BRITISH MINING No.39

MEMOIRS
1989

* * * * *

Skillen, B.S. 1989
“Aspects of the Alum Mining Industry about Glasgow”
British Mining No.39, NMRS, pp.53-60

Published by the

THE NORTHERN MINE RESEARCH SOCIETY
SHEFFIELD U.K.

ISSN 0309-2199

ASPECTS OF THE ALUM MINING INDUSTRY ABOUT GLASGOW

Brian S. Skillen

SYNOPSIS

Textile manufacture and printing in the Glasgow area was the principal reason for the growth of the local alum industry. In 1725 *a white linen works was established, and linen printing was begun by* 1738. *The many looms of the Barony Parish produced linen goods, which were printed for handkerchiifs, gowns and curtain materials. The extraction and modification of natural dyestuffs for these materials was therefore an important local industry. Cudbear, a dyestuff made from the lichens Ochrolechia tartarea and Urceolaria calcarea,*[1] *that were also the source of litmus, gave a good permanent purple with alum. The alum was probably imported from England and the continent, thus pushing up its price. It made economic sense to trace local sources and this became possible with the utilisation of shale from abandoned mine workings.*

Attempts to exploit alum shale began between 1766-69 using the white efflorescences of hair salt – two parts sulphate of iron to one part of aluminium – which were found in the old coal wastes at Hurlet. However, Messrs Nicholson & Lightbody's works was not successful as their source gave too light a yield to be profitable and was soon abandoned. Alum continued to be supplied from outwith Scotland, principally from Whitby. This cannot have suited dye manufacturers such as George Macintosh, who in 1777 established his Cudbeat Works in Glasgow. Macintosh's contribution to the alum industry began with his introduction of acetate of alumina to the dye trade. This popular mordant was well suited to the printing and dyeing of delicate fabrics and was more responsive than alum alone. It was prepared by a double decomposition of a solution of alum and acetate of lead, the soluble aluminium and potassium acetates thus formed being decanted from the heavy insoluble lead sulphate. Its success economically was hampered by its dependence on large quantities of alum. Macintosh turned his attention to Hurlet as a cheap source of local alum. He formed a partnership with John Wilson, who had gained considerable experience at the Whitby Alum Works, to exploit the Hurlet deposits. Production of alum commenced in 1797 under Macintosh, Knox & Company, who were joined in 1800 by another notable industrial chemist Charles Tennent of St. Rollox.[2]

Chemically the alum formed a group of double sulphates through set formulae, of which there were five and all essentially correct to create "alum" or potash alum. The general formula was $M^{I}\ M^{III}\ (SO_4)\ 2\ 12\ H_2O$, where M^{I} could be potassium, sodium or ammonium; M^{III} could be aluminium, chromium, iron and so on.[2.1] The thresholds of the formulas could therefore be very wide and the technology left much to natural processes; it was Macintosh's speeding up of the process by heating that contributed much to Hurlet's success.

Hurlet.

The decomposing salts which Macintosh exploited for alum lay between the Hurlet coal and limestone, varying in thickness from a few inches to feet. The occurrence was localised to about an eighth of a mile of former workings, these being exceptionally dry with a temperature range from 60-63° fahrenheit, which helped the breaking up process.

The chemical works established above ground occupied 4-5 acres, with a profusion of buildings, chambers for acid preparation, two evaporation furnaces and lixivating vats. At nearby Nitshill, the alum works there had three furnaces and the working area provided space for great mounds of raw material.

The mineral shales and the decomposing salts once extracted were broken up and piled on a bed of fuel to about 4 feet high. Once calcination had begun more mineral was added to the pile, which could be as much as 200 square feet at the base. Apart from the mounds of raw material, the rest of the site was given over to burning. Combustion was rapid, but the mound had to be kept well sealed to stop air getting in and affecting the burning, this was done by sealing cracks, as they appeared, with watered down shale. It required about 130 tons of the decomposing shale to make a ton of alum. Once the calcination was complete, the residue was run off to pits, from which it was pumped and added to fresh calcined ore. The process was repeated until the gravity was brought to 1.l5. The saturated liquid was placed in pits to deposit contaminants and also boiled for the same purpose. The purified liquid was concentrated by boiling in leaden pans. It was passed on to settling tanks and muriate of potash or impure alkalis of the soap industry were then added to reduce the specific gravity from 1.4 or 1.5 to 1.35. The alkali potassium chloride was supplied from Tyneside, being sold at £12-£20 per ton by the Newcastle alkali manufacturers. The quantity necessary was measured by a Twaddel hydrometer, built by Twaddle to Macintosh’s design. When the specific gravity exceeded 1.35 it did not crystallise, forming instead a greasy magma, which had to be further reduced if it was to crystallise at all. Urine was added for this purpose and crystallisation was accomplished by evaporation. The crystals which formed, often as octahedra and quite large, were purified by washing and boiling. The saturated solution was poured off into casks and allowed to solidify, an ancient practice known as “roaching” which was done in 7 by 3 feet casks at Hurlet. The casks were unhooped a fortnight or so later, the alum then forming a solid pillar of 32 cwt.[3]

The alum yield off the Hurlet shales was far higher than that at Yorkshire. But this was partly due to Macintosh’s evaporating furnaces, for the flame drawn by chimney draught across the surface of the alum solution served to concentrate it. It may also be mentioned that calcining the alum shortened the alum making process by many months. Hurlet alum could therefore be produced much more cheaply than that of Whitby which left much of the process to the actions of nature.[4]

Campsie

The Hurlet works was extremely successful and soon tempted others to follow suit. But because of the limited reserves attentions was turned elsewhere, principally to the Campsie District. Geologically the Campsie area was similar to Renfrewshire; the Campsie Main Coal and Limestone were equivalents of the Hurlet seams. The Main Coal was pyritic and the shale lying between it and the limestone more so, the shale proving useful for alum making. The extraction of iron and aluminium sulphates became an important local industry as a result. The local textile trade of Campsie was another reason for the alum makers to choose the area. It is interesting to note that there might have been two alum works in the Campsie district, had Walter Logan, a mercantile agent in Glasgow, managed to establish an alum making plant in partnership with a man named Laird, in the area. The scheme did not succeed,[5] probably on account of the shales being less productive than expected.[6]

Alum making began in the Campsie district c180S, possibly by chance following Macintosh’s arrival at Barraston to establish a tanning business, using the crystal clear waters of the area. The works was close to the pit heads of the Barraston Colliery and these attracted Macintosh’s interest as a speculative investment, additional to his own trade. Certainly once he was experienced at Hurlet, he took a lease of the local Barraston minerals and worked them for some time. In the process he found the alum shale and exploited the iron sulphates in a copperas works which was established at latest by 1805. It is difficult to say how long this working lasted for the benefit of the lease was on offer by 1808.[7] There are references to a Loftus, Hurlet & Campsie Alum Works in 1809,[8] but its exact location is uncertain. What became the Campsie Alum Company does not seem to have been established then, it in turn growing up around Macintosh, Knox & Company’s large coal and limeworks at Lennoxtown,[9] a year or so later. This seems the most likely base, for the partners were the same as those at Hurlet, the two areas then being worked by a partnership of Macintosh, Major Finlay, R.E., John Wilson of Hurlet, and James Knox. Charles Stirling afterwards became a partner, and remained in the firms ‘till c1829.[10] Finlay was a brother of Kirk man Finlay of Toward Castle and had some experience of the extractive industries in quarrying at Toward.

The Campsie alum works is described in the *Agriculture of Stirlingshire* (1812) as follows:

> “In the immediate vicinity of Campsie, there are considerable chemical works carried on, where alum, copperas, soda, Prussian Blue & c., are manufactured on an extensive scale: and in which a very large capital appears to be embarked. The Company produced the alum and copperas from a decomposed aluminous schistus found in considerable quantity in the adjoining coal wastes. This schistus forms originally the covering or roof of the coal strata of the district, and is composed of silex, alumine, or clay, iron and sulphur; the two latter probably in a state of chemical union. Soon after the coal is wrought, this schistus, of various thickness, separates from a limestone stratum immediately above; thus falling down into the waste. In process of time, indeed, generally after the lapse of many years, owing to a constant circulation of air through these wastes, which being level free, are always dry (an indispensable requisite to this operation of nature) the sulphur becomes oxygenated; and is converted into vitriolic or sulphuric acid; this, uniting with the iron, forms copperas, and with clay, sulphate of alumine, from which crystallised alum is afterwards made.
>
> The decomposed schistus, as taken out of the waste, is lixivated, and the lixivia evaporated. Upon cooling, pure sulphate of iron, or copperas, separates. The mother waters are then boiled with a solution of potash, by which (the triple salt) crystallised alum is formed; this separates in its turn by cooling, and is purified by subsequent crystallisation.”[11]

The Campsie alum works was by 1812 producing 1,000 tons per annum, using 3,000 tons of coal and 300 tons of potassic materials. The abundance of local coal was of considerable benefit to the Alum Company, explaining why the Alum Company became such a dominant minerals owner in the area. The potassic materials had to be brought in from other works, most commonly as soapers' salt. Tennent's works at St. Rollox may also have been a source of potassics in part payment for the raw alum materials which were sent there from Campsie. By 1835 alum production had increased to 2,000 tons per annum and the price had fallen to £12 per ton,[12] and by 1846 it was still further reduced to £9 l0s. per ton.[13]

The alum shales were pursued with considerable vigour across the Campsie District mining area. Old coal workings were frequently reopened to work the shales in their wastes, a pattern of operation illustrated by the Black Road Pit, an old colliery close to the Baldernock Road, a short distance west of the boundary between the Lennox property and the Eleven Plough Lands of Balgrochan. The pit had been wrought c1823, and c1838, under lease from Lennox, but had been dormant from at least 1840 to 1852, when it was reopened to extract alum shale. The shales were separated from the coal by a thin wedge of ironstone and not surprisingly it was often found useless having been brought down in working the coal. Between August 1852 and February 1853, 616 tons 12 cwt. of alum shale was taken from the pit.[14] More might well have been expected and it was often the case that the Alum Company took draconian measures to conserve the shales for their own use. This naturally brought dispute with those who worked the mines for coal, and the history of alum making in Glasgow was often one of litigation. It was also a case that the Campsie Alum Company willingly enforced their monopoly of the trade, and the technicalities of who owned what and where presented a more significant problem to alum mining than its actual extraction.

Alum Miners versus other miners

The Alum Company often imposed its interests on others and this is well illustrated considering John McGilchrist's working of Bankier from c1850. He found a quantity of the pyritic alum shale in the mine and took a sample to Glasgow, where he showed it to Messrs Miller the chemical manufacturers. They were immediately interested, realising that by this means they could overcome the high price charged by the monopolistic Alum Company. McGilchrist arranged to supply what was in the mine at 9/6d. per ton and brought the weight of the Campsie Alum Company down on his shoulders:

> "I don't recollect whether 1 was sent for or not, but shortly after this I recollect of calling again on Mr King in his office in Glasgow. Mr King proposed that I should put out the rest of the pyrites out of the pit and lay it down at Hungryside – and he would boat it and sell it himself – (I think) it was 6/6d. per ton I bargained for to bring it out of the pit and lay it down at Hungryside."[15]

John King was quite unwilling that the Alum Company's local monopoly should be breached. John King had had a long relationship with alum, having worked at Hurlet as a young man, and risen to a managerial position at Campsie, then to ownership on the deaths of Charles Macintosh (1843) and George Macintosh junior and Charles Stirling, so it was in his personal interest to strengthen the will of the Campsie Alum Company.[16]

The definition of mines and minerals created further litigations, most especially where two minerals were wrought in the same mine by different parties; the rights of each had to be clearly defined; and the strong willed John King naturally pursued his. This is shown clearly in case of John King & c., trading as the Hurlet Alum Company v the Earl of Glasgow, in 1850.[17]

John King and others had had successive leases of alum shale found in connection with the coal strata at Hurlet from 1753. The Hurlet Alum Company had powers of access to the coal wastes but no right to work any other minerals.

In 1800, the alum shale was let for 63 years, reserving the coal, limestone and ironstone, with the exclusive use of 5 pits for working these minerals to the lessor. The Alum Company had no right in these pits, except in the event of working of the limestone, when they were to be told so that they could get the alum shale resting between the coal and the limestone.

In 1818, the Earl of Glasgow leased his mines to John Wilson, inclusive of the alum shale for £2,000 per annum; obliging Wilson to honour the Alum Company’s access rights. An agreement to continue for 9 years was reached, with powers to break at 4 so that the Alum Company was excused rent to 1823. Messrs Wilson were expected to keep the pit in order and to avoid falls of roof by leaving in sufficient roof supports. They were given the liberty to charge the Alum Company 1/6d. per ton for the ore comprised in their former tack.

In 1823, the Alum Company complained that the colliery water was rising and covering the alum ore which had been collected, a claim for damages resulted. In 1824 and 1829, Wilson’s lease was renewed, with full powers of working but to avoid any damage to the alum shale. From 1837 to 1843 the Alum Company regularly complained that the alum shale was being damaged by rising water. In claiming damages they stated that Wilson’s workings were in breach of the covenant protecting their rights, for he had allowed subsidences across 30 to 40 acres of the workings, where the alum shale was lost.

In 1846, the Earl of Glasgow’s law agents stated:

> “That the alum ore lying above the old pillars was not let to anyone; therefore the coal tenant ought to have it. In the general letting of the alum ore, it was not contemplated that the pillars were to be removed; hence, any found, on their removal, was no encroachment on the field of the Alum Company, but the allowance for Mr. Wilson to take out the pillars was an after arrangement, and, therefore, that part of the alum ore was at the landlord’s disposal.”

Messrs King replied:

> “That the whole ore in the Earl’s coals pits and coal wastes at Hurlet is conveyed to us.”

The lease had at no time stated otherwise and had specified very clearly the rights of the Alum Company. In 1847, Wilson commenced his workings, and the Alum Company pulling out stood upon their rights of damages.

The merits of the case hinged on whether the alum shale resting upon old pillars of the wastes was or was not included in the letting to the Alum Company, whilst the coal and limestone was let to Wilson and whether Wilson in working the coal, did not unlawfully damage the rights of the Alum Company as defined by the Earl of Glasgow. The trial by jury lasted several days, the outcome being that the alum shale was indeed under lease to the Alum Company; that Wilson in his working away the pillars and claiming the alum shale, had damaged the plaintiff; and, therefore, a verdict was given for several thousand pounds, a large proportion of which cost was borne by the Earl of Glasgow, whose law agents had advised the workings by Wilson.[18]

The very real problems of working Hurlet, led to the abandonment of the Renfrewshire alum shales, at a comparatively early date as no longer profitable, this in turn increased the importance of the works at Campsie.

The End of the Alum Industry

The yield of the alum shales varied greatly, so much so that exploitation often proved uneconomic, as early as 1830 in the case of the Woodhead Mines, which were in the neighbourhood of the Campsie Alum Works. In a letter to the estate factor of Wood head, the Alum Company expressed its reservations:

> "In-consequence of the deteriorated quality of the alum schist in the Woodhead Mines and of other causes more fully narrated in the letter of which the enclosed is a copy we hope to be exempted from payment of the rent stipulated in the alum ore lease until the ore is in a fit state for being applied to the purpose of alum making."[19]

Alum production did though continue, even to the late 19th. century, though expected yields were seldom met. Reserves of alum shale grew less and less, though many old workings were opened up again to work the shales for short periods. Then there came competition as the production of cheap sulphuric acid allowed alum to be made from aluminous clay and acid. Faced with failing reserves the shale alum producers faltered in the face of the new technology and suffered considerable losses.[20] Both Campsie and Hurler turned their production lines to basic chemicals and alum shale technology became a thing of the past.

Alum and Society

Artificial dyestuffs production took root in the expansion of the textile industries in the Glasgow area. The demand for mordants and dyes created the need for alum which formed the basic raw material of the chief mordant copperas. This local need coincided with the growth of shale alum technology and the identification of local reserves in old coal wastes, a resource which Macintosh and his partners were well placed technically and demographically to exploit. They ensured an almost exclusive possession of the trade with Macintosh's techniques of roasting and heating which shortened the alum making process by many months.

Alum was useful for many purposes, and though the main centres of the alum industry were Campsie and Hurlet, where the raw salts occurred elsewhere, notably in the Kilpatrick District where there were geographical similarities, every effort was made to exploit them. These salts were sold to the copperas makers at 15/- per ton,[21] but it was never the significant trade established elsewhere. Indeed the Macintosh enterprises took very definite steps to suppress any rivals.

Alum was useful for hardening tallow, also for degreasing printing equipment to help ink adhere to the blocks. It also proved useful in the explosives trade, for wood and paper soaked in alum solution lost its flammability and could then be used to line gun powder containers. Alum could also be used in tanning and as an astringent in medicine. The contribution of alum to social technology was considerable.

REFERENCES

1. BOLTON, Eileen M. *Lichens for Vegetable Dyeing.* 1960. p.12.
2. SINGER, Charles *The Earliest Chemical Industry.* 1948. p.263-279. CLOW, A. and N.L. *The Chemical Revolution.* 1952. HARDIE, D.W.F. and PRA TT, J.D. *A History of the Modern British Chemical Industry. 1966.* TAYLOR, F.S. *A History of Industrial Chemistry.* 1957. p.216-299.

2.1 There was no standard formula for alum till 1935. The first steps towards a standard formula were taken in the mid 19th century, with the formulation of Cannizzaro’s system. Cannizzaro was Professor of Chemistry in Genoa from 1855 and in 1858 he published *Sketch of a Course of Chemical Philosophy.* This was a scheme for determining atomic and molecular weights, once the atomic weights of elements composing a compound and its molecular weight were known, its true formula, the number and kind of the atoms in its molecules, could be worked out. Cannizzaro’s system was slowly adopted and standard formulae began to emerge. But in the case of alum no standard formula was immediately derived. In 1850, the potash alum formula was KO, $SO^3 + Al^2 O^3 3SO^3 + 6Aq + 18 Aq$. A new formula was derived as $Al_2 (SO_4)_3 + K_2SO_4 + 24H_2O$. Later the fact that the constituents were not simply mixed was recognised by writing the formula as $K_2SO_4Al_2(SO_4)_3.24H_2O$. However some authors continued to use varied formulae and even up to the 1870s the formula could be seen as $K_2Al_2(SO_4)_4.24H_2O$ or as $K Al(SO_4)_2.12H_2O$. It was the case that no means of deciding could be found till the X-ray analysis of crystals developed. Thus with alum only in 1935 did Beaver and Lipton show that the two sulphates did not exist in the crystals as individuals and showed reasons, based on X-ray studies, for writing the formula as $KA1 (SO_4)_2.12H_2O$.

3. HERBERT, Luke *The Engineer* & *Mechanics Encyclopedia.* 1835, and SINGER, Charles op.cit. 1948.
4. MACINTOSH, George *Biographical Memoir* of the *late Charles Macintosh.*1847. p.48-49. and HARDIE, D.W.F. and PRATT, J.D. op.cit. 1966, p.46-47.
5. CLOW, A. and N.L. op.cit. 1952. p.240.
6. Hurlet & Campsie Alum Company Papers. Strathclyde Regional Archives.
7. *Glasgow Herald* 12 August 1808.
8. *Clyde Commercial Advertiser* 21 June 1809.
9. *Glasgow Chronicle* 29 February 1812.
10. CAMERON, John *Parish of Campsie. 1892.*
11. GRAHAM, P. *General View of the Agriculture of Stirling shire.* 1812. p.344.
12. New Statistical Account. Vol.VI “Parish of Campsie” 1845.
13. MACINTOSH, George op.cit. 1847. p.44.

14. Hurlet & Campsie Alum Company Papers. Notes on the Black Road Pit by James King, 10 February 1859. S.R.A.
15. Lennox Estate Papers. Statement by John McGilchrist, Bankier, 1859. S.R.A.
16. SKILLEN, Brian *The Mines* & *Minerals of Campsie.* 1985. p.28-29.
17. John King & c., The Hurlet Alum Company v The Earl of Glasgow. 1850. 12D 704; aff. 7 Bell App.100.
18. DUNN, Mathias *A Treatise on the Winning and Working of Collieries.* 2nd. edition. 1852. p.308-31O.
19. Hurlet & Campsie Alum Company Papers. Copy of a letter sent to Henry Gordon, 16 October 1829. S.R.A.
20. CLOW, A. and N.L. op.cit. 1952. p.241. and MACINTOSH, George op.cit. 1847. p.181.
21. WHYTE, Andrew and MACFARLAN, Duncan *General View of the Agriculture of the County of Dunbartonshire. 1811.*

other sources:

SKILLEN, Brian Stanley
The development of mining in the Glasgow area, 1700-1830.
M. Litt Thesis. The University of Glasgow. 1987.
Appendix 2.

ACKNOWLEDGEMENTS

I acknowledge D.P.H. Lennox of Ludlow, Shropshire, for his kind permission to use the Lennox Estate Papers. Andrew Jackson and the staff of Strathclyde Regional Archives, for access to the deposited estate papers, plans and mining documents. I also acknowledge Professor Anthony Slaven of The University of Glasgow, for help and guidance during the construction of this piece.

B.S. Skillen
46 Munroe Road
Jordanhill
Glasgow
G13 1SF