

# The 1900 arsenic poisoning epidemic

Peter Dyer

## Introduction

At the very end of the nineteenth century, in 1900, a mysterious outbreak of disease appeared in the Manchester area. It turned out to be arsenic poisoning caused by contaminated beer.

Some aspects of the epidemic have been described by Alan Gall in a previous issue of *Brewery History*<sup>1</sup> and need not be repeated here.

## The poisoning epidemic

The epidemic occurred in the second half of 1900. It was centred on Manchester and Salford, but also affected Liverpool and other places. The true nature of the disease was not realised at first, as the victims were assumed to be suffering from alcohol-related complaints such as peripheral neuritis.

Dr Kelynack of Manchester Royal Infirmary and William Kirkby of Owens College (i.e. the Victoria University, Manchester), published an account of the epidemic. Their book *Arsenical Poisoning in Beer Drinkers* dealt with the subject from the medical point of view, with full

details of symptoms, treated under chapter headings and subheadings such as Manifestations in connection with the cutaneous system, Erythromelalgia, Nervous system, Motor impairment, Reflex disturbances, and so on, and also described some of the chemical tests made of the beers. The frontispiece was a photograph of a foot showing keratosis and erythema with pigmentation.

As Kelynack and Kirkby wrote:

peripheral neuritis is unfortunately a very common affection in Lancashire amongst alcoholics, and for at least twenty years has been a prolific cause of paralysis. The subjects affected are almost invariably beer drinkers. Some observers go so far as to claim that peripheral neuritis never develops simply in spirit drinkers. Many cases, however, have certainly occurred in imbibers of 'mixed drinks'.<sup>2</sup>

The number of cases had now increased to epidemic proportions, and the beer was suspected:

The people themselves and some of the brewers early admitted that something was 'wrong' with the beer. In some districts the sufferers labelled their malady with the name

of the brewery from whence came their disease-producing drink. In Salford the presence of conspicuous pigmentation of the skin led to the popular designation of the affection as 'khaki disease.' A man recently returned from Canada spoke of his condition as 'foot and mouth disease'.<sup>3</sup>

While some victims were heavy drinkers, others drank beer in moderation, such as a pint of stout daily.

Among the case histories related was that of a two-year-old girl from Bacup, whose father kept a pub. The girl 'was accustomed to get little "sups" of beer from the kindly-disposed customers at the bar.' She developed symptoms of poisoning.<sup>4</sup>

Another victim was a man in Liverpool who had been a teetotaler for six months and had then drunk 36 pints of beer in three days and then stopped; 48 hours later he was seized with stomach pain, itching and tingling of the hands and feet. The symptoms were severe, but soon disappeared, and he recovered within a week.<sup>5</sup>

It was Dr E.S. Reynolds of the Crumpsall Workhouse Infirmary, Manchester, who first realised the probable cause of the epidemic. The disease was characterised by paralysis of muscles and loss of function in sensory nerves, and was similar to peripheral neuritis, which typically resulted from chronic alcohol poisoning. Since, however, many of the patients were clearly only moderate beer drinkers, and

their symptoms included unfamiliar features such as pigmentation of the skin, Dr Reynolds concluded that they were suffering not from alcohol poisoning but from arsenic poisoning. Samples of beer were then tested by Professor Dixon Mann of Owens College, and arsenic was found.

Dr Reynolds reported his findings in the *British Medical Journal* in November 1900. It then turned out that the outbreak was not confined to Manchester, but extended to other places, mainly in Lancashire and Staffordshire. Dr Tattersall, medical officer of health for Salford, suspected the products of a particular Salford brewery, and arranged for samples of the brewery's raw materials to be tested by Professor Delépine, also of Owens College. The glucose and the invert sugar were found to be arsenical.

The beer had been contaminated with arsenic. The source of contamination was arsenious acid present in glucose<sup>6</sup> and invert sugar<sup>7</sup> from Bostock & Co, sugar refiners of Garston, near Liverpool, which had been manufactured from sulphuric acid containing arsenic, supplied by a firm in Leeds (Nicholson & Son). Some arsenic might also have come from malt dried with gas coke.

Selenium was also suggested as a poison present in Nicholson's acid, but no evidence was found to confirm this, and indeed the absence of selenium from Bostock's sugars and the beers brewed with them appeared to have been proved.<sup>8</sup>

The progress and extent of the epidemic are described in the Royal Commission and Local Government Board reports and Kelynack and Kirkby's book. Over 6,000 people suffered from poisoning, and at least 70 died. The real death toll was almost certainly higher, as deaths had frequently been certified as due to chronic alcoholism, cirrhosis of the liver, Addison's disease or other causes.

### **The Royal Commission**

A Royal Commission was set up in February 1901 - incidentally, by one of the first official acts of Edward VII after his accession to the throne on the death in January of Queen Victoria - to look into the epidemic and its causes and to recommend possible safeguards to prevent the introduction of arsenic into foodstuffs in future.

The Commission took evidence from 22<sup>nd</sup> February to 20<sup>th</sup> June 1901 (18 days) and from 7<sup>th</sup> March 1902 to 3<sup>rd</sup> April 1903 (11 days). It issued a First Report in July 1901 and a Final Report in November 1903. The chairman was Lord Kelvin, and Dr George Seaton Buchanan was the secretary.

Persons who gave evidence before the Royal Commission included medical officers of health, public analysts, analytical chemists, professors at Owens College, the chairman of the Inland Revenue, the manager of a German potato glucose factory, brewers, maltsters and hop-grow-

ers, and manufacturers of other food products.

The brewers who appeared as witnesses were James Grimble Groves MP, chairman and managing director of Groves and Whitnall Ltd (Salford and Manchester), Richard George Hooper Tomson, manager of Threlfall's Brewery Company Ltd (Salford); W.R. Deakin, brewer at Manchester Brewery Company Ltd (Manchester); Henry Weld Blundell, chairman of Cornbrook Brewery Company Ltd (Manchester); George E. Cowell, managing director of Wilson's Brewery Company Ltd (Manchester); Cornelius O'Sullivan, chemist at Bass, Ratcliff and Gretton Ltd (Burton-on-Trent); and Thomas Watson Lovibond, managing director of Newcastle Breweries Ltd (Newcastle upon Tyne). Otto Overbeck of Grimsby also appeared, but in relation to a meat extract substitute of his own invention, not to the brewery he managed.

The evidence of these witnesses, apart from describing the epidemic and their reactions to it, also incidentally gives information on the brewing trade at the time.

### **The brewers' reaction**

The principal breweries involved, starting with Groves and Whitnall, reacted immediately and 'worked night and day recalling to their breweries beer from public houses'; beer found to be contaminated was 'run by hundreds of gallons into the sewers'; and all fresh brews were

tested. In some cases the beer was set aside to be poured away later in the presence of the excise officers, so that the brewery could claim a refund of the duty paid. The Manchester Brewers' Central Association set up a committee of experts to advise them. Breweries in Liverpool, Birmingham and elsewhere took similar measures.

A few brewers were less energetic. For example, arsenical beer from a Stone brewery was still on sale at Northampton a month later, and arsenical beer from a small brewery in Nottinghamshire was also still on sale in December. A brewery in Market Drayton sent its publicans a fresh supply of beer but took no action to recall the contaminated beer.<sup>9</sup>

James Grimble Groves, of Groves and Whitnall - of Regent Road Brewery, Salford and Alexandra Brewery, Hulme, Manchester<sup>10</sup> - acted promptly and efficiently. His firm destroyed 4,010 barrels brewed in October and November 1900 (claiming a rebate of duty on 2,899 that had not been sent out of the brewery), and perhaps as many as 10,000 barrels altogether. The beer was taken back to the brewery and poured away there, not disposed of by the publicans.<sup>11</sup>

Groves felt that his company's name was associated with the 'arsenic scare' by the public, who had initially jumped to the conclusion that they were the only brewery involved, so that they had borne more than their fair share of the blame.<sup>12</sup> The Manchester brewers had similarly first

thought that there was a specific problem with his brewery's beers, before they realised that it was a much wider problem.

Groves and Whitnall now had all their brews analysed, and a certificate was attached to each barrel sent out, in the following terms:<sup>13</sup>

I certify the purity of the brew of beer from which this cask is filled.

(Signed) A.K. MILLER, Ph.D., F.I.C., F.C.S.,  
the Laboratory, Withy Grove.

GROVES AND WHITNALL, LIMITED.

Groves explained to the Royal Commission that they used invert sugar as priming only in the cheapest, single X beer (also referred to as fourpenny beer as opposed to sixpenny beer). Half a gallon of sugar was added to 35½ gallons of beer; ironically, the sugar was their dearest raw material and was only used in the cheapest product. The fourpenny beer was generally fermented in slate vessels.

Their beers were single X mild ale, F mild ale, XX mild ale, C mild ale, two strengths of bitter ale, and three qualities of stout. 8-12½% of glucose was used in the mash.<sup>14</sup>

It was only by mischance that Groves had used the contaminated sugar; they had turned to Bostock's temporarily because their regular suppliers Garton, Hill & Co were unusually busy.

Richard Tomson had joined Threlfall's as a junior clerk in 1864 and was now the

manager of the Manchester part of the business. They used invert sugar but not glucose. There was no priming in the 8d beers and very little in the bitter beers; it was used principally in the 'common beers', i.e. the 6d and 4d beers. They used caramel and a 'very expensive' porter sugar.

Threlfall's destroyed 5,558 barrels, partly in the brewery and partly in the retailers' cellars. They sent messengers to the pubs in Manchester and Salford, and spent over £5 on telegrams to the more distant ones (they supplied beer to about 40 different towns). All their beer was now being analysed for arsenic. Tomson observed that they were 'never much in love with too much chemist' in brewing, but would probably now set up their own laboratory.<sup>15</sup>

Tomson had been in the trade all his life, and so had his father and his grandfather, and he had never heard of such a thing as arsenic in beer: it 'came upon us like a thunderclap', he told the Commission.

They made about 50% of their own malt, at Worksop, Horncastle and Lincoln, and bought the rest from Jones of Shrewsbury and Soames of Grimsby.<sup>16</sup>

W.R. Deakin of the Manchester Brewery Co Ltd also gave evidence. Nearly all their trade was to tied houses. They brewed fourpenny and sixpenny beers, stout, and 'better' beers - mild and bitter ales. They brewed with malt, corn, sugar and hops, using 14 to 20% of glucose in the mash.

They destroyed 1,250 barrels. They had had nine people going round destroying the beer (it was poured down the drain), working up to eleven at night, and the last barrel was destroyed within two days. Only at Wolverhampton had they not been quite quick enough: a sample of arsenicated beer was taken from the Royal Oak half an hour before their man arrived to destroy it, and the company and the pub manager were prosecuted and fined.<sup>17</sup>

H. Weld Blundell, chairman of Cornbrook Brewery Ltd, said that invert sugar was used in various beers. Maize grits were also used in the mash for the lighter beers and all the running beers, but no glucose. A little invert sugar was also used for priming stout, but not the other beers. Weld Blundell produced figures for the proportion of invert sugar used in specific brews.<sup>18</sup>

G.E. Cowell of Wilson's Brewery testified. Wilson's had two breweries, at Newton Heath and Oldham. They had destroyed 1,292 barrels at the brewery, and 97 in various pubs. There had been some delay in destroying the beer, because of uncertainty as to whether the excise duty would be refunded;<sup>19</sup> in the meantime the beer had been stored at a disused brewery belonging to Wilson's which was going to be pulled down.<sup>20</sup>

Outside Manchester and Salford, a small brewer 'not far from Warrington' had noticed in September 1900 that something was wrong with his beer and that

his customers were preferring tea to beer. This brewer, who was himself poisoned, did all he could to withdraw the beer. He had been supplied with English glucose instead of his usual American glucose.<sup>21</sup>

A publican in Nantwich was convicted of selling arsenical beer. The North Cheshire Brewery had told him not to sell the beer, but he nevertheless did. A test purchase of a quart was made by the inspector's 13-year-old son. The publican was fined £2 and the brewer £30.<sup>22</sup>

### Laboratory analyses

William Kirkby of Owens College analysed samples of beers from Manchester breweries. These included draught beer and bottled ale from Brewery A; draught bitter, draught stout, draught ale, bottled stout and pale ale from Brewery B; stout, bitter beer, best XX and common X from Brewery D; X ale, stout and luncheon ale from Brewery E; and best beer, stout and common beer from Brewery F. Several contained arsenic; one sample of draught ale from Brewery B was brewed with 50% sugar in

the mash and was highly contaminated.<sup>23</sup> Carter Bell, the analyst for the county of Cheshire, analysed 82 samples of beer from Cheshire in late 1900, and found that 30 contained arsenic.<sup>24</sup>

Professor Delépine of Owens College analysed samples of dark Munich beer and light Vienna lager from Moellers, importers in Manchester, and found them free from arsenic.<sup>25</sup>

The Government Laboratory tested 748 samples of beer from 67 breweries, mainly in Lancashire, Staffordshire and Yorkshire, but also in eight other counties. These breweries had applied for repayment of duty when the beer was destroyed. All the samples contained some arsenious oxide, the greatest amount of arsenic being found in a stout brewed by the Executors of William Astley, Nelson. In some cases the arsenic had been traced to the malt or yeast used, not the sugar.

The 67 breweries (names and addresses given as in the Commission's report; Ashton-under-Lyne and Bardsley should be under Lancashire, not Staffordshire) were:<sup>26</sup>

#### *Cheshire*

Macclesfield Stockport	North Cheshire Brewery Robinson, F.
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#### *Denbighshire*

Wrexham	Lassell & Sharman [Caergwrle]
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#### *Cumberland*

Penrith Workington	Glasson's Brewery Workington Brewery
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#### *Gloucestershire*

Bristol	Auty & Co.
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<i>Lancashire</i>		Waterloo	Thorougood's Brewery
Barrow	Case & Co.	Wigan	Oldfield Brewery Co.
Blackburn	Holden R. Whewell, T.	<i>Leicestershire</i>	
Bolton	Hamer, J.	Melton Mowbray	Langton & Sons
Burnley	Fort, J. [Colne?] Grimshaw, J. Kenyon, J. [Barrowford]	<i>Nottinghamshire</i>	
Burscough	Thorougood's Brewery	Everton	Farmer's Brewery Co.
Chorley	Hilton, P. Taylor, W.	<i>Shropshire</i>	
Ince	Morton, W.	Market Drayton	Pearce's Crystal Fountain Brewery
Liverpool	Gilmour & Co. Glover & Sons Jones & Co. Mellor & Sons Robinson's Brewery Tarbuck's Brewery	<i>Staffordshire</i>	
Manchester	Bedford Brewery [Leigh?] Boddington's Breweries Chester's Brewery Co. Cornbrook Brewery Duxbury, Sarah Groves & Whitnall Kay's Atlas Brewery McKenna's Brewery Openshaw Brewery Seed & Co. [Radcliffe] Wilson's Brewery Co. Worsley Brewery [Pendlebury] Yates' Castle Brewery	Ashton-under-Lyne Bardsley Bilston Burslem  Darlaston Lichfield Newcastle Stone Walsall West Bromwich	Scholfield & Son Shaw & Bentley Harper, R. A. Parker's Burslem Brewery Co. J. Pritchard & Sons Lichfield Brewery Co. Ridgway & Sons Joule & Sons Lord, J. Bates, T. H.
Nelson	Astley's Executors Strickland, J.	<i>Warwickshire</i>	
Newton-le-Willows	Forshaw, R. [Burtonwood?]	Birmingham	Birmingham Breweries Co. Dare, W. Evans, E. Meade & Co.
Oldham	Oldham Brewery Co.	<i>Yorkshire</i>	
Ormskirk	Ellis, Warde & Webster	Halifax	Brown and Brear [Hipperholme]
Poulton-le-Fylde	Catterall & Swarbrick	Ilkley	Ilkley Brewery Co.
Rochdale	Phoenix Brewery [Heywood]	Leeds	Albion Brewery Co.
		Sheffield	Tomlinson, H., Ltd.
		Shipley	Seth, Senior, & Sons [Shepley]

A list of samples taken in Lancashire merely identified the breweries by code numbers. Of 348 samples of beer, 251 were genuine or free from arsenic, 52

slightly arsenicated but passable, and 45 contained a quantity of arsenic injurious to health.<sup>27</sup> The corresponding list for Staffordshire gave details of the brew-

eries, however. They included local breweries and home-brew pubs, as well as brewers from outside the county.<sup>28</sup>

## Liverpool

Dr E.W. Hope, the medical officer of health for Liverpool, described the situation in the city. He told the Royal Commission that Liverpool had 2,223 houses where beer was sold, and a 'very large quantity' of beer was consumed in the city - perhaps three-quarters of a million gallons a week for a population of 668,000. In Liverpool 267,522 gallons of beer had been poured away, from 12 different breweries, mostly located in Salford and Manchester. It was the brewers themselves who took the initiative, as Dr Hope pointed out; if not, the authorities would have brought proceedings under the Food and Drugs Act, but that would have necessarily been against the

retailer, who could have been 'some old woman in a back street, it may be, who had absolutely no means of knowing the quality of the stuff she was selling'. He mentioned two cases in which the publican had kept contaminated beer instead of sending it back to be destroyed; one case concerned the Cornbrook Brewery and the other an unspecified Liverpool brewery.<sup>29</sup>

The incriminated beers were produced by local breweries in Liverpool itself or from Manchester, Salford or Chester, rather than non-local suppliers such as Guinness and the Burton breweries.

Dr Hope produced a list of 60 brewers and wholesalers in Liverpool whose beers had been tested. In the case of those marked ‡ some samples had been found to be contaminated with arsenic, although often only in small traces, and some cases were doubtful:<sup>30</sup>

Alsopp's	Findlater's	Jones ‡
Barker ‡ (doubtful)	Gartside	Joplin
Bass	Gatehouse	Kensington Brewery
Bate & Sons ‡ (doubtful)	German Lager Beer Co.	Lager Beer Co.
Beardhills	Glover and Sons ‡	McEwan's
Bell, John	Greenhall, Whitley	Montgomery's ‡
Bent's ‡ (trace, doubtful)	Groves and Withnall ‡ (trace)	Rigby's
Birkenhead Brewery	Guinness	Mellor's ‡
Bleazard	Harding and Parrington ‡	Robinson's ‡
Bramley & Sons	Heyes	Salt & Co.
Burton Bell & Co. ‡	Higson's	Showell's
Burton Brewery Co.	Hill's (Burton)	Smart's
Cain's ‡	Houlding's ‡ (trace, doubtful)	Smith, Mumford's
Cornbrook's ‡	Ind, Coope & Co.	Smith, Tadcaster
Evershed's	Jeffreys	Tarback's ‡

Tetley's	Walker's ‡ (doubtful)	West Cheshire
Threlfall's ‡ (trace)	Walker's Peter	Whitbread
Thoroughgood's ‡	Watson, Woodhead ‡ (trace)	Whittle Spring's
Tower Brewery Co.	Webster	Worthington
Trueman's	Webster & Atkins	Yates ‡ (trace)

Dr Nathan Raw of the Mill Road Infirmary drew attention to the fact that the 'long pull' had been typical of Liverpool: a customer drinking in a public house would be given the correct measure, but one who sent out for beer to drink at home would be given from 1½ to 2 pints if he ordered a pint. Dr Raw said that this practice had now been abolished.

## Staffordshire

The Staffordshire samples were collected from 3<sup>rd</sup> to 21<sup>st</sup> December 1900 and 17<sup>th</sup> January to 23<sup>rd</sup> February 1901. The breweries whose beer was found arsenical were:<sup>31</sup>

Manchester Brewery Company  
 Joule & Son, Stone  
 Ridgway & Co., Newcastle-under-Lyme  
 Farquhar's, Burslem  
 Market Drayton Brewery Company  
 Pearce & Co., Market Drayton  
 Wright & Co., Market Drayton  
 Newport Brewery Company

Lichfield Brewery Company  
 Price, West Bromwich  
 Pritchard, Darlaston  
 Bates, West Bromwich (a 'very minute trace')  
 Harper's, Bilston

Beer from Bents' Brewery, Stone, had come under suspicion on medical grounds but was not found arsenical.

The complete list of breweries whose beers had been analysed in the county was as follows (excluding three doubtful entries):

Alton Brewery Company  
 Atkinson, Aston Park Brewery  
 Smith, Aston  
 Harper, Bilston  
 Birmingham Brewery Company  
 Bloxwich Brewery Company  
 Ellwell & Co., Brierley Hill  
 Boulter and Sons, Brownhills  
 Roberts', Brownhills

Parker's, Burslem  
 Allsopp & Co., Burton  
 Bass & Co., Burton  
 Bell & Co., Burton  
 Bindley & Co, Burton  
 Burton Brewery Company  
 Charrington & Co., Burton  
 Cooper & Co., Burton  
 Eadie & Co., Burton

Ind Coope & Co., Burton  
 Robinson & Co., Burton  
 Salt & Co., Burton  
 Truman & Co., Burton  
 Walker & Co., Burton  
 P. Walker, Burton  
 Worthington & Co, Burton  
 Blencowe & Co., Cannock  
 Pritchard, Darlaston  
 Hanson & Sons, Dudley  
 Dix & Co., Hanley  
 Malam [Hanley]  
 Lichfield Brewery Company  
 Lichfield City Brewery Company  
 Manchester Brewery Company  
 Market Drayton Brewery Company  
 Pearce & Co., Market Drayton  
 Steele, Market Drayton  
 Wright & Co., Market Drayton  
 Ridgway & Co., Newcastle  
 Newport Brewery Company  
 Rollaston, Niterton [sic - perhaps Rolinson of  
 Netherton]  
 Jordan, Oldbury  
 Showell's, Oldbury  
 Moore and Simpson, Perry Barr

Well Head Brewery Company, Perry Barr  
 Nock, Quarry Bank  
 Shifnal Brewery Company  
 Cheshire's Brewery Company [Smethwick]  
 Bates, Sponwell Brewery  
 Eley's Stafford Brewery  
 Hedge & Co., Stoke  
 Pim & Co., Stoke-on-Trent  
 Showell's, Stoke-on-Trent  
 Bent's, Stone  
 Joule & Son, Stone  
 North Worcestershire Company [Stourbridge]  
 Flower and Sons, Stratford  
 Stretton Brewery Company  
 Bunting & Co., Uttoxeter  
 Wrekin Brewery Company [Wellington]  
 Bates, West Bromwich  
 A.J. Price, West Bromwich  
 Woodall, West Bromwich  
 Butler & Co, Wolverhampton  
 South Stafford Brewery Company  
 [Wolverhampton]  
 Wolverhampton and Dudley Brewery  
 Company  
 Yardley & Co., Wolverhampton  
 Wordsley Brewery Company

The following were classified as Home-Brewed:

Oak and Ivy Inn, Bilston  
 Limerick, Gornall  
 Bird-in-Hand, Hilderstone  
 Elm Tree Inn, Kinver  
 Junction Inn, Norbury  
 New Inn, Quarry Bank  
 White Horse, Quarry Bank  
 Wharf Inn, Shebdon  
 Angel Inn, Stafford  
 Castle Inn, Stafford  
 Maltster's Arms, Stafford  
 Prince Albert, Stafford  
 Princess Royal, Stafford  
 Star and Garter, Stafford  
 Waggon and Horses, Stafford

Hawthorn, Walsall Wood  
 Noah's Ark, Wednesbury  
 Park Inn, Wednesbury  
 Rising Sun, Wednesbury  
 Robin Hood, Wednesbury  
 Royal Exchange, Wednesbury  
 Old Oak, Willenhall  
 Tumbledown Bridge, Willenhall  
 Cock Inn, Woodseaves  
 Bird-in-Hand, Wordsley  
 George and Dragon, Wordsley  
 Whitehouse, innkeeper, Gnosall district  
 Parton, Great Chatwell  
 Baker, Great Chatwell

Apart from the 13 listed above, their beers were found free from arsenic. All the beers from home-brew pubs were free from arsenic. Some breweries' beers were analysed most often than others, notably Joule's and Bent's of Stone, the Lichfield Brewery Co, Parker's of Burslem and the Manchester Brewery Co, but this may not be significant.

Staffordshire was seriously affected by the epidemic, but the distribution of cases of poisoning was very uneven. The towns of Lichfield, Stone and Darlaston were the worst affected, whereas Wolverhampton apparently had no cases.

A large number of cases were attributed to one brewery in Lichfield. A 'very large brewery' in the Potteries supplying a great number of houses had brewed arsenical beer, but the number of cases of poisoning reported in that district was relatively low, so that Dr Reid, the county medical officer, considered that there was no sufficient evidence to connect the brewery with those cases. Another brewery had almost certainly brewed arsenical beer, but the county health authorities had not been able to obtain a definite sample. There were also two breweries where most of the brewery workmen had fallen ill.<sup>32</sup>

## Two inquests

Among the inquests on the victims were those on Mary Dyer conducted by the Manchester coroner and on Mary Rankin

conducted by the Liverpool coroner, which *The Times* reported in detail.

Mary Jane Dyer, who died in the Crumpsall hospital in Manchester, was in the habit of obtaining beer from pubs that sold Groves and Whitnall's beers only. The coroner was told about the samples of materials that had been taken from the brewery, and J.G. Groves attended the inquest to explain that his firm had recalled and destroyed many thousands of barrels of beer. The chairman of Nicholson's, John Carr Nicholson, and his brother Joseph Nicholson explained that his firm made sulphuric acid from pyrites rather than brimstone, although brown oil of vitriol might still be called brimstone in the trade. They had had a standing order from Bostock's for five tons a week, but did not know what Bostock's used the acid for. They could have supplied arsenic-free acid if asked.

The coroner suggested that no blame could attach to the brewers or beer retailers. The jury agreed that the cause of death was arsenical poison in beer, but could not agree on the question of liability. They returned an open verdict, but blamed Groves and Whitnall, Nicholson's and the chemists employed by Bostock's for carelessness.<sup>33</sup>

Mary Rankin of Liverpool had got beer from several places including James Lambert's public house in Great Homer Street. Lambert sold Walker's, Bent's and Yates's beers, as well as Ind Coope's Burton beer. Joe Walsh, another landlord

in the same street, sold Walker's, Bent's and Yates's beers. E.J. Chevalier, the managing director of Bent's, and representatives of Peter Walker and Sons and Ind Coope testified that they had not obtained their glucose or sugar from Bostock's (Ind Coope did not use glucose). William Cain, a director of Robert Cain and Son Ltd, said that they had used glucose before the beer scare, but had now stopped. A.N. Wyatt, managing director of Yates Castle Brewery Ltd of Ardwick, Manchester, said that they had used Bostock's glucose, and analyses had found it to be of good quality; once a contaminated sample had been found, they withdrew from sale all beer brewed with Bostock's glucose. The Nicholson brothers explained their firm's dealings with Bostock's.

The jury agreed that death was caused by arsenic poisoning through drinking beer. They found that Nicholson's and Bostock's had been careless or indifferent, but not culpably negligent.<sup>34</sup>

### **Prosecutions in Lancashire**

Prosecutions were brought by local authorities against some retailers, for example by Manchester Corporation against three publicans in Ancoats and Hulme and nine beerhouse keepers.<sup>35</sup> Liverpool Corporation decided not to prosecute, on legal and other grounds.

In the county of Lancashire - the administrative county, excluding the county

boroughs - prosecutions were brought under section 6 of the Food and Drugs Act 1875 (selling to the prejudice of the purchaser beer not of the nature, substance and quality demanded) against the licensees of the Stanley Arms, Liverpool Road, Eccles; Duke of Wellington Inn, Bolton Road, Pendlebury; Coach and Horses Inn, Bolton Road, Pendlebury; Albert Inn, Bolton Road, Pendlebury; Man and Scythe Inn, Kearsley; Grapes Inn, Little Lever; Crown Inn, Blackburn Street, Radcliffe; Royal Oak Hotel, Bowlee, Middleton; Freemasons' Arms Hotel, Market Place, Heywood; Daisy Field Inn, Keb Lane, Bardsley, Ashton-under-Lyne; Dyers' Arms, Whitelees Road, Littleborough; Printers' Arms, Stubbins Lane, Ramsbottom; a beerhouse at 1A Russell Street, Nelson; Derby Arms Hotel, Colne; Black Bear, Ormskirk; Junction Hotel, Lathom; Prince Albert Hotel, Fulwood; Saddle Inn, Lea; St. George's Hotel, Kirkham; Horns Inn, Garstang; Middle Holly Inn, Cabus, near Garstang; White Horse Inn, Myerscough; and Golden Bell, Broughton. In most cases the publicans were fined from 20s to £5; some cases were dismissed on technical grounds.

The procedure adopted was that, if arsenic was found in a sample of beer, the analyst

at once notified the police by wire; information was then conveyed to the beer-seller, who on his part communicated with the brewer, and further sale of the implicated beer was discontinued by sealing up the remaining bar-

rels of the same brew found on the premises until complete analysis had been obtained. When an appreciable quantity of arsenic was finally certified the contents of the sealed barrels were promptly destroyed ...

The beers certified as 'passable' were unsealed and allowed to be sold. The Lancashire county officials secured the destruction of arsenicated beer in 5,313½ thirty-six-gallon barrels and 22,680 pint and 12,398 half-pint bottles, in addition to the beer that was destroyed by the brewers privately.<sup>36</sup>

## Malting

The fuel - coal or coke - used to dry the malt always contained arsenic. In the British system of malting, the grain was exposed directly to the products of combustion of the fuel in the kiln, and quantities of arsenic could therefore be deposited on the malt. Arthur Ling, a consulting chemist and brewing expert, said that he had never met with a sample of malting fuel that was free from arsenic.<sup>37</sup>

Malt was normally made by floor malting. As Henry Taylor, maltster of Ware and Sawbridgeworth, Hertfordshire, explained the process:

In the floor process the barley, after being received from the farmer, is sweated or slightly dried on the kilns. After that it is put into the barley lofts and then shot into screens to remove all imperfections in the way of light corn, &c. It is then put into the cisterns for a

certain number of hours; after that it is moved on to working floors for germination, and when sufficiently converted is loaded on the kilns.<sup>38</sup>

In connection with a discussion of the pneumatic system of malting, Henry Taylor was asked, 'You do not approve of German beer?' 'I like it very much', he said, 'but it is a different class of stuff altogether.' The malt made in Germany would not suit London or Burton brewers at all.<sup>39</sup>

The Royal Commission went into the question of malting in great technical detail. It was generally thought by maltsters and brewers that, to produce proper malt, the actual products of combustion had to pass through the grain. If a method could be developed of drying the grain with hot air only, the resulting malt would be free from arsenic. But it was not yet certain that this would work satisfactorily, and the costs of adapting existing malt kilns would be considerable.

## The pure beer debate

The question was raised of whether sugar should be used in brewing at all. This was already a subject of controversy. Thus Sir Cuthbert Quilter, MP for Sudbury, had promoted a Pure Beer Bill in Parliament, and a Beer Materials Committee had sat from 1896 to 1899. Following the arsenic scare, meetings were held in various parts of the country to press for a statutory definition of beer

as brewed exclusively from barley malt, hops, yeast and water. Alternatively, labelling rules might be introduced, so that consumers would know what adjuncts had been used.<sup>40</sup> Also following the scare, some breweries apparently announced that in future their beers would be brewed from malt and hops only. The Pure Beer Bill was withdrawn after the Royal Commission issued its first report in July 1901.<sup>41</sup>

A writer in the *Manchester Guardian* took the opportunity to advocate the introduction of a pure beer law in Britain. He suggested that legislation on the materials used in beer should be brought in, and thought it rather humiliating that England's great rivals in the production of beer, the Bavarians, had actually done this nearly five hundred years previously. He argued that beer should be made from malt, hops and water only, which might demand more skill from the brewer, but would eliminate the danger of a beer made with chemicals which looked correct but was not. He also advocated the use of German-style cold fermentation.<sup>42</sup>

Before the Royal Commission, Sir Lauder Brunton referred to the demand that no glucose or sugar but only malt and hops should be used, but said that he was told that this would make it difficult to brew 'the light beers similar to the German laager [sic] or Pilsener beers which have come to be so extensively drunk in this country within the last thirty years'. He also pointed out that English and German barleys were different.<sup>43</sup>

R.C. Garton - a partner in Garton, Hill & Co, brewing sugar manufacturers of Battersea - spoke in praise of sugars in brewing. In his view, they were not adulterants, but represented progress in brewing science.<sup>44</sup>

T.W. Lovibond, managing director of Newcastle Breweries, which he described as a business involving £2 million and 200,000 barrels a year, stated that he considered sugars a practical necessity for modern brewing. If adjuncts generally were prohibited, more foreign barley would have to be used in brewing, as only the very best English barley was suitable for use on its own.<sup>45</sup>

Lovibond, who had been chairman of the Country Brewers' Society in 1899-1900, noted that in September 1899 there were approximately 6,796 breweries, of which nearly 5,000 were publican-brewers, 300 were small breweries, and only 1,400 of any importance.

Newcastle Breweries used inverted cane sugar (inverted by yeast, not sulphuric acid) and maize grits. The use of adjuncts enabled them to brew a better beer more quickly than an inferior all-malt beer. Since about 1880 the public had developed a taste for lighter and cleaner beers.<sup>46</sup>

Light all-malt lager-type beer could be brewed in this country, he said; Tennent's of Glasgow produced a good 'lager', as did the Tottenham Brewery, London, but there was no great demand for it.<sup>47</sup> The

main difference with German beers was in the method of mashing, although the malt was also dried differently.

Rudolf Wahl of the Nord-Deutsche Kartoffel-Mehl Fabrik, Küstrin, stated that glucose was used by German brewers. Its use was prohibited in Bavaria, Württemberg and Baden, 'for political purposes' in the interests of farmers, but Wahl asserted that 'it is publicly known that [brewers] do use substitutes - they smuggle them in in Bavaria'. Rice was also used. Wahl noted that the solid glucose used in brewing in North Germany was mainly for top-fermented beer.<sup>48</sup>

C.S. Reed, a former MP for Norfolk, said that he had drunk 'some exceedingly bad beer' in his time, and blamed the substitutes, pure malt beer being harmless.<sup>49</sup>

### **Dr Buchanan's report**

In addition to the Royal Commission's reports, there was also a report produced for the Local Government Board. This was drawn up by Dr Buchanan and dated 25<sup>th</sup> January 1901.

This report gives some details not in the Royal Commission's report. Thus Buchanan and his colleague Dr Darra Mair had visited (in Lancashire) Manchester, Salford, Liverpool, Blackburn and Preston, (Cheshire) Birkenhead and Chester, (Staffordshire) Wolverhampton, Bilston, Walsall, Darlaston, Stone and Lichfield, (Worcestershire) Stourbridge,

(Shropshire) Market Drayton, (Yorkshire, West Riding) Ilkley and (Nottinghamshire) Worksop and Everton, which appeared to have been affected by the epidemic.<sup>50</sup> He gave statistics and details of the typical symptoms of sufferers noted in the various places. In the particular case of Chester, there were clinical differences in the cases which suggested at first that the disease there might be tropical beri-beri rather than arsenical poisoning; little was known about the causes of beri-beri, however.

Buchanan and Mair tried to trace the breweries whose beer might be responsible, and concluded that there were substantial grounds for suspicion in certain cases, but the report identifies them only by code letters or numbers, not by name. Buchanan commented inter alia that in Stourbridge all the cases were attributed to beer from a single brewery, of Stone and Liverpool, and that in Stone the same brewery, together with another local brewery, was stated by patients to be their sole source of beer. Darlaston was a town served by some 20 different breweries, besides home-brew pubs. Worksop was the site of the maltings of a large Manchester brewery, and 15 of its employees at the maltings, which it supplied with its beer, had suffered from poisoning. In Everton, a village near Retford in Nottinghamshire, the sufferers were believed to have consumed only beer from a small brewery in the village.<sup>51</sup>

As to Chester, the city was only on the margin of the epidemic, but approximate-

ly 46 persons in the city suffered from poisoning. Three patients in the Birkenhead Workhouse Infirmary also stated that their sole source of beer was a brewery in Chester, identified in Dr Buchanan's report only by the symbol (xi.), and beer from that brewery was found to be 'unmistakeably arsenical'.<sup>52</sup>

According to Dr Buchanan:

In illustration of the difficulty in which certain brewers have recently found themselves in consequence of the detection in their beer of arsenic which had apparently not been introduced by brewing sugars, I may cite the case of a brewery at Chester (xi.). This brewery, up to the end of September, 1900, used Bostock glucose for brewing, together with Bostock invert sugar for priming. Onwards from the end of September they used an American, arsenic-free, glucose for brewing, but continued Bostock invert sugar for priming. At the beginning of December, their recently brewed beer was pronounced arsenical by several analysts - in the main, doubtless, because of their use of contaminated priming sugar. After December 1st, all the materials used in brewing, save the malt and hops, analysed by two analysts independently, were pronounced free from arsenic. With these materials, and with plant thoroughly scoured, twelve successive brews were made, and samples of the beer of each brew were sent to each of the two analysts. In the case of three brews only both analysts found no arsenic whatever in the beer; in other three, both reported 'traces,' while each of the remaining six brews have been declared to contain 'traces' of arsenic by one or the other analyst. The

brewer stated to me that there was no difference to his knowledge between the constituents of the nine contaminated brews and those of the three 'arsenic-free' brews. The same malt had been used, and the same hops, and these and other materials were in the same proportion in each brew. The casks in each instance were new. At the date of my visit, none of the beer of the nine contaminated brews had been issued to retailers or to the public.<sup>53</sup>

The unnamed brewery would appear to have been the Chester Lion Brewery, as they dealt with Bostock's and, as noted below, claimed for a debt of £10,445 in the liquidation of the company. One sample of Bostock's glucose taken in Chester on 29<sup>th</sup> June 1900 (before the epidemic) was also found by the Government Laboratory to contain 1.21 grains of arsenious oxide per pound.<sup>54</sup>

### **Liquidation of Bostock's and legal proceedings**

The first meeting of the creditors of Bostock & Co, which was being compulsorily wound up in the Chancery Court of the County Palatine, was held in Liverpool on 20<sup>th</sup> March 1901. Many prominent brewers were present in person. The meeting was told that Bostock's had been solvent up to the arsenic trouble, but had then decided to go into voluntary liquidation.<sup>55</sup> This became a compulsory liquidation after a winding-up petition was presented by Richard Holden Ltd, of Novas New Brewery,

Blackburn, who had sued Bostock's for damages.<sup>56</sup> Among the principal creditors were Cornbrook Brewery Company (claiming £6,698 14s.11d), Groves and Whitnall (£15,769), Chester Lion Brewery Company (£10,445), and Lichfield Brewery Company Limited (£14,495). The committee of inspection included J.A. Pearson of Lasale's [sic] Brewery Company, Wrexham; F. Eastwood of Chesters' Brewery Company, Manchester, John Mellor of Liverpool and Richard Holden. All these breweries must have been customers of Bostock's.

At the meeting Watson Rutherford, a director of Bostock's, said that they company had only been formed in 1896 to buy the business originally run by Mr Bostock in his lifetime. The owners had taken over what appeared to be a good business, and traded successfully, until late on a Saturday night or early on the Sunday morning they suddenly discovered that they had been sending out products contaminated with arsenic. On the Monday morning they telegraphed to everyone they could think of who might have been supplied with their products and asked them to stop using them. They were now claiming against Nicholson & Sons, whom they regarded as responsible. However, Nicholson's representative, who was also present at the meeting, described the claim as preposterous and absurd.<sup>57</sup>

Richard Holden Ltd, brewers, of Blackburn, also sued Bostock's for £2,700 for spoilt beer and general dam-

ages. They won the case, although Bostock's appealed to the Court of Appeal on two specific points concerning the measure of damages (£300 awarded for the difference between the cost of brewing beer to replace the beer which had to be destroyed and the selling price of the beer to the brewery's customers, and £50 for the cost of printing and advertising notices announcing the change of brewing materials).<sup>58</sup>

Bostock & Co's claim against Nicholson and Sons Ltd in the Court of King's Bench succeeded, but only to a limited extent. On 8<sup>th</sup> March 1904 judgment was given for the plaintiffs. The judge awarded damages for the price paid by them for the impure acid and for the value of the goods spoilt by being mixed with the impure acid, but not for the loss of goodwill of their business, as that did not arise directly from the acts of the defendants. Counsel estimated the damages as of the order of £5,000 to £8,000 rather than the £152,000 Bostock's had hoped for.<sup>59</sup>

At least one individual victim of poisoning sued the retailer who had sold him the tainted beer. A Blackburn labourer by the name of Wren sued Mr Holt of the New Brewery beerhouse, where he claimed to have drunk four to six pints of beer a day for 12 months (this was in addition to the nine-gallon cask he kept at home and the whisky he always had on his way to work in the morning). He attributed his illness to arsenic; the defence argued that he was a heavy drinker, a person of unclean habits, and probably suffering from alco-

holic neuritis. The jury accepted Wren's claim and awarded him damages of £50.<sup>60</sup>

Incidentally, Bostocks had also used the arsenical invert sugar to make treacle-like products called 'Table Syrups', flavoured with various fruit essences, but fortunately only a few tins had been sold, and most of those had been returned because the syrup had solidified.

### **The Halifax outbreak**

There was a further apparent outbreak, on a smaller scale, at Halifax in early 1902. Two patients died. Samples of beer and brewing materials were taken in January and February 1902 and analysed.

Arsenious oxide was discovered in samples of beer brewed by Webster and Son and Ramsden, both of Halifax, and Bentley's Yorkshire Brewery Co Ltd, of Leeds. More samples collected from pubs in Halifax were tested, from the above three breweries and from the Cross Keys home-brew house (Swift's), Alderson's, Stocks (Shibden Head), Halifax Brewery Company, Brear and Brown, Bentley and Shore [sic] (Lockwood Brewery, Huddersfield), Boardmans, Aspinall (Halifax), R. Whitaker and Sons (Halifax), C.B. Whitaker (Luddendenfoot), Fielden [sic] and Company (Halifax) and J. Smith (Tadcaster). Some were arsenic-free, or contained only minute traces, but arsenic was found in samples from Alderson, Aspinall, Bentley & Shaw, Cross Keys,

Halifax Brewery Company, Ramsden, Webster and Son, R. Whitaker and Yorkshire Brewery Company.

When it was announced by the medical officer and one of the analysts that the disease was attributable to arsenic in beer, the local brewers reacted at first with incredulity and some hostility. There were threats to sue, and the coroner complained publicly about a visit paid him by a brewer before an inquest. However, F. Buckley, managing director of Webster's, called a meeting of the principal brewers and advised them to have their beers analysed. H. Hammond Smith visited all the breweries concerned and collected information, with the cooperation of the brewers. Two Halifax brewers also gave evidence to the Royal Commission: G.S. Thompson, manager of Whitaker's Brewery, and Mr Buckley.

In this case, however, brewing sugars were not to blame. The problem lay in the malt. It appeared that the Halifax beers had been brewed with malt from the 1900-01 malting season which had been dried over local gas coke, which contained arsenic. More recently made malt, dried over anthracite, was largely free from arsenic.

Webster's, Ramsden, Yorkshire Brewery Company and Whitaker's all made their own malt (apart from porter malt bought in from Dublin and London). They had mostly used gas coke, but also some oven coke and anthracite, and Webster's had switched to anthracite after the

'Manchester scare', as well as installing new machines for brushing the malt. Other breweries bought in their malt. The Cross Keys - described by Hammond Smith as 'a public-house with a small brewery attached, kept by Mr. Swift' - bought malt, crushed and ready for the mash tun, from Firth and Blackburn of Cleckheaton and Broadbent of Bingley. Swift used malt and flaked maize, but no glucose or invert sugar. A consignment of malt from Firth and Blackburn had been refused or returned by a brewer in Lancashire as being too arsenical to use, and the same malt then sent to Swift.<sup>61</sup>

The Royal Commission concluded generally that there could be no doubt 'that a considerable proportion of beer brewed in some parts of the country before 1900 contained noteworthy quantities of arsenic, mainly derived from malt and from brewing sugars'. Malt was more likely to have been contaminated with arsenic when made in a gas coke kiln rather than one using oven coke or anthracite. The use of gas coke had been common in Yorkshire and the Midlands but not in the south of England; now that the problem was understood, maltsters had generally switched to anthracite.<sup>62</sup>

## Conclusion

There seem to have been no direct legislative consequences in terms of licensing law; at most there was an indirect effect on the development of public health law.

This was a difficult period for breweries generally, for economic and social reasons, and the epidemic and the link in the public mind between beer and arsenic can hardly have made things easier for them. Yet any loss of reputation appears to have been only temporary. The people went on drinking beer as before. Even the customers of the small brewery near Warrington no doubt soon switched back from tea to beer.

## Author's note

This article is to be read together with Alan Gall's article 'What's your poison?' in *Brewery History* No 128.

## Bibliography

- Kelynack, T.N. and Kirkby, W. (1901) *Arsenical Poisoning in Beer Drinkers*, Bailliere, Tindall & Cox: London (cited as Kelynack)
- Buchanan, G.S. (1901) *Report to the Local Government Board on recent Epidemic Arsenical Poisoning attributed to Beer* [Cd. 459], London (cited as Buchanan)
- First Report of the Royal Commission appointed to inquire into Arsenical Poisoning from the consumption of beer and other articles of food and drink - Part I.* Report [Cd. 692], London 1901 (cited as First Report)
- First Report of the Royal Commission appointed to inquire into Arsenical Poisoning from the consumption of beer and other articles of food and drink - Part II. Minutes of Evidence and Appendices - Vol. I.* Evidence

received in 1901 [Cd. 1845], London 1903 (cited as Minutes I)

*Final Report of the Royal Commission appointed to inquire into Arsenical Poisoning from the consumption of beer and other articles of food and drink - Part I. Final Report* [Cd. 1848], London 1903 (cited as Final Report)

*Final Report of the Royal Commission appointed to inquire into Arsenical Poisoning from the consumption of beer and other articles of food and drink - Part II. Minutes of Evidence and Appendices - Vol. II. Evidence* received in 1902-3 [Cd. 1869], London 1903 (cited as Minutes II)

Groves, W.J.P. & Groves, K.G. (1949) *The History of a Brewery 1835-1949*. Groves and Whitnall Ltd.: Salford & Manchester. The arsenic epidemic is not mentioned at all in this book, which admittedly does not claim to be a comprehensive history of the brewery.

## References

1. Alan Gall, 'What's your poison?', *Brewery History*. No 128, pp.49-53.
2. Kelynack, p. 1. Peripheral neuritis was believed to be uncommon in cities such as Glasgow where spirits were drunk more than beer.
3. Kelynack, p.2.
4. Kelynack, p.50.
5. Kelynack, p.100.
6. Glucose 'in the brewing and confectionery industries, is a technical term having a meaning quite distinct from its purely chemical significance. It embraces all those substances which are more correctly denominated "starch-sugar." Starch - maize starch, sago starch, rice starch, or potato starch - is submit-

ted to hydrolysis by means of dilute sulphuric or hydrochloric acid': Kelynack, pp.93-94.

7. Invert sugar 'is produced by the action of sulphuric acid ... upon cane sugar under the influence of heat. The resulting compound consists of glucose and fructose. The free acid is neutralised by the addition of chalk, and the calcium sulphate is separated by filtration. In order to obtain a preparation of a paler colour, the liquid is more or less decolourised by passing it through animal charcoal. It is then brought to a suitable consistence by evaporation': Kelynack, p.93.

8. First Report, p. 3.

9. Buchanan, p. 18.

10. Groves & Whitnall Ltd was formed in 1899 to acquire the brewery with 309 freehold and long leasehold houses, 282 houses held on short leases and annual tenancies, and 748 unlicensed properties, and also Leigh & Co's bottling works, Salford. The company later bought the business of the late James Cronshaw, Alexandra Brewery, Hulme, and the tied houses of William Dockray, Chorlton Road Brewery, Manchester: see *The Manual of British and Foreign Brewery Companies 1903*, London 1903, p.145.

11. Minutes I, pp.64, 71.

12. Minutes I, p.67.

13. Minutes I, p.65.

14. Minutes I, pp.66-68, 72.

15. Minutes I, pp.113-118.

16. Minutes I, p.118.

17. Minutes I, pp.144-146.

18. Minutes I, pp.183-185 and Appendix 13.

19. The rule was in fact that drawback was possible on beer that had not left the brewery but could not be paid on beer that was already in the publican's cellar. Henry Spencer, collector of Inland Revenue for the

Manchester collection, said that in one case a 'very zealous supervisor, with one or two officers' had worked until 10 or 11 on a Saturday night and for six or seven hours on the Sunday as well to get the accounts in order. The brewers had mainly been concerned to get the barrels emptied quickly so that they could reuse them: Minutes I, pp.203-204.

20. Minutes I, pp.188-189. The Oldham brewery was presumably Jowett, Waterhouse & Co, taken over by Wilson's in 1896 (listed in Century under Royton).

21. Minutes I, pp. 127, 156.

22. Minutes I, p. 169.

23. Kelynack, pp. 90-92; Minutes I, pp.133-134. The breweries were not named.

24. Minutes I, p. 169.

25. Minutes I, pp. 179, 192.

26. Minutes I, pp. 286, 291-293.

27. Minutes I, Appendix 10, Tables I and II.

28. Minutes I, p. 154 and Appendix 8.

29. Minutes I, pp. 40-42.

30. Minutes I, p. 44.

31. Minutes I, p. 233.

32. Evidence of Dr George Reid, county medical officer for Staffordshire, Minutes I, pp.76-85.

33. *The Times*, 10th, 11th, 17th, 19th and 22nd January 1901.

34. *The Times*, 12th and 25th January, 6th February and 11th March 1901.

35. *The Times*, 9th January 1901.

36. Minutes I, p.154 (evidence of Edward Sergeant, medical officer of health for Lancashire) and Appendix 11, Table III; the supplying breweries were again identified by numbers only.

37. First Report, p. 5; Minutes II, p.98.

38. Minutes I, p.206.

39. Minutes I, p.210.

40. Letter from A.H. Allen, public analyst for Sheffield, *Manchester Guardian*, 7th December 1900.

41. Gourvish, T.R. and Wilson, R.G. (1994) *The British Brewing Industry 1830-1980*. C.U.P.: Cambridge. p.296, n. 90.

42. 'Arsenic in Beer', by a Chemical Expert, *Manchester Guardian*, 7th December 1900.

43. Minutes I, pp.222, 224.

44. Minutes I, p.231.

45. Minutes I, p.259.

46. Minutes I, pp.269, 262.

47. Minutes I, p.264.

48. Minutes I, pp.277-279.

49. Minutes I, p.306.

50. Buchanan, p.2.

51. Buchanan, pp.10-11; *The Times*, 4th December 1900 (on the Worksop poisoning; the unnamed brewery might have been Threlfall's).

52. Buchanan, pp. 11, 13.

53. Buchanan, pp. 20-21.

54. Minutes I, p. 297.

55. *London Gazette*, No 27283, 12th February 1901, p. 1091.

56. *London Gazette*, No 27282, 8th February 1901, p.1009; No 27305, 16th April 1901, p.2692. The liquidation was still pending in 1903: *London Gazette*, No 27523, 10th February 1903, p.873. See also *The Times*, 19th February 1901.

57. *Manchester Guardian*, 21st March 1901; *The Times*, 21 March 1901.

58. *The Times*, 25th January 1902. The amount of damages awarded seems to have been £1,820.

59. *The Times*, 9th March 1904.

60. *The Times*, 18th November 1901.

61. Minutes II, pp.14-31; Final Report, pp.8-10.

62. Final Report, pp.7-8, 27.