polarised light the apparent microspherulite is found to be a grain of a quartz mosaic.

PHENOCRYSTS.—*Sanidine:* Some well-formed crystals, when fresh and sharply outlined reminding one of a microperthite; often converted into sericite, leaving only an outer margin of felspar.

Biotite rare; a colourless crystal or two converted into almost colourless chlorite.

Quartz in corroded bi-pyramids, numerous.

A little *zircon* and *leucoxene.*

Microspherulitic Rhyolite, replaced by quartz.

Locality.—Upper part of the valley of the middle branch of the Hikutaia River, Ohinemuri County.

Formation.—Acid group of Pliocene age.

Remarks.—The specimen comes from the bank of the river at the base of the most easterly of the Maratoto Peaks, about two chains above the junction of the rhyolite with a remarkable agglomerate of Beeson's Island rocks. This has no cementing medium or matrix. Through it the rhyolite has seemingly been erupted; but the nature of the most easterly Maratoto Peaks, and the mode of occurrence of the rhyolites more to the east and around the sources of the Tairua River, supports the intrusive theory of their origin.

No. 153/3969.

M.C. — Rhyolite banded with greyish-white and chalky-white streaks, cavernous.

The chalky-white bands are transparent and brown by transmitted light, and consist of negative microspherulitic material; the greyer are clearer, almost colourless by transmitted light, and consist of coarser irregular, sometimes spherulitic (or radio-fibrous), intergrowths of felspar and tridymite. The felspar is orthoclase in most cases, but some albite was observed. The middle of the grey streaks is rich in tridymite. The felspar in many cases has undergone the so-called "re-fusion" change.

Phenocrysts.—*Plagioclase* altered along cracks into "re-fusion" substance; remainder fresh, and often shows albitic twinning; ext., 26°/27°.

Pyroxene: Some pseudomorphs consisting of very feebly double-refracting material with fibrous more widely double-refracting veins were certainly pyroxene; leucoxene is associated with them.

Biotite with pronounced pleochroism, brownish-yellow / almost colourless, straw-yellow, in ragged flakes, sporadic, not abundant.

Magnetite and *leucoxene:* A little.

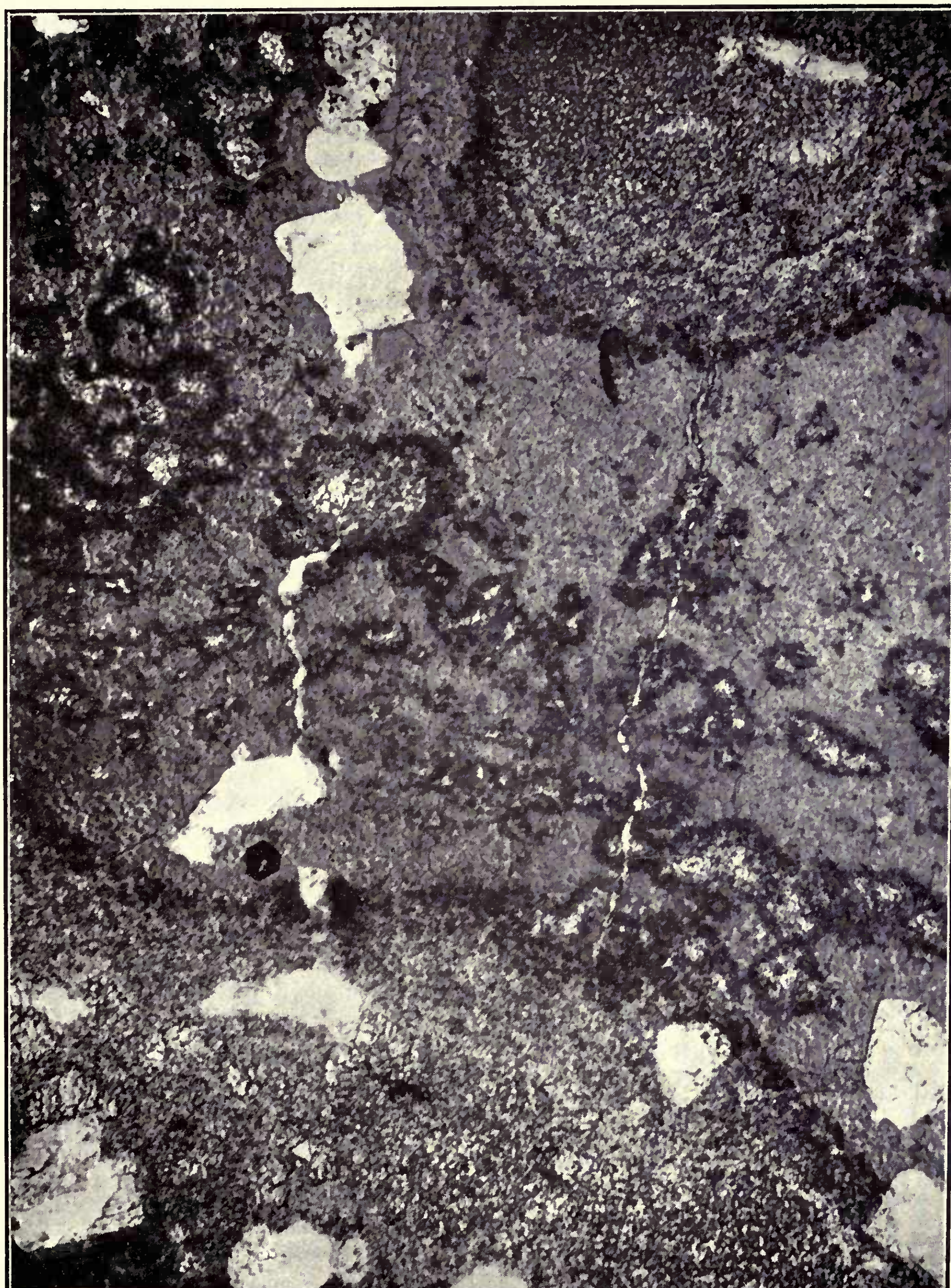
The cavernous portions not shown on the slice.

Negative Microspherulitic Rhyolite, with plagioclase.

Illustration.—The slice shows moderate contrasts which, however, under proper treatment has enabled the production of a strong negative.

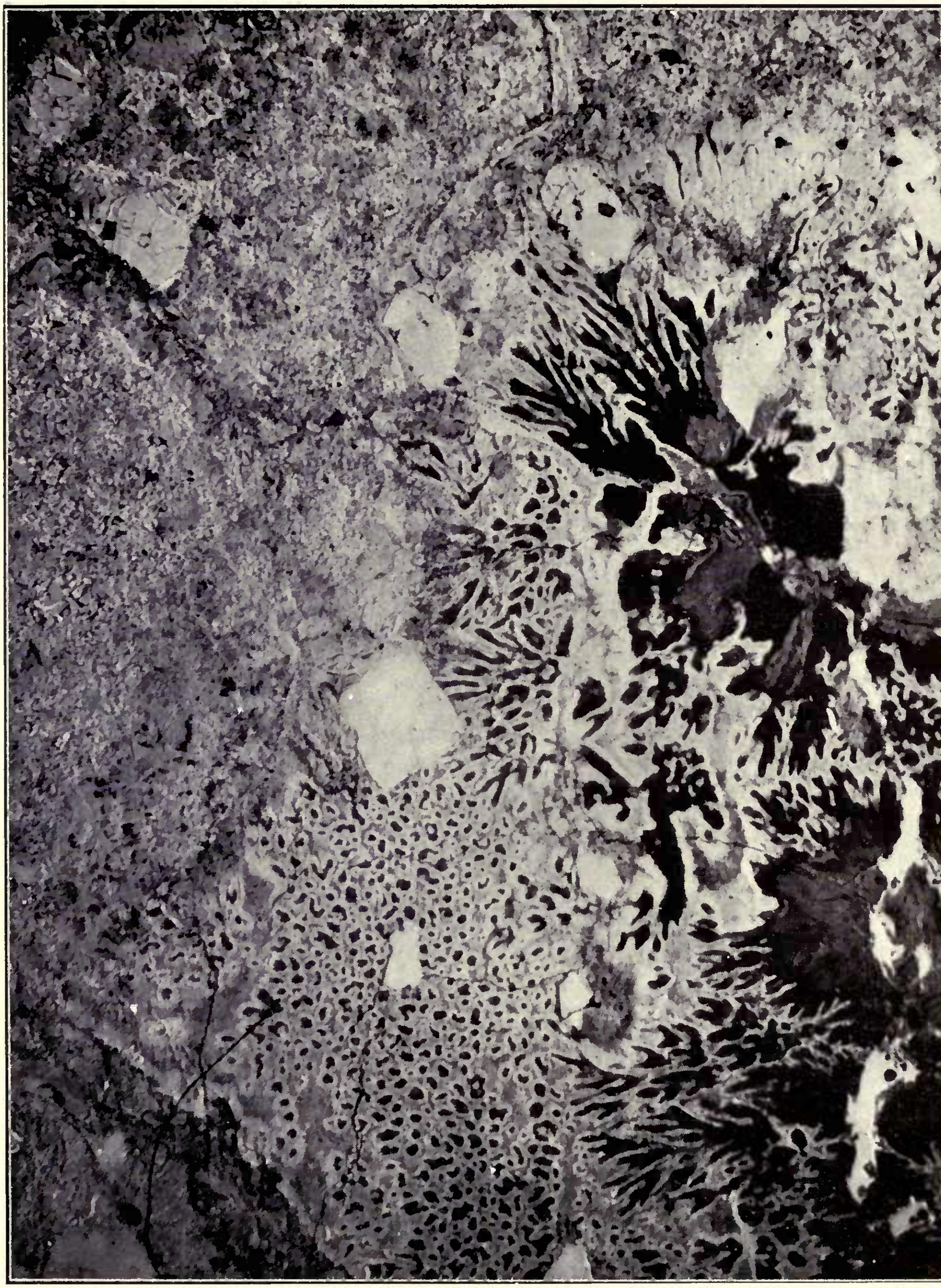
Photographed by ordinary light; magnification, 40 diameters; area photographed, middle right, which resembles generally the other parts of the slice, though in some parts the phenocrysts are both larger and more numerous.

Locality.—Road to the "Wires" from Hikutaia, Hikutaia district.



No 153/3969. NEGATIVE MICROSPHERULITIC RHYOLITE WITH PLAGIOCLASE.

[*To face p. 244.*



No. 154/3979. SPHERULITIC RHYOLITE CONTAINING PLAGIOCLASE.

[*To face p.* 245.

Formation.—Acid group of Pliocene age.

Remarks.—This rock is exposed as a lava-stream outlying from and in date perhaps older than the pumiceous agglomerate that more to the east forms the steep scarp known as the "Steps," and thence to the eastward underlies the acid rocks of the basin of the "Wires" and Big Dam in the Upper Tairua Valley.

No. 154/3979.

M.C.—A network of violet-black rhyolite with white spherulites occupying the meshes.

U.M.—Matrix: Negative microspherulitic material enclosing positive cervicorn spherulites, and passing itself into mosaics of quartz.

The positive spherulites are produced into richly ramifying processes, very obvious on account of their warm brown colour; about the centre of the spherulite this colour is much weaker, and the reaction with polarised light correspondingly more marked. By reflected light the brown material is chalky-white. The periphery of the positive spherulites, including all the surface of all their branches, is covered with a uniform layer of negative microspherulitic material. This is the invariable relationship which holds between the positive and negative spherulitic matter in all the slices I have examined. It follows that the positive spherulites have commenced, and in many places completed their growth, before the negative have begun to form.

Phenocrysts.—*Plagioclase r.i.* above balsam; ext., 27°; a few crystals and fragments.

Biotite: Pleochroism brown / straw-yellow; a few corroded crystals.

Quartz in bi-pyramids, often broken and corroded.

Spherulitic Rhyolite, containing plagioclase.

Illustration.—The slice shows moderate contrasts.

Photographed by ordinary light; magnification, 40 diameters; area photographed, lower left, in which is shown an echinate spherulite, as seen in section of the interior central part, some of the processes being cut at an acute angle, others nearly at right angles.

Locality.—Hikutaia River bed, at first crossing above the township, Hikutaia district.

Formation.—Acid group of Pliocene age.

Remarks.—The same as for No. 3948.

No. 155/3985.

M.C.—Light violet-grey rhyolite passing into white; phenocrysts of biotite and quartz.

U.M.—MATRIX chiefly negative microspherulitic; microspherules differ in size and coarseness; where coarser, nests of tridymite occur.

Positive spherulitic matter, often elongated axially, is also present, and contains black trichites and transparent colourless belonites. Perlitic cracks occur in the microspherules concentric with the periphery, and also on the positive microfelsite when this surrounds a phenocryst; in this case the cracks are more or less concentric with the outline of the phenocryst.

PHENOCRYSTS.—*Plagioclase:* Crystals and rounded fragments, far from abundant, some partly replaced by tridymite.

Quartz: Fragments and bi-pyramids, often intensely corroded, frequently surrounded by positive spherulitic growths, fairly common.

Biotite: Several crystals, straw-yellow / dark greenish-brown to black.

Zircons are associated with the biotite.

Microspherulitic Rhyolite, with plagioclase and quartz.

Locality.—Hikutaia River bed, at the first crossing above the township, Hikutaia district.
Formation.—Acid group of Pliocene age.
Remarks.—The same as for No. 3948.
Nos. 3948, 3949, 3951, 3979, and 3985 were all taken from the broad shingle-bed of the Hikutaia River bed, where, in the clean-washed and well-rolled boulders, a greater variety could be collected than from exposures of the rhyolites *in situ* on the north side of the valley or towards the source of the main branch of the river. It is needless to say that these specimens have in one sense a less value than such as have been collected from the solid rock, but they were collected with a full appreciation of the importance of the remarks made on pages 12–15 of the introduction to this report.

No. 156/4001.

M.C.—Greyish-black compact rock sprinkled with felspar crystals.

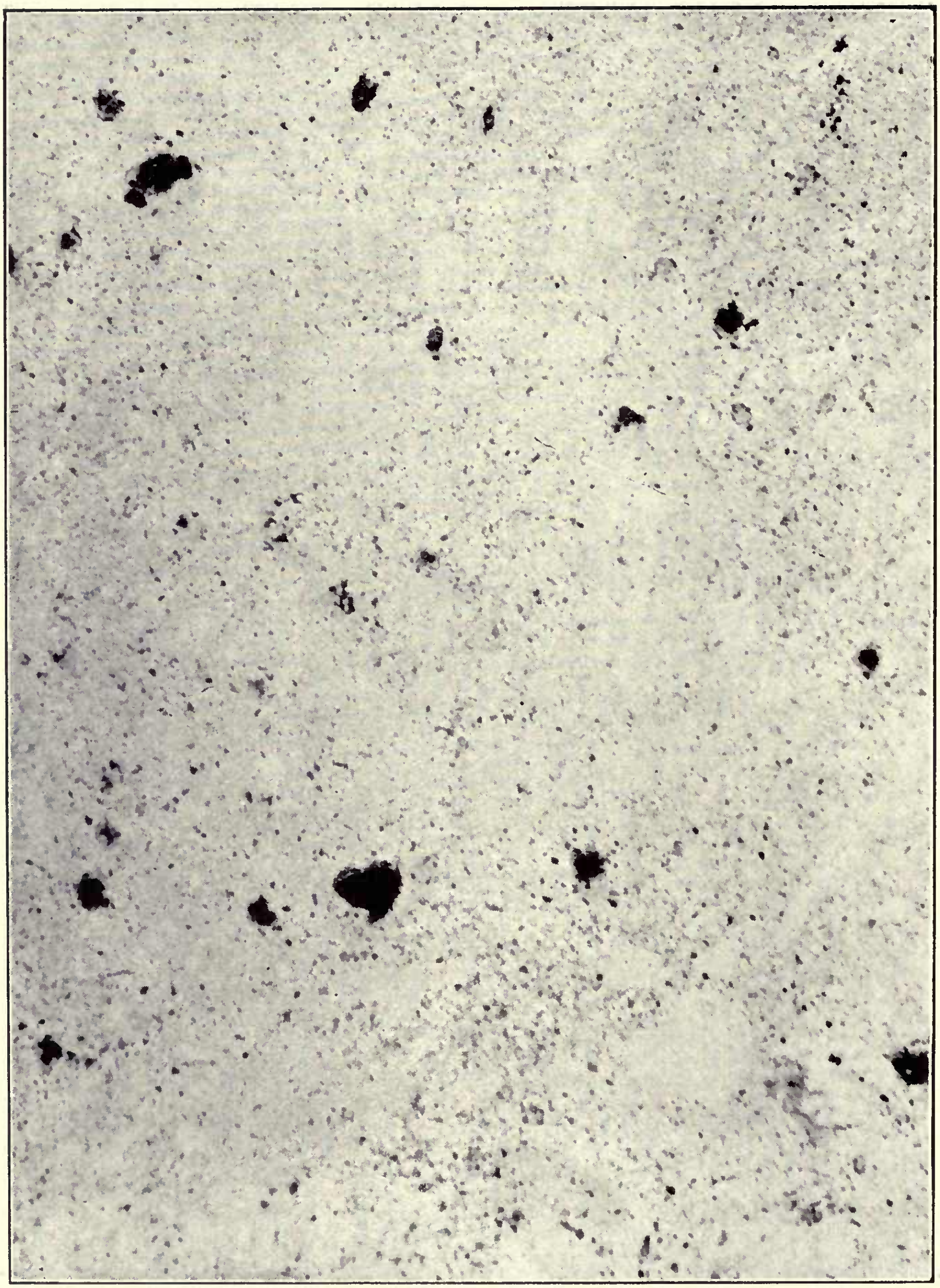
U.M.—MATRIX minutely pilotaxitic, dusty with excess of magnetite, crowded with small felspar laths in flow-lines, rare ferro-magnesian grains, some leucoxene granules.

PHENOCRYSTS.—*Plagioclase:* Crystals, clusters, and fragments with usual andesitic character. Inclusions various, sometimes occur as a coarse network of glass; ext., 25°/30°.

Augite: Fresh well-formed crystals, also clusters, almost colourless, faint-green.

Hypersthene represented by pseudomorphs in green serpentine with associated leucoxene and magnetite; abundant.

Hornblende rare; one or two resorption pseudomorphs.



No. 157/4013. MUCH ALTERED ANDESITE OR PERHAPS DACITE.

[*To face p.* 247.

Magnetite: A good many scattered grains.

Minutely Pilotaxitic Hypersthene Andesite.

Locality.—Second or middle one of the three deep cuttings on the road (above the gorge) from Hastings to the Mahara Royal Mine, Tapu Creek, Thames County.

Formation.—Thames-Tokatea group.

Remarks.—On the exposed surfaces this rock is darker in colour than when fracture of the solid is made, the joints of the rock are also darker but often coated with white or transparent splendent crystals.

No. 157/4013.

M.C.—Bluish-grey rock with white spots, glistening with pyrites.

U.M.—Matrix: Minute jagged grains of quartz, scales of sericite and chlorite, granules of leucoxene.

Phenocrysts.—*Felspar* outlines preserved; material mostly converted into carbonates and sericite. When the carbonate is dissolved away in hydrochloric acid the remainder of the pseudomorph stains readily with aniline dyes.

Pyroxene represented by pseudomorphs of chlorite rarely well outlined; carbonates may be associated with the chlorite.

Leucoxene in fairly large grains.

There is no evidence, so far as the microscope is concerned, to show that this was an ash; the slices simply show a much-altered andesite or, perhaps, dacite.

Andesite or, perhaps, Dacite, much decomposed.

Illustration.—Slice shows but poor contrasts.

Photographed by ordinary light; magnification, 40 diameters; area photographed, the middle part, which is characteristic of the whole of the slice.

Locality.—The Sheridan Mine, Tapu Creek, Thames County.

Formation.—Thames-Tokatea group.

Remarks.—This rock was adhering to a block of coarse breccia and was selected as a sample of "miners' sandstone." When collected the specimen was considered fragmental, and, being of fine grain, may have been called ash.

No. 158/4035.

M.C.—Dark-black basaltic-looking rock, sparkling with small crystals of plagioclase.

U.M.—Matrix: Large amœboid patches or mosaics in which small felspar laths, grains, and prisms of augite and magnetite are numerous. Near phenocrysts of felspar and elsewhere the amœboid patches disappear, and the felspar laths then become more sharply defined. This is owing to the fact that the material of the mosaic has a *r.i.* nearly equal to that of the felspar, only a little below—it is probably quartz; while near the felspar the glassy condition may be retained.

PHENOCRYSTS.—*Plagioclase:* Well-defined crystals, coarsely twinned, zonal, submarginal zones of inclusions, sometimes several zones of inclusions; in many cases the core is specially distinguished by inclusions, the margins remaining clear. The inclusions sometimes become altered to radio-fibrous serpentine or chlorite; ext., 15°/23°.

Augite: Numerous crystals, faint-green to almost colourless, extinguishing up to 42°, include magnetite and decomposition products. Vapour cavities of large size are present.

Hypersthene: Numerous pseudomorphs in green serpentine, which is fibrous, extinguishing at 0°, and pleochroic, brownish-yellow / ferrous-green. Apatite sometimes included.

Hornblende: Resorption pseudomorphs are fairly numerous.

Magnetite occurs in large grains.

Pilotaxitic Hypersthene Andesite, containing hornblende.

Locality.—Same as No. 4001.
Formation.—Thames-Tokatea group.
Remarks.—Same as for No. 4001. Both this and that numbered 4001 are rather uncommon rocks, and are seen in this district along the middle valley of Tapu Creek. They do not appear in the bluff along the shore of the gulf south of the mouth of Tapu Creek, or should the same rocks be present they are so affected as to present a totally different appearance. These dark basaltic rocks on Tapu Creek are, in their visual characteristic, most nearly approached by the rocks of the big cutting after passing Brown's Camp, on the road from Kuaotunu to Mercury Bay. Those latter, however, belong to the Kapanga group.

No. 159/4044.

M.C.—Heavy compact black rock with phenocrysts of felspar.

U.M.—MATRIX pilotaxitic, crowded with felspar microliths, pyroxene grains or their pseudomorphs, and magnetite granules.

PHENOCRYSTS.—*Plagioclase:* Single crystals, abundant fragments, and clusters; zonal; often rich in inclusions, and then liable to decomposition into carbonates.

Augite: Fragmentary faint-green crystals still undecomposed; extinguishing at 40°.

Hypersthene: A good deal, but decomposed into green serpentine pseudomorphs; carbonates sometimes associated. Intergrown with augite, which remains unaffected within the hypersthene pseudomorph.

Hornblende represented by resorption pseudomorphs, but rare.
Magnetite grains, a fair number.

Pilotaxitic Hypersthene Andesite, with very little hornblende.

Locality.—Waiorongomai Creek, Te Aroha district, Piako County.
Formation.—Thames-Tokatea group.
Remarks.—This rock is from the bed of the creek, less than a quarter of a mile above the battery.

No. 160/4053.

M.C.—Volcanic agglomerate.

U.M.—Matrix: Scarcely any cement; the finer particles and broken crystals fill up the interstices between the larger. Some quartz mosaics. Evidences of pressure are afforded by the bending of the twinning lamellæ of some of the fragmentary plagioclase. The rock has been much altered by percolating water.

Fragments.—(i.) *Pyroxene Andesite:* Dark reddish-brown granular matrix, black by transmitted light, filled with iron-hydrates, opaque, once a glass; crowded with felspar laths in flow-lines, some swallow-tailed; vesicular, vesicles small, round, or larger irregular, filled with granular serpentinous decomposition products and a little quartz, which is commonest at the margins of the vesicles. Phenocrysts colourless augite extinguishing at 41°, passing into carbonates.

(ii.) *Pyroxene andesite:* Reddish-brown matrix with minute felspar rods, not very numerous, and minute quartz grains. Vesicles not numerous, but as in (i.). Colourless augite passing into serpentinous material and carbonates. Hypersthene completely serpentinised.

Plagioclase: Large crystal cluster, broken externally; ext., 20°/ 35°.

(iii.) Probably *altered olivine basalt:* Matrix small rectangles of plagioclase, ext. 20°/ 30°, in flow-lines, and small grains of augite bordered by opaque iron-ore; filmy lines of granular brown substance suggest the former presence of glass, but isotropic serpentine after olivine is not present. Some quartz in mosaics and augite extinguishing at 43° occur.

Among the scattered crystals of the rock pseudomorphs after hypersthene associated with unchanged augite may be mentioned.

Volcanic Agglomerate, composed largely of andesitic rocks.

Locality.—Cascade Creek, west slope of Te Aroha, opposite the township, Piako County.

Formation.—Thames-Tokatea group (?).

Remarks.—At the waterfall a variety of rocks, partly *in situ* and partly brought down from the higher part of Te Aroha, are found in the solid and as large boulders in the bed of the creek. Boulders of large size and of various description extend down the creek and across the main road into the township, and a variety, mainly andesic, but varied in tint from light-green to dark-purple, can be collected along the bed of the stream.

The sample was taken from a fallen mass in the bed of the stream, but a similar rock appears at and above the waterfall.

No. 161/4058.

M.C.—Fine-grained bluish or purple rock.

U.M.—MATRIX pilotaxitic, with felspar laths, chloritic decomposition products after pyroxene, magnetite and leuxocene grains.

PHENOCRYSTS.—*Plagioclase:* Well-formed crystals, more numerous fragments much cracked, fissures filled with quartz or another felspar, green decomposition products; zonal, submarginal, central, and general inclusions; ext., 20°/24°. Twinning various and irregular. A little epidote present in some.

Augite: Fragments, crystals, and mosaic clusters, almost colourless or faint-yellowish; ext., 40°. Twins.

Hypersthene represented by pseudomorphs of green serpentine; no cores remain.

Magnetite: Large grains sparingly scattered.

Some thin veins of microspherulitic rhyolite are intruded into this rock; the thinnest veins contain only microspherulitic matter, the wider are also occupied by carbonates and chlorite. Their intrusive nature is well shown by the manner in which they cut through felspar crystals of the andesite.

Pilotaxitic Hypersthene Andesite, traversed by rhyolite.

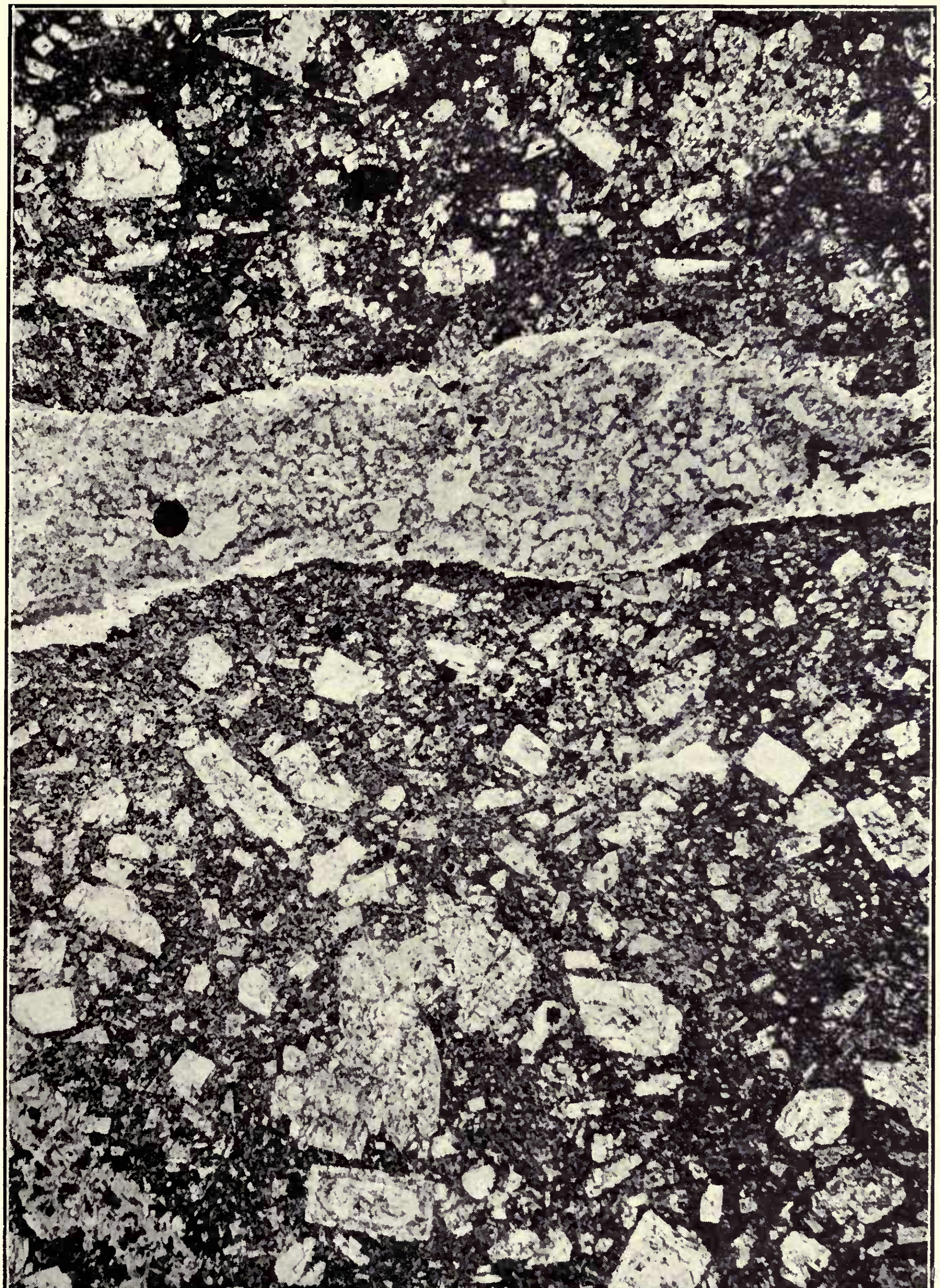
Illustration.—Slice shows fair contrasts and a narrow band of a different kind of rock running across the part photographed.

Photographed by ordinary light; magnification, 40 diameters; area photographed, the middle part, through which runs one of the thin veins of rhyolite mentioned in the description of the slice by Professor Sollas. With the exception of this thin band of rhyolite, the illustration is fairly representative of the slice.

Locality.—Cascade Creek, west side of Te Aroha, within the township, Piako County.

Formation.—Thames-Tokatea group (?).

Remarks.—This rock is associated with breccias, of which the fragments are much larger. The photo-reproduction does not indicate the brecciated condition of the rock. In certain cases, as in this instance, the slices seem to have been cut from the solid fragments of a breccia; and, as a consequence, that is described as part of a solid lava-floe, which in the field is seen to be fragmental.



No. 161/4058. PILOTAXITIC HYPERSTHENE ANDESITE TRAVERSED BY RHYOLITE.

[*To face p.* 250.

The occurrence of rhyolite in this specimen is of interest, and specially so with reference to the occurrence of acid rocks in Karangahake Mountain, the next district to the north where spherulitic rhyolites and trachyte have a considerable development within the auriferous area of that district.

No. 162/4061.

M.C.—Black lustrous rock with glassy phenocrysts of plagioclase and some yellowish crystals.

U.M.—Matrix pilotaxitic, with felspar laths in flow-lines; chloritic decomposition products, granules of magnetite and leucoxene.

Phenocrysts.—*Plagioclase*: Usual andesitic character; ext., 30°/30° to 36°/36°. Some filled with a network of green decomposition products.

Augite: Numerous small crystals, faintly greenish, almost colourless, twinned; extinguishing up to 43°.

Hypersthene: Fairly numerous pseudomorphs in green serpentine; cores of unaltered material present, with the usual pleochroism.

Magnetite, with associated *apatite,* fairly common.

Pilotaxitic Hypersthene Andesite.

Locality. – Cascade Creek, Te Aroha Mountain, near the township, Piako County.
Formation.—Thames-Tokatea group (?).
Remarks.—The specimen was taken from the bed of the creek a short distance below the waterfall. This rock is closely associated with the green and purple breccia at the waterfall, and may be said to occur there *in situ.*

No. 163/4064.

M.C.—White and grey porous decomposed rock (miner's sandstone).

U.M.—Matrix colourless, dusty, with patches of network, white by transmitted light, brown by reflected; *x.n.* show interlocking quartz grains forming greater part of the matrix, but also a very considerable quantity of sericite, which becomes more abundant in the white patches. Scattered grains of leucoxene abundant.

Phenocrysts represented by pseudomorphs only.

Felspar: Some ill-defined areas consisting chiefly of sericite and pyrites may represent felspar.

Pyroxene: Octagonal and long rectangular sections occur in which the replacing mineral consists of quartz, sericite, and pyrites; the sericite in some cases directed with the long axes of its scales parallel to the long sides of the rectangle, and stopping short on each side of and against a transverse line, just as the serpentine fibres or scales do in a pseudomorph after hypersthene. These sections may therefore represent pyroxene. The quartz occurs as mosaics in part, and in part as a single crystal filling half the outline of a section.

Pyrites in granules may contribute largely to these pseudomorphs.

Hornblende : Some of the sections recall this mineral ; the pyrites they contain runs in rows of granules, giving a fibrous appearance to the pseudomorph, and forms a border recalling the reaction border of hornblende.

The sericite or muscovite in these cases lies with its long axis parallel to the length of the section (axis *c*). Patches of leucoxene after ilmenite are numerous and characteristic.

This is evidently a volcanic or dyke rock altered by replacement with quartz and pyrites ; originally an andesite or a rhyolite, more probably the former.

Altered Andesite.

Locality.—Waiorongomai Creek, Te Aroha district.

Formation.—Thames-Tokatea group (?).

Remarks.—This specimen, highly decomposed, was taken as representative of "miners' sandstone" in the district of the Upper Thames goldfields.

During the progress of the examinations made between 1896–98 it was the practice to collect examples of the rocks in the various conditions in which they occurred at the surface and in mines. Highly altered and decomposed rocks thus form a large part of the collection, and of these not a few, and this amongst the rest, were sent to England for description.

No. 164/4080.

M.C.—Grey-black compact rock, hackly fracture, phenocrysts of plagioclase and ferro-magnesian minerals, patches of yellow-grey material.

U.M.—MATRIX colourless glass crowded with felspar laths and rectangles, pyroxene prisms, magnetite granules, and needle-like belonites.

PHENOCRYSTS.—*Plagioclase :* Numerous large crystals of ordinary andesitic character ; ext., 22° / 24°. Many are crowded with glass inclusions.

Augite : Small crystals and fragments, numerous, faint-yellowish, almost colourless ; ext., 39°.

Hypersthene also abundant ; pleochroism greenish-blue / pinkish ; includes magnetite and apatite, this latter striated by black rods parallel to the axes *c* and *a* as well as *b*.

Hornblende : Resorption pseudomorphs rare.

Ilmenite and *magnetite :* Several large grains, with associated *apatite*.

Xenoliths of a similar but more coarsely crystallized rock occur, and show

No. 164/4080. HYALOPILITIC HYPERSTHENE ANDESITE WITH BUT LITTLE HORNBLENDE.

[*To face p.* 253.

greater progress of decomposition, pseudomorphs in carbonates being present. These are probably the yellowish-grey material of the hand-specimen.

Hyalopilitic Hypersthene Andesite, with but little hornblende, containing xenoliths.

Illustration.—Slice shows fair contrasts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, middle part, which may be considered characteristic of the whole of the slice.

Locality.—Waiorongomai Stream, Te Aroha district.

Formation.—Thames-Tokatea group (?).

Remarks.—Collected from the bed of the stream 10 to 15 chains above the battery, from rock showing on the left bank of the river.

No. 165/4081.

M.C. — Light greenish-grey fragmental rock with reddish streaks and spots, speckled green and white, decomposed.

U.M. — Matrix minute grains of quartz, indeterminable granules like leucoxene, a few felspar laths, and chlorite. The whole minutely granulo-crystalline, sometimes obscurely micropœcillitic. Set in this are numerous fragments, chiefly of andesite and of the phenocrysts characteristic of andesite, *e.g.*

Phenocrysts.—*Plagioclase* much altered, but some fairly fresh; converted into epidote, quartz, and carbonates. The fresher crystals ext., 28° / 29°.

Augite more abundant than felspar, sometimes quite fresh, faint-yellowish in colour, twinned. Sometimes pseudomorphs of hypersthene are included in the augite. Some of the augite transformed into epidote.

Hypersthene represented by pseudomorphs in green serpentine.

The fragments of andesite are (i.) pilotaxitic with felspar laths in flow-lines, the non-felspathic part of the matrix sometimes replaced by epidote; (ii.) vesicular fragments, the vesicles filled with chlorite, surrounded by epidote, or also filled with fibrous epidote; (iii.) once hyalopilitic andesite, the felspar laths well preserved, some long and slender, the inter-felspathic material converted into chlorite.

A Fragmental Rock composed of **Andesitic Material.**

Locality.—Cascade Creek, near Te Aroha Township, Piako County.

Formation.—Thames-Tokatea group (?).

Remarks.—This specimen was taken from the solid at the waterfall, where it is associated with red and green fine-grained breccias or ash-beds.

No. 166/4088.

M.C.—Compact greyish-black basalt-like rock.

U.M. — MATRIX faint yellowish - brown, almost colourless, pilotaxitic, crowded with felspar laths in stream-lines, more sparingly with grains of augite and magnetite.

PHENOCRYSTS abundant. *Plagioclase* of usual andesitic character; ext., 20°/22°.

Augite: Faint yellowish-brown crystals, horned, zonal; ext., 43°.

Hypersthene abundant, fresh, or showing only incipient change, twinned; bordered by augite on sides parallel to *c*, but not to *a* and *b*.

Magnetite grains fresh.

Pilotaxitic Hypersthene Andesite.

Locality.—Bullion Creek, near the upper end of Tapu Creek Gorge, Thames County.

Formation.—Thames-Tokatea group.

Remarks.—A very noticeable rock, and seemingly one of the best preserved in the district. However, for some reason a good negative could not be obtained from the slice returned with the specimen, and as a consequence there is no illustration.

No. 167/4096.

M.C.—Granite-like rock containing white felspar, greenish-black biotite, and other ferro-magnesian minerals of medium grain.

U.M.—HOLOCRYSTALLINE, hypidiomorphic, granular.

Felspar: Numerous apposed crystals, interstices between the angles filled with quartz. Zonal, frequently with a well-marked marginal zone. When, as in some rare cases, the zone extends across the albitic lamellation without itself showing signs of twinning it extinguishes parallel. Twinning on more than one plan, albite, pericline, and Carlsbad. The felspar is very fresh, but muscovite is not uncommon in it. Little crystals of faintly green augite are included, associated sometimes with a minute crystal of magnetite; the augite extinguishes at 39°, and is found *nowhere else* in the slice. Hypersthene is also included as short rounded prisms, extinction parallel, with low double refraction; pleochroism greenish-blue / topaz-yellow.

Separated by specific gravity the principal felspar is found to be andesine (sp. gr. 2·675), but some labrador is present (sp. gr. 2·74), and a little orthoclase (sp. gr. 2·547 and a little over). The orthoclase grains give odium and potassium coloration to the Bunsen flame.

Quartz is interstitial; it contains irregular liquid cavities with bubbles, also belonite-like crystallites.

Biotite occurs in fairly large crystals, corroded; pleochroism deep orange-brown / straw-yellow; pleochroic aureoles rare, and few included zircons. Apatite is present as an inclusion, sometimes surrounded by yellowish-green epidote; and there is a good deal of magnetite. Acquires a green colour by weathering.

Hornblende generally in association with biotite, in corroded crystals beginning to decompose; pleochroism olive-green / straw-yellow; twinned according to 100. Sometimes forms a core to biotite.

Magnetite, ilmenite, and *sphene* are present.

The minerals of the rock were separated and quantitatively estimated, with the following result:—

	Per centage.
Orthoclase	3·8
Andesine (formula Al_2An_1)	51·6
Biotite	21·1
Hornblende	4·8
Quartz (including felspar of sp. gr. 2·65) ...	17·0
Magnetite	1·1
Zircons, &c.	0·6
	100·0

The presence of augite and hypersthene in the felspar is extremely interesting, taken in conjunction with the facts described by me at Barnavave, County Carlingford, Ireland, it suggests that the hornblende and biotite of this rock are secondary formations resulting from the action of the magma on previously consolidated pyroxene.

Quartz Biotite Diorite.

Locality.—Coast-line one mile north of Adams's Farm, Moehau district.
Formation.—A dyke in rocks of the Maitai series.
Remarks.—This rock occurs as a massive dyke on the east slope of Moehau Mountain, and great masses of this and other dykes in connection with the Maitai series encumber the shore of this part of the Hauraki Gulf.

No. 168/4153.

M.C.—Cream-white spherulitic rhyolite.

The positive spherulites are formed of slender, radiating, branching processes which extend from an irregular central area to terminate in a continuous layer, formed by a trumpet-like expansion of their distal extremities, somewhat like a roof supported by Gothic arches. Between the columns various structures occur, immediately bounding them is sometimes a layer of microspherulitic matter, while the rest of the interspace is filled with coarsely fibrous negative microspherulites or quartz mosaics, or both; quartz globules, &c., and mosaics may also occur sporadically in the positive spherulitic matter. In many cases tridymite instead of quartz is associated with the negative microspherulites.

While the fibrous structure of the + spherulites is very obvious with ordinary light, it yet has very little effect on polarised light; and the same is true of the crystals of felspar proceeding from the periphery of the — spherulites. This, however, is not the effect of imperfect crystallization, but of subsequent alteration, which has produced throughout the rock the so-called "refusion" pseudomorphs.

Altered Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The particular specimen above described was collected by H. D. M. Hazard, Esq., Government District Surveyor at the Thames, from whom Professor Park obtained a sample of the same rock, which it appears was described in a paper on the rhyolites of the Hauraki Goldfields, by Park and Rutley, but in that paper the locality was wrongly referred to Omahu Peak, on the opposite side of the peninsula. (See Quart. Jour. Geol. Soc., 1889, vol. lv. pp. 452–455.) Spherulites having like structures are found on Omahu Peak, but they are small in comparison with those that come from Paku Island.

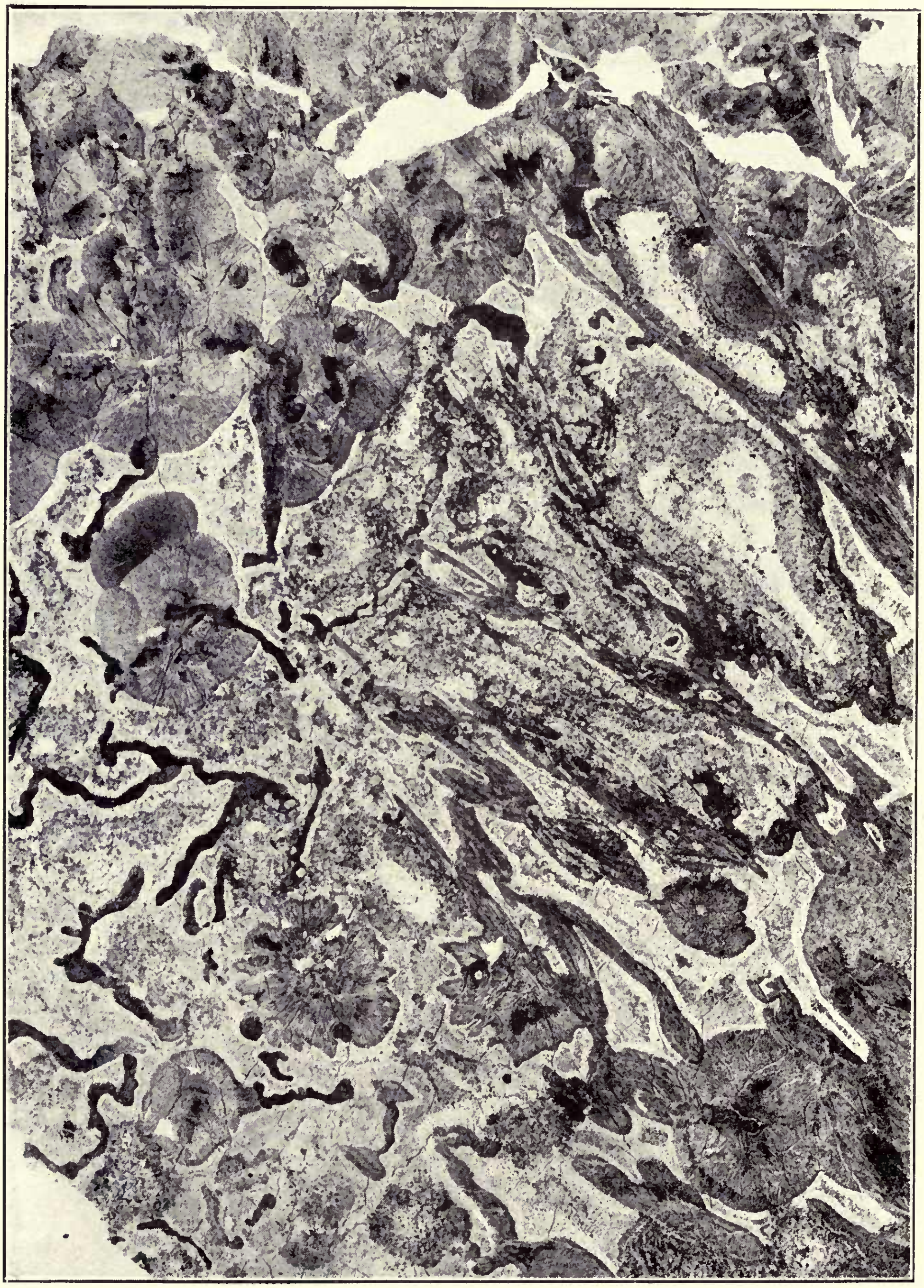
No. 169/4161.

M.C.—Coarsely spherulitic rhyolite.

U.M.—The first consolidated material appears as winding anastomosing threads or bands of microfelsitic material. This traverses all the other constituents of the rock. The middle line of these threads is clearer as a rule than the marginal portions, which are finely fibrous, the fibres running obliquely outwards and forwards. Among them are some black branching fibres. This is a form of positive spherulitic matter. In places these threads are replaced by a quartz mosaic.

The next material to crystallize was that of the positive spherulites, which probably appeared almost simultaneously with the foregoing. They vary in outline in the usual manner, from single spherules to composite forms, with or without cervicorn processes. Patches of quartz mosaic have been occasionally developed in them as subsequent growths.

The third in order of growth is the negative microspherulitic matter which forms a narrow almost continuous margin to the surface of both the preceding, its fibres directed on the whole at right angles to the surface on which it is seated. The interstitial areas which remain are filled partly with negative microspherulites, often quite spherical, but varying in degree of



No. 169/4161. SPHERULITIC RHYOLITE.

[*To face p.* 257.

coarseness of fibre, and quartz mosaics, which seem to have been the last constituents to consolidate. In places tridymite (?) takes the place of quartz mosaics.

The negative spherulitic material contains stellate crystallites sparingly dispersed. They consist of short transparent prisms (augite ?) seated on a minute magnetite granule. These are characteristic ; they do not appear in the other kinds of material.

The negative microspherulites are to be found most coarsely crystallized in the interstitial regions, as amongst the quartz mosaics. Their rays then extend outwards into definite crystalline forms, which are those of felspar. The *r.i.* is much below quartz, the extinction most usually 5° to 7°, so that sanidine evidently contributes largely to these structures. Some of the crystals, however, may be albite. In some cases the felspar makes a mosaic.

In the coarsely crystallized complexes of quartz and felspar small flakes of brown biotite may be observed.

Spherulitic Rhyolite.

Illustration.—Slice shows good contrasts.

Photographed by ordinary light; magnification, 15 diameters; area photographed, the greater part of the slice.

Locality.—Paku Island, at mouth of Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—Of the illustrations placed opposite the descriptions this was produced under the least magnification, and perhaps it had been to advantage had others been produced under like powers. At the outset the intention was first to represent a considerable portion of the slice under low powers, and, secondly, a part of the area of the first under a much higher power. This, however, would have added greatly to the cost of the work, and the plan was abandoned.

No. 170/4162.

M.C.—Spherulitic rhyolite.

U.M.—The section passes through a spherulite from centre to surface. The long, slender, radiating processes of the positive spherulite are the most conspicuous objects in the slide; they take a slightly sinuous course, branching, anastomosing, and giving off lateral growths on the way, till they terminate in a continuous peripheral layer, the fibres of which are somewhat coarser than those of the processes. The peripheral layer is produced by an expansion of the radiate processes in trumpet-like curves. Immediately outside it follows a thin colourless layer with negative microspherulitic structure, and stellate crystallites and microliths. This is succeeded by two broader zones, the inner of brownish colour, distinguished by stellate crystallites, and extinguishing in obscurely spherulitic patches with a positive sign. The outer is more obviously crystalline; loose tufts of wandering positive spherulitic fibres, clear and colourless, run through it; the stellate crystallites are replaced by stellate microliths and flakes of brown biotite. A row of negative microspherulites and large isolated examples, with perlitic and radiating cracks, lie in this layer. In places it passes into a complex of tridymite and sanidine, and occasionally a micropœcillitic mosaic of quartz occurs.

Spherulitic Rhyolite.

Illustration.—The slice shows moderate contrasts.

Photographed by ordinary light; magnification, 25 diameters; area photographed, the greater part of the slice, which is small. The slice has broken up in the process of grinding or of mounting, and only a portion of the original has been preserved. This, however, is sufficient to indicate one of the finest spherulites in the whole collection.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—Paku Island is remarkable for the number and beauty of the spherulites contained in the rhyolite that forms the island.

No. 171/4175.

M.C.—Spherulitic rhyolite; positive spherulites of large size form the mass of the rock.

U.M.—The positive spherulites present the usual character, the radiating processes are margined by a negative microspherulitic layer. They have undergone a certain amount of quartz mosaicising. The interspaces between them are filled with coarsely fibrous negative spherulites and clear quartz mosaics, containing minute sanidine crystals and some biotite scales. Iron-ochre is present, and frequently forms threads between the radial fibres of the negative spherulites, and radiating parallel with them. In some places tridymite is present instead of quartz as a constituent of the coarsely crystalline complexes.

Spherulitic Rhyolite.

Illustration.—The slice shows good contrasts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, middle and middle lower parts, of which parts the reproduction is a fair representation, but does not represent the whole of the slice.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

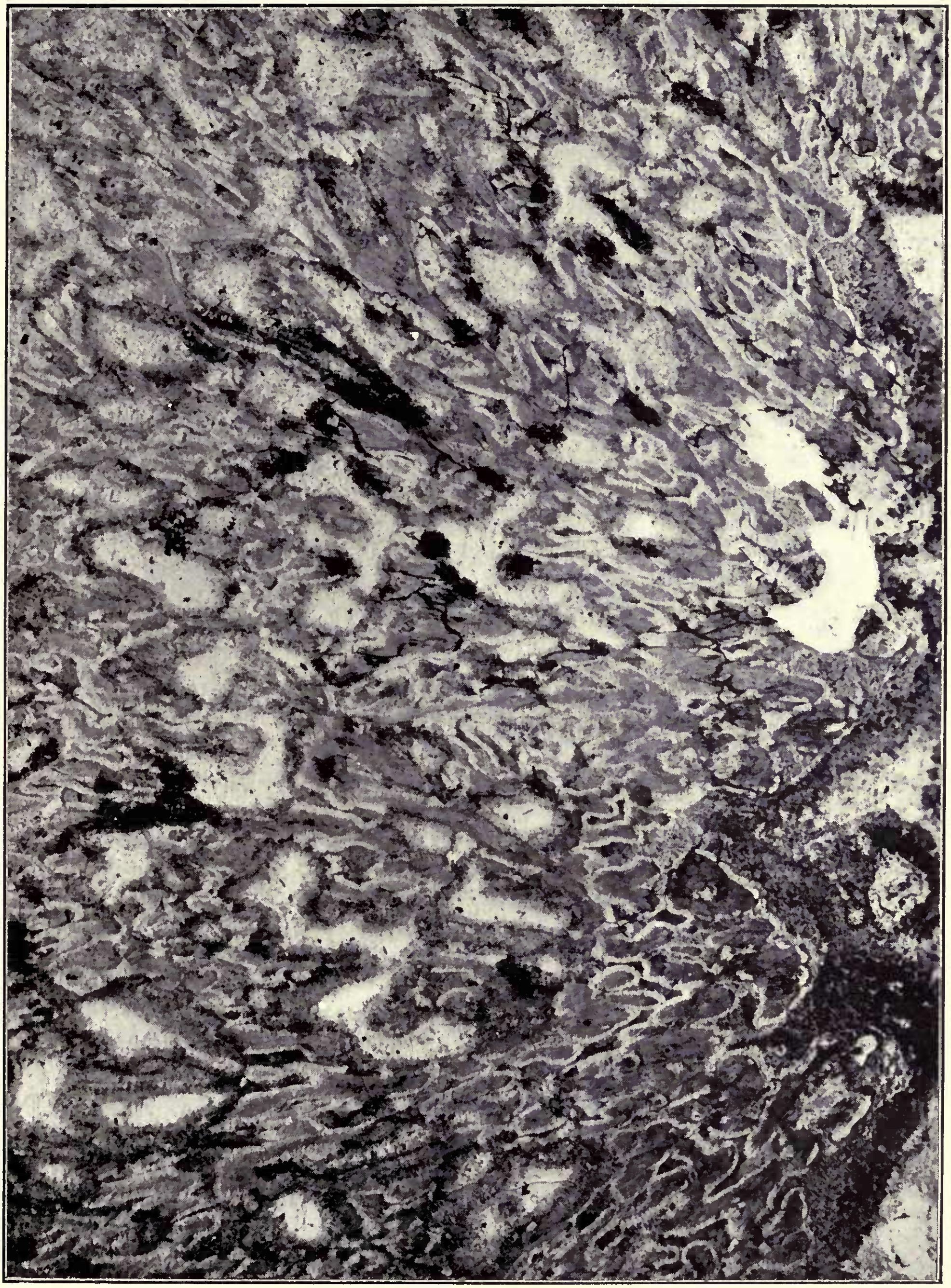
Formation.—Acid group of Pliocene age.

Remarks.—The slice does not show either the middle part or outer edge of this spherulite as distinctly as the part photographed, and the actual centre is not represented on the slice. The illustration is, however, characteristic of the part photographed.

No. 170/4162. SPHERULITIC RHYOLITE.

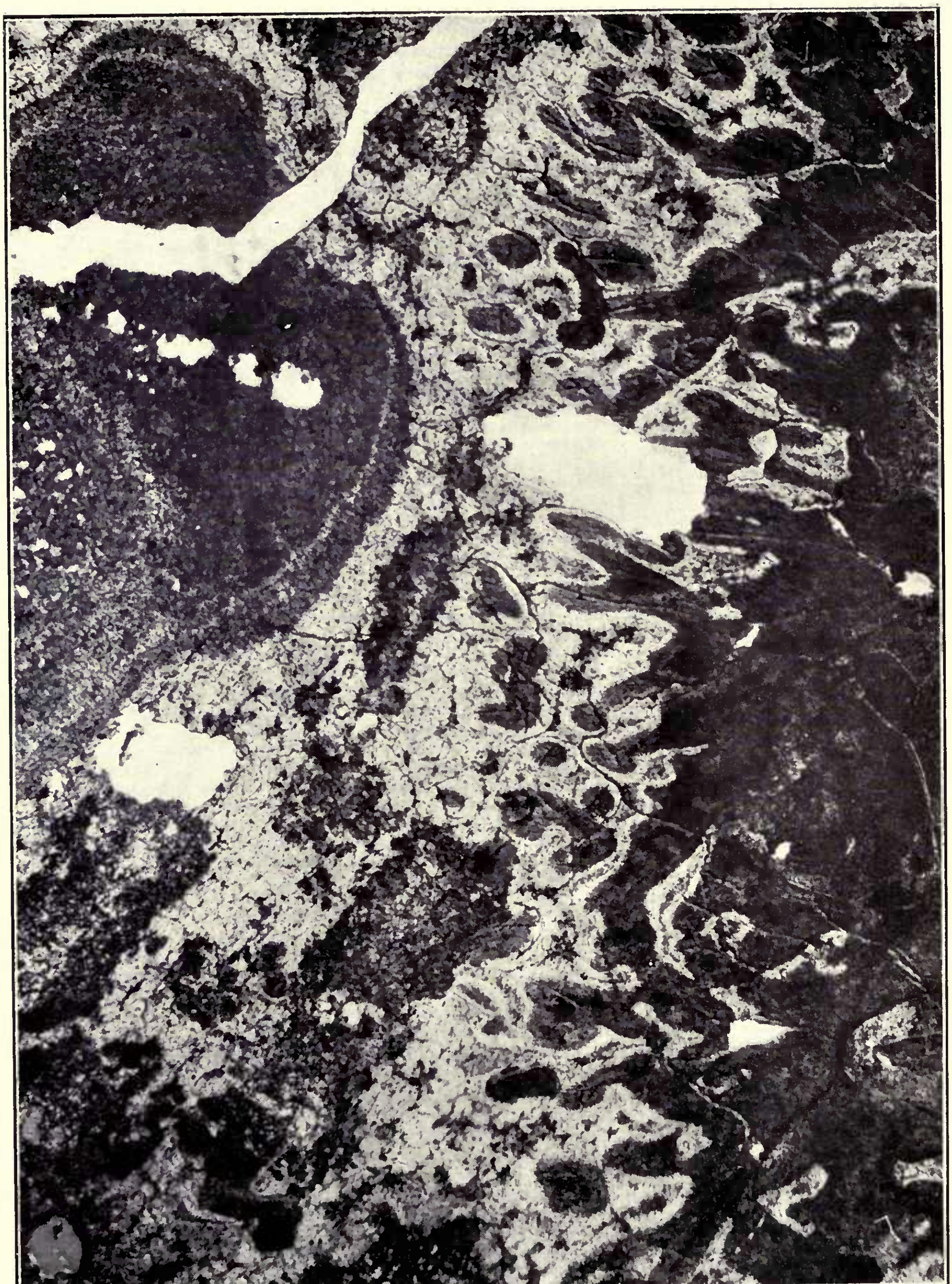
[*To face p.* 258.

i.



No. 171/4175. SPHERULITIC RHYOLITE.

[To face p. 258.
ii.



No. 173/4185. SPHERULITIC RHYOLITE.

[*To face p.* 259.

No. 173/4185. SPHERULITIC RHYOLITE.

[*To face p. 259.*

No. 172/4182.

No slice. Same rock as No. 173/4185, and hence not cut.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—This rock is not common on Paku Island, and red-coloured rhyolites are nowhere common on Cape Colville Peninsula. It is possible that in this case the reddish colour is due to the action of bush-fires.

No. 173/4185.

M.C.—Coarse, reddish, spherulitic rhyolite.

U.M.—The positive spherulites are large and complicated, with numerous radiating anastomosing arms, bordered by negative microspherulitic matter; the remainder of the interspaces between them is filled with negative microspherulites and crystal complexes, as also are the spaces left between adjacent positive spherulites. The arms of the latter do not expand to form a continuous peripheral layer; on the other hand, positive spherulites are present, which consist wholly of positive spherulitic material continuous from centre to surface. Quartz "globulaire" and quartz mosaics occur sporadically as secondary deposits in the spherulites. Crystallites are abundant in the microfelsitic material;—curved trichites, single or several proceeding from one centre, as well as branching plumose ones, which run with the positive fibres. Trichites in the negative material are incrusted with minute crystals, which, when large enough to visibly affect polarised light, are found to extinguish up to 43°, thus must be augite.

The crystal complexes consist of crystals of sanidine-like felspar, tridymite, quartz mosaics, and minute crystals of brown biotite.

Spherulitic Rhyolite.

Illustration.—Slice shows good contrasts.

Photographed by ordinary light; magnification, 40 diameters; area photographed, upper left, which is fairly representative of the whole slice.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The red colour of the rock, which is uncommon, and the considerable size of the spherulites are the chief characteristics of this rock.

No. 174/4204.

M.C.—Grey spherulitic rhyolite.

U.M.—Complicated *positive spherulites,* bounded by negative microspherulitic border. Interspaces filled with negative microspherulites and crystal complexes. *Negative spherulites* contain radiate microliths of augite. Positive generally without trichites, which are replaced by magnetite grains; plumose, branching, dark fibres present as usual.

Crystal complexes formed of *quartz,* or *tridymite, felspar,* and *biotite.*

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—The acid group of Pliocene age.

Remarks.—See description of districts collected from under head of "Paku Island," *ante,* p. 89.

No. 175/4205.

M.C.—Resembles No. 174/4204 in all essential characters.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The specimen being very similar to No. 174/4204, the same remarks apply.

No. 176/4216.

M.C.—Reddish-violet, hard rhyolite.

U.M.—Finely banded, consisting chiefly of negative microspherulites of various degrees of minuteness, but fairly uniform in the same band. Alternating with these are bands of — microspherulites with coarse rays and bands of crystal complex. Both echinate and smooth positive spherulites occur sporadically, and traversed like the rest of the rock by crystallites running in stream-lines.

The echinate spherulites would appear to have been the first to crystallize out, and next the smooth ones; then followed negative microspherulites, and finally the crystal complexes. But preceding all these were the crystallites. The crystallites are pencil-pointed belonites, and black rods which pass into belonites; stellate microliths of augite with a magnetite centre are common. The echinate spherulites consist of transparent fibres which are plumose in arrangement, and thus not precisely radial. Extinction is also not precisely radial; partly in consequence of the plumose arrangement, partly also because

No. 176/4216. SPHERULITIC RHYOLITE.

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single fibres do not all extinguish parallel—many extinguish at 22°. In some instances adjacent fibres extinguish symmetrically on each side of their line of union at this angle.

The rounded spherulites are clearer and freer from granulation than the echinate, and their fibres somewhat better defined.

The negative microspherulites follow the stream-lines without suffering any deviation due to the presence of the positive spherulites; the rock had ceased to flow when crystallization was in progress. The smaller, not apparently fibrous microspherulites are often traversed by perlitic cracks. The larger, coarser forms are partly immersed in tridymite(?), and their fibres then grow out into definite crystal forms, which seem in many cases to be sanidine. Quartz and a little biotite are also present.

Spherulitic Rhyolite.

Illustration.—The slice shows fair to good contrasts in different parts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, middle part, which gives a good idea of the general character of the slice, and at the same time shows the different kinds of spherulites mentioned in the description.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—It is somewhat remarkable that echinate spherulites are not found on the east side of the peninsula north of the mouth of the Tairua River, in Paku Island, nor on the west side of the mountain range, with a single exception from Hikutaia Valley, south of Omahu Peak. Yet this form of spherulite is not confined to the localities mentioned, but occurs plentifully on the main range between the second and fourth branches of the Tairua River. The echinate spherulites in Omahu Peak are much smaller, and the processes proportionately more extended than chances to be the case with most examples from Paku Island.

No. 177/4219.

M.C.—Banded rhyolite with spherulites and lithophysæ.

U.M.—This closely resembles No. 176/4216, but is lithophysal. The slide shows but one lithophysa, imperfectly developed; it lies in the middle of a positive spherulite, and is occupied by a ragged mass of tridymite(?) traversed by felspar threads; the holes in this may have been torn out in grinding the slice. The line of demarcation between the central and peripheral regions is fairly definite, and in some cases the inner margin of the outer layer has grown inwards in crystalline facets; at the same time felspar fibres are more abundant on the outer side of the central mass than towards the interior.

As in other examples, the negative microspherulitic matter can be traced from a stage in which it resembles mere glass, when seen by ordinary light, up to a coarsely crystallized condition, affording obvious crystals of felspar, which give an extinction of 9° most commonly, and which may therefore be soda orthoclase (Or_1Ab_1). In the most glass-like state* they are absolutely structureless under ordinary light, but give an obvious cross between *x.n.*, which might be regarded as an effect of strain, especially as such spherulitic areas are defined or traversed by perlitic cracks concentric with the outline of the spherule; but immediately bordering these apparently structureless spherulites are others in every way similar, except that they present over the whole or part of their area a fine but evident radiate fibrous structure, and from these to the coarsely fibrous negative spherulites there is an easy transition.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—The general appearance of the slice is that of No. 176/4126. The specimens also are similar.

No. 178/4223.

M.C.—Spherulitic rhyolite with lithophysæ.

U.M.—This shows with admirable clearness the uninterrupted extension of the stream-lines, as indicated by the black crystallites, through all the structures of the rock, positive as well as negative spherulites.

A lithophysa appears in one slice. It occupies the interior of a positive spherulite, and contains tridymite; but there is nothing to show whether it is primary or secondary in origin.

All the structures present in the other spherulitic rhyolites are shown in this, as follows:—

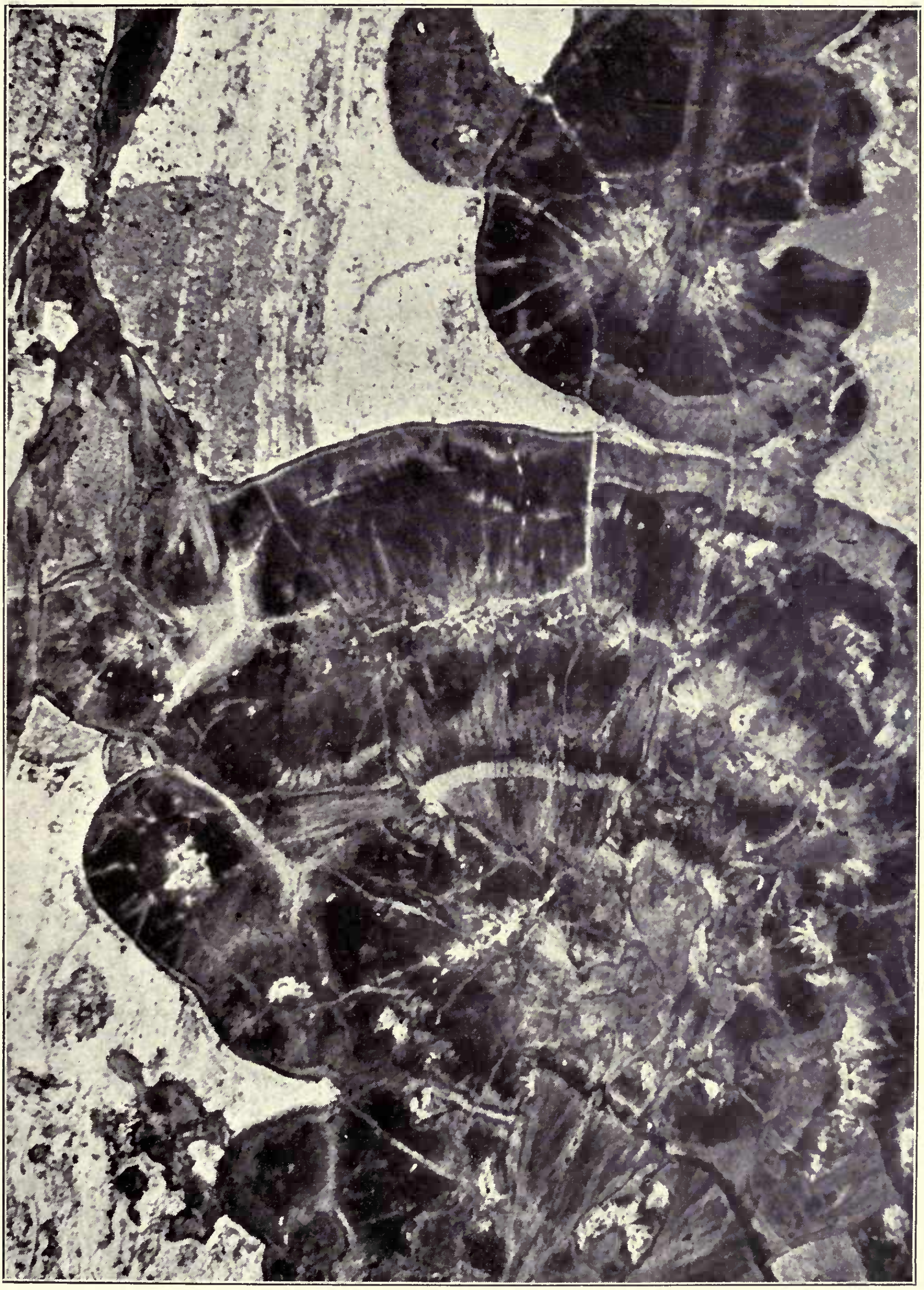
(i.) Crystallites, both trichites and belonites; microliths of felspar and pyroxene.

(ii.) Positive spherulites, spherical and cervicorn; the finely fibrous kinds first produced.

(iii.) Negative microspherulites, the negative layer bounding the positive spherulites, best seen over the slender processes of the latter, must be later than the material it surrounds.

(iv.) Positive spherulitic growths enclosing negative spherulites, the latter colourless and structureless, with a stellate augite microlith in the centre. Evidently this positive material is later than these negative spherulites. The positive spherulitic matter, like the negative, may present a very coarsely crystallized fibrous form; in this rock, however, coarse — microspherulites are absent. Some layers consist of confusedly intermingled tufts of positive spherulitic fibres and negative microspherulites, which must have formed almost simultaneously.

* This is not a primitive state, though deceptively like it, but secondary, due to decomposition.



No. 178/4223. SPHERULITIC RHYOLITE.

[*To face p. 262.*

In the coarsely crystallized layers small crystals of green biotite occur.

Spherulitic Rhyolite.

Illustration.—The slice shows good contrasts, and to represent it thoroughly a number of photographs should be taken.

Photographed by ordinary light; magnification, 25 diameters; area photographed, lower left, within which lies one of the largest spherulites shown in the slice.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The remarkable character of this rock has been referred to in the above description. As to the mode of its occurrence, &c., see descriptions of districts, Paku Island, *ante* page 89.

No. 179/4226.

M.C.—From same specimen as No. 178/4223.

U.M.—Bands of larger and smaller microspherulites, including positive cervicorn spherulites. As usual, the negative microspherulites look like brown glass in their least developed stage, and only present the spherulitic character between *x.n.* As crystallization becomes more obvious a few rays of uncertain nature first appear. Some of these are evidently lines of vapour cavities, others faint-bluish threads of higher refractive index than the material in which they are immersed. These rays increase, and the uniform brown colour diminishes and disappears, a colourless microspherulite resulting. The rays of this may be very slender or coarser, and terminating in crystal forms of felspar. The coarser forms adjoin lenticles or irregular bands composed either of quartz, felspar, and a little biotite, or of tridymite and felspar. Some of the negative microspherulites present a central nucleus of quartz.

The positive spherulites are mosaicised in places by quartz; the fibrous structure appears to persist within the mosaics, but this appearance is produced by residual granules of black iron-oxide and rows of vapour cavities. A few tufts of coarsely fibrous positive spherulitic material are present.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The same as for No. 174/4204.

No. 180/4229.

M.C.—Spherulitic rhyolite, in places lithophysal.

U.M.—The greater part of the rock consists no longer, as in the preceding rhyolites, of negative microspherulites, but of a mixture of diffuse plumes of coarse positive spherulitic fibres, negative microspherulites, and tridymite. The negative microspherulites must have existed before the fibrous material around them, and probably the two growths occurred almost simultaneously. The coarse positive fibres pass towards their extremities into a linear row of felspar crystals, and then break up into isolated crystals, which are irregularly scattered among tridymite(?).

The usual brown positive spherulites, some compact and spherical, others beginning to run out into processes, are included in the slice.

The rock has undergone some alteration, so that some of the microspherulites appear isotropic (the refusion(?) change).

A little quartz is present.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—The same as for No. 174/4204.

No. 181/4230.

M.C.—Banded and spherulitic rhyolite with small lithophysæ.

U.M.—Positive spherulites predominate, some of them lithophysal. The lithophysæ occur in those spherulites which have formed latest, so far as this can be judged from their relations to the other spherulites. The lithophysæ are lined, or partly lined, by tridymite, sometimes with included crystals of felspar. They appear to be subsequent in origin to the formation of the spherulites. Negative microspherulites form a large part of the rock, but their place is often taken by positive spherulitic material. Some of the negative spherulites exhibit the growth of their felspar rays into definite felspar crystals. It is impossible to determine this felspar with any assurance of certainty by the microscope; the probabilities are that both sanidine and albite are present—they are generally elongated parallel to the axis *a*.

The positive spherulitic fibres also develop into definite felspar crystals; possibly these are elongated parallel to axis *c*, a supposition confirmed by the common occurrence of extinctions up to and exceeding 21°. It is a singular fact that the common brown positive spherulites rarely give rise to coarser rays and crystals. This behaviour characterizes the coarser, clearer, and more colourless positive spherulites which have formed simultaneously with or later than the negative microspherulites. In accordance with the supposed elongation parallel to *c* is the fact that these later positive growths do not give a simple cross between *x.n.*, but additional dark arms, which make an angle of 21° and over with the cross-wires of the eye-piece, are present.

Where the crystallization becomes coarsest, felspar, tridymite, and biotite may be recognised.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—The same as for No. 4204.

No. 182/4233.

M.C.—Identical with No. 4232.

U.M.—Alternating layers of finer and coarser microspherulites and sporadic positive spherulites, some lithophysæ.

The distinction of the positive spherulites into two varieties is again shown here, and the slice is in many respects a most instructive one.

The first-formed positive spherulites are very irregular, with vermicular processes, sometimes anastomosing. They are bounded by a negative fibrous layer where they traverse microspherulitic substance, but not when they enter one of the later-formed positive spherulites.

The later-formed positive spherulites display less tendency to run out into processes, and affect a more spherical form. They are clearer and more transparent, and they alone are excavated by lithophysæ. The lithophysæ are both central and concentric, and are lined or partly filled with tridymite and felspar crystals—*i.e.*, of the same material as that of which they consist, but coarsely crystallized, and not fibrous. As is commonly the case, a concentric banding occurs within the spherulites, indicating changes in the rate of growth; and it not uncommonly happens that the interruption indicated at one place along one of these lines is continued in another part of the spherulite by an accumulation of tridymite, from which the fibres of the spherulite external to the line of growth proceed as from a fresh origin—*i.e.*, the centres of new tufts of fibres lie in the external surface of the tridymite. Hence the tridymite was formed during the growth of the spherulite. Were the tridymite replaced by quartz, or transformed into quartz, we should have a structure corresponding to the concentric quartz infillings of the older pyromerides. Further, whenever we meet with a rich development of tridymite in these rhyolites we may expect to find cavities associated with it, and it would not surprise me if additional sections furnished evidence of the presence of cavities in some of the concentric infillings.

Other lithophysæ occur between the spherulites. Thus, in one instance there is a notable space left between the contiguous spherulites. This is lined by tridymites and felspar, and an empty cavity is left in the middle.

Finally, a lithophysa occurs within a positive spherulite which was formed even later than those of the second period ; it arises within the angle formed by the meeting of the surfaces of two of the later spherulites ; its sides are formed of ordinary positive fibres, but its centre of coarser cavernous tissue, which ceases altogether near the rounded end of the spherulite, leaving a cavity bounded in front by a very thin layer of positive fibres. This looks like a contemporaneous growth.

The negative microspherulitic layers alternate with bands of tridymite and felspar in crystal complexes, and these latter pass at the extremity of some of the bands into diffuse coarsely fibrous positive growths. Tufts of clear coarsely positive fibres also cross the negative microspherulitic layers.

Spherulitic Rhyolite.

Illustration.—Slice shows good contrasts.

Photographed by ordinary light; magnification, 40 diameters; area photographed, middle left, where flow-lines sharply abut against portions of two large spherulites closely connected with each other.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—The same as for No. 4204.

No. 183/4219.

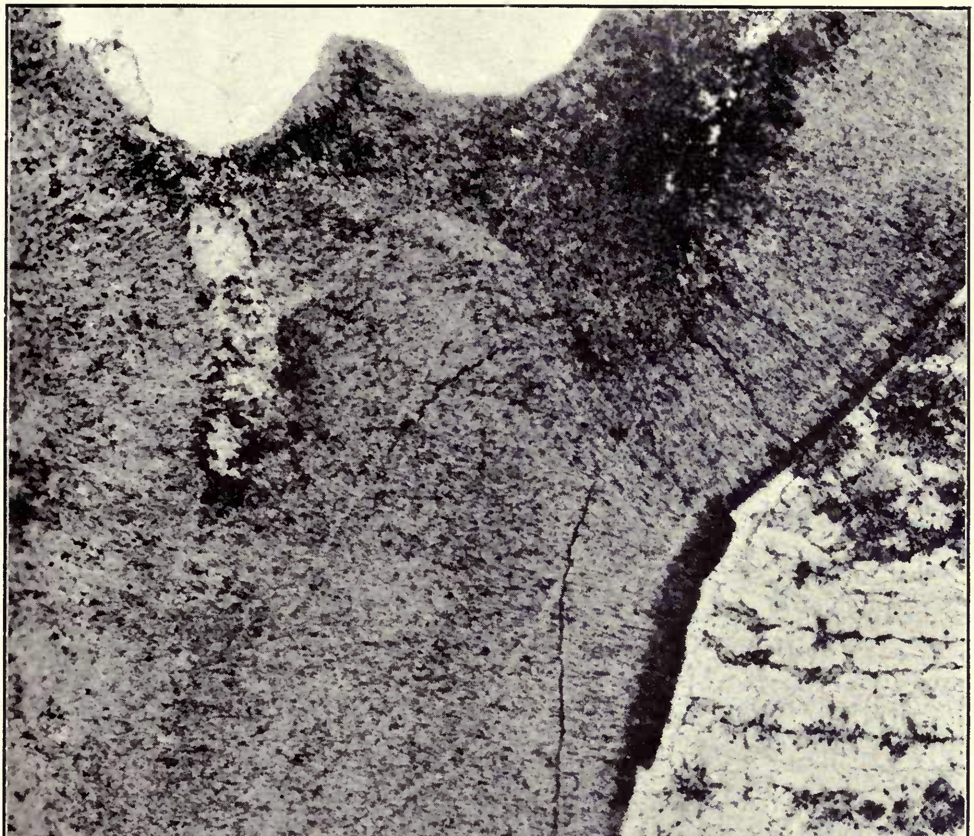
M.C.—Banded rhyolite with spherulites and lithophysæ.

U.M.—Brown positive spherulites traversed by belonites and trichites in line of flow, as well as by forked felspar microliths, which are sometimes so numerous as to suggest felspar laths tangentially arranged — a deceptive appearance. Isotropic spherulites like negative microspherulites are also present ; they are yellowish in colour, with a radiate structure indicated by radial rows of granules ; sometimes they inclose a forked sanidine microlith. Negative microspherulites of the usual character alternate with bands of tridymite and felspar complexes, and tufts of positive fibres cross them.

Lithophysæ very well shown as concentric or excentric deposits of tridymite, with or without cavities, the tridymite traversed by fine threads of felspar.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—Part of sample No. 4204.



No. 182/4233. SPHERULITIC RHYOLITE.

[*To face p. 266.*

No. 184/4279.

M.C.—Greyish- to yellowish-white, granular, porous, somewhat friable rock.

U.M.—Matrix minutely crystalline sericite, rounded granules of ferric-hydrate, magnetite, quartz, and leucoxene; a few zircons; minute granules accumulated into rounded areas about the size of negative microspherulites.

Quartz mosaics occur in rounded, and oval, and lenticular areas; some of the rounded masses are hollow in the centre, and either empty or filled with matrix. Some of the mosaics are square in section; some rectangular, with rounded corners, suggestive of pseudomorphs after some phenocrysts. The rock is not determinable.

Quartz Sericite Rock, probably once a rhyolite.

Locality.—Low-level tunnel, Broken Hills Mine, Tairua Valley, Thames County.

Formation.—Acid group of Pliocene age.

Remarks.—Some confusion has hitherto existed as to the identity and the exact nature of this rock. The specimen is from a thick and remarkable band of light-grey rhyolite-like rock that forms the western slopes of Broken Hills, and in seemingly stratified bands or floes rises from the river-bed some two-thirds up the side of the range, the higher and eastern parts of which are of andesic character. The eastern rocks, it had been ascertained, were auriferous; and at the time the specimen was collected, to reach the auriferous rocks to the east a low-level tunnel at some distance above the river was in process of excavation, but had not then passed through the rhyolite. An assay plant had been established in connection with the mine, and tests made showed the presence of gold, but not in payable quantities in the rhyolite.

On the south-west angle of Broken Hills this rock forms high precipices, facing east or towards the higher part of the hill. This is due to the greater readiness with which the andesic breccias, here in contact with the rhyolite, is broken down and removed by denuding influences. To the north of the mine this rock crosses to the left bank of the river, and from the outcrop there seen specimen No. 4293 was taken.

No. 185/4286.

M.C.—Black aphanitic andesite with phenocrysts of glassy felspar.

U.M.—Matrix violet-brown transparent glass, ultra-microscopic, granular, crowded with well-defined simple prisms of augite, each with one or more minute grains of magnetite attached. Crowded also with very unusual felspar microliths; these have the form of plates (parallel to 010) of such extreme tenuity that two or three of them, or more, may overlie one another in the thickness of the slice, and even then have no visible action on polarised light. Larger plates of felspar, very similar but of far greater dimensions, are present, which have *r.i.* above balsam, and thus are more basic than oligoclase.

Phenocrysts.—*Plagioclase* rarely twinned; *r.i.*, above balsam; when twinned, ext. 20°/ 25°; in some cases undulose. Crystals small and not numerous.

Augite: Faint-yellowish long prisms, small, lying in stream-lines; extinguishing up to 42°.

Hypersthene faintly pleochroic, quite fresh, sometimes intergrown with augite, occasionally in clusters.

Magnetite: A few large grains.

Hyalopilitic Hypersthene Andesite.

Locality.—South of Broken Hills, on the road from the upper landing to the crossing at the fourth branch of the Tairua River, Thames County.

Formation.—Kapanga group (?).

Remarks.—The specimen was collected from one of many loose boulders on and alongside the track. The rock was not observed *in situ*, but must occur in the vicinity of where the sample was collected. There is some doubt as to the age and the group to which the specimen should be referred, since it possibly belongs to the latest semi-basic outburst that followed the eruption of the acid group of Pliocene age.

No. 186/4293.

M.C.—Finely banded rhyolite.

U.M.—Layers of coarser and finer mosaics of quartz and sericite; with ordinary light browner and more granular bands are seen alternating with colourless less granular; cavities run parallel with the banding. The crystallites of the original rock still indicated as black rods and rows of granules in stream-lines following the banding. Streaks rich in ferric hydrate occur here and there. The quartz mosaics are more or less dusty with sericite, and still show remains of crystallites.

Phenocrysts.—*Quartz* in dihexahedra and irregular corroded grains invaded by matrix. These grains overgrown by a subsequent deposit of quartz, which may be distinguished from the original by included sericite, and by its ragged external margin.

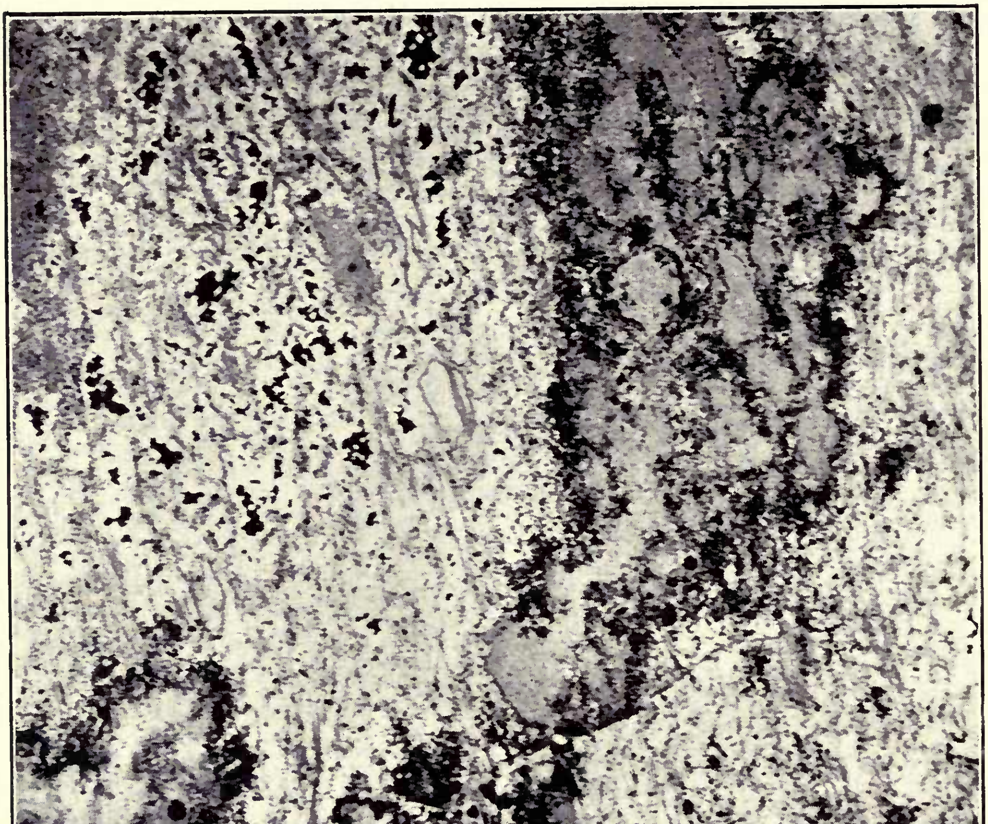
Negative crystal cavities are present in the original, often of considerable size.

Muscovite with associated leucoxene and sometimes ferric hydrate may represent original biotite.

Felspar is represented by rare pseudomorphs in sericite; these are of comparatively large size.

Rhyolite, replaced by Quartz and Sericite.

Locality.—Left bank of the Tairua River, between first and second crossings below Broken Hills Mine, Thames County.



No. 187/4298, RHYOLITE TRANSFORMED INTO QUARTZ SERICITE.

[*To face p. 269.*

Formation.—Acid group of Pliocene age.

Remarks.—This rock is separated from that on the west slope of Broken Hill by the bed of the river only, the shingle in which obscures the continuity of the rock. The rock has been regarded as an altered andesite, its present condition perhaps lending colour to the assumption.

No. 187/4298.

M.C.—Violet-grey rhyolite, brecciated and altered into white material in part.

U.M.—Streaks of finely grained sericite and quartz alternating with streaks of clear quartz mosaics. Quartz "globulaire" occurs sporadically. In some parts grains of iron-pyrites thickly scattered. Phenocrysts are not represented. The rock was probably at one time a banded rhyolite, consisting of alternating layers of negative microspherulites and crystal complexes. Some of the sericite areas recall positive vermiculate spherulitic processes.

Rhyolite, transformed into Quartz and Sericite.

Illustration.—The slice shows but little contrast, the negative obtained being strong in comparison.

Photographed by ordinary light; magnification, 40 diameters; area photographed, middle part, which fairly represents the rest of the slice.

Locality.—The upper (highest) workings on Broken Hills Claim, Tairua Valley, Thames County.

Formation.—Acid group of Pliocene age.

Remarks.—The specimen was collected from an opencast excavation lying east of the first rib of andesic breccia on Broken Hills, and its rhyolitic character was not suspected on its being sent for description.

Whether this band is to be regarded as intrusive has yet to be determined by observation in the field.

No. 188/4304.

M.C.—White finely banded rhyolite, with fine platy structure parallel to banding, ochreous, of platy separation planes.

U.M.—Negative microspherulitic rhyolite with secondary quartz. This is a most interesting rock. The negative microspherulites can still be traced, but they are completely immersed in a kind of quartz "globulaire."

Phenocrysts of felspar almost entirely converted into quartz and sericite occur sparingly; in a few instances original material remains, and is negative in the direction of elongation of the crystal; *r.i.*, below balsam (orthoclase).

Negative Microspherulitic Rhyolite, with secondary quartz.

A silicified rhyolite, still retaining structure.

Locality.—Mine-workings on the west side of swamp at Ohui, on the east coast, south of Tairua mouth, Thames County.

Formation.—Acid group of Pliocene age.

Remarks.—At the source of the creek falling into the swamp at Ohui, on the road thence to the upper landing on the Tairua River, there are andesitic rocks which underlie the acid rocks that generally are met with at the surface, and form a great development both to the north and south of Ohui. Whether any of the mine-workings on the east side of the swamp have been carried on in andesic rocks I cannot tell. All the works examined on the west side were at the time of my visit being prosecuted in rocks belonging to the acid group, and rocks of an andesic type were nowhere to be met with.

No. 189/4310.

M.C.—Violet-grey, almost colourless glassy rhyolite, passing into pumice.

U.M.—Colourless glass drawn into vesicles, containing belonites in stream-lines, granules of magnetite, occasional microliths of sanidine, and rarely green hornblende; perlitic cracks met with here and there. A second constituent occurs, resembling glass, but distinguished from that just mentioned by a lower *r.i.*, granular structure, and faintly brown colour; under high magnification it is resolved into spherules various in dimensions down to almost ultra-microscopic minuteness, and usually arranged symmetrically in rows like the markings on *Pleurosigma* or other diatoms. They do not give rise to crystals as their size increases, but always retain their spherical form. In the same cluster they present a remarkable uniformity in size; and when within the limits of a single patch the size differs, the change often takes place abruptly. Each spherule is glassy-clear and colourless, and the brownish colour of an aggregate of minute spherules is due to interference, and partly to the presence of intervening gas-pores. These cavities containing air are obvious between the spherules when of comparatively large size. In some cases a patch consists of a number of areas within each of which the alignment of the spherules is constant, but different from that in the others, a sort of mosaic then arising. At the edge of the pumice cavities in the glass a substance occurs similar to that of the globules, but forming a continuous structureless selvedge. It seems possible that the whole of this material is silica-hydrate (opal).

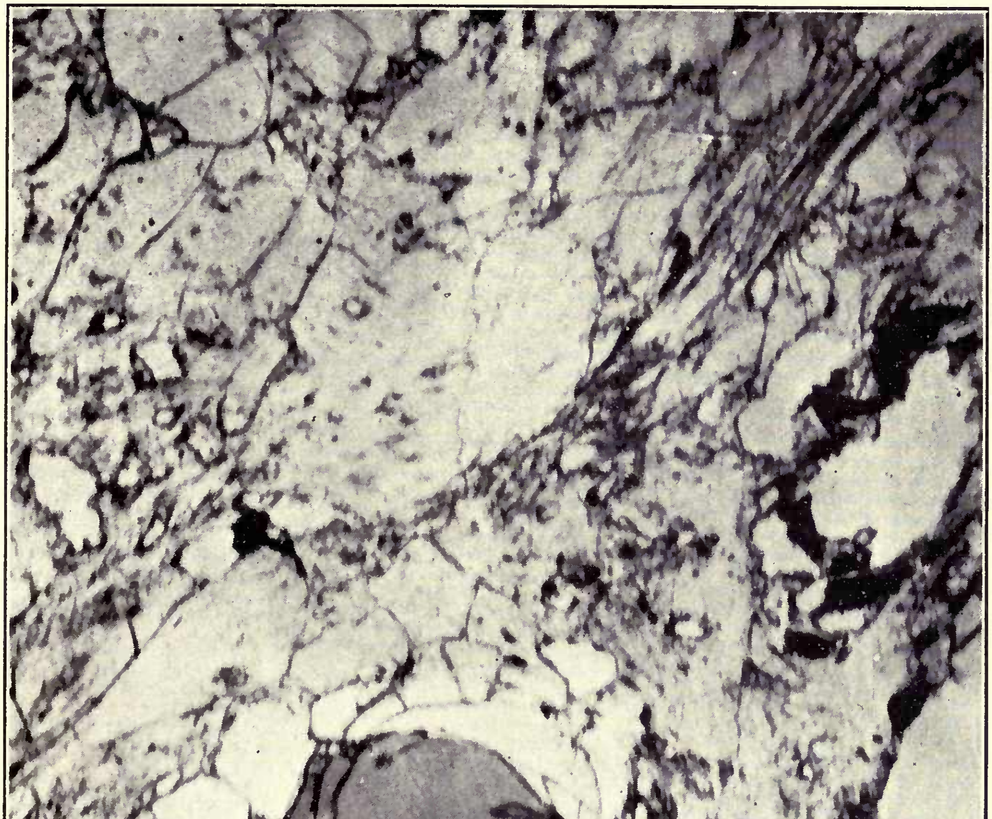
PHENOCRYSTS.—*Sanidine:* A few crystals, but not so common as plagioclase.

Plagioclase twinned on albite, Carlsbad, and pericline plans; ext., $5°/5°$, $10°/10°$; *r.i.*, above balsam; microtin habit.

Pyroxene faint yellowish-brown, nearly colourless; ext., $0°$; undergoing hydration. Hydrated products fairly common.

Quartz: Bi-pyramids, much fractured, and invaded by glass.

Rhyolitic Glass, passing into pumice, containing plagioclase.



No. 189/4310. RHYOLITIC GLASS PASSING INTO PUMICE CONTAINING PLAGIOCLASE.

[To face p. 270.

Illustration.—The slice shows fairly good but not strong contrasts.

Photographed by ordinary light; magnification, 40 diameters; area photographed, middle part, which is fairly characteristic of the rest of the slice.

Locality.—Marsh's Farm, at junction of the Hikuwai River, Tairua Valley, Thames County.

Formation.—Acid group of Pliocene age.

Remarks.—This rock is singular in comparison with the other rocks of the district, and is specially to be distinguished on account of its containing an abundance of gem opal of high quality. It does not appear that the presence of opal was noticed in the rock or the slice, as no mention of it is made in the description. In the notes accompanying the specimen it was mentioned that this rock constitutes the matrix of the opals found in the Tairua Valley. Something like a small opal appears in the illustration.

Fire opals of considerable size and of great beauty are found in this rock, but the means applied to their extraction generally resulted in the destruction of the specimen.

No. 190/4345.

M.C.—Cream-white stony rhyolite.

U.M.—Positive spherulites with well-crystallized rays, sometimes close, sometimes diffuse, long, and irregular, sometimes expanding towards the distal extremity into recognisable quartz, and occasionally suggestive of micropegmatite. Negative microspherulites lie in the midst of these positive spherulites, but they are much altered.

Layers of negative microspherulites were originally present, but they are now so completely changed that they rarely react towards polarised light; they are usually structureless or granular, but may sometimes show a few radial fibres, or give a faint cross and negative sign.

Tridymite is abundant, and frequently forms nests within the positive spherulites.

Traces of crystallites are preserved, and occasional forked microliths of felspar.

Altered Spherulitic Rhyolite.

Locality.—Paku Island, at mouth of Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—A very fine-grained rock that, to the unaided eye, does not show definite structure.

No. 191/4359.

M.C.—Violet-grey and white rock, porous, earthy-looking.

U.M.—Flow structure marked; bands and streaks of different colour and composition, and stream-lines of crystallites, trichites, and belonites, in some streaks microliths of felspar also. Stream-lines often contorted. Movement had apparently ceased before the growth of positive spherulites.

Spherulites, all positive, frequently show close concentric structure; alternating fine bands of clearer and browner colour, usually become clear and colourless at periphery, the rays expanding wedge-like; tridymite is obvious between them. They frequently extinguish at high angles, up to 43°, though mostly at 0°; their *r.i.* is about the same as balsam; they seem to be in part at least albite elongated parallel to *c*. The black, curved, branching fibres which are always present in positive spherulites are well displayed. The interstices between the spherulites, and parts of the interior of the spherulites themselves, are occupied by tridymite, with which, sometimes, felspar crystals are associated. Biotite (brown) occurs in these crystal complexes.

PHENOCRYSTS.—*Plagioclase* in small crystals, rare; *r.i.*, above balsam; ext., 5°/5°. Glass inclusions present.

Quartz absent.

Pyroxene represented by pseudomorphs in serpentine.

Positive Spherulitic Rhyolite.

Illustration.—Slice shows moderate contrasts.

Photographed by ordinary light; magnification, 40 diameters; area photographed, middle part, which indicates the general character of the slice.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The slice shows spherulites throughout, but these are not elsewhere so much disturbed by after-movements as appears in the part reproduced.

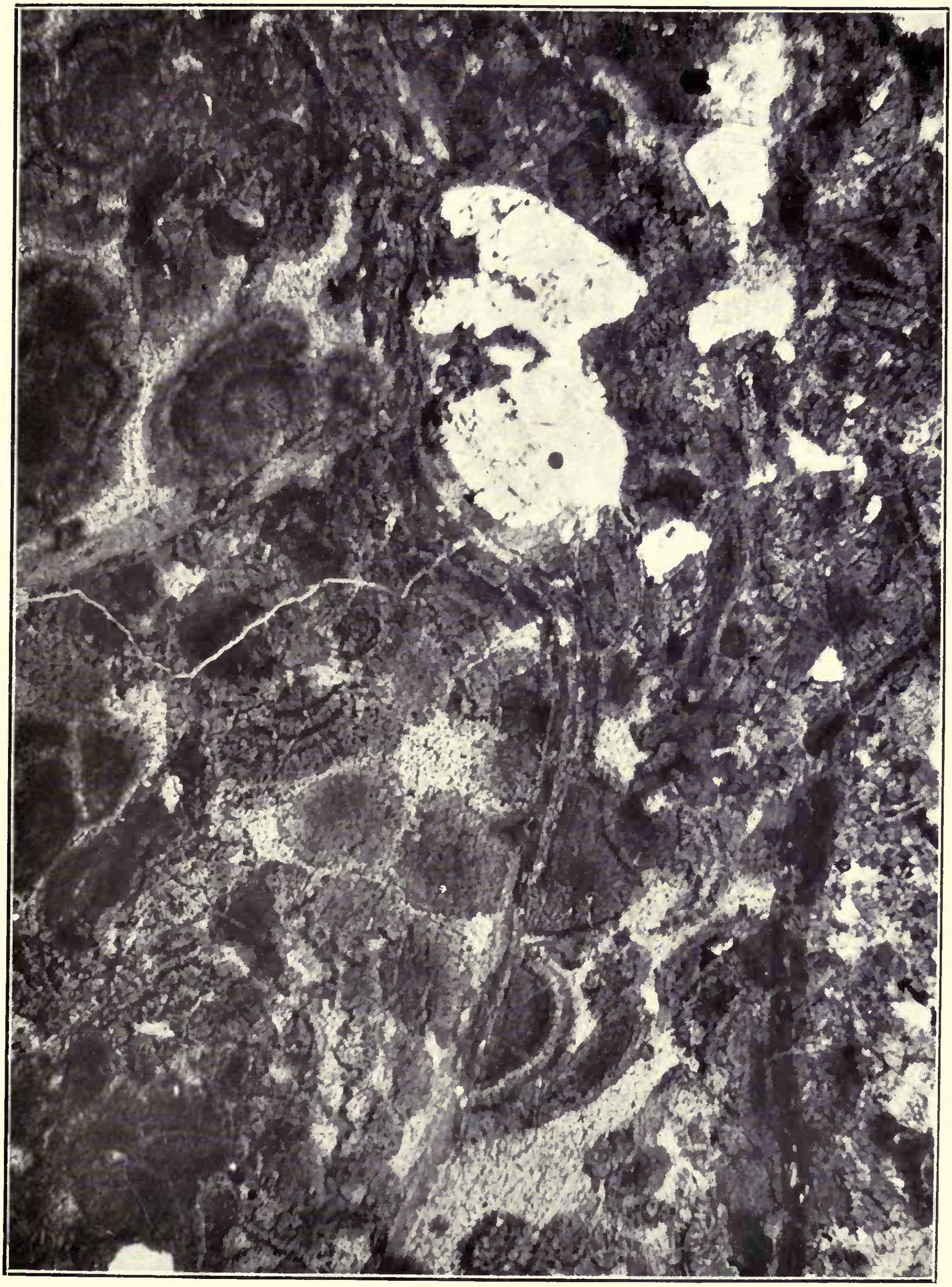
No. 192/4364.

M.C.—Black pitchstone with perlitic cracks.

U.M.—Colourless glass with perlitic cracks. Short, black, rod-like crystallites generally, but somewhat sparingly, dispersed in flow-lines; along certain lines abundant and crowded. These lines are as straight as if ruled, but bend round obstacles in stream-like fashion; remains of crystals giving a patchy extinction are associated with them.

Microliths are rare; faintly greenish to colourless elongated prisms are very sparingly met with; the extinction is often parallel; strain shadows make it difficult to observe; when twinned the ext., 0°/24°, 0°/40° were observed. They are possibly pyroxene. Fuses with intumescence in blowpipe-flame.

Pitchstone.



No. 191/4359. POSITIVE SPHERULITIC RHYOLITE.

[*To face p.* 272.

No. 192/4364. PITCHSTONE.

[*To face p.* 273.

i.

No. 193/4366. PITCHSTONE.

[*To face p.* 273.
ii.

Illustration.—The slice affords but feeble contrasts.

Photographed by ordinary light; magnification, 40 diameters; area represented, lower left, which shows a series of irregular cracks and somewhat faint concentric lines, also strong herring-boned lines, produced during the process of grinding, and which in polishing the slice could not be removed.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—As a glass, with but little to give it character if photographed, this slice might well enough have been overlooked; but the distinction between the natural and artificial lines and markings was thought would be of interest, and give some value to the illustration.

No. 193/4366.

M.C.—Reddish-brown pitchstone with perlitic cracks.

U.M.—Colourless glass with thread-like streaks of a yellow and violet colour, straight or highly contorted (damascened). The violet glass is finely granular, and appears composed, indeed, of minute granules of nearly uniform size; probably these granules produce the violet colour, and the glass in which they lie immersed is colourless.

Perlitic cracks are numerous, and are generally lined by doubly refracting fibrous material; this may fill the smaller cracks, but merely forms a film about the sides of the larger, leaving the rest of the cavity occupied by colourless isotropic material. The place of the fibres may be taken by doubly refracting globular material.

Black rod-like crystallites and magnetite grains are numerous; also trichites, both straight and zigzag. These are black by transmitted light, vermilion or some other tint of red by reflected light.

Microliths of prismatic form, colourless to faint-green, like those in No. 4364, occur, but are very rare.

In the blowpipe-flame the rock fuses with intumescence to a colourless glass.

Pitchstone.

Illustration.—Slice shows good contrasts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, lower left, which is fairly characteristic of the slice, showing well the lines of flow along which the glass is more or less contorted. There is, however, but little evidence of the concentric lines that abound in other parts of the slice.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The reproduction from the original photograph is satisfactory, even though there be a softness of the rendering which might imply a want of perfect focus for the original. Such, however, was not the case; and the specimen, though focused under circumstances that in other cases gave crisp negatives, still failed to afford the like.

No. 194/4372.

M.C.—Spherulitic rhyolite with contorted stream-lines.

U.M.—Alternating layers of brown obscurely crystallized material, "microfelsite," with associated colourless negative spherulites, traversed by crystallites and microliths in flow-lines; of colourless, coarsely fibrous, negative spherulites and associated tridymite, or sometimes quartz; irregularly distributed positive spherulitic growths not common.

Crystallites of the usual character, belonites and trichites, and some stellate forms.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—This specimen comes from the sea-face on the north side of the island, where the rocks show the most wonderful plications and crumplings on both a large and a small scale. On approaching the sea-cliffs of this part of the island the general appearance of the rock closely simulates that of a highly contorted gneiss which rises in precipices that are nearly vertical to a great height. The sea washes the base of the cliffs, and below high-tide mark the rocks are polished so as to show the larger features of their structure in a most remarkable and instructive manner.

No. 195/4375.

M.C.—Compact spherulitic rhyolite with brecciated flow-lines, the brecciation probably contemporaneous with last stages of consolidation.

U.M.—Bands of brownish or yellowish-brown negative microspherulites without radio-fibrous structure when seen with ordinary light, and colourless negative spherulites with obvious fibres in association with quartz mosaics.

The negative microspherulites are larger than usual. The non-fibrous ones are traversed by the stream-lines with crystallites through their central portion, but outside this the crystallites are arranged in concentric lines. (i.) Either the growth of the spherulite must have produced a redistribution of the crystallites, or (ii.) the stream-lines must have been disturbed by a kind of puckering, and each pucker must have determined the formation of a spherulite; or possibly movement may have taken place after the spherulite commenced to form. The obviously crystalline fibres frequently arise in the outer envelopes of a non-fibrous form, and sometimes a case may be met with in which they develop from the centre through some portion (such as a quadrant) of a form otherwise non-fibrous. The non-fibrous spherulites are traversed by perlitic cracks, concentric with their circumference, and evidently subsequent to the formation of the spherulite.

No. 195/4375. NEGATIVE SPHERULITIC RHYOLITE.

[*To face p.* 275.

The quartz mosaics contain perfectly developed crystals of felspar, some of which extend from the rays of the negative microspherulites; their refractive index is far below that of quartz, and they must be either sanidine, soda-orthoclase, or a mixture of sanidine and soda-orthoclase. Some give measurements strongly suggesting soda-orthoclase, others sanidine, others albite; but it is impossible to obtain any certain evidence.

Biotite occurs in the quartz mosaics; its pleochroism is faint-yellow to almost colourless / dark red-brown.

Note A.—The following case shows plainly that the stream-lines have been displaced before the formation of the spherulite. A stream-line is bent, and the spherulite has formed with its rays at right angles to the curve.

As there is no accession of material during the growth of a spherulite, the deformation of the stream-lines cannot have been produced by this growth. The puckering of the stream-lines may lead to the formation of detached spheres, of which examples occur on the slice.

Negative Spherulitic Rhyolite.

Illustration.—The slice in all parts of it shows good contrasts.

Photographed by ordinary light; magnification, 40 diameters; area photographed, lower left, which, though not showing the abundance of perlitic concentric lines that distinguishes other parts, is in other respects fairly characteristic of the whole slice.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—This is a somewhat remarkable specimen, and the reproduction from the original print is crowded with a wealth of detail such as appears in but a few others of the illustrations in this volume.

No. 196/4381.

M.C.—Spherulitic rhyolite with lithophysæ.

U.M.—Streaks of negative and positive spherulitic material showing contorted stream-lines. The positive material, as usual, presents itself in several varieties; the earliest-formed and least obviously fibrous are brown in colour and irregular cervicorn in growth, the latest are colourless and clear and more regularly formed. Quartz mosaics are commoner in the interstices than tridymite, and, though more usually associated with the negative spherulites, are not infrequent in the positive, some of which are beautifully mosaicised.

As usual, the lithophysæ are partly filled with tridymite.

Spherulitic Rhyolite.

Illustration.—The slice shows but poor contrasts under ordinary light, and polarised light was used instead, which, if it gave sufficient contrast, at the same time somewhat blurred the outlines and details that are seen in the part represented; magnification, 48 diameters; area photographed, middle part.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—Apparently the spherulite fragments in the upper and lower left corners of the reproduction have at one time been united and formed one spherulite.

No. 197/4384.

M.C.—Spherulitic rhyolite finely and evenly banded, pinkish-white, violet, and chalky-white bands.

U.M.—The slice shows alternations of isotropic and spherulitic bands with transition between the two.

The isotropic material is of a faint yellowish-brown colour by transmitted light, milky-white by reflected light; it is granular with ultra-microscopic granules; it contains minute stellate crystallites unlike the ordinary pyroxene ones, and sometimes these are arranged along a line axiolite fashion. It is cracked perlitically, the perlitic crack sometimes separating an inner isotropic central area from an outer crystalline radio-fibrous portion. A casual observer would certainly mistake this substance for glass; as a matter of fact, it is a decomposition product like that of the "re-fused" felspar. This is very clearly shown by staining with aniline dyes.

The spherulitic bands consist of negative microspherulites coarsely crystallized, and, as usual, associated with streaks of tridymite. They are colourless and transparent, their felspar rays extinguishing at 0° and up to 20°. Flakes of biotite, colourless/ sage-green, are associated with the more coarsely crystallized felspar tridymite complexes; a few augite microliths are also present.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

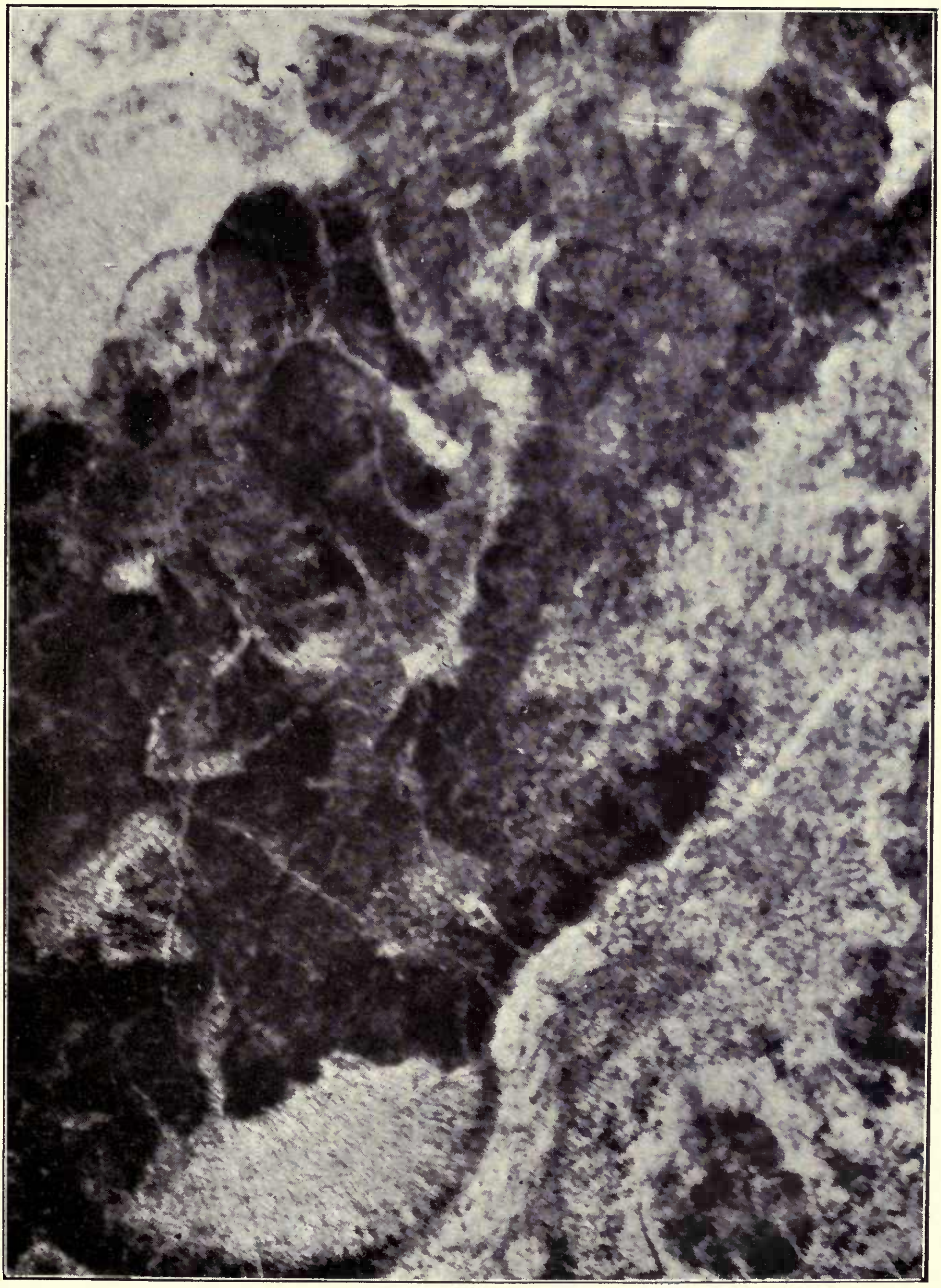
Remarks.—See Paku Island (*ante*, page 89).

No. 198/4386.

M.C.—Finely banded rhyolite, bluish, yellowish, and white thin parallel bands, extraordinarily regular, recalling a finely laminated sandstone.

U.M.—Consists almost entirely of layers of negative microspherulites, some larger, some smaller, but faintly uniform in each band.

The following layers may be distinguished:—



No. 196/4381. SPHERULITIC RHYOLITE.

[To face p. 276.

(i.) Almost colourless, and by ordinary light apparently structureless, but containing crystallites, minute rod-like colourless prisms, lying with the long axes in stream-lines; a line of these crystallites may run so straight as to coincide with one of the cross-wires of the microscope across the field. This consists of negative microspherulites, which may form a medial layer of more or less spherical form bordered on each side by brush-like forms. Sometimes the negative spherulites become much larger than usual, and then present perlitic cracks.

(ii.) Similar, but the radio-fibrous structure obvious by ordinary light; the crystallites absent, and nests of tridymite lying between the negative spherulite, or in some cases interstitial quartz. Stellate crystallites sometimes afford a nucleus.

(iii.) Complex bands formed of (i.) and (ii.), with irregular cavities filled by large growths of tridymite, bordered by positive spherulitic growths of an unusual character. They are colourless and very minutely fibrous, and possess a *r.i.* not far removed from that of quartz. The middle of the cavity may remain empty.

(iv.) Brownish layers of positive microfelsitic fibres.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks. —See Paku Island (*ante*, page 89).

No. 199/4387.

M.C.—Grey rhyolite, finely banded.

U.M.—Very similar to No. 4386 : shows all that No. 4386 does, and, in addition, large microliths of two kinds ; one green, without pleochroism, in simple prisms with forked or pencil-point-like terminations, extinguishing at 42°, is no doubt augite ; the other in colourless prisms, also sometimes with forked ends, and with both lower *r.i.* and lower double refraction, is equally doubtless felspar. Stellate crystallites and woolly caterpillar-like forms, a few trichytes, granules of magnetite, are also present.

Positive Microspherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—See Paku Island (*ante*, page 89).

No. 200/4388.

M.C.—Finely and evenly banded rhyolite.

U.M.—Alternating layers of negative microspherulites, isotropic material, and irregular streaks rich in tridymite. Some quartz is associated with the negative microspherulites, which are fairly large, and frequently present an isotropic central area. Various crystallites and microliths are present.

The isotropic material is not glass, but felspar which has become converted into a pseudomorph of some unknown substance. This is the so-called "refusion" pseudomorph.

The structure of the negative microspherulites is clearly displayed; they obviously consist of felspar rays with intervening tridymite; the felspar has a slight-bluish colour and the tridymite a faint-pinkish, and the latter can be clearly traced from interstitial areas filled with tridymite continuously extending into the microspherulites between the felspar rays.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—See Paku Island (*ante*, page 89).

No. 201/4394.

M.C.—Black, glassy rhyolite containing spherulites.

U.M.—Almost colourless faintly brown glass with crystallites in stream-lines, and some small phenocrysts enclosed in positive spherulites.

The glass contains a vast number of very minute granules somewhat uniformly scattered through it; they are transparent and colourless, or appearing slightly green, since they possess a *r.i.* somewhat higher than that of the glass. The other crystallites are trichites, — uniformly thin black filaments, curved, undulating, rarely zigzag, several proceeding from one centre or from a grain of magnetite: these radiate groups are very abundant. Belonites, which appear to be minute prisms of felspar, are present; gas-pores are not uncommon, often of large size, and generally of irregular form.

Transparent globulites arranged in rows are sometimes visible.

PHENOCRYSTS.—*Plagioclase:* Well-formed crystals, albite and Carlsbad twins; *r.i.*, above balsam; ext., 20°/24°; some are not twinned, and extinguish parallel, but their *r.i.* is above balsam.

Pyroxene: One rather small transverse section was observed, showing (010) (100) (110), with characteristic cleavage and no pleochroism; presumably augite.

No. 201/4394. SPHERULITIC GLASSY RHYOLITE CONTAINING PLAGIOCLASE AND AUGITE.

[*To face p.* 279.

Magnetite: A few large grains, with associated colourless crystals of apatite.

Spherulites: These are positive, and without cervicorn processes. In one case a cluster of plagioclase crystals forms a nucleus. Nests of tridymite occur near its outer margin, and in some of these the felspar rays of the spherulite can be traced as long rectangular crystals. Tridymite is evidently the mineral associated with felspar over the greater part of the spherulite. Certain parts of the spherulite (patches and lanes) are distinguished from the remainder by greater clearness and loss of relief, looking very flat in comparison with the rest. This would seem to result from the substitution of quartz for tridymite; the *r.i.* of the quartz and felspar being more closely approximate with each other and with the balsam leads to a reduction in the relief of the spherulite and in the distinction between its fibres among themselves.

Spherulitic Glassy Rhyolite, with plagioclase and augite.

Illustration.—Under moderate magnification none of the details of the description are readily seen; and, except lines of fracture, which are irregular or concentric, there is little that gives contrast within the glass of the slice. Two spherulites are partly preserved, most of the slide having broken away in the course of preparation. The spherulites are in strong contrast with the other parts of the slice that have been preserved.

Photographed by ordinary light; magnification, 48 diameters; area photographed, middle right, which shows the lower spherulite with contained phenocrysts near the centre of the once unbroken spherulite.

Locality.—Supposed to be from some part of Cape Colville Peninsula.

Formation.—Acid group of Pliocene age.

Remarks.—The specimen was obtained from a resident at the Thames, who could give no information about it other than that he believed it was from some part of the peninsula. At first sight it seemed to be an obsidian with spherulites of considerable size, and as such it was considered worthy of a place among the specimens sent to England for description.

No. 202/4396.

M.C.—Dark-grey spherulites in a white groundmass.

U.M.—Large rounded positive spherulites in a clear perlitic altered glass.

Glass very regularly divided by perlitic cracks, from the sides of which extensive alteration has proceeded, producing a comparatively broad marginal band of fibrous crystalline material, the fibres running at right angles to the surface from which they proceed. Spherules of a similar fibrous material lie in the glass adjacent to the marginal band. The colour of the band is faintly but distinctly green, there is no pleochroism, its fibres extinguish parallel, its *r.i.* is about the same as that of balsam, its double refraction is high, and the optic sign positive. I should have set it down as chalcedony but for its green colour and high double refraction; it is probably some hydrous alteration product. On the other side of this fibrous band—*i.e.*, within the glass—are numerous colourless isotropic globules, looking like drops of oil; these may be opal. The remainder of the interior of a "pearl" may be occupied by a mosaic of finely fibrous spherulites, and thus nearly all the original glass may become transformed into crystalline structures.

Spherulites of the ordinary positive type. Dark crystallites still maintaining their original direction traverse them in stream-lines. One spherulite having grown to completion, a second has started from its surface, and this has afforded a starting-place to a third.

Spherulitic Rhyolite—spherulites immersed in altered glass.

Illustration.—The slice shows good contrasts.

Photographed by ordinary light; magnification, 33 diameters; area photographed, middle part, showing in part spherulites of considerable size, but more particularly the remarkable manner in which perlitic cracks affect the glass in which the spherulites lie immersed.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The glass of this rock contains vast numbers of spherulites, varying in size from that of a peppercorn to that of a good-sized hazel-nut, and these either fall out or are readily freed from the matrix, generally without damage. Most of these spherulites are enveloped in a shell formed of very small spherulites, which adhere more or less firmly to the surface of the large spherulite.

This slice is further illustrated at page 122 of the present volume of this work, where, the magnification being less, a more general view of the slice can be obtained.

No. 203/4425.

M.C.—Black glassy rhyolite with brown spherulites.

U.M.—Colourless perlitic glass with numerous crystallites, enclosing positive rounded spherulites, sporadically scattered or arranged in parallel bands; narrow cracks filled with dark-brown granular material traverse the rock more or less parallel with these bands, cutting through spherulites and glass alike. These cracks are sometimes united by transverse ones.

The glass contains black trichites, straight and curved, and in stellate groups; belonites, colourless, with rounded, forked, or square ends, sometimes slightly swollen at the ends, and then suggesting conjoined globulites; also microliths, some with forked ends, extinguishing parallel (felspar), some long, jointed, and evidently apatite.

Globulites, very minute, are generally scattered, and have no real connection with the belonites. Minute specks with high double refraction shine out here and there between *x.n.*; they may be pyroxene.

No. 202/4396. SPHERULITIC RHYOLITE, SPHERULITES IMMERSED IN ALTERED GLASS.

[*To face p.* 280.

The sides of the perlitic cracks are beginning to pass into alteration products, probably by hydration. Gas-pores sometimes occur in the centre of a "pearl" and within the perlitic cracks. Opal is developed in globules about some of the cracks.

The spherulites are positive, and occur in successive growth; after the formation of the larger a second crop of smaller arose, starting from the surface of the first; a third, looking like structureless or merely granular rufous glass, followed; between *x.n.* these behave like the obviously fibrous forms. Sometimes the rufous or orange-red forms preceded the last of the smaller ordinary forms. The black plumose trichites which greatly help to express the fibrous structure of the ordinary positive spherulites are absent in the rufous forms, and this, taken in connection with the generally diffused red colour of the latter, suggests that the iron-oxides which crystallize out generally in the form of trichites remained suspended as fine granules in the rufous forms. In many cases the black plumose trichites become converted into red ferric hydrate, as, indeed, they do in the obviously fibrous spherulites of this slice.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.

Formation.—Acid group of Pliocene age.

Remarks.—The same as for the previous specimen (No. 4396).

No. 204/4574.

M.C.—Spherulitic rhyolite with brown spherulites in white altered glass, and lithophysæ containing opal.

U.M.—Colourless perlitic glass, altered along the perlitic cracks as described in No. 202/4396. The unaltered glass is colourless and remarkably structureless. Minute flecks of colourless material with a slightly different refraction index can be just made out in it, and they are very abundant. Occasional trichites are met with, but they are rare.

The positive spherulitic growth is very complex. It surrounds an irregular mass of brown granular material, white by reflected light, which shows signs of irregular spherulitic structure itself. Between this and the ordinary positive growths are some very coarsely crystallized, colourless, clear spherulites which take their origin from the inner surface of the enclosing outer spherulites. The fibres of these colourless spherulites are partly positive, partly negative, and they consist largely of tridymite, with characters more nearly approaching those given by mineralogists than most of the tridymite in these rocks. This is one of the most beautiful examples of this mineral I have seen.

The brown granular material (white by reflected light) in the centre of the spherulites is opal; its double refraction in places may be due to chalcedonic fibres. The small spherulites about its margin, which give such marked effects between *x.n.*, may also be chalcedony—almost certainly are.

Spherulitic Rhyolite.

Locality.—Paku Island, at the mouth of the Tairua River, Coromandel County.
Formation.—Acid group of Pliocene age.
Remarks.—The same as under description of Paku Island (*ante*, page 89).

END OF VOL. I.

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