

New Localities for the Mineral Agalmatolite, with Notes on its Composition.

By WILLIAM HAMILTON BELL, F.G.S.E.

[Read May 21st, 1886.]

THE rock-like mineral, known as Agalmatolite, derives its name from the Greek word *αγαλμα*, an image. It has also received the trivial name of Pagodite from Pagoda; it having been long used by the Chinese as the substance from which they carve their images and pagodas.

The earlier mineralogists confined the above names to hydrated silicates of alumina and potash, doubtless a product of the decomposition, or alteration, of orthoclase felspar; an intermediate stage in its conversion into the kaolin which is so abundant in the Celestial Empire.

Jameson, Phillips, Allan, Nicol, and all the fathers of mineralogy, admitted no other substance under the name. Nicol, who was a thoroughly well-read mineralogist, writes: "Many substances are named Agalmatolite which are really distinct;" and he clearly defines the species, which he makes the same as that called Agalmatolite in the present communication.

As the number of mineral analyses increased, we find magnesian silicates to have been placed in the same category, so that in the ponderous work of Dana the term has been more or less loosely applied to the following three different substances:—

First. The substance already noticed, the true Agalmatolite, which is a massive variety of Pinite.

Second.—A massive, and what has been called an indurated, variety of steatite. This is a hydrated silicate of magnesia.

Third.—A massive pyrophyllite, which is a hydrated silicate of alumina; differing from true agalmatolite in containing no silicate of potash or other alkali.

Professor Heddle, in his article on mineralogy in the *Encyclopædia Britannica*, again restricts the name Agalmatolite to the substance which originally was so designed; and it is well that it should be so restricted, as there is evidently much want of precision in the including of steatitic or magnesian minerals under the title.

There is a similar and a similarly misleading vagueness in the manner of using the term potstone, which in some of its properties resembles this.

The formula which Dr. Heddle gives for Agalmatolite, in his article in the

Encyclopædia Britannica, is $4\text{Al}_2\text{O}_3 + 2\text{SiO}_2 + 2\text{K}_2\text{O} + 8\text{SiO}_2 + 2\text{H}_2\text{O}$; this gives in percentages 55 per cent. silica, 33 of alumina, 7.6 of potash and 5 of water.

The first discovery of Agalmatolite in Britain was by Dr. Heddle himself. In his *Geognosy of Scotland* he states that it occurs at several points in the bands of Laurentian gneiss in Sutherland, and especially at the end of the hill Kean-na-Binn, at Lua Yayi near Eriboll. In his *Geognosy of Scotland*, he gives his analysis of the mineral as found there:—

Silica	...	...	...	48.723
Alumina	...	...	...	81.58
Ferric Oxide	...	...	...	2.48
Magnesia	...	...	...	1.809
Potash	...	...	...	9.485
Soda	...	...	...	1.312
Water	...	...	...	5.752

101.091

Hardness 2 to 3, cuts like slate pencil, specific gravity 2.8 to 2.9; and he makes the following remarks:—"It is many years ago since Dr. MacCulloch "threw out the suggestion that indurated steatite was of the nature "of Agalmatolite. Of several substances which might lay claim to such "a name as indurated steatite, this is perhaps that which most deserves it. "The above analysis shows the nature of the substance for the first time, "and probably proves Agalmatolite to be British. The definite informa- "tion thus obtained enables us to recognise as the same mineral certain "hitherto doubtful green masses which occur in the granitic rocks. "This substance, and its probable mode of formation, was also noticed by "Hay-Cunningham, who writes: 'Near the village of Rispond, the gneiss "makes a transition into a rock, composed of large concretions of serpen- "tine, between the two there being also every mode of gradation.' "Cunningham's serpentine is the Agalmatolite; while I have to admit that "it is a mere conjecture (indeed the merest conjecture, seeing that pieces of "oligoclase equally large are rarely to be seen in these felspar bands) "which assigns the occurrence of the mineral to a change of oligoclase, "yet I have to say that I have not infrequently seen orthoclase passing "in its exposed surfaces into a substance not to be distinguished from this. "I instance the orthoclase of a dyke at Geo-na-Shermaig, of an infiltration "vein at Knock Dhu near Lairg, and probably a similar vein in the red "granite near Murdoch Head Quarry, in Aberdeenshire."

In 1881 and 1882 I was engaged on an inquiry into the serpentine rocks at Coyle Hill, near Ballater, Aberdeenshire. During my inquiry

I became acquainted with the constituents and appearance of these rocks, and was struck on finding, in the granite rocks in Ballater Pass, a mineral so similar in appearance to serpentine, that, like Hay-Cunningham, I called it serpentine, or serpentinous matter in the granitic rocks.

Ballater Pass runs between the hill Craighendarroch (at the foot of which Ballater lies) and another hill about 500 feet high, a mile north-east of Ballater. Both hills rise abruptly on each side of the Pass. The rocks on the east are a mass of confused blocks of coarse red granite; and it was when searching minutely for minerals which I had been told were to be found there, that I came across Agalmatolite. I was puzzled at its frequent occurrence, although in small quantities; but as serpentine is found everywhere in that neighbourhood, I allowed it to pass from my mind, but kept the specimens. It was only during the spring of last year (1885) that the finding of this mineral recurred to me, by reading the quotation I have made from Dr. Heddle's *Geognosy*. I was further interested in it on reading the report of Messrs. Peach and Horne on the question raised by Dr. Archibald Geikie on the north-west succession of rocks at Eriboll, and where this substance Agalmatolite is introduced. This report is found in *Nature*, in November 1884.

It occurred to me then that the mineral which I had found in 1880 in Ballater Pass was Agalmatolite, and on my showing my specimens to Dr. Heddle, he at once identified it as that mineral last summer. As I had no particular leaning to geological inquiry elsewhere, I returned to Ballater to prosecute my researches in this and other matters previously noticed there. I found this mineral in several parts of the Pass, but generally interspersed throughout the granitic rocks, and I sometimes found it running along a joint of the rock, as if it had, in a pasty semifluid state, been seeking an entrance there. On breaking up the rock, however, I never found that it had obtained an entrance. I have seen the mineral in this way run along a straight line of joint for yards.

My first search was in two quarries about 200 feet up a "ruckle"* of loose granite blocks, and the above was all I found there; but on going up the Pass to the west, about 200 yards from the stables of Monaltrie House, and crossing the Ballater Burn by a wattle bridge, I found it in great quantities; the mineral was also found in greater thickness, but generally seemed to cover the blocks; indeed, about this spot there was hardly a block that was not permeated by it or covered with it. I found it mostly at this point and in the rocks at the bottom of the *débris*, which

* "Ruckle" or "rickle," *anglicé*, a rough heap.

extended 200 feet up. I saw, however, green or yellowish matter like it on the solid rocks, at the very top of the cliffs, which were quite inaccessible to me.

When I returned from Ballater Dr. Heddle kindly asked me to go to St. Andrew's with my specimens. The result of our comparison of my specimens with those in his possession was that he expressed himself satisfied with their identity, and that he has little doubt that they would be found to be identical in substance with the Sutherland mineral. He, however, pointed out that from the intimate intermixture in my specimens with the silica, especially of the granitic matrix, it would form an almost impossible task to separate it sufficiently therefrom for analysis.

We found in one of the Supplements to Dana's Mineralogy that the mineral occurs at Glyden Bech, in Carnarvonshire; and after full consideration, we came to the conclusion that it was identical with my specimens, although the locality is new. The mineral may not, however, be of very rare occurrence, as Dr. Heddle stated that he had found it in Rubeslaw Quarry. Mr. Henry Mowbray Cadell, of the Geological Survey, also found it at East Ruadh, in Glen Fynne. Mr. B. N. Peach, also of the Survey, obtained long slabs of it from under the sea at Peterhead when the Harbour Works were being carried out there; Mr. MacConochie, also of the Survey, found it on the east side of Loch Garve, in Ross-shire, at the foot of Little Ben Wyvis; and Mr. Livingston, Rector of Fort William Academy, has obtained it in Glen Loy, near Banavie, on the road to Loch Arkaig.

In all these localities, including that in which I found it, the mineral is looser in structure than that from Eriboll, analysed by Dr. Heddle. Mr. Peach has also given me a piece from the same place; it has a more scaly appearance. This, however, would arise from its containing a minute quantity of what is probably mica.

Professor Ivison Macadam has kindly analysed the mineral as I found it, and also Mr. Peach's specimen from Kean-na-Binn, near Eriboll. (p. 28.)

The large amount of silica here obtained, certainly, at first sight, seems to throw doubt upon this being Agalmatolite. Mr. Macadam writes to me: "Looking at the care with which the material was picked, and the fact that no silica was observable even when the rough sample was viewed under high microscopic powers and with the polariscope, I am inclined to consider the whole of the silica constitutional, and look upon the slight variations in the proportions of silica shown by the analyses of your samples as bearing out this opinion. I am inclined to the belief that this mineral is formed under similar conditions to Agalmatolite, excepting that silica has been present in greater proportions than is necessary to form true Agalmatolite."

Dr. Heddle thinks this is equivalent to making it a new mineral, and observes that "if we regard it as a mere mixture of true Agalmatolite and silica, that intermixture would amount to about two-thirds of the whole, and that so large an amount of silica cannot be in union with the basis in any true mineral." Dana, who places Pinite among the uni-silicates, remarks:—"Agalmatolite is like ordinary massive Pinite, but contains more silica, so as to afford the formula of a bi-silicate, or nearly so, and it may be a distinct species;" and in the last edition of his work he gives no section of ter-silicates, remarking, "The species hitherto arranged under that head being proved to have no existence."

Dr. Heddle, remarking on the above, shows that, with the exception of combinations with lithia and glucina, 55 per cent. given for Agalmatolite is about as high as in the most acid silicates, and thinks that the question of admixture with free quartz could be settled by an examination of the picked material with the polariscope, the high depolarising powers of quartz would enable its presence to be at once detected.

Analyses by W. IVISON MACADAM, F.I.C., F.C.S., &c.

		Ballater Pass.			
		Kean-na-Binn.	No. 1.	No. 2.	No. 3.
Silica...	...	51·219	84·295	83·225	84·744
Alumina ...	...	33·046	8·593	9·991	10·131
Ferric Oxide	...	2·522	1·481	2·448	0·841
Magnesian	„	0·331	2·112	1·112	1·301
Calcic	„	0·141	1·586	1·077	1·013
Potassic	„	6·495	2·045	2·125	2·325
Sodic	„	0·184	0·163	0·132	0·151
Water	...	6·027	—	—	—
		99·965	100·275	100·110	100·509