



The great copper trials. (in nineteenth century Wales)

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Townsmen and farmers have seldom been allies, and never less so than in nineteenth-century Britain. Rapid industrial and commercial growth tipped economic and political balances in favour of the towns, and the unregulated physical growth of the latter engulfed or destroyed much agricultural land. One zone of intense conflict, where continual chafing of the countryside by a particularly offensive industry provoked periodic outbursts of litigation, was the western end of the south Wales coalfield.

For most of the nineteenth-century Swansea (Abertawe) and a handful of its neighbours along the coast smelted virtually all of Britain's copper and much of the world's. Copper smelting brought wealth to the district, but at a substantial cost. The ores of copper are notoriously impure and the many roastings and meltings required to drive out the impurities and separate the metal from the ore produced mountains of slag and furnace ash, and billowing clouds of foul-smelling smoke that was laced with sulphur and arsenic.

Until the nineteenth-century, Swansea and its neighbours had been careful to keep copperworks at a sanitary distance. Bowing to pressure from its powerful portreeve, in 1720 Swansea reluctantly granted the lease of a copperworks, but in 1746 its chastened Corporation recanted by banishing copper smelting from the borough. Fifty years later, Lady Molly Mackworth of Neath (Castell Nedd), who had inherited an estate developed by a celebrated copper smelter, refused to sign the lease of a copperworks for fear that the smoke would 'waste' the elegant grounds. But neither the obduracy of the gentry, nor the strictures of urban corporation could keep copper smelting out of that corner of south Wales. The hard glistening coals in the picturesque hillsides around Swansea and Neath were ideal for smelting copper, and the copper ores of Cornwall, just short sea journey away, were drawn irresistibly to them. Refining processes then were prodigal of coal, and the Welsh coals lay midway between the orefields of Cornwall and the metal hungry factories of the English Midlands. By 1823 there were nine copperworks in the lower Tawe valley, just outside the town limits, and a few more close to Neath.

Social status in Swansea was a matter of distance from the furnaces and chimneys: around the works clustered the row houses of the copperworkers; west of these, on hillsides overlooking the valley bottom and the coastal flats, were the villas of the merchants and burgesses; and in the far west, on the approaches to the fair lands of Gower (Gwyr), the estates of the copper-masters. The largest of these, Singleton Park, belonged to Swansea's copper king, John Henry Vivian, co-owner with his brother, Sir Richard Hussey Vivian, of the giant Hafod works. Here, overlooking the bay, Vivian built a fine mansion house in the Elizabethan style. His wife Sarah was a gifted gardener and in sight of the copper smoke she grew the delicate plants that then were pouring into Britain from all corners of the world.

Downwind of the smelters, on the other hand, lay a nether world: a volcanic region of bitter, smoke-filled air and huge mounds of furnace waste, or 'slag', strewn indiscriminately over the valley floor. Wild vegetation, where there was any, had been reduced to the hardiest, acid-tolerant brackens. The scene invariably conjured up visions of hell, especially when seen at night:

The Swansea valley forms no bad representation of the infernal regions, for the smell aids the eye. Large groups of odd chimneys and ractory flues emit sulphureous arsenical smoke or pure flame; a dense canopy overhangs the scene for several miles, rendered more horrible by the peculiar lurid glare... All vegetation is blasted in the valley and adjoining hills... On a clear day the smoke of the Swansea valley may be seen at a distance of forty or fifty miles and sometimes appears like a dense thunder cloud.

(Charles Frederick Cliffe, 1848)

From time to time townspeople complained about the smoke, but usually in tones of irritation, not anger. For copper-worker, merchant, physician and lawyer, copper smoke was the price of prosperity, or security, and few people in the town or the copper neighbourhoods questioned that it was one worth paying. Farmers living downwind of the smelters took a different view. They complained loudly and long, and to mollify them John Henry Vivian and others invested time and money in efforts to suppress the smoke and eliminate the poisonous gases.

Vivian's experiments began about 1810, and culminated in 1822 when he won the highest commendation in a competition, initiated by the Cambrian Institution, (forerunner to the Royal Institution of South Wales), to obviate the injurious effects of copper smoke. To solve the smoke problem Vivian engaged a pair of 'knowing heads': Professor Richard Phillips, Chairman of the London Chemical Society, and Michael Faraday. At the time, the association was a rare instance of co-operation between factory and laboratory.

To treat the smoke, Phillips and Faraday built long horizontal flues between the furnaces and the smoke stacks. As the smoke passed through the flues it was made to run gauntlets of fire, steam, and water: separate experiments subjected it to flames, ignited charcoal, steam, and showers of plain water, soda water and lime water. Of the treatments, the simplest was the most effective. Showers of plain water eliminated most of the soluble gases, including the arsenious acid gas, but it left untouched Vivian's 'great enemy' - the sulphurous acid gas. None of the experiments had any significant effect on the volume of smoke. The knowing heads had failed to reduce either the toxicity of the smoke or its quantity.

The next logical step was to encourage the smoke's departure from the district. To this end the stacks were raised. The coppermen claimed that from the tallest of them (244 ft. in 1830) smoke had never been seen to reach the ground. But farmers a few miles east

of the smelters knew otherwise. Not only did the smoke reach the ground but the taller stacks, they argued, exacerbated the problem by spreading the smoke over a larger area. Frustrated by what they regarded as either incompetence in the copper-masters, or indifference, the farmers decided to seek damages. In 1832 a group of eleven of them, from the parish of Llansamlet which lay northeast of Hafod directly in line of the prevailing southwesterly winds, preferred an indictment for public nuisance against John Henry Vivian.

The 'Great Copper Trial' was held at the Carmarthen Assizes in the spring of 1833. The plaintiffs, represented by farmer Thomas David of Llansamlet, dismissed Glareorgan venues because they thought no jury from an industrialised county would indict the Vivians and, by association, the copper industry as a whole. The confrontation was a classic one, pitting farmer against townsman and Welsh-speaking Welshmen (the Cymry Cymraeg) against English copper-masters and their English and Anglo-Welsh supporters. It was to prove a hopelessly one-sided fight.

To defeat the indictment the Vivians brought in Sir James Scarlett, K.C., former attorney-general (in the Duke of Wellington's administration) and the future Baron Abinger. Scarlett was easily the most successful advocate of the day and his fee reflected his reputation: an unheard of (in Carmarthen) 400 guineas. His opponent was plain John Evans from Merthyr Tydfil, an able barrister but with no reputation outside Glareorgan.

Evans opened with a broad attack upon the smoke: like the poisonous Upas tree, he declaimed, it 'spread desolation all around'. Land exposed to the smoke soon failed to produce grass and in wet weather, when rainwater acted as a solvent for the poisons in the smoke, crops could be destroyed within hours. Animals exposed to the poisoned pastures sickened and died. Topsoil, no longer secured by plant roots and fibre, had been washed from the slopes and the exposed subsoil eroded into a badland of gulleys and ridges. Four farms near the Hafod works had been abandoned and three of the farms leased by the plaintiff, Thomas David, were no longer productive.

A host of Llansamlet farmers and an experienced government metallurgist, Perceval Johnson, provided corroborating evidence, describing how sulphurous acid gas first discoloured plants, then destroyed them. Morgan Morgan testified that the parish of Llansamlet had once been good corn, hay, and pasture land; that in twenty years the oak, the ash, the sycamore, and the hawthorn had all died: 'they died standing and had to be cut down afterwards'; that the once verdant and beautiful Kilvey Hill, under constant bombardment from a battery of chimneys at its foot, was now 'as barren as a road'. To keep the poison out of his nose, Morgan took snuff- first from paper, then, as the need increased, from a box.

Thomas Hopkins declared that cattle exposed to the smoke became lame and were unable to eat. Smoke elongated their teeth and made them 'grow over one another'. Horses were similarly affected, their teeth finally blackening and decaying. Richard Bowen testified that after the enlargement of the Hafod works the bones of his cattle became brittle and their ribs broke; lumps as big as fists appeared on their knees and leg joints, and their hoofs 'grew wild'. Unable to stand, the cattle fed lying down or on their knees. None had milk.

Zechariah Jenkins, who had also lost hay and corn, produced the swollen leg of a cow that had died, and enumerated his stock losses: five cattle, four calves, and a mare in the space of a few years. The front teeth of the cattle loosened and eventually came out. The cattle also had great lumps on their legs and when the animals were opened their lungs were found to be 'rotten'. The symptoms of the sick animals were so consistent that they acquired a name: 'Effryddod', or crippling disease, in Welsh; 'smoke disease' in English.

Other farmers testified in the same vein, contrasting the pleasant landscapes of their

youth with the leafless and barren ones of their maturity. They spoke of times, as one observer put it, 'not before the flood, but before the smoke'. The names of the places they mentioned were evocative: 'Hafod', a summer home, 'Brynhyfryd', pleasant hill, 'Glan Dwr' (anglicised to Landore) a watery bank, 'Cae Morfa'r Carw', a marshland where deer grazed.

Though injury to humans was not a major issue at the trial, the plaintiffs described the Sirocco-like disorders commonly associated with exposure to the smoke. These were a dry sensation in the throat, a bitter, metallic taste in the mouth, loss of appetite, shortness of breath, tightness across the chest, smarting eyes and frayed tempers. Though no copper worker would publicly denigrate his working or living conditions, coppermen were known to be sallow complexioned, desiccated, wiry and thin, and like all the inhabitants of the smoke districts, they suffered unduly from consumption. In 1850 the historian W.R. Lambert was to write that when men from outside the district were hired by the copperworks they either became used to the conditions or died within a very few months. 'When I came here from the ironworks six years ago', confided one, 'I suffered much from my stomach... I spat blood for some time, but I became used to it'.

Without even token urban or industrial support, the plaintiffs position was hopeless. In a speech said to have been 'of great eloquence and power', Sir James Scarlett swept aside their allegations. Though the Llansamlet farmers sought damages, not closure of the works, Sir James built his defence on the economic threat posed by any strain on the character of the copper industry. A verdict of guilty would, he declared, 'destroy' the towns of Morriston and Swansea and - counting workers and their families in the mining districts of Cornwall and the manufacturing towns of the English Midlands - impoverish 90,000 souls. It was, he proclaimed, 'a violent thing to ask'. Then, for good measure, he rang patriotic changes by pointing out that closure of the Welsh copper works could jeopardise the safety of Royal Naval vessels whose hulls were sheathed with a skin of copper to fend off barnacles and wood eating worms.

The plaintiffs' evidence he attacked on the grounds of its circumstantiality: Thomas David and his companions (the 'Club') had clearly failed to prove a causal connection between crop and animal diseases and copper smoke. Crop failures Sir James attributed to 'bad land and worse culture'. Coalfield soils - as he had forced the metallurgist, Perceval Johnson, to admit - were cold and clayey, and Welsh farming methods backward. Manuring, liming, and proper husbandry, asserted Sir James, would have saved the crops, and decent shelter and vigilant herding the animals. 'Effryddod' he attributed to dampness and undue exposure to wet, westerly winds.

Of the human ailments attributed to copper smoke Sir James was even more dismissive. Only one town witness had testified against the smoke, and the nausea he spoke of had occurred fourteen years earlier. Where were the testimonies of physicians and apothecaries, and of workers who had daily contact with the smoke? Far from being a danger to health, he opined, copper smoke was, a blessing a shield against cholera and other diseases then endemic in industrial towns. Children in the copper districts were, he noted, renowned for their cheerful dispositions and 'healthful and florid countenances'. Examiners for the Health of Towns Commission, who visited Swansea in 1845, would wonder how smoke virulent enough to kill vegetation and scour glass could not be harmful to human tissue, but before a jury and a public willing to believe otherwise, Sir James could simply dismiss any suggestion of a link between copper smoke and ill health.

To complete his defence, Sir James summoned witnesses to defend the copper industry against 'the execrations of the petulant'. An estate manager noted how the coming of the works had added incalculably to the value of land and property in Swansea and its region. A farmer averred that crops growing in soil that had been properly limed and manured had nothing to fear from the smoke. A Swansea surgeon vowed that not only

had he never seen a disease directly attributable to copper smoke, but that epidemics were less frequent in the copper districts than elsewhere. Copper smoke he regarded as an antiseptic against ague, or malaria.

The verdict, of course, was never in doubt. In his summing-up, the judge, Mr Justice Patterson, pointed out that the plaintiffs had clearly failed to sustain the charge of public nuisance. Against the distress of a handful of farmers had to be balanced the wellbeing of an entire community. The copper workers were universally opposed to the action. Though they worked in great heat and fume-filled air, they were comparatively well paid and because copper - one of the scarcer metals - commanded high and fairly stable prices their jobs were relatively safe. On the industrial social scale copper workers were a cut above colliers and iron workers. Many, too, worked for employers who, judged by the standards of the day, were benevolent. Although much the worse for wear in 1833, Morriston had been designed as a model community by John Morris in the 1780s. And in the 1840s the Vivians, through the village of Tre-Vivian, would offer workers at their Hafod works larger-than-average houses, a modern sewage system, and a school for their children.

A boat so bountifully laden was in no danger of being rocked, even by a supposedly disinterested Carmarthen jury. To the surprise of no one, the jury returned a verdict of not guilty.

The day that followed was one of general rejoicing in Swansea, Hafod, Morriston, and Landore. South Wales' leading English daily, the Cambrian, expressed its 'heartfelt satisfaction' with the outcome, and in Swansea and the valley towns church bells rang and cannon fired throughout the day. Thoroughly beaten, the Llansamlet farmers retreated, but in little more than a year Thomas David and his supporters were back on their feet jousting with opponents only fractionally lighter than the Vivians, and just as invincible.

Safe from prosecution, the Swansea copper-masters did nothing more to suppress the smoke and by mid-century the lower Tawe valley was a wasteland beyond all hope of agricultural redemption. Even the Vivians discontinued the use of their tall stacks, ostensibly on the grounds that the increased draught in the furnaces made the fires difficult to control. In Swansea, debate over copper smoke shifted to questions of public health, but in neighbouring valleys, where farms and woodlands could still be saved, the focus was still on damage to property. Like the Tawe, the Nedd also had copperworks near its mouth, but because the Nedd valley is considerably wider than the Tawe the smoke had been able to dissipate. Only farms adjacent to the works had suffered smoke damage. But by mid-century farmland and woodland in the central and upper reaches of the valley began to show signs of wear and tear. The offending smoke, however, came not from the chimneys at the mouth of the Nedd, but from a solitary stack high on the side of the Afan valley.

In 1841 the English Copper Company acquired a works in Cwmafan, a village about two miles inland from Port Talbot. To protect valley farms from smoke, the company built a gargantuan arched-stone culvert, eleven feet high and a mile long, from its furnaces on the floor of the valley to the summit of Mynydd y Foel, a thousand feet above the valley floor. On clear and blustery days smoke emerging from the short stack on Mynydd y Foel sailed harmlessly over the valley. But in copper smelting districts all winds are ill winds and tall stacks, as the Llansamlet farmers had demonstrated thirty years earlier, merely extended their range. Valleys are natural wind funnels and from Stacy Foel some of the smoke drifted up the Nedd to settle on woods and farm land six or seven miles away.

At the centre of the Nedd valley dispute was Nash Edwards Vaughan, owner of Rheola, the largest and most beautiful estate in the valley. Vaughan was also a member of a county assessment committee that had seen the value of farmland plummet around

copperworks in the Tawe valley. His immediate concern, however, was for woodland at Rheola, slowly being destroyed by fall-out from distant Cwmafan. On the strength of a letter from Hussey Vivian that vouched for the effectiveness of a new German (Gerstenhofer) condenser in trapping sulphurous acid gas, Vaughan sued the English Copper Company. Faced with a 'trial and the irrefutable testimony of Hussey Vivian - who had begun building Gerstenhofer condensers at the Hafod works - the English Company capitulated. Condensers were built at Cwmafan but after Nash Vaughan's premature death in 1868 they were taken down; the company alleged that they were expensive to operate and only partly successful in cleaning the smoke.

The Cwrnafan works was also at the centre of two further disputes. In 1890 tenants of the Margam estate, to which belonged much of the land in the Afan valley, complained to Lady Emily Talbot of damage to their farms from smoke issuing from Stac y Foel. The stack, and the furnaces to which it was connected, were now owned by the Rio Tinto Company which in 1884 had bought the disused plant of the English Copper Company. As an assiduous steward of her estates, and a keen gardener, Lady Talbot had laboratory tests conducted on soils, hay, and sheep from the affected farms. All the tests proved positive: soil and hay were impregnated with sulphur, and the sheep with large quantities of copper. Under cover of the 1881 Alkali Act, which stipulated that all factories use 'the best practicable means' to rid smoke of noxious and offensive gases, she served an injunction on Rio Tinto which had not replaced the condensers dismantled by the English Copper Company.

Rio Tinto responded to the injunction with the indignant assertion that its ores, which had been concentrated at the Company's Spanish orefields, were the purest then in use. To meet the terms of Miss Talbot's injunction, the company added portentuously, smelting operations would have to be moved to Spain. The workers' response was swift and vehement. Led by an incensed and vociferous clergy, they demonstrated in Margam Park, held public meetings, and organised a petition. Miss Talbot and her tenants were pilloried. For want of 'better cultivation and a little fresh seed', railed one of the leaders, the livelihoods of hundreds of families were put at risk. And it was hard, wrote another, 'that an industrious community should suffer for the sake of a few farmers'. Most vituperative of all was a remark from the chairman of the workmens' committee: 'The farmers are at the root of all the evil. They are really spoilt children'.

Though Rio Tinto had no intention of moving its smelters to Spain, nor Miss Talbot of pressing to the limit the terms of her injunction, the Cwmafan copperworkers saw themselves as dispensable pawns in a struggle between two titans - 'the heiress of the wealthiest commoner in England', as one of their spokesmen put it, and the directors of one of the wealthiest companies in the world'. 'The Copper Industry of Wales', thundered one lengthy headline, '[was] in Danger of being driven out to satisfy the Greed of Capitalists'. In the end, Miss Talbot withdrew her injunction in exchange for a generous, face-saving settlement: an immediate payment of pounds 1,400 followed by annual payments of 700 pounds.

Encouraged by Miss Talbot's success, farmers throughout the valley sued Rio Tinto for damages, all settling for small sums ranging from 30 to 100 pounds. Among the aggrieved were the owner and tenant of an upland farm near Tonmawr, a remote village in the headwaters of the Alan. In response to a request for damages of 650 pounds Rio Tinto offered 10 guineas to each at first, then 75 to the tenant. Angered by the contrast between the company's generosity with Miss Talbot and its niggardliness with 'poor ignorant farmers', as Rio Tinto obviously saw them, they decided to sue for damages. The dispute came to trial at the Swansea Summer Assizes in 1895.

In many ways this final trial was reminiscent of the first at Carmarthen. The disputants appeared equally mismatched. Though the landlord had means ('coal in Tonmawr', as one witness put it) only the tenant, William Rees, appeared at the trial. He was

represented by local barristers, whereas Rio Tinto, like the Vivians, hired prominent English QCs. Rees, too, was a Cymro. He insisted on testifying in Welsh against an abusive objection from a powerful London barrister (J.C. Bingham) in what was then one of the most adamantly English-speaking towns in Wales.

The plaintiffs opened, as had the Llansamlet farmers, with a litany of complaints. They detailed damage to crops and stock and called fellow farmers and expert witnesses to corroborate them. A professor of agriculture deposed that he had found 'enormous' amounts of copper in the spleens of sheep, and lethal quantities in livers and kidneys. A chemist testified that specimens of grasses from the farm contained traces of arsenic and copper and that they had been 'grossly injured' by sulphur.

Rio Tinto, for its part, first imputed the competence of the Tonmawr farmers, then called witnesses to refute their evidence. One alleged that the brown, sere condition of the grasses was due to the poor quality of the soil and - in this decidedly damp part of Wales - the action of the sun. A veterinarian testified that Cwmafan sheep did not die of copper poisoning, and a butcher that the quality of local meat was not affected by copper-smoke. Assertion followed by dogged counter assertion for an entire week.

In summing up the exhaustive trial, the judge (Mr Justice Lawrance) indicated clearly that he thought the plaintiffs were owed damages. Rio Tinto's payments to Lady Talbot and to independent farms in the valley were, he suggested, tantamount to an admission that smoke from Stac y Foel had injured land and stock. The jurors retired for six hours but when they returned the foreman announced that they were divided irreconcilably. Without unanimity there could be no verdict. Mr Justice Lawrance declared a remanet and adjourned the trial.

Though inconclusive, the trial in effect was a victory for Rio Tinto. Yet on this occasion no church bells rang and no cannons roared. By 1895 the Welsh copper industry was in terminal decline and though it would linger in the region its vitality had gone. As the furnaces and chimneys cooled, so too, of course, did the smoke dispute.

When looking back, it is difficult not to side with the farmers and landowners. The farmers in particular were hopeless underdogs and they were treated roughly by the courts. But to characterise the farmers as gallant Davids and the copper-masters as ugly Goliaths would be misleading. Geography, and the economics and technology of the nineteenth-century, had contrived to locate an offensive industry in a farmed and settled district. Conflict was inevitable. John Vivian of Cornwall put his finger on the dilemma in a letter to his son, John Henry Vivian of Swansea, at the first rustle of a long robe in the Taw valley: 'Copper works there must be, [and where else can they be] but where the coals are: and wherever coals and copper works are, there will be plenty of inhabitants'.

Copper works are now where the ores are - in deserts and mountains, for the most part. Travellers may wince at the sight of the moonscapes downwind of the smelters at Sudbury, on the inhospitable Canadian Shield, but they simply hurry on. Few briefs are held for unproductive and unattractive nature.

FOR FURTHER READING

George Grant Francis, *The Smelting of Copper in the Swansea District*, (London, 1881); Martin Phillips, *The Copper Industry in the Port Talbot District*, (Neath, 1935); W. Rhys Lambert, "Some Impressions of Swansea and its Copper Works in 1850", *Glamorgan Historian*, Volume 5, (1968); W.G.V. Balchin, *Swansea and its Region*, (University College of Swansea, 1971); William Rees, *Industry Before the Industrial Revolution*, Volume I, (University of Wales Press, 1968); Dafydd Tomos, *Michael Faraday in Wales*, (Gwasg Gee, 1972).

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