

149. *PHEGopteris polypodioides*, Féc.

"In ravines." B. Both species are more or less abundant all along the coast, the latter more than the former.

150. *PELLÆA (ALOSORA) GRACILIS*, Hook.

Not very common, but distributed in localities apparently along the coast? Mr. Butler found it "but upon one small rock which had fallen from the cliffs at Forteau; and on my last visit to F. I could not find even that." I am sure I have seen it more than once in my expeditions, but, unfamiliar with its small size and delicate texture, I have not collected and identified it.

151. *CYSTOPTERIS FRAGILIS*, Bernh.

"Amour." B.

152. *CYSTOPTERIS MONTANA*, Bernh.

"Amour." B.

153. *ASPIDIUM SPINULOSUM*, Swartz.

Abundant everywhere along the coast and in the interior.

154. *ASPLENIUM FELIX-FŒMINA*, Bernh.

"On hillsides." B.

155. *OSMUNDA CINNAMOMEA*, Linn.

Rare. I found several small specimens growing about the edges of a small pond at Bonne Espérance, August 11, and I believe found it in one or two other places near by.

156. *BOTRYCHIUM LUNARIA*, Swartz.

Very abundant in a few small spots at Bonne Espérance; found in dry places distributed sparingly along a limited line of coast. "Amour." B.

157. *LYCOPODIUM ANNOTINUM*, Linn.

"Ravines and hillsides." B.

Several other species were collected this season, but I have been unable to secure names for them as yet.

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**ON THE BLACK NODULES OR SO-CALLED INCLUSIONS IN THE MAINE GRANITES.**

**BY GEORGE P. MERRILL.**

Accompanying the samples of granite collected by agents in the employ of the building-stone department of the tenth census, there were received at the museum from various States, but principally from Maine, numerous specimens of the dark nodules or so-called *inclusions* so abundant in many of the granites of that region. I have prepared thin sec-

tions of these, together with a considerable number collected by myself, and submitted them to microscopic examination, in order to ascertain their composition in comparison with the rock in which they are contained. The results of the examination are given below. It may be well to state that all the granites spoken of bear biotite as their characterizing accessory and without exception contain together with orthoclase a varying amount of an undetermined triclinic feldspar. These nodules are of all sizes from that of a filbert to a foot in diameter, of a color varying from light bluish-gray to almost perfectly black, and of a texture usually too fine to allow a certain determination of their mineral composition by the unaided eye. They are commonly oval in shape, though angular forms are not rare. In definiteness of outline they vary considerably. In a few cases the fine black material blends gradually into the coarser material of the surrounding rock without sharp lines of demarkation. In others again the line of separation is so complete as to leave a distinct groove, easily traceable with the point of a knife. In the most cases, however, although the separation is as sharp as the granular structure of the rock will permit, there is no abrupt line of demarkation such as would lead one to suppose them to be foreign bodies taken up by the granite while in a plastic state. They show no tendency to separate from the matrix, but possess the same amount of tenacity at their line of contact as elsewhere. These spots are so abundant in many of the Maine rocks as to be a serious drawback to their extensive use for architectural purposes. As they are fine grained and take a good polish, they might not at all times be considered as particularly objectionable in polished work, but for the fact that owing to the large proportion of mica they contain they weather more rapidly than the inclosing granite, and thus after a short time greatly mar the beauty of the stone. On bush-hammered and other rough-finished surfaces they appear as irregular dark blotches that are very unsightly.

JONESBORO.—The granite quarried at Jonesboro is a coarse red rock, quite poor in mica, of even texture, compact, and hard. Under the microscope a part of the biotite is seen to have altered into a greenish chloritic product, while a few small apatite and zircon crystals, together with scattering grains of magnetite and sphene, are brought to view. The feldspars, as is usual in red granites, are found to be quite opaque. Dark patches in the rock are not particularly abundant, and I have examined but few. These are oval in shape, from one to three inches in diameter, of a bluish-gray color, very fine grained, and quite hard. Their outlines are usually quite well defined.

Under the microscope these are seen to be largely feldspathic in composition, the crystals in polarized light often showing a somewhat radial arrangement. They are quite impure. The fine, even texture of the nodule is sometimes broken by the presence of larger crystals of a plagioclastic feldspar, which are of particular interest, since their angles

and corners are often greatly rounded and the crystals reduced to mere oval grains. These rounded crystals are quite small, being only from 1<sup>mm</sup> to 4<sup>mm</sup> in length. The mica, as seen in the section, is in part biotite of the ordinary yellowish brown color; in part a colorless variety, occurring in small slender laminae which are often arranged in fan-shaped forms, or again in part a green chlorite, with the characteristic fibrous radiated structure. A few grains of pyrite are present, together with some epidote and numerous grains of magnetite. The quartz granules are frequently pierced by small colorless microlites, which could not be accurately determined.

SULLIVAN.—The Sullivan granite is a coarse, gray rock, containing, so far as observed, but few accessory minerals, a few small crystals of magnetite, apatite, and zircon only being visible under the microscope. Dark nodules are very abundant in this rock, and I have examined a considerable number. As a whole, these are very fine and compact, with outlines well defined. By the microscope they are seen to be composed of essentially the same minerals as the surrounding granite, but in varying proportions and in a more finely divided state. But little quartz is present, while the feldspar is largely triclinic, sometimes showing a well-defined zonary structure. In all biotite is very abundant, frequently obscuring all other ingredients. Magnetite, in the form of small rounded grains, is usually very plentiful, together with very many colorless microlites such as were noticed in the Jonesboro rock. One of the inclusions in this rock is of so peculiar an appearance as to merit special attention. In size it is about 2 inches square and 6 inches long, with sharp angles and corners. On three sides and the ends, although the line of demarkation is perfectly sharp and runs in nearly straight lines, still there is no perceptible separation between the inclusion and the enclosing granite, the contact apparently being perfect. On the fourth side, however, there is a distinct groove traceable with a knife-point for several inches, as though the imperfect fluidity of the granitic mass had prevented its completely enveloping it. I can conceive, however, that this effect may have been produced by weathering, as this side was exposed at the time of my finding the specimen. The texture of this specimen is too fine to allow any determination of its composition by the naked eye. In color it is almost perfectly black. In thin sections the composition is found to be quite simple, consisting of mica scales and magnetite granules, so abundant as at times to almost entirely obscure all other ingredients. But little quartz is to be seen, and the feldspar is largely a triclinic variety.

MOUNT DESERT.—The rock quarried at Somesville, Mount Desert, is a coarse pinkish gray granite, in which much of the mica is of a greenish color, apparently of a chloritic or talcose nature. Magnetite, apatite, zircon, and sphene occur as accessories. The dark nodules in this rock closely resemble those in that of Jonesboro. The larger grains that lie imbedded in the even gray groundmass of the inclusion

are, however, in this case quartz, and not feldspar. The proportion of green mica in the inclusion is much greater than in the granite proper, and the colorless microlites are here again abundant. It presents no other new features.

**EAST BLUE HILL.**—This is a coarse rock in which large snow-white crystals of orthoclase of an inch or more in length, twinned after the Carlsbad law, are frequently developed, giving the rock a beautiful porphyritic structure. Muscovite, magnetite, and zircons are the more common accessories. The biotite usually occurs in reddish-brown laminæ, which are frequently surrounded by a black border of magnetite grains. Often, however, it is found altered into a chloritic product, enclosing very many small perfect crystals of the magnetite. Black nodules in this rock are, so far as my experience goes, very irregular in outline, small in size, and quite black. Under the microscope they are found to contain the same deep reddish-brown and green mica, enclosing grains of magnetite, as does the surrounding granite. There is a very evident increase in the proportional amount of feldspar, and a corresponding diminution in the amount of quartz.

**MOUNT WALDO.**—This is a coarse, gray rock, much resembling the last mentioned. The feldspar is in part microcline, and the usual amount of apatite and magnetite is present. The nodules in this granite are said to be quite abundant, though I have been able to obtain but few, one only of which needs especial mention. This is oval in shape, about  $1\frac{1}{2}$  by 3 inches in size, of firm texture, and dark gray in color. Almost exactly in the center of the fine homogeneous mass of the nodule is a large crystal of microcline, some half an inch in diameter. Its angles are quite sharp. The finer surrounding material is composed of quartz, orthoclase, microcline, biotite, apatite, and magnetite in about the usual proportions of the granite, though in a more finely divided state. Colorless microlites also occur in these inclusions.

**HURRICANE ISLAND.**—In the Hurricane Island rock the feldspar is nearly all orthoclase, though under the microscope a few crystals of a plagioclastic variety are seen. Some hornblende is present, though not enough to be macroscopically evident. The nodules in this rock are quite abundant, and I have examined a considerable number. These are usually quite black and of a fine, homogeneous texture. Their outlines are well defined, showing under the microscope an abrupt transition from the ordinary coarse texture of the granite to the finer-grained inclusion. There is, however, no tendency to separation along this line of contact; a thin section of the rock made to include portions of both granite and inclusion, after being ground to a thinness of one four hundredth of an inch, being transferred to the mounting slide without difficulty. Under the microscope the fine-grained portion is found to consist of hornblende and biotite in about equal proportion, and in great abundance, together with varying amounts of quartz and feldspar. The proportion of quartz varies in different inclusions. Sometimes it is quite

abundant, and again it is almost entirely absent. Of the feldspars the triclinic variety is usually in excess. The chief point of note in this case is that the hornblende and plagioclase occur in much larger proportion in the inclusions than in the granite proper. There are also found in this rock narrow vein-like inclusions which are light gray in color, of fine texture, and very hard and compact. These consist of quartz and feldspar, with only rarely a shred of mica and hornblende, or grain of magnetite.

VINAL HAVEN.—The Vinal Haven rock is of much finer texture than that of Hurricane Island, and contains a larger proportion of plagioclase. It contains a little hornblende, though in very sparing quantity. Accessories are not abundant. Small crystals of sphene are occasionally found, occurring in close contact with the mica laminae, but they are not plentiful. I have seen but few inclusions from this locality, and they differ from the containing granite only in their finer texture and perhaps increased proportions of feldspar. The vein-like inclusions noticed in the Hurricane Island rock occur also here, and are of the same composition.

BIDDEFORD.—I have seen but two of the nodules in these granites. They differ from the inclosing rock only in their finer texture, increased proportion of biotite, and perhaps slight diminution in the proportional amount of quartz.

The results of the examination may be briefly summarized as follows: The nodules differ from the surrounding rock in their increased proportional amounts of biotite, or hornblende, and magnetite. In the majority of cases there is also an increase in the amount of feldspar, chiefly a triclinic variety, and a corresponding diminution in the amount of quartz. This, however, is not invariably the case. With the exception of the colorless needle-like crystals, they in no case contain minerals not found in the enclosing granite. These results agree closely with those of Mr. J. A. Phillips,\* who has examined similar formations in granites of other localities, and who considers them as of concretionary origin; "as the result of an abnormal arrangement of the minerals constituting the granite itself."

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\* On Concretionary Patches and Fragments of other Rocks contained in Granite. J. A. Phillips, esq. Quar. Jour. of Geol. Soc., vol. xxxvi, 1880, p. 19.