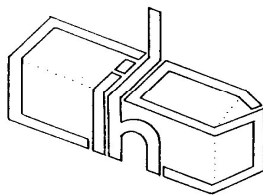


# Cumbria Industrial History Society



## BULLETIN

[www.Cumbria-industries.org.uk](http://www.Cumbria-industries.org.uk)

No. 63

DECEMBER 2005

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### EDITORIAL

Another year for the Society is starting and after a very successful year with two wonderful conferences and some well attended outings I would like to thank all the members on behalf of the committee for supporting the society. The committee works very hard on your behalf to arrange the events and they do appreciate it when there is a good attendance.

Next years programme is nearing completion and Ron has done a wonderful job of arranging the April conference again, booking forms are enclosed. The rest of the programme looks interesting and as a departure from the norm we are trying to arrange a weekend trip to Iron Bridge area. Proposal forms are enclosed and if you would like to attend please return them to David Beale as soon as possible so arrangements can be taken further.

You should all have received Volume five of the Cumbrian Industrialist, I would like to apologise for the slight error in the layout. I do already have one paper for volume six and so if any members out there have some research they would like to put on paper please contact me.

I would like to take this opportunity on behalf of the committee to wish all members a merry Christmas and a happy New Year. Please remember that subscriptions are due in January and membership renewal forms are enclosed.

## MERRY CHRISTMAS

## **SOCIETY EVENTS**

### **MEMBERS EVENING TUESDAY 21<sup>ST</sup> FEBRUARY 2006 7.30PM CONSERVATIVE CLUB PENRITH.**

There will be another chance to see Mike Davies-Shiel's slides on Force Crag Mine along with short presentations from other members. If you would like to give a short presentation please contact a committee member or turn up on the night.

Directions to Penrith Conservative Club for Members Evening (21st February 2006).

The club is situated on Southend Road next to the main post office in Penrith. However, access to the meeting room is via the rear entrance to the building directly from Southend Road car park, which is free after 6pm. From Junction 40 of the M6 take the A66 east to the first roundabout (A6). Turn left towards Penrith along Bridge Lane, passing B&Q and the hospital. At the mini roundabout (½ mile) fork left into Southend Road, passing the Leisure Centre on the left and continue for 200 yards. Follow the signs left into the car park and turn right just after the toilets to park, from where the room will be visible on the right.

### **WOODLAND INDUSTRIES SUNDAY 14<sup>TH</sup> MAY 2006 10.30AM.**

Meet Barker's Woodyard nr. Newby Bridge SD 357 854. Joint meet with Coppice Conference.

### **APRIL CONFERENCE SATURDAY 22<sup>ND</sup> APRIL 2006 CHARLOTTE MASON COLLEGE AMBLESIDE**

See enclosed booking form for details.

### **JUNE EVENING WALK 14<sup>TH</sup> JUNE 2006 SILVERDALE COAST AREA**

A walk to look at a smelt mill site. Limekilns and other industrial sites. Meet at grid Ref. SD 475 736. Further details in next Bulletin.

### **CARLISLE CANAL JULY 2006**

A proposed coach trip to view the remains of the Carlisle canal with David Ramshaw. Please see enclosed form.

### **MINES OF CARROCK FELL SATURDAY 12<sup>TH</sup> AUGUST 2006 10.30AM.**

A look at the tungsten mine at Carrock with hopefully one of the ex miners, picnic lunch at Ian Dunmurs to view his tool collection and look at the Quakers meeting house. Afternoon Carrock End mine, potash kiln and retting ponds at Linewath Farm and copper and lead smelting sites. Further details in the next Bulletin.

### **SEPTEMBER WEEKEND MEETING**

Some members have suggested the Society should hold a weekend meeting outside the area. A preliminary proposal is included. If interested please return to David Beale by April to allow further developments.

### **AUTUMN CONFERENCE**

This is planned for the Ulverston area and will cover the industries of that area.

## **NON SOCIETY EVENTS**

### **KESWICK MINING MUSEUM**

Ian Tyler has published his programme of summer walks for 2006 and they include trips to Greenside, Dufton, Raughtongill, etc. Further details from the Museum.

### **NORTHERN PENNINE SILVER IN THE LATE MEDIEVAL PERIOD**

8<sup>th</sup> April 2006 at North Pennine heritage Trust Centre Nenthead. Book places with Shiela Barker The Rise, Alston, Cumbria, CA9 3DB e-mail [Sheila.barker@cybermoor.org.uk](mailto:Sheila.barker@cybermoor.org.uk).

## **BOOK REVIEW**

### **THE INDUSTRIAL ARCHAEOLOGY OF SOUTH ULVERSTON**

By R. Mckeever and J. Layfield pp.172 paperback 2004 £12.99

An interesting example of a detailed local study of the industries of a small area, some of which obviously derive from the local materials and resources, others which appear to have migrated there or been started by local entrepreneurs to create employment. The authors have comberd numerous primary and secondary sources to build up the picture. Each chapter is footnoted but there is no final bibliography. The illustrations are good and the authors have added a number of their own colour prints of the contemporary scene. The story of the building and operation of the Ulverston canal is fully narrated. It was very important in the relocation of industry away from the shore to the canal head in the nineteenth century. The rasilway is less fully described but the Bardsea branch and its connecting tramway is shown to be important in serving various enterprises. The local industries range from quarrying (limestone) and iron ore both of which have left surface remains to cotton spinning, tanneries, ropemaking etc. Later there was a large paper mill and of course Glaxo Chemicals which took over the site of the North Lonsdale Iron and Steel Co. (established during the boom years of the 1870's but like most of Cumbria's ironworks victim of the slump in the 1930's). The sketch maps are particularly useful in locating the smaller firms and associated workers' dwellings are also noted. One thing only marrs this production; either somebody's spelling is suspect, or it has not been properly proofread. Mike Davies-Shiel's name is consistently misspelt despite the help he gave to the authors. Wharf (a pier or loading dock) never appears correctly, and roll is confused with role. Authors please get someone else to read your text before you go to print!

A. D. George.

### **GUNPOWDER GUIDED WALK**

A free 12 page A4 colour printed leaflet is available at the Langdale Estate which gives a guide to the remains on the site (Timeshare and Hotel) and a history of the site.

## REPORT ON VISIT TO SOUTH TYNE VALLEY HEAD

A large group assembled on a fine day for a walk to the source of the South Tyne and to view the industrial remains along the way.

Below are notes on the sites passed. The walk started at NY 757 384 and followed the South Tyne Way from near Tynehead farm.

### TURNPIKE ROAD

Pack horses were used to carry the majority of materials and ore around the area and the state of the roads were very poor in condition. A few toll roads had been formed with the alston to Hexham in 1778 and alston to Stanhope in Weardale in 1793 –94 and a start on the road to Brampton in the same year.

However these were badly maintained and in 1823 J L McAdam was commissioned to inspect the roads in the area by the Greenwich Hospital commissioners he concluded that the roads were badly aligned poorly constructed and badly maintained. He drew up a plan for new roads to link Alston to all the major centres within 36 miles of it and calculated that the saving on haulage of lead ore coal and timber would be at Least £2,500 per year. An act was passed on 12<sup>th</sup> April 1824 and the new road over Yad Moss to Middleton was opened for traffic later that year.

### LIME KILNS

Field kilns both behind and on hill side opposite

### MINING

Area known as Priorsdale. Split into two liberties A) Hole liberty hillside opposite B) Hill liberty (tynehead Manor) Few records as not part of Alston Moor.

Possible evidence mines worked in 1219 by Robert de Vieuxpont possible working the clargillhead and sir John Veins very silver rich and that these were the original Carlisle mines

### WINDY BROW NORTH VEIN

NY 7700 3820

Worked for a length of 675 feet worked by Isaac Vipond and John Teasdale in 1840 yielded 102 bings in 1840 but only 35 in 1843

### WINDY BROW (BRAE) VEIN

Three workings NY 7641 3804  
NY 7700 3810  
NY 7703 3795

Stephenson, Elliot and Hopper held the lease from 13<sup>th</sup> August 1779 to 1795 raised 1387 bings 7 cwt of lead ore. Lease then held by Nicholson Hopper till 1813 raising 238 bings 6 cwt of ore. From 1813 to 1855 Thomas Pearson and Thomas Greenwell got 170 bings 6 cwt and J Walton and co raised 158 bings 2 cwt by 1842 total raised 2000 bing 5 cwt. Probably worked in two ends.

### STOW CRAG VEIN (MINES)

A series of shallow shafts and open cuts along the west bank of the Tyne from its confluence with Dorthgill. 2186 tons of concentrate raised between 1811 and 1871. Particularly rich ore contained 69.1 % lead and upto 75.55 oz of silver per ton of lead.

Some copper ore was produced 856 tons in 1820's – 1830's and 20 tons 1870 –1871. found in the Hazel.

### WINDY BROW VEIN DORTHGILL FOOT LEVEL

NY 7610 3806

Along line of the Windy Brow Vein. To cut the St John Vein

Pumping shaft on side of river below bridge.

### SIR JOHN LEAD MINE

Existing remains date to 1854 local business men secured a sett at 1/7<sup>th</sup> royalty and proposed to work the sir John and Great Sulphur vein

Reduction in royalty to 1/12<sup>th</sup> on report from Evan Hopkins and John Calvert mining engineers but both suggested mine would do well.

By February 1857 reported that they had driven a number of rises along the vein and were working ore in different places. Also the mine shop was nearly constructed and the water race and wheel pit would be finished next month.

In March 1857 a washing tub for dressing the ore arrived at the mine. Also lead ore was being produced from Kindred's working and a nice string of copper ore had crossed the level.

By June 1857 the water wheel was at the mine and a leat to deliver water to the wheel from Tynehead Fell was almost complete and construction of a crusher was progressing. A low level was been driven from a recently sunk shaft and also a drift was been driven between no 1 and no 2 rises to improve ventilation and allow stoping to occur.

By August the stamps were nearly ready for working and the water wheel was erected. Rails had been laid in the lower level and hoppers built to deliver the ore into wagons. Ore was being raised from the workings at 24 cwt to the fathom.

1859 was a dry summer and the water wheel could not work.

The driving of the levels continued underground and eventually in 1862 they cut the st john vein said to be 8 fathoms wide full of spar intermixed with galena.

A second vein was cut to the east of St john 5 feet 6 inches wide

Eventually the great sulphur vein was cut but it was hard going

January 1864 they were 7 fathoms into the great sulphur vein some ore being produced. The st john vein had produced some samples of copper ore but they concentrated efforts on the great sulphur vein and copper ores had been found with 4.9 % copper content worth £3. 10s per ton at Newcastle.

In November 1865 flooding occurred with the water the getting the better of the pumps and it took till April 1866 before work could start again. They appear to have continued to work the various veins and continued looking for other veins until 1873 when a sale notice appeared mine and plant was auctioned on 23<sup>rd</sup> February 1873. It would appear the sale was not a success the mine was abandoned and equipment removed although crushing plant and water wheel was left

1881 show the formation of the Tynehead Sulphur Copper and Lead Co but no record of their activity appears.

Reopened in 1941 to gain access to the great sulphur vein to determine the quantity of pyrites for use in the war not taken on.

Attempts were made to work gold here unsuccessfully.

There is a possibility that Tungsten is present at depth but not proved.

In 1971 the site showed a mine shop adjacent to the adit entrance consisting of blacksmith shop and living quarters. Shaft midway between adit and wheel pit. Shaft 8ft diameter thought to reach the bottom of the Tyne bottom limestone or the Whinsill about 18 – 22 metres. The timbers upon which the pump balance beam or rocking beam stood are still in psotion on the edge of the shaft. A short distance below the level of the shaft can be seen the timber work arranged to make provision for a waygate the spear pump and adequate room for raising a kibble. The pump barrel can be seen with the wooden spear sticking out of the top

### TYNEHEAD SMELT MILL

Built at end of 18<sup>th</sup> century in 1796 was owned by Utrick Walton and Co and was producing 8000 pieces of lead cost of transporting lead £480

1821 was occupied by John Lowry and had two ore hearths one slag hearth one refining furnace and a reducing furnace

1829 Derwent Mining Co had 1 refining, 1 calcining, 1 reducing, 2 smelting and 1 slag hearth. Compared with Nenthead at the time which had 2 refining, 1 calcining 1 reducing 4 smelting and 2 slag hearths.

1848 owned by J C Jopling esq.

Put to let in January 1850 still occupied by J C Jopling consisted of three ore hearths, 2 roasting hearts, one refining and one reducing furnace one slag hearth, separate pots and other offices. An excellent blast with a plentiful supply of water.

View Allen Cleugh vein at Cocklakes and possibly the workings beside the flue.

#### ALLEN'S CLEUGH VEIN

Worked from near Cocklakes and level in Whinsill runs for 850 feet possible produced 31 tons lead ore between 1811 and 1855

Three levels lower middle and upper. Upper level building is a ruin 10ft square Dressing floor 230 ft down valley

#### JOSH'S HUSH

Trial level on Green Bank Vein

#### CALVERT MINE

Little detail of underground 985 tons lead ore between 1811 and 1870 when mine closed 7.7 oz silver between 1854 and 1870.

#### DOSEY VEIN

Level at NY 7540 3567 in the Single Post Limestone

Out put 1811 1855 2,910 bings

Leased 1876 by J P Walton and Co nothing known.

#### TYNE BOGS VEIN

Level at NY 7536 3553

Surface and shaft working on both veins 1219 tons of lead ore concentrate between 1811 and 1870 silver recover 8.1 oz between 1855 and 1868

#### BOWMANS SPRING VEIN

Surface shaft at NY 7561 3544 to the scar limestone

#### MIDDLE TYNE GREEN VEIN

Level at NY 7528 3502 beneath the Single Post Limestone 2100 feet of workings poor quantities

Out put 1811 – 1855 731 bing

## FAR TYNEGREEN VEIN

Level NY 7531 3473 in shale above the Tynebottom limestone only small quantities of ore

## LADIES VEIN

Level at NY 7537 3450 top part of the Tyne Bottom Limestone and a Whimsey shaft in the Scar Limestone production 165 tons of lead concentrate 1811 – 1865 silver 7.4 Oz.

## **MEDIEVAL GLASS MAKERS IN ULVERSTON - ANY OTHER INFORMATION?**

Some time ago, as a result of visiting the Newcomen Society's excellent website, I came across a reference to a medieval 'glasswright' in Ulverston<sup>1</sup>. Unfortunately it is contained in the subsequent discussion of the article and there is no indication of the source, only that it came from the comments of a Mr E Wyndham Hulme. The content of the reference is as follows:

*'the term "glasswright" appeared to be the North Country equivalent of "glazier", an equivocal term which was subsequently replaced by the word "glassmaker". He [Mr Wyndham Hulme] identified the individual in question with John, the glasswright, who had made glass at Ulverston, co. Lancs., prior to 1351 but had gone elsewhere, probably to Staffordshire'*<sup>2</sup>.

While extremely interesting, this information was ultimately useless without additional references to support it, and so I assumed it was something of a dead end. I have subsequently discovered that its probable source was the Duchy of Lancaster Assize Roll<sup>3</sup>. John, it seems, was the father of a Richard Glasswright, and grandfather of Roger Glasswright. While recently examining sources relating to the manor of Neville Hall in Ulverston I came across a second reference to a possible fourteenth century glassmaker. An account of a trial held in 1347 lists the tenants of the manor in 1309, amongst whom is a Richard Glaswright<sup>4</sup>. Quite what the relationship between the various Glasswrights is, if any, is uncertain, but it would seem likely that three members of the same family are recorded between pre-1309 and 1351: John, Richard, and Roger. Whether all four were actually glassmakers, as the name suggests, is unknown, as is the location or extent of any production sites, but this is still an extremely intriguing insight into a little-known industry in the area during this period.

If any members have come across similar references I would be most interested in hearing from them. Similarly, if anyone familiar with the contents of the Transactions of the Newcomen Society can confirm the source of the reference from 1926 it would be much appreciated.

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## ***References***

<sup>1</sup> Halahan 1926, 83

<sup>2</sup> *ibid*



<sup>3</sup> quoted by Farrer and Brownbill (1914, 355n)

<sup>4</sup> Fell 1898, 203

### ***Bibliography***

Farrer, W, and Brownbill, J, 1914 *The Victoria History of the County of Lancaster*, **8**, London

Fell, TK, 1898 Neville Hall, Ulverston, *North Lonsdale Mag Furness Misc*, **3:9**, 203-205

Halahan, BC, 1926 Chiddingfold and its Glass Makers in the Middle Ages, *Trans Newcomen Soc*, **5**, 77-85

### **QUERIES ARISING FROM OUR WEB SITE (WWW.CUMBRIA-INDUSTRIES.ORG.UK)**

As my e-mail address is on the site as a contact point, I receive a very varied range of communications including countless offers of cheap Rolex watches and ways of enlarging anatomical parts I don't possess, but also interesting queries from family historians and others. Some of these, like "Do you know where I could find information about a telephone company in Whitehaven in 1893 where my great great uncle William McLaughlin, worked?" are immediately referred to the local Record Office, and I am pleased to say that in this case the questioner reported that she had received a very helpful response. Others are forwarded to all the CIHS committee members in the hope that someone can help, or to one member with known expertise in that particular field.

An example of the latter category was a simple question "What is the melting point of brick?". I suspected that the answer might not be equally simple, but Graham Brooks is the brick expert so it was left to him. A David Layland wrote from Canada: "I work for a shortline railway in Vancouver, British Columbia. I recently found a piece of rail stamped "West Cumberland 1875", I am sure that I have found a piece of some of the oldest rail to be found in Canada". I knew enough to refer him to the Corus web site, but Chris Irwin was able to give him much more information. Of course, anything about water power is immediately forwarded to Mike Davies-Shiel. He responded to a recent query from a student about mills on the River Ehen with some information and suggestions for research that the young man could undertake for himself. Sometimes Mike's replies are so detailed that it seems a shame for the information to be lost in our files, so here is an example:

**Question:** Apparently the first Abraham Darby established a copper smelter and brassworks at an unknown site within Coalbrookdale, Shropshire. He initially obtained supplies of copper ore from a mine situated north of Shrewsbury – Harmer Hill / Pim Hill mine. It would appear that his ore supplies were unreliable so he sourced copper from the Lake District from c. 1714 (Pearce, A, (1995) *Mining in Shropshire*). Did Lake District copper mines dispatch shipments of undressed ore? If this be so, is it possible that Darby was supplied with shipments of unstamped ore which he would dress and smelt using his own equipment? Assuming that Darby may have been receiving shipments of ore in the rock (granite??) – so to speak, is it possible that, over time, deposits of green verdigris may form on the surface of pieces of rock that contain copper ore, or rock that may have come into close contact with rock rich in copper?

**Answer:** The GRANITES of Cumbria do not contain much copper. Since it is never in sufficient quantity to be worth mining it is a MINERAL and not an ORE. Copper minerals occur usually on the joint faces and more rarely in the (our) granites themselves, having moved up from deep-seated origins to fairly close to ‘grass roots’ – as Cumbrian miners would say – that is, within the zone of rainwater penetrating down. Once the dynamic pressure of moving rocks in the crust has caused copper sulphides to move up into the hydrated (water) zone, the minerals are quickly altered and instead of being mainly brassy yellows, become carbonates of brilliant emerald green (malachite) or deep bright blue (azurite), or pinky-red oxide (cuprite), all with higher copper content than the sulphides.

Most of the metalliferous rocks of Cumbria are volcanic in origin, mainly felsites / rhyolites. Many of these at moderate depth contain the sulphides of copper, with zinc, lead and silver intermixed, sometimes in veins, but often in the DISSEMINATED form. This means that small clumps of crystals up to 2 mm across are thickly sprinkled throughout the rock itself. The ore is usually chalcopyrite which contains some iron and is a bright brassy yellow, which readily tarnishes to iridescent colours when it comes to the air. If such ores are close to grass roots, they may well oxidise, but even then the volcanic rock is unlikely to be discoloured with verdigris. We have a whole range of minerals associated with our deep-seated rocks, such as antimony, arsenic, bismuth, fluor, but NO tin whatever.

The whole rock has to be blasted out and crushed to ‘fines’, a sand, in order to separate the heavier metallic minerals from the rock. With our heavy rainfalls, it was always easiest for the mine company to empower water wheels to crush, separate and concentrate the ore. Absolutely no point whatever in sending the ore in its rock to the person wanting copper. All the early Austro-German mine companies also smelted the ores to the metal before selling them out. They had the analyses, the techniques etc (mostly secret processes). With sulphide fines, the percentage yield is always much lower than with carbonates or oxides. However if there were extremely large deposits, a yield as low as 3% could be made to pay, but only with a throughput (today) of c. 1M tonnes p.a.

Besides volcanic rocks that contain copper minerals, there are, of course, the white carboniferous limestones that ring our central volcanic fells. By its porous nature, such a country rock, when copper invades - whether as veins or disseminated – the percolating rainwaters to great depths DO convert sulphide ores to carbonates and oxides. Such ores therefore do stain the rocks below them or wherever waters move through the limestones.

Incidentally, ores cannot be ‘stamped out’ as they are in the form of grit or sand. Abraham Darby I, II or III would have received his copper in bars.

As to your date of 1714, our copper mines about that time were graced with the presence of the famous Nehemia Champion of Bristol. He was given (leased?) access everywhere. Miners worked for him at Stoneycroft in Newlands vale west of Keswick, and also at Cockley Beck mine at the head of Duddon Dale where there was a very wide and profitable vein. Champion was making brass in quantities, in smelters along the R. Avon between Bath and Bristol. He travelled up quite often and was well reported in the early newspapers c. 1710-1717, and then until at least 1743.

**Question:** Can you describe the appearance (colours / textures etc) of slags produced by smelting granite copper ores (I am familiar with the appearance of Cornish tin slags – if this helps?). Would copper slags feature green verdigris colouring to a greater or lesser extent?

**Answer:** The Elizabethan Austro-German Mining Company smelted all their concentrate in Cumbria, having partial control of the forest charcoals. They finally, as a Company, departed c.1710, having fallen foul of the Earl of Derwentwater, who held all the mineral rights around Keswick. When researching mines as part of my self-assigned Waterpower remit, I discovered several of the Elizabethan smelt sites around Keswick and Caldbeck. Sulphide ores, once in concentrate form, were spread out in shallow tanks and sprayed with water to oxidise the sulphur content and then roasted over open fires to remove it . Then the ores were put into furnaces with charcoal to temperatures up to 2000°C , which melted all to a liquid. Slags came away as liquid. They look like cold glass that has been molten. and broken surfaces are a shiny purplish black with conchoidal fractures. The cold exteriors are a dull purple-black with streaks of dull crimson or purple in them. Since the 1500s, enough time has passed for any breakages to convert to the emerald green of malachite, but generally they are fairly rare across a large heap of slag. Carbonates and oxides of copper smelted easily, usually to a dirty white sandy grit.

Incidentally, one can always tell if the green mineral in a hand specimen is indeed malachite. In a sure test, lightly touch the tip of your tongue to the specimen. If it sticks, it IS malachite. It is the only metal mineral that does this.

Yours sincerely, Mike Davies-Shiel

Some queries remain unanswered so perhaps readers can help: one concerned a jug and bowl marked Brathwaites Fairy Lustre Ware, Cumbria – does anyone know of this factory? And recently we have had an appeal for articles or old photographs of industrial sites in West Cumbria which are now nature reserves – Siddick Ponds (formerly St Helen’s Pit), Maryport coastal grasslands (old railway and coal wash area), and Harrington nature reserve (storage reservoir for local iron works).

If you have an e-mail address and some area of expertise which might help to answer future queries arising from the web site, I should be pleased to add you to the circulation list - please e-mail me with details.

Helen Caldwell



WHEELPIT AT ST JOHNS MINE TYNEHEAD.

**DESCRIPTIONS OF MANUFACTURING BUSINESSES, PREMISES, PROCESSES,  
AND PRODUCTS IN THE *CARLISLE JOURNAL*, 1822**

(Continued from the *Bulletin of the Cumbria Industrial History Society*, No. 62, August 2005)

Compiled by G. W. Oxley

**416. Iron working in Carlisle**

R W & R Porter have reduced their prices of common bar iron and hammered bars, axle arms, sock plates, etc. of their own manufacture  
Advertisement, *CJ* 1209, 12 Jan. 1822

**417. Wind corm mill at Wigton**

A wind mill having two pairs of stones, a flour machine, a barley mill, drying kiln, and out offices, all in a complete state of repair.  
Advertised to be let by the owner John Wilkinson of Southwaite mills near Cockermouth , *CJ* 1209, 12 Jan. 1822

**418. Limestone quarries at Broadfield in the parish of Dalston**

Advertised to be let by the owner James Brougham, esq., *CJ* 1208, 5 Jan. 1822

**419. Corn milling at Warwick Bridge**

Insolvency of Thomas Watson  
Advertisement, *CJ* 1213, 9 Feb. 1822

**420. Weaving at Long Island, Carlisle**

All the machinery now at work, comprising a cop winding machine, three warping mills, four dressing machines, sixty looms, a steam engine of eight horse power, with all the millwright work, steam pipes, steam apparatus, dressing tubs, desks, counters, iron safe, etc., etc.  
Advertised to be sold by William Halton and Reuben Norman, assignees in bankruptcy of John Thompson, Bankrupt, *CJ* 1215, 22 Feb. 1822

**421. Iron working in Carlisle**

R W & R Porter's prices: Welsh bar iron 8/6 per hundredweight, hammered bar iron 13/- to 16/- per hundredweight; abatement to purchasers taking quantity. Orders for machinery, ploughs and several other purposes readily executed  
Advertisement, *CJ* 1216, 2 March 1822

**422. Iron and brass founding in Bochengate, Carlisle**

Dalston and Hewitt have taken over the premises recently occupied by Nicholson and Co. Where they intend to continue this business. Several smiths and molders are required, one of each as a foreman who will be allowed liberal wages   Advertisement, *CJ* 1216, 2 March 1822

**423. Milliners, dressmakers and straw hat makers in ?**

Dissolution of the partnership of Mary Liddle and Margaret Porter, trading as Liddle and Porter. Mary Liddle is to continue the business and seeks apprentices

Advertisement, *CJ* 1217, 9 March 1822

**424. Flax working in Carlisle**

Thomas Wyllie, importer and dresser of flax, hemp etc., manufacturer of shoe and shop thread, and dealer in tar has removed his shop from Rickergate to Scotch Street  
Advertisement, *CJ* 1218, 16 March 1822

**425. Milliner's and dressmakers in Carlisle**

Dissolution of the partnership of Ann Park and Sarah Thompson. Miss Park is to establish the same business in Mr. Barclays Lodgings, Paternoster Row  
Advertisement, *CJ* 1219, 23 March 1822

**426. Cotton spinning at the Frigate Cotton Mill, Denton Holme, near Carlisle**

Machinery comprising eight large spinning wheels with spindles, drums, belts, and other requisites; three carding engines; one twist frame; roving machines; and other machinery used in the manufacture of cotton yarn. Also a large water wheel. The mill was lately occupied by John Thompson. Mr Dixon of Denton Holme will send a person to show  
Advertised to be sold, *CJ* 1220, 30 March 1822

**427. Hosiery manufacture in Castle Street , Carlisle**

The stock in trade of R & G Cowan, twelve stocking frames in excellent working order, finishing utensils etc. During the last ten years R & G Cowan have established a most respectable connexion in Cumberland, Westmorland, and Northumberland and for the twenty years before that time the business was profitably carried on by Mr T Marston. Being shortly to enter another branch of the trade which will require their whole attention they are under the necessity of withdrawing from the hosiery business  
Advertised to be sold, *CJ* 1221, 3 April 1822

**428. Dyeing and sizing in Shaddongate, Carlisle**

The insolvency of John Robley and Joseph Liddle  
Advertisement, *CJ* 1222, 13 April 1822

Their stock in trade and a quantity of indigo, dye woods, and other articles used in the trade, dyeing and sizing utensils, an indigo mill, two metal vats, one copper and one iron boiler, several tubs, dyeing poles, dye sticks, etc. Also horse and cart and cart gear  
Advertised to be sold, *CJ* 1223, 20 April 1822

**429. Slate quarrying at Grasmere, Loughrigg and Langdale**

The white Moss Slate Co. Have entered upon these quarries of the Earl of Lonsdale and have a regular supply of slate on sale at Threlkeld, at Keswick, at their quarries, and at Kendal Canal Basin. Apply to their agents: William Robinson, carrier, at Keswick, Thomas Skelton or Edward Gibson at Kendal  
Advertisement, *CJ* 1223, 20 April 1822

**430. Wind corn mill at Colt Park Holm Cultram**

The mill has one pair of French Burrs, a barley mill, a dressing mill, three pairs of grey stones, all in good repair, a dwelling house, a drying kiln, a barn a byre, a stable, a garden, an orchard well stocked with fruit trees, and six acres of land. Advertised to be sold by the owner John Garth of Colt Park, *CJ* 1225, 4 May 1822

#### **431. Milliners, dressmakers and straw hat makers in ?**

M. Liddle has a well selected assortment of millinery, dresses, leghorn, chip, superfine split fancy straw and other bonnets of various shapes suited to the season. She seeks apprentices  
Advertisement, *CJ* 1226, 11 May 1822

#### **432. Cotton Mill at Dalston**

Masons, carpenters, and millwrights are sought to tender for the work of enlarging, altering and repairing the mill lately occupied by Waldie & Co.. Proposals should be made to Mr Donald of Low Cummersdale who has plans and specifications. All the machinery on the site is to be sold  
Advertisement, *CJ* 1226, 11 May 1822

#### **433. Hat manufacture in English Gate, Carlisle**

A sale shop and warehouse neatly fitted up with utensils and adapted for the employment of six to eight journeymen      Advertised to be let by the owner, John Richardson, *CJ* 1228, 25 May 1822

#### **434. Woolen manufacture at Caldbeck**

Messrs. Graves and Scott have improved their machinery and can manufacture carpets, blankets, sagatha, duffles, plaidings, and stocking yarns, and all different kinds of coarse woolen goods in the best manner, on the lowest terms, and at the shortest notice. They attend John Thompson's shop at Dockrow on Tuesdays, their own shop at Wigton (West Street) also on Tuesdays, Aspatria on Thursdays, the Spredaeagle at Carlisle on Saturdays and have appointed Joshua Parker of Brampton and Mr Tweddle of Longtown, innkeeper, to take in work for them on market days.  
Advertisement, *CJ* 1229, 1 June 1822

#### **435. Woolen manufacture at New Annan**

Thomas Little returns thanks for past support in carding and spinning country wool. Having appropriated his fine engines (formerly occupied in stocking manufacture) to carding of the first parcels and all his machinery being in good order his employers may depend on being punctually attended to and having their wool done in a proper manner at the following prices: fine wool 1  $\frac{3}{4}$ d, coarse white 1  $\frac{1}{2}$ d, mixture 2  $\frac{1}{2}$ d per pound, spinning 4d per dozen, weaving common breadth common blanketing 5d, narrow 3d per yard, oil for the wool at shop prices. He has always kept a double scribbler to break the wool before it is put into the carder, which makes a great improvement of the goods in wearing. His cart will make the first call of the season at Bowness, Kirkbride, Abbey Town and Wigton on Tuesday 11th; at Longtown, Springfield and Chapelknowe on Thursday 13th. Carding will be returned weekly; yarn spun and goods dyed also returned as expeditiously as possible. He has an experienced dyer of cloth ; woolen and linen and silks done on the most moderate terms  
Advertisement, *CJ* 1230, 8 June 1822

#### **436. Woolen manufacture at Keswick and Cockermouth**

Notice issued by the woolen manufacturers that offenders against the provisions of the statutes of 23 Henry VIII and George III will be prosecuted. Signed by Dover, Younghusband & Co., John Twentyman & Son, Joseph Bowe, Praddow & Howe, Sarah Sealby & Son, John Brownrigg & Co., John Williamson, R & W Clark, Henry Stoddart, Ann Hodgson & Son, Lightfoot and Hardisty, John Mayson, James Gordon, Joseph Grave, John Robinson  
Advertisement, *CJ* 1230, 8 June 1822

#### **437. Coach and harness making in Scotch Street, Carlisle**

Dissolution of the partnership of Thomas Milburn and John Nixon, Sr. Trading as Millburn & Co. The business to be continued by Thomas Milburn and John Nixon who have selected some of the best workmen and materials..  
Advertisement, *CJ* 1230, 8 June 1822

#### **438. Dyeing at Broadguards, Carlisle**

A good dwelling house and large dye house, store, ware rooms, dwelling rooms and other conveniences lately occupied by Robley and Liddle, dyes, bleachers and starchers. The premises are well supplied with water and are calculated to carrying on an extensive business  
Advertised to be let, *CJ* 1231, 15 June 1822

#### **439. Woolen manufacture in Wigton**

Richard Dugdale, carder, spinner and woolen manufacturer has erected machinery upon the newest and most approved principle whereby he is enabled to make carpets, blankets, duffels, plaidings, checks, stocking yarns and various other kinds of stout woolen goods in a superior manner and upon reasonable terms. Wool is taken in at his shop opposite New Street and at his works commonly called the Little Mill every day, and at the house of John Ferguson, grocer, at Abbey on Saturdays, where he likewise takes in all sorts of goods to dye. RD has appointed John Potter, dyer, to take in work for him at his works in Buckabank, at his shop adjoining the Fleece Inn in Penrith (a part of the premises late occupied by Mr Huntington, iron monger) to which place he has lately removed from the Green Market  
Advertisement, *CJ* 1231, 15 June 1822

#### **440. Soda water manufacture in English Street, Carlisle**

J. Fisher, chemist and druggist has erected one of the most complete and powerful machines for the manufacture of this salubrious article to the highest possible perfection. It may be supplied in stone or glass bottles  
Advertisement, *CJ* 1231, 15 June 1822

#### **441. The New Brewery at Maryport**

Of modern construction upon an excellent plan, easily worked, having a plentiful supply of water, and capable of brewing twenty barrels at a time with a large malting convenience, a cistern which will wet thirty two Carlisle bushels of barley, large granaries and storerooms complete. Attached to these buildings is a large yard fronting onto two streets and containing nearly half and acre of ground for building. Casks and movables may be taken at a valuation. Apply to James Ritson at the brewery.  
Advertised to be sold , *CJ* 1236, 22 June 1822

#### **442. Mill at Carwinley**

Advertised to be let , *CJ* 1236, 20 July 1822

#### **443. Flax mill at Alston**

Mill, machinery, implements and utensils, for the remainder of a term of 1000 years  
Advertised to be sold , *CJ* 1236, 20 July 1822

#### **444. Cotton mill at Water Lane, Carlisle**

A mill and machinery occupied by John Slater & Co., dwelling houses, counting houses, warehouses, garden, orchard, and other offices on a site of three acres. The mill is 160 feet by 60 feet and has six stories besides garrets. It contains 25,000 spindles with ample preparation of every description upon the newest and most approved principles, a thirty-six horse power steam engine with three boilers and pipes complete and all in the best working order and condition. The mill is heated by steam with a cistern at the top sufficient to contain twenty tons of water and pipes and conductor into each floor in case of fire. The reservoir to supply the engine is fed from an inexhaustible source. The whole buildings were erected within the last eighteen years in the most substantial manner and the premises immediately open upon the Carlisle Canal which effects a cheap and ready communication with the Liverpool, Manchester, and Glasgow markets, and upon all the roads connected therewith. 'The situation possessing such singular advantages may be safely considered to be the best in the

north of England for carrying on the cotton spinning business to the same extent. The mill and warehouse are lighted by gas. Advertised to be sold by the owner Mr Eliot, *CJ* 1236, 20 July 1822

#### **445. Weaving shops in Shaddongate, Carlisle**

Four six room shops with two dwelling rooms above, one six loom shop with four rooms above, one four loom shop with four rooms above, and two single loom shops with four rooms above occupied by Robert Gibbins, John Dobson, Thomas Matthews, Edward Ridley, Thomas M'Gowan, John Simpson and others and owned by John Lowry, a bankrupt. Advertised to be sold, *CJ* 1236, 20 July 1822

#### **446. Cotton manufacture in Carlisle**

Insolvency of Joseph Stoddart and Francis Stoddart  
Advertisement, *CJ* 1238, 3 August 1822

#### **447. Dyeing in Carlisle**

Insolvency of Joseph Emley and Joseph Emley, jr., of Denton Hill  
Advertisement, *CJ* 1239, 10 August 1822

#### **448. Gingham and check manufacture in Carlisle**

Insolvency of John Hewson and William Robinson  
Advertisement, *CJ* 1239, 10 August 1822

#### **449. Iron founding in Carlisle**

The public are respectfully informed by the proprietors of the old established iron foundry in Carlisle whose manufacture has always been so much preferred to that of the various companies which have successively attempted to carry on the same business there that another new foundry under the firm of Dalston and Hewit, lately started are devising every means in their power to get hold of various cast iron goods made by the old foundry with a view to using them as patterns instead of being at the expense of originals. Castings from the spurious patterns will of course be similar to, and may be taken for, the manufacture of the foundry where the originals were made at great expense but cannot, in the nature of things, be equal to goods cast from genuine moulds. The proprietors therefore in self defence think it necessary to say this much and caution those who may be sent to them or their agents against purchasing goods under this view. Being naturally desirous to retain their cast iron business the proprietors of the old foundry are selling articles at much reduced prices-with the superiority of their manufacture and the prompt execution ensured by their more mature and extensive arrangements must evidently render it in the interest of the public to resort to their establishment  
Advertisement, *CJ* 1239, 10 August 1822, further material on the same theme, *CJ* 1243, 7 September 1822

#### **450. Rush and cane bottomed chair making in Black Swan Lane, Wigton**

Advertisement by James Salkeld, *CJ* 1240, 17 August 1822

#### **451. Tanyard at Scotby**

Tanyard with drying lofts, bark mill, and other conveniences for carrying on an extensive business and about one and a half acres of land called Guncroft, occupied by Thomas Armstrong  
Advertised to be sold, *CJ* 1241, 24 August 1822

#### **452. Coach building in Kendal**

James M'Naught has just finished a Johnson's patent wagon and a Stanhope gig; dennets and vehicles of every description are constantly on sale at his warehouse  
Advertisement, *CJ* 1244, 14 September 1822



**453. Water corn mill at Wampool**

It has a dwelling house, barn, byre, stable, and other outhouses. The mill has a dressing mill, a barley mill, a large drying kiln and every other convenience for drying corn and has undergone complete repair. It has a constant supply of water and is four miles from Wigton, three from Bowness, and ten from Carlisle  
Advertised to be sold by the owner Silas Lawson, *CJ* 1247, 5 October 1822

**454. Lime works at Talentire**

A farm and extensive lime works four miles from Cockermouth and five from Maryport  
Advertised to be let, *CJ* 1248, 12 October 1822

**455. Hosiery manufacture in Carlisle**

Thomas Marston has entered the premises formerly occupied by R & G Cowen and intends to manufacture the same items Advertisement, *CJ* 1248, 12 October 1822

**456. Dye house in Nelson's Lane near Irish Gates, Carlisle**

A dwelling house and dye house, customary tenure of the manor of John de Chapple  
Advertised to be sold by the owner, Joseph Banks Nelson, *CJ* 1249, 19 October 1822

**457. Saddle and harness making in Brampton**

Insolvency of Thomas Nichol  
Advertisement, *CJ* 1250, 28 October 1822

**458. Carding Mill at Willow Holme, Carlisle**

Premises lately occupied by Robert Martindale as a carding mill and woolen manufactory, having a water wheel with a constant supply of water. Apply to Mr Donald at Willow Holme  
Advertised to be let, *CJ* 1252, 9 November 1822

**459. Print field at Woodbank, two miles from Carlisle**

A dwelling house for the residence of a genteel family and a print field occupied by John Topping and forty acres of land occupied by John Topping and John Bell. The print field has every description of building necessary for carrying on the business of printing cottons and calicos, with a water wheel and proper machinery  
Advertised to be let, *CJ* 1253, 16 November 1822

**460. Water corn mill at Whins Farm, ?near Crofton**

Well accustomed, in complete repair, having a constant supply of water at all seasons, and capable of carrying on an extensive business. Apply to Isaac Bell at Crofton Hall  
Advertised to be let, *CJ* 1253, 16 November 1822

**461. Haltwhistle Manor Mill**

The mill is well watered and undergoing thorough repair by James Lennox of Carlisle. It has a cast iron water wheel sixteen feet in diameter and three feet wide, a cast iron pit wheel, a crown wheel, a cast iron fly wheel with wood cogs and cast iron jacks working in the same. There are one pair of French burrs 4'6' in diameter, one pair of grey stones 4'10' in diameter, a dressing mill, a barley mill for shilling barley, a sack tackle for taking up bags, and a deighting (sic, ? weighing). An appropriate quantity of land to suit the tenant is available.

The mill adjoins the town of Haltwhistle where there is a good corn market and as well situated for town and country work. Proposals to Miss Cuthbertson, owner                      Advertised to be let, *CJ* 1253, 16 November 1822

#### **462. Woolen mill at Caldbeck**

Messrs. Graves and Scott have purchased all the woolen machinery lately belonging to Robert Martindale of Willow Holme, Carlisle, and removed it to their manufactory at Caldbeck. They are now enabled to execute every description of carpets, blankets, checks, sagatha, duffles, plaidings, stocking yarns, etc., etc., in the very best manner, with greater expedition than heretofore and at the lowest terms. [*The shop attendances in 434 are repeated*]  
Advertisement, *CJ* 1253, 16 November 1822

#### **463. Corn mills at Monkhill**

Monkhill windmill and the adjoining Burgh or Wormanby Mill which has one pair of French burrs, one pair of grey stones, a dressing mill, a barley mill and a reservoir or lough adjoining containing twenty-eight acres and chiefly covered with water. They are four miles from Carlisle, nine from Wigton, 6 from Longtown, and close to the canal  
Advertised to be sold, *CJ* 1255, 30 November 1822

#### **464. Corn mill at Huddlesceugh near Renwick**

The mill has one pair of grey stones, one pair of blue stones, a barley mill and cylinder, and two drying kilns and lies three miles from Kirkoswold and ten from Alston. There is a good dwelling house and thirty one acres of land. The mill has a constant supply of water and can carry on an extensive business. There is lime and coal at a convenient distance  
Advertised to be let, *CJ* 1258, 21 December 1822

#### **465. Spinning mill at Little Dalston**

The premises were recently occupied by Robert Dugdale & Co., are in good repair and well calculated to carrying on any business requiring a powerful fall of water. A number of cottages will be let with the mill. Apply to Mr Donald of Low Cummersdale  
Advertised to be let, *CJ* 1259, 28 December 1822

#### **466. Machine and steam engine making in Carlisle**

The formation of a society at the sign of the Minerva for assisting persons belonging to the trade when traveling in quest of employment and for supporting sick and infirm members of the society  
Advertised, *CJ* 1259, 28 December 1822

### **NOTES FOR CONTRIBUTORS**

I am very happy to accept any material for the Bulletin. I produce it in MS Word and admittedly do find it easier if long articles are submitted in an electronic form either as an attachment to an e-mail or the body of an e-mail or on floppy disc or CD. If you can not produce the original in MS Word either submit it in its original form or convert it, a hard copy of the article would be appreciated also to ensure that all characters etc. have been converted properly.

Photographs can either be submitted as j-peg files or I can scan and return prints and slides.

For further advice on any material either for the Bulletin or Industrialist please feel free to contact me.

## A VERY BRIEF HISTORY OF THE PERIODIC TABLE AND NUCLEAR ENERGY

*The inclusion of Nuclear Energy in the CIHS Spring Conference, 2006 'Powerful Cumbria' suggested the following introduction.*

**John Dalton** (b. Eaglesfield, Cumberland 1766 d. Manchester 1844): Quaker: Opened a school at age 12. Between 1803 and 1808 he turned the emerging knowledge of chemical combination (following discoveries by J B Richter, J L Proust, A L Lavoisier) into his *New System of Chemical Philosophy* -

- ! Atoms are real separate material particles which cannot be divided by any known chemical means
- ! Atoms of the same element are similar to one another in all respects and equal in weight
- ! Atoms of different elements have different properties (weight, affinity etc.)
- ! Compounds are formed by the union of atoms of different elements in simple numerical proportions (such as 1:1, 1:2, 2:3, . . .)

And this led to modern atomic theory. As more and more elements were discovered, it was Dmitri Ivanovich **Mendeleev** (1834-1907) in **1871** who wrote their names on cards and arranged them in order of their atomic weight. He placed them in a column (omitting hydrogen, the lightest, as an odd-man-out). When he came to one chemically similar to the first in the column he started a second column and found the similarities between neighbours continued as he went down. This happened again in more columns. (He thoughtfully left gaps where convenient. Later these were filled by newly discovered elements.) This became our modern *Periodic Table* of the elements.

In the table, the elements were placed in order of atomic weight (ie essentially taking unity for hydrogen, the lightest), but the weights did not go up in equal steps. They increased more rapidly - roughly (not uniformly) at rather more than twice the rate of the increase in ordinal number.

In **1897** Joseph John **Thomson** (1856-1940) measured the charge/mass ratio of the negative particles emerging from an electric discharge in low pressure gas. These particles became known as *electrons*. It was supposed that an atom contained a negative charge made up of electrons balanced by an equal positive charge. Thomson found by x-ray scattering that the number of electrons was different for each element and was roughly equal to its atomic weight. Later (**1911**) **Barkla** and others showed the number was equal to the ordinal number in Mendeleev's periodic table. It was called the *atomic number*.

The arrangement of an atom was still unclear. The idea that the atom consisted of a dense positive *nucleus* surrounded by orbiting electrons, something like the solar system, rather than a homogeneous 'pudding' of electrons embedded in positive electricity was demonstrated by Ernest **Rutherford** (1871-1937) - his experiments on scattering charged particles (viz  $\alpha$ -particles).

Then positive particles, much heavier than electrons, were extracted from the gas discharge and their charge/mass measured. It varied with the type of gas. The lightest one turned out to be a hydrogen atom positively charged by losing its electron - ie a hydrogen nucleus. Rutherford in **1920** called it *proton*.

But this did not explain why the atomic weights do not go up in equal steps.

James **Chadwick** (1891-1974), in **1932**, proved that the nucleus contained two types of particle, of nearly equal mass: the positive proton and the uncharged **neutron**. (The mass of the electron is roughly 0.00055 atomic mass units compared with the proton 1.00758 and neutron 1.00893 where 1 atomic mass unit is  $1.6599 \times 10^{-24}$  gram.)

It turns out that a particular element - with its fixed number of electrons and protons - may have different numbers of neutrons - different **isotopes** of the element.

Returning to the Periodic Table - the heaviest atom that seemed to be discoverable was **uranium** - atomic number 92. As extracted from various minerals, found in many parts of the world, its atomic weight is about 238. (If there are several isotopes present, the atomic weight found will be the weighted average of the components.) A particular isotope may be symbolized as  ${}_{92}\text{U}^{238}$ .

Perhaps, if an atom beyond 92 could be made, it would be unstable and spontaneously disintegrate.

Enrico **Fermi** (1901-54) in **1934** bombarded various heavy elements, including uranium, with neutrons and found some different elements produced. Some had atomic number >92 and these split up into ones of much lower atomic number. This is called **fission**, (L.Meitner & O.Frisch 1939).

When fission occurs, energy is released in various forms of radiation and particles, including **neutrons**. If there are more neutrons emitted than were absorbed, and if the system can be designed so they interact with more of the fissionable atoms, a **chain reaction** is possible.

This could lead to an **explosion**, or, if controlled somehow, a **steady energy source**.

The probability of this induced fission happening depends on the energy of the bombarding neutrons. And the resulting product - the **ash** - is also affected.

Fission neutrons have high energy (>1MeV ie 1 million eV where 1 eV = 'electron volt' is the energy acquired by an electron travelling in an electric field, in traversing a potential difference of 1 volt.) Some nuclei are made to fission much more by **thermal neutrons** (~0.025 eV - ie of energy comparable to that of an atom in the crystal lattice due to its temperature).

Neutrons are slowed down by many collisions with nuclei in the material they pass through, especially if it is of light atoms such as hydrogen (say in water or paraffin), beryllium, carbon (as graphite). Such a material is called a **moderator**. (In this context, hydrogen often appears as deuterium - hydrogen with a neutron added to its single proton nucleus - ie  ${}_{1}\text{H}^2$ . Water made with this is called *heavy water*.)

Some nuclei, instead of scattering a neutron, will capture it, to form a heavier isotope. A notable one is cadmium (essentially the isotope  $\text{Cd}^{113}$ ).

The design of the system has been a source of employment for many technologists and engineers. Firstly: how do you stop these neutrons escaping? You maximize the volume to

surface ratio by making the lump of fissionable material spherical (subject to any other considerations). Then: you wrap something round it which will scatter the neutrons so that some of them will go back into the lump; and at the same time moderate their energy. Or, you can chop the lump up and mix it with this moderator. This problem has employed many mathematicians. Thirdly, if you want a power station rather than a bomb: you need to transfer the heat generated by fission in the lump to a coolant and thence, for example, to a water boiler to drive a steam turbine. The coolant may also act as a moderator.

The first energy source made in this way was built by Fermi's group in a squash court at Chicago University and started on 2<sup>nd</sup> December **1942**.

Uranium naturally contains two isotopes -  $U^{238}$  mostly, and  $U^{235}$  (0.71%). [There is also  $U^{234}$  at 0.006 %.]  $U^{235}$  is fissioned by the thermalized neutrons, but, as their energy is being progressively reduced from  $>1\text{MeV}$ , they reach an energy ( $\sim 25\text{ eV}$ ) at which they are strongly absorbed by  $U^{238}$ ; so many are not available for inducing the fission. However,  ${}_{92}U^{238}$  when it captures neutrons gives  ${}_{92}U^{239}$  which disintegrates quickly by emitting a beta-ray (negative electron) to form neptunium  ${}_{93}\text{Np}^{239}$  which emits another beta-ray to form plutonium  ${}_{94}\text{Pu}^{239}$  which is fissionable by slow neutrons. So plutonium, which can be separated chemically, from the uranium, is another possible fuel.

The Chicago *pile* as it was called consisted of rods of uranium fitted into a matrix of blocks of graphite, all carefully purified. Also inserted were cadmium plates, which absorbed neutrons, When these were withdrawn, a sustained chain reaction occurred, which could be controlled by adjusting their position.

It was estimated in **1947** that -

The fission energy from the 235 isotope in 1 pound of natural uranium, taken to be 200 MeV per fission, would equal that of nearly 5000 tons of coal.

Whether the cost could be brought below that of coal was not then known.

[To make a nuclear explosive, the problem is somewhat different. One way is to separate the  $U^{235}$ , which is fissionable by slow neutrons, from the  $U^{238}$ . Another is to utilize the fact that  ${}_{92}U^{238}$  when it captures neutrons gives  ${}_{92}U^{239}$  which disintegrates quickly by emitting a beta-ray (negative electron) to form neptunium  ${}_{93}\text{Np}^{239}$  which emits another beta-ray to form plutonium  ${}_{94}\text{Pu}^{239}$  which is fissionable by slow neutrons. Then a just subcritical lump of this - ie one which does not quite sustain a chain reaction - has to be rearranged to become critical. The tricky part is doing this so that it goes off properly before it blows itself apart and becomes subcritical again.]

*Annual Review of Nuclear Science, 1956* listed over two dozen reactors in several countries intended to deliver an electrical output roughly in the range 1 to 200 Mw (megawatt). Most of these were experimental or proposed, but a few were feeding into the public electric supplies. These included 8 reactors each delivering about 46 Mw situated at Calder Hall, Cumberland and Annan, Dumfriesshire.

Bibliography J. Bronowski "The Ascent of Man", BBC 1973; BCA 1976.

F K Richtmeyer & E H Kennard "Introduction to Modern Physics", McGraw-Hill 4ed 1950.

L Davidson, W A Loeb and G Young "Nuclear Reactors for Electric Power Generation" in Annual Review of Nuclear Science, 1956, vol.6 p.317.

Ian Dunmur.

## A HISTORY OF WHITEHAVEN WORKS

### THE THIRTIES

1939 Frank Schon (subsequently Lord Schon) and Fred Marzillier registered Marchon Products Ltd. and occupied an office in London.

### THE FORTIES

1940 As the blitz intensified, Schon and Marzillier moved to West Cumbria and restarted the Marchon operation in Whitehaven.

1941 Production of chemicals began in the form of firelighter blocks manufactured from sawdust, coal distillation residues and naphthalene. The 'factory' was first the garage of Mr Schon's home in Hensingham, then premises in Swingpump Lane, supplemented by use of a small warehouse in Whitehaven (the Guinea Warehouse, Newtown).

1943 Operations transferred to seven acres of the site at Kells.

1944 Commissioning of S1 Plant: first manufacture of toiletry intermediates.

1949 Sir Stafford Cripps opened a 50,000 square foot warehouse complex and new offices.

### THE FIFTIES

1952 First sod cut by Lord Adams for the Solway Works (sulphuric acid/cement plant).

1953 First Phosphate plant commissioned.

1954 First Fatty Alcohol plant opened by Sir Henry Tizard.

1955 Anhydrite Mine opened by Lord Lieutenant Sir Robert Chance. (Mine remained operational until the mid 70's.) Duke of Edinburgh visited Marchon. First two sulphuric acid plants opened. A&W Ltd. purchased Marchon Products Ltd. Marchon Italiana registered.

1957 First phosphate-rock carrier Marchon Trader built for the Morocco-Whitehaven run. Oil Additives plant opened. Eltesol plant opened. Fred Marzillier retired from executive directorship.

### THE SIXTIES

1961 Marchon Italiana's Castiglione factory opened. F3 phosphoric acid plant opened. Second carrier *Marchon Enterprise* built.

1962 Third Sulphuric Acid plant opened. *Marchon Venturer* built.

1963 Whitehaven technology used for two detergent plants in Russia.

1964 New Fatty Alcohol plant built.

1966 First Queen's Award for Export Achievement. Frank Schon knighted.

1967 Fourth and fifth Sulphuric Acid plants opened. Sir Frank Schon resigned from A&W board.

1968 F4 Phosphoric Acid plant opened. Marchon France registered. Marchon Products became A&W's Marchon Division.

1969 Marchon France's factory began producing. Second Queen's Award for Export Achievement.

### THE SEVENTIES

1972 Sir Frank Schon made Baron. Second factory opened in Italy (Frosinone). Factory opened in Spain (Alcover). Marchon Division (headquartered at Whitehaven) took responsibility for A&W's agricultural business (several factories in Lincolnshire). (These interests were sold in the early 80's.)

1973 Marchon Division given responsibility for overseas A&W companies e.g. in Australia and India and for sales offices on European mainland. Conversion of sulphuric acid production from the anhydrite to the sulphur-burning route began with changeover of two of the five streams.

**1975** Third Queen's Award for Export Achievement. Whitehaven made headquarters of A&W's Detergents and Chemicals Group with responsibility for 10 UK and 7 overseas factories plus worldwide network of sales offices and agents.

**1976** First Phosphoric Acid Purification plant (MO Plant) opened. Last sulphuric acid/cement kiln decommissioned. All sulphuric acid now produced from liquid sulphur. Fourth Sodium Tripolyphosphate plant (DS4) commissioned making Marchon Works largest single-site producer of this material in the world.

**1977** Marchon Sports & Social Club building in Coach Road. Whitehaven opened by Lord Lieutenant John Wade.

**1978** Tenneco takes full ownership of A&W.

**1979** Second Phosphoric Acid Purification plant (MMO Plant) and fifth Wet Process Phosphoric Acid plant (F5) commissioned.

## **THE EIGHTIES**

**1980** New Phosphoric Acid complex comprising F5 Wet Process Phosphoric Acid plant and MMO Purified Phosphoric Acid plant officially opened by HM The Queen.

**1984** Third Phosphoric Acid Purification plant (UFEX) opened.

**1987** Extended and developed version of MO plant, re-christened MOS plant opened. As part of company-wide restructuring, commercial operations transferred from Whitehaven to A&W's European headquarters in Birmingham.

**1989** Extension of Oil Additive plant opened.

## **THE NINETIES**

**1990** Reflecting heightened public concern nationally and internationally on environmental issues. £6 million spent at the works on reducing emissions of dust and fumes. First Environmental Plan published. Demolition/clearances programme begun.

**1991** Structuring of Works Management. Computerised company-wide programmes for order processing and production planning (PRMS) and engineering maintenance (Idhammar) introduced. Private prosecution by Greenpeace. Greenpeace block outfall pipe. Road tanker deliveries subcontracted to Tankfreight.

**1992** F5 Phosphoric Acid plant closed. Raffinate Treatment plant and Landfill site opened. Discharges of gypsum and heavy metals from phosphoric acid manufacture eliminated. Completion of BS5750 programme for the site. Demolition of Whitehaven Harbour silos.

**1994** Albright and Wilson re-floated on the London Stock Exchange as an independent company.

**1997** PWA expansion - £8.5 million project to boost overall capacity by 30,000 metric tonnes per annum.

**1999** Rhodia, a French company, took over Albright and Wilson.

**2000** Whitehaven's phosphate activities were run down and eventually closed.

**2001** Huntsman, a private American company, bought Whitehaven's surfactant Plants from Rhodia.

**2004** Whitehaven's surfactant activities run down, with virtual closure of the site in **2005**

## **FACTS ABOUT THE MARCHON WORKS**

- Was the largest single-site producer of Sulphuric Acid in Europe
- Was the largest single-site producer of Sodium Tripolyphosphate in the world
- Area of site 133 acres (54 hectares)

- Maximum No of employees was about 2,500 (excludes contractors)
- Sister factories in Europe:  
France (2), Italy (2), Spain (2),
- Sister factories overseas:  
Singapore, Australia (2), South Africa

Gordon Atkinson and Trevor Purnell.

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