AN ANALYSIS OF JADEITE FROM MOGOUNG, BURMA.

By Oliver C. Farrington.

The specimen of jadeite here described (No. 81306), was obtained from Mr. James Wickersham, of Tacoma, Washington, he having forwarded it to Major J. W. Powell, Director of the U. S. Geological Survey, for examination. The material sent consisted of fragments taken from a jade bowlder procured in Burma by Rev. J. A. Friday, who was for ten years a missionary in the vicinity of Mogoung. As these fragments seemed to be typical specimens of the unworked Burmese jadeite, and came from a source which could leave no doubt as to their genuineness, it was thought desirable by Prof. F. W. Clarke, Chief Chemist of the Survey, that a somewhat extended examination should be made of them, and they were accordingly placed in the hands of the writer for this purpose.

Concerning the mode of occurrence of the jade, the information which Mr. Friday obtained is largely corroborative of the previously published statements of Dr. Anderson*, and since these give an excellent description of the Mogoung "diggings," we quote them here:

> A stone known in commerce as jade is extensively worked in the Mogoung district of Upper Burma.
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> The mines, or rather pits, are in a valley 25 miles southeast of Meinkhoom, as many as 1,000 men being engaged in digging, during certain seasons of the year. The stone is found in the form of more or less rounded bowlders, associated with others of quartz, etc., embedded in a reddish yellow clay. The pits are not after any particular plan and none exceed 20 feet in depth. They occur all over the valley and at the base of the hill. The masses which are removed are of considerable size, and I saw some in a godown of a merchant at Rangoon so large that it required three men to turn them. * * * The greater portion of the Mogoung stone was formerly exported to Momien, in Yunan, and a considerable amount still goes there. It is possible therefore that the specimens of jadeite from China, of which analyses have been published, were originally obtained in Burma. It appears however that there are jade mines in Yunan also, as well as in other provinces of China.

In regard to the methods employed by the natives in working the jade, Mr. Friday states that they break, by heating, the bowlders which

* Geology of India, Part iv, p. 94.

contain it, until a suitable piece is found. This is then laid aside to be sold to the caravans which come to the mines for this purpose from China and other countries, or it is worked by the native artisans.

These latter cut the bowlders with a saw made of a bow of bamboo, strung with a steel wire composed of finer wires twisted together. Keeping the stone wet by water dripping from above, they sit down before it and with this primitive tool saw away day after day till they have reduced it to the desired shape. This process seems painful and laborious enough, but before the use of steel was known, its difficulties must have been far greater.

The specimens examined had in general a pure white color, but contained occasional spots of light green. For the purpose of analysis, only the white portions were used.

The analysis gave the following results:

	I.	II.	Mean.	Ratio.	Theory for $NaAl(SiO_3)_2$
SiO_2	58.99	59.45	59.22	.987 4	59.4
Al_2O_3	24.77	24.32	24.55	.241 } 0.98	25.2
Fe_2O_3	.32	.36	.34	.002 }	
CaO	.14	.22	.18	.003 } 0.96	
MgO	tr.	tr.	.....	}	
Na_2O	14.51	14.42	14.46	.233 }	15.4
Ign	1.14	1.15	1.14	.....	.....
	99.87	99.92	99.89	.....	100.0
G. =	3.3308				

The state of oxidation of the iron was not determined. Manganese was probably present in minute quantity, as indicated by the color of the sodium carbonate fusion, but it was impossible to precipitate a weighable amount. The analysis shows no essential differences from those made of similar material by Schoetensack* and Damour,† except in the fact that the percentages of CaO and MgO are very small. As neither of these molecules would be present in a typical jadeite, the material analyzed may therefore be considered as unusually pure, and the close approximation of the ratios to those required by the formula tends to confirm the correctness of the latter.

Macroscopically the jadeite is subtranslucent, exhibits a homogeneous, fine-grained texture, and is very tough. Under the microscope it is seen to be made up of small irregular granules and flat, parallel fibers closely interwoven. The granules rarely exceed 0.06 mm. in diameter and the fibers have an average width of only 0.05 mm. with a varying length of from 0.15 mm. to 0.6 mm. In this fineness of grain the material differs from the Monghoung jadeite described by Schoetensack, as he states that to consist of "grobkörnigen und auch langgezogenen Lamellen." The absence of distinct crystal forms renders optical orienta-

* Die Nephritoide des mineralogischen und des ethnographisch-prähistorischen Museums der Universität Freiburg im Breisgau. Inaug. Dis., Berlin, 1885.

† Bull. Soc. Min., IV, 1881, 157.

tion difficult, but occasional sections show parallel cleavage lines giving an extinction angle of 35°. Others showing cleavage lines nearly at right angles give an angle of extinction =0°. A form with cleavage cracks making an angle of 63°, evidently from the orthodiagonal zone, shows the emergence of an optic axis with finely colored rings. Indications of an alteration process appear in some portions of the section in a clouding and opacity extending inward from the cleavage cracks. These portions under a higher power exhibit a finely fibrous structure which is developed in the individual granules and which suggests that alteration to amphibole is taking place. As compared with the American jadeites described by Clarke and Merrill* the Mogoung specimen shows chemical and optical differences which correspond to those already mentioned, as distinguishing it from the jadeites described by Schoetensack and Damour (*loc. cit.*), viz: smaller percentages of the elements replacing Na and Al and microscopically a finer texture.

* Proc. U. S. Nat. Mus., XI, 1888, 115.