ART. III.—FEATHER-ALUM (HALOTRICHITE) FROM GLACE BAY, CAPE BRETON. BY E. GILPIN, F. G. S., F. R. S. C. CHIEF INSPECTOR OF MINES.

(Read March 9th, 1885.)

DURING a visit to the Glace Bay Coal Mines, in Cape Breton County, I had specimens of Melanterite, or Green Vitriol, and a few pieces of a white fibrous mineral brought to me from some heaps of shale and slack coal, which were being removed from the pit. The former mineral is not unfrequently met with, the latter being new to me I made two analyses of it, and thought that the results might interest some of the members of the Institute.

The mineral is of a white colour, turning brown on exposure, and of a delicate fibrous structure. It is soluble in water and

The analyses gave:

Protoxide of Iron..........	16.570
Alumina..................	9.131
Sulphuric Acid............	39.715
Water....................	35.097
Silica....................	Traces
Magnesia.................	do
Lime.....................	do
	100.513

This analysis, while not agreeing exactly with any given in Dana's mineralogy, would apparently place the mineral in the Halotrichite group.

The following table shews the composition of a number of specimens of Halotrichite compared with that of the mineral under consideration.

Locality.	Sulphuric Acid.	Alumina.	Ferrous. Oxide.	Water.
Moorfield....	36.03	10.91	9.37	42.03
Hurlet.....	35.60	7.12	13.56	43.71
"	30.90	5.20	20,70	43.20
"	28.63	2.85	19.35	48.58
Freyenwalde	43.90	15.25	7.50	33.10
Glace Bay...	39.71	9.13	16.57	35.09

It would be interesting to know how much time was occupied in the formation of this mineral at the Glace Bay Mines, some of the fibres being one-third of an inch in length. It can, however, only be remarked that the gallery in which it occurred had been excavated about twelve years ago.

Another hydrous sulphate, found as a product of decomposition in Coal Mines, is known as Alunogen.

The following analysis of a specimen occurring as an efflorescence at the Scotia Mine in Cumberland County, is taken from the report of the Canadian Geological Survey for the year 1878-79.

Sulphuric Acid...........	36·935
Alumina.....	13.479
Ferric Oxide.............	2.888
Ferrous Oxide............	.157
Water....................	45.109
Lime.......	.140
Magnesia................	.138
Potash...................	.087
Sulphur.............. ...	.131
Insoluble................	.235
	99.299

Some years ago a hydrous sulphate of Alumina and Magnesia of similar origin was found on Silurian Slates at Newport, and was shown by the late Professor How to be identical with Pickeringite, a mineral up to that time known only in Peru.

Melanterite, the first of the minerals mentioned in this paper, belongs to the Copperas group, which contains among its more noteworthy species, the hydrous sulphates of Iron, Zinc, and Copper. The first named occurs in nature as a product of the decomposition of iron pyrites, and is largely made from the waste oil of vitriol from wire and galvanising works, with scrap iron, and from alum shale. The production of Copperas in the United States in the year 1882 was estimated at 15,000,000 pounds, valued at three quarters of a cent per pound. It is largely used by tanners and dyers on account of its forming a black colour with tannic acid. It is also used in paper mills, bleacheries, paint and ink manufactories, and as a disinfectant.

White Vitriol is a similar compound, formed naturally from the oxidation of Zinc Sulphide, and commercially by the action of Sulphuric acid on Zinc. As met in the Arts, White Vitriol is a form made by melting the Crystallised Sulphate and agitating it until it cools in a granular state.

Blue or Copper Vitriol is used in many dyeing and other chemical operations. When it occurs in nature in solution, as in the water flowing from copper lodes, large quantities of the metal are obtained by exposing it to the action of iron, when it is precipitated as a red mud, easily smelted and refined.

The minerals Feather-Alum and Pickeringite mark further steps in this chemical action of air and moisture on Sulphur. They may, broadly speaking, be considered as belonging to the native Alum group, the members of which contain water and sulphate of Alumina and some other sulphate. In Potash Alum, the common Alum of the shops, this other sulphate is a sulphate of potash. The corresponding sulphate in the other Alums is that of Soda, Magnesia, Ammonium, Iron or Manganese, and finally we have Alunogen, already referred to, a simple hydrous sulphate of Alumina.

We have already remarked on the formation of Sulphate of Iron by the oxidation of iron pyrites. When this action takes place in the presence of clays, largely composed of Silicate of Alumina, part of the Sulphuric Acid unites with the Alumina, and the commonest resulting form is that of a hydrous sulphate of Iron and Alumina, such as the mineral forming the subject of this paper. As the alkalies are frequently present in appreciable quantities in clays, true Potash or Soda Alums are often formed.

When clay slates are impregnated with these sulphates they are termed Aluminous, and are sometimes rich enough to yield Alum on the commercial scale. The following outline of the process is from Dana's Mineralogy, p. 128. The rock is first slowly heated, after piling it in heaps, in order to decompose fully the pyrites, and transfer the Sulphuric Acid of any Sulphate of Iron to the Alumina, and thus produce the largest amount possible of Sulphate of Alumina. It is next lixiviated in stone cisterns. The lye containing this sulphate is afterwards concentrated by evaporation, and then the requisite proportion of Potash (sulphate or chloride, alum containing potash as well as alumina) is added to the liquid. A precipitate of Alum falls which is afterwards washed and crystalised. In France Ammoniacal Salts are used instead of Potash, and an Ammoniacal Alum is formed.

At Whitby, in Yorkshire, the business of Alum making is a very old one, having been commenced by Sir Thomas Challoner in 1460, who brought workmen from France where the process had long been kept secret as a privilege of the ecclesiastical powers. The Alum shale occurs in strata of Liassic age, and is overlaid by a hard compact stone, known locally as "dogger." The Shale bed is about 200 feet thick, and is a hard bluish gray shaly clay which rapidly crumbles on exposure. The whole deposit abounds in iron pyrites, but only the richer portions are excavated for treatment. About 65 tons of the Shale yield a ton of Alum. It would unduly extend the limits of this paper to give the full details of the manufacture, which is based on that already outlined.

In the United States there are no deposits of Alum Shale of any commercial value, but the salt is manufactured to the extent of 20,000 tons annually, valued at about $800,000. It is nearly all made from alum clays imported from France and England. The process of manufacture is very simple and consists in mixing the Alum Shale with Sulphuric Acid, dissolving out the resulting

Sulphate of Alumina, adding an Alkali Sulphate and crystallising the resulting salt.

Domestic records show that through long ages the natural supplies of Copperas and Alum equalled the demands of the dyer and manufacturer. When this source was no longer adequate the chemist showed how the slow operations of nature could be hastened, and now these useful chemicals are produced with readiness, and at a price formerly deemed unattainable.

These minerals, however, are highly interesting from a different stand-point. Hitherto we have regarded them as the source of agents which have become indispensable to our comfort, and literally the foundation of many of the varied hues that man affects in his dress. But the study of their origin and natural transmutations give an instructive insight into some of the changes that are continually going on in the earth. We see them marking several of the alterations which have led to the disintegration of rocks, the formation of soils, of economic ores, etc.

In conclusion I may mention that the manufacture of these commercial Salts has not been undertaken in Canada. The total value of textile fabrics, which may call for various processes of dyeing, manufactured in the Dominion, was according to the last census nearly $20,000,000.

There would therefore appear to be a field for the manufacture of these Copperas and Alum Salts, in this country, and some of the shales of our coal fields may be found well adapted for the purpose.