A GEOLOGICAL EXCURSION TO PORT CYGNET IN CONNECTION WITH THE AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 1902.

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The interest attaching to the plexus of felspathoid rocks, now known to occur at Port Cygnet, led to a flying visit being paid to the locality by members of Section C. (Geology) of the Australasian Association for the Advancement of Science, in January, 1902. The occurrence of this division of eruptive rocks in Tasmania is so restricted, and their development is exposed so instructively, that a brief account of the excursion will be interesting to others besides the actual visitors.

Seventeen members took advantage of the opportunity, and travelled to Port Cygnet by one of the Channel steamers, making the trip in a few hours. A call was made at Kettering, in the D'Entrecasteaux Channel, where Professor E. C. Hogg led the party to an exposure of Permo-Carboniferous till, with glaciated pebbles. Oyster Cove, where the belt of alkali rocks comes through from Port Cygnet, was not visited, the entire energies of the expedition being reserved for the better known area at Lovett. Elæolite syenite, essexite and alkali rocks with trachytoidal groundmass, occur at Oyster Cove.

The assistance rendered to the cause of Science by the Hon. Edward Mulcahy, the then Minister of Lands, Works, and Mines, in lending the services of the two State geologists, was appreciated by the members and duly acknowledged at the time. Despite the short time at the disposal of some of the professors, who had to return to Hobart to attend a meeting of Council, the area examined was considerable, the only regret being that members could not linger a few days longer at a spot which it was recognised must eventually become one of classic interest to petrographers.

As the steamer drew near to the jetty at the head of the arm of the Huon, known as Port Cygnet, about a mile south of the township of Lovett, the scene was owned to be highly

picturesque. Wooded heights ascend from the water's edge on each side, and large fruit orchards diversify the aspect of the slopes. The view eastwards is shut in by the high range in the background, a ridge of Mesozoic diabase (dolerite), the holocrystalline plagioclase-augite rock, which R. M. Johnston shows, is prolonged southwards from Mt. Wellington and apparently forms the axis of the peninsula which divides the waters of Port Cygnet from the Channel. This high ridge is flanked by Permo-Carboniferous sandstone and mudstone on either side, and, according to F. J. Ernst, crosses the zone of alkali rocks in their N.E.-S.W. course. Westwards the same Permo-Carboniferous beds are found, also broken through by the elæolite syenites, tinguaites and allied rocks, which the members of the Section now hastened to examine *in sitû*.

At the extreme head of the arm the water is shallow, and old residents say that it has receded considerably in recent years. The shores are flat, and no good exposures of rock are visible. The first outcrop of the alkali rocks is seen on the shore, between the two jetties, but a more striking development occurs at, and immediately south of, the Regatta ground. This point, the termination of a projecting headland a few hundred feet wide, consists of elæolite-syenite with varieties of alkali and alkali-quartz, syenite passing at each margin into darker varieties, which have been determined by Professor H. Rosenbusch, to whom samples were submitted by the Mines Department, as jacupirangite, essexite, and nephelinite (or monchiquite). Generally speaking, there are no sharp divisions between the central mass of light-coloured syenite and the dark marginal rocks, though well-defined bands and veins of the lighter rock traverse the other, sometimes in such profusion as to form a meshwork. At other times the most gradual variation is seen from one to the other, the lighter variety growing darker by imperceptible stages. The darker rocks also vary considerably, both in texture and colour. It is impossible to resist the conclusion that we are here in the presence of an example of magmatic differentiation. The leucocratic centre is elæolite-syenite, and the dark marginal rocks are differentiated products. Of the latter, the mica nephelinite (containing large crystals of biotite) has only been found as scattered stones, but a little excavation work would probably reveal the bed-rock. The locality is between the Regatta Box and the Point. Professor Rosenbusch says this rock is nephelinite with the habit of a monchiquite, to some extent actually a monchiquite with a groundmass of nepheline, instead of analcime or glass. Monchiquite is usually considered to be

a rock composed of the dark silicates in a groundmass of analcime. Some authors affirm the analcime to be Primary, others believe it may be the hydration product of original glass.

The essexite of the Regatta ground is a dark dioritic-looking rock found at the water's edge below the Regatta Box. I have also seen it at Oyster Cove. It consists of labradorite and andesine felspars + augite + amphibole with quartz and iron oxide. Although it possesses the characteristics of its family, it differs, according to Professor Rosenbusch, in type from other essexites known to him, and requires further study.

The jacupirangite (nepheline + augite) is not always so intensely pyroxenic as typical specimens from Jacupiranga. Professor Rosenbusch has, with his usual kindness, furnished me with the following note upon it.

"It is a highly pyroxenic differentiation of the elæolite and alkali syenites at the Regatta ground, Port Cygnet, and possesses the characters of the so-called jacupirangite of San Paulo, in Brazil, and of Alnö, in Sweden. It would be rather interesting to examine the sand of any adjacent creeks which may flow over the syenites with this jacupirangite facies. The interesting mineral, Baddeleyite ($Zr O_2$) may be expected to occur."

Further south from this promontory a few dykes were visited on the shore of the Arm, traversing mudstones of Permo-Carboniferous age. One is a green sölvsbergite porphyry, its colour due to aegirine. It contains parallel layers of porphyritic tabular crystals of sanidine. Another dyke, a little further south, contains the new variety of garnet, Johnstonotite. It is a mica sölvsbergite. Professor Rosenbusch calls attention to an undetermined mineral which he has observed in it. He says.—

"This rock contains in small quantities, but widely distributed, a strongly refractive, red, transparent, isotropic mineral, which I have noticed in many other rocks of the alkali series, but which I have not been able to determine yet. I suspect that it belongs to the pyrochlore group."

The next day the party visited Mount Livingstone, one mile N.E. of Lovett, where large collections were made of the beautiful elaeolite syenite porphyry, which seems to form the axis of the hill, and can be gathered in loose blocks on the crest. These rocks had been previously designated phonolitic trachyte and nosean or hauyne trachyte by the writer, but Professor Rosenbusch has identified them as elaeolite syenite porphyries with trachytoid groundmass. He has taken the trouble to accompany his identification with the

following remarks. Speaking of the porphyry with the large biscuit-like felspar crystals ("magpie' locally), he says:—

"Large crystals of orthoclase with splendid cleavage parallel to P (001), M (010), and ($\bar{1}$01), a little triclinic felspar, a few pseudomorphs of natrolite after nepheline, pseudomorphs of iron ores after nosean and biotite (?) and some garnets lie in a very fine fluidal trachytic groundmass of felspars. The pseudomorphs after nepheline are the most charming aggregates of natrolite that I have ever seen, except in the tinguaites from Alnö. At the same time it is also possible that the original mineral was sodalite. These pseudomorphs are also enclosed in the felspars. The rock is strongly impregnated with pyrite. I hesitate only whether to call it an alkali syenite porphyry or on elæolite syenite porphyry."

The pseudomorphs of iron ore after nosean have been a puzzling question for some time, and I sent a slide to Professor Rosenbusch containing a section of one of them plainly replacing garnet, and suggested that garnet may have been the original mineral in all instances. The Professor's reply shows an openness of mind which is refreshing to meet with now-a-days. It is as follows:—

"I agree with you in referring the iron ore pseudomorphs in the slide which you sent me to garnet (melanite). At the same time, I am not sure whether this holds good for the pseupomorphs in my slides. It may possibly do so. The difference in habit may be due to varying thickness of the slices. In my slices the forms remind me of nosean in leucitophyres and allied rocks. Had I seen your slide first, perhaps my interpretation would not have occurred to me."

It may, therefore, well be that some of these iron ore pseudomorphs are really after nosean, while others replace garnet. From the fact that we have undoubted nepheline in in this group of rocks, it is likely that the matrolitic pseudomorphs are after nepheline.

Closely allied with the above is a fresh-looking garnetiferous porphyry of trachytic aspect, with glistening phenocrysts of sanidine, and spotted in places rather abundantly with small soft grey or white crystals of haüyne or nosean. Nosean trachyte or phonolite appeared a convenient name, but Professor Rosenbusch call it a melanite-bearing elaeolite syenite porphyry. He writes:—

"The felspar is fresh and like sanidine. A few small elaeolites are converted for the most part into aggregates of natrolite. The dark constituent is an amphibole with $\mathfrak{c} : c = 20° \gamma$—$a$ weak, $\mathfrak{c} = b$ blue green, $\mathfrak{a}$ greenish yellow.

The garnet is fresh, zonally marked, highy idiomorphic, and occurs not only as phenocrysts, but also as a constituent of the trachytoid groundmass."

The nosean mineral, though plentiful in many specimens of the rock, is rare in others, and is sometimes quite absent. A suggestion was made to me in Victoria that the identification of the nosean might be incorrect. I felt satisfied that no mistake had been made, and Professor David, to whom I showed a slide, confirmed the reference. Professor Rosenbusch also recognised nosean, or haüyne, in a slide which was sent to him. He says :—

"Whether haüyne (rich in Ca) or nosean (rich in Na) is present cannot be determined without chemical investigation, but one of these two minerals is undoubtedly here."

I do not know that nosean or haüyne has been recorded elsewhere in Australasia.

Mount Mary is situate to the west of Lovett, and a trip made to it disclosed the occurrence of other members of the alkali series. The elaeolite, or alkali syenite porphyry, with the biscuit-like felspar phenocrysts, was seen at the Mount Mary mine, and a little above it the hillside was strewn with stones of green tinguaite, or fluidal tinguaite porphyry. The summit is occupied by a grey tinguaite porphyry, with large glassy sanidine felspars, and rich in fresh-looking melanite, but poor in nepheline. It occurs in contact with Permo-Carboniferous sediments, impregnated with pyrites. Near the summit are outcrops of the alkali syenite intrusion, which apparently forms the mass of the mountains.

On the Back Road the plutonic rock is well exposed. With respect to this Professor Rosenbusch writes :—

"It consists of dull orthoclase, fresh and beautifully zoned albitic felspar, with basic margins; augite ($\mathfrak{c} : c = 48^\circ$) green in colour, with occasional narrow margins of deeper tint passing over into aegirine augite. The rock belongs to the alkali augite syenites, though it does not agree with either Pulaskite, Nordmarkite, Umptekite, or Laurvikite, &c.; in fact, it does not correspond exactly with any of the numerous rocks of that series. According to its dominant structure, I would call it either an alkali syenite with porphyritic facies, or an alkali syenite porphyry with granular facies."

The visit of the members of Section C. to Port Cygnet has proved of double value to the cause of geological science, inasmuch as it has led to the above remarks from this great German master of petrology.

These intrusive rocks carry pyrites, and along the lines of their contact with the Permo-Carboniferous sedimentary strata some silicification has taken place, accompanied by a concentration of pyrite. Some of the contact stone assays 5 to 6 ozs. silver and from ½dwt. to 2 or 3 dwts. gold per ton. The district has yielded about 3000 ozs. alluvial gold, most of which was derived from the small flats near Lymington.

The variations which distinguish the Port Cygnet rocks from alkali rocks elsewhere may be appealed to in illustration of the theory of petrological provinces. They cannot be exactly correlated with the known members of the series elsewhere, and possibly new names may be required for some of them.

The study of the group is not complete, and as it progresses readjustment of the nomenclature are inevitable, but at present the series would be arranged as follows:—

ALKALI ROCKS.

Family 1.—Alkali Granite.
Not represented.

Family 2.—Alkali Syenite.

(*a*) Plutonic representatives:—

1. Quartz augite syenite: a medium-grained, yellowish rock at Regatta Point (alkali felspar + augite + quartz).
2. Alkali syenite at Regatta Point and on Back Road (orthoclase and albitic felspar + augite + amphibole with accessory biotite, quartz, sphene, and apatite). Has frequently a porphyritic facies.

Family 3. Elaeolite Syenite.

(*a*) Plutonic representatives:—

1. Elaeolite syenite: coarse syenite rock at Regatta Point, and near top of Mount Mary (alkali felspar + elaeolite + alkaline pyroxene + amphibole). Contains melanite and biotite, also hydronephelite after elaeolite [or sodalite], and accessory sphene and apatite.

(*b*) Complementary and dyke representatives:—

1. Elaeolite Syenite porphyry, viz –

   (i.) The biscuit felspar rock on Mount Livingstone and Mount Mary ("Magpie") [orthoclase and a little triclinic felspar + alkaline pyroxene and amphibole + melanite and iron ore pseudomorphs after nosean and garnet with natrolitic pseudomorphs after nepheline (or sodalite)]. Has a fluidal felspathic groundmass.

(ii.) The nosean rock on Mount Livingstone, closely related to the preceding. (Sanidine + amphibole + alkaline pyroxene + melanite + nosean or haüyne. Aggregates of natrolite after small crystals of nepheline.

2. Mica sölvsbergite. Dyke on beach one mile south of Regatta Point: (orthoclase and albite felspars + brownish yellow mica + garnet + a pyrochlore mineral (?).
3. Sölvsbergite porphyry. a little north of the preceding. (Phenocrysts = sanidine + aegirine and natrolite after aegirine. Groundmass = acicular aegirine + sanidine + analcime and a little nepheline.
4. Tinguaite porphyry: On Mount Mary (Phenocrysts = aegirine augite + melanite + sanidine + sphene + nepheline. Groundmass = sanidine + acicular aegirine + analcime.
5. Jacupirangite: at Regatta Point (nepheline + augite.)

Family 4.—Essexite.

(*a.*) Plutonic representatives.

1. Essexite, dark, dioritic-looking rock below the Regatta Box (Labradorite and andesine felspar + augite + amphibole + quartz).

Family 5.—Theralite.

(*a.*) Plutonic representatives absent.

(*b.*) Complementary and dyke representatives:—

1. Mica nephelinite. At Regatta Point (Nepheline + augite + biotite + amphibole and accessory apatite. Has the habit of a monchiquite.

Family 6.—Ijolite.

This is not represented, unless with H. Stanley Jevons* we detach jacupirangite from the elaeolite syenite family and place it among the felsparless ijolites. Its tendency to variation in mineral constitution and its usual intimate association with elaeolite syenite incline me to retain it as a differentiation of that magma.

The alkali rocks are also found in other parts of Tasmania, and to make their enumerations complete I cite the additional localties, viz:—

Family 4.—Essexite.

(*c*) Effusive representatives:—

1. Trachydolerite: the bluffs at Table Cape and Circular Head (labradorite + augite + olivine, with analcime and apatite (and nepheline?).
2. Melilite basalt: on the Shannon Tier, at Sandy Bay, and near Rokeby (melilite + olivine (sometimes as fayalite) + augite + perofskite.

* A systematic nomenclature for igneous rocks. H. S. Jevons, M.A., Geol. Mag. 1901, p. 304.

Family 5.—Theralite.

(*c*) Effusive representatives :—

1. Nephelinite : on the Shannon Tier (nepheline + augite).
2. Limburgite : a dyke on the Emu Bay railway, near Burnie (olivine + augite).

The alkali rocks form one of the two primary divisions of the eruptives. One division is that comprising granites, syenites, diorites, gabbro, and the ultra basics : the other comprises the alkali eruptives. The latter, though not so universally abundant as the former, illustrate a remarkable aptitude for differentiation in the alkaline magma : hence numerous variations from typical forms and increasing additions to the nomenclature. The occurrences of Tasmanian rocks belonging to this division are consequently of distinct interest to both the petrographer and the geologist.