# *Sir Thomas Oliver (1853-1942) and the Health of Antimony Workers*

*R I McCallum*

**SUMMARY**

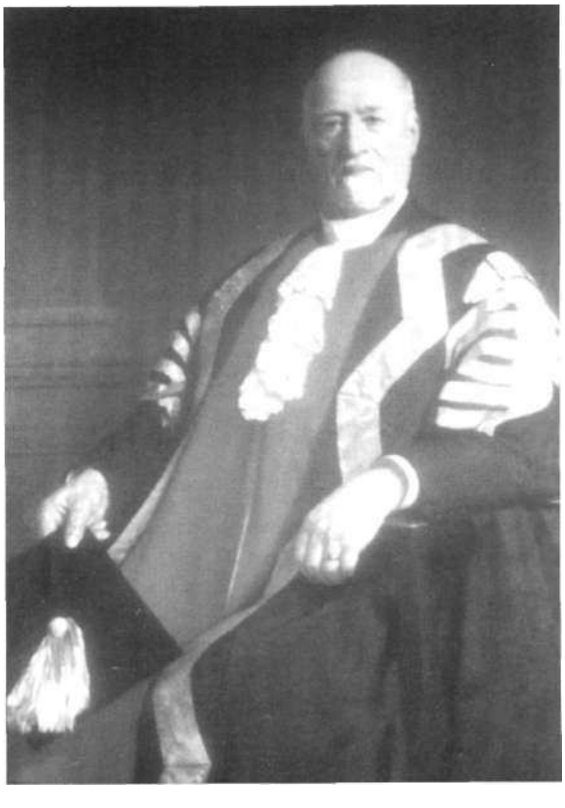
Imported antimony sulphide ore has been processed in the north-east of England on Tyneside since 1864, first at Gateshead and then at Willington Quay, until the process closed in 2000. The health of antimony workers was a concern of Sir Thomas Oliver (1853-1942) who was distinguished in the field of occupational medicine, particularly in connection with diseases due to lead exposure. Antimony appears to have fascinated him but he underestimated its toxic effects on the process workers in concluding that they were healthy and that there were no industrial hygiene problems in the process. Subsequent investigations have presented a much less satisfactory picture although in recent times the factory atmosphere had been transformed so that Oliver's view had probably come true.

RÉSUMÉ

Le sulfure d'antimoine a été raffiné au nord-est de l'Angleterre depuis 1864, d'abord à Gateshead, plus tard à Willington Quay, jusqu'à la fermeture de la raffinerie en 2000. Sir Thomas Oliver (1853-1942), practicien distingué dans le domaine de la médecine du travail, en particulier les maladies causées par l'exposition au plomb, s'intéressait beaucoup à la santé des ouvriers employés dans le raffinement de l'antimoine. L'antimoine possédait une fascination pour lui, mais en arrivant à la conclusion que les ouvriers se trouvaient en bonne santé, et que le traitement de ce métal ne leur présentait aucun problème d'hygiène industrielle, il a sous-estimé ses effets toxiques sur les ouvriers. Depuis, la recherche médicale a produit des résultats plus inquiétants; cependant, plus récemment l'atmosphère de l'usine a été transformée de telle manière que le point de vue d'Oliver s'est probablement enfin réalisé.

**INTRODUCTION**

In 2000 the processing of imported antimony ore on Tyneside ceased after over I 30 years, I I I years on the same site at Willington Quay, the company having been at one time a major producer in the United Kingdom and in Europe. The health of process workers at this factory has been a matter of concern since the early 20th century and over many years there had been a number of studies both of the workers and of the working environment, beginning with that of a leading physician in Newcastle upon Tyne, Sir Thomas Oliver (1853-1942). He was one of the foremost specialists in occupational medicine in the United Kingdom of the late 19th and first part of the 20th century. He was born in the west of Scotland at St Quivox, near Prestwick in Ayrshire, educated at Ayr Academy, and graduated MB CM with commendation at Glasgow University in 1874, and MD with honours in I880.[12] LikeThackrah of Leeds in the 19th century or Donald Hunter of London in the 20th century, Oliver was primarily a general physician, with an interest in the effects of work on health, and he was also a university teacher in Newcastle upon Tyne. After qualifying in medicine he worked first as a pathologist in the Glasgow Royal Infirmary, and then in 1875 studied in Paris under Jean Martin Charcot (1825-1893) It seems likely that he maintained and fostered contacts in France by further official visits to factories there, and in Germany, Belgium, and the Netherlands. After a period in a general practice in Preston in



*Portrait of Sir Thomas Oliver painted byT. 6. Garvie in 1890, in the University of Newcastle upon Tyne*
*(Courtesy ofthe late Dr. F.J.W. Miller & University of Newcastle upon Tyne)*

Lancashire from 1875-79, during which he published a translation of a work by Charcot on Multiple Sclerosis *(Sclerosis in Scattered Patches)* in l876,[3] he moved to Newcastle upon Tyne in the north-east of England as physician to the Royal Victoria Infirmary and the Princess Mary Maternity Hospital. In 1880 he was also appointed a lecturer in physiology in the Newcastle medical school, then part of Durham University (the Cathedral city of Durham is situated 15 miles to the south of Newcastle), and was promoted to Professor in 1889. He became a Fellow of the Royal College of Physicians of London in 1890, and was knighted in 1908. From 1911 to 1927 he was Professor of Medicine, and during the 1914-18 war he helped to raise theTyneside Scottish Brigade. He was president of the Durham College of Medicine in 1926-1934, and Vice-Chancellor of Durham University from 1928 to 1930. He was also Deputy Lieutenant of Northumberland, and received honorary doctorates from Glasgow, Sheffield and Durham as well as a number of honours from other countries: the Freedom of the City of Boston, USA in 1923; the gold medal of the Assistance Publique in 1924; Chevalier of the Legion D'Honneur by France in 1929; and a Medal *of* Honour from Bruxelles University in 1920. He became an authority on lead poisoning, a condition of which there were at that time many examples from Newcastle and its area, and made this the subject of a Goulstonian Lecture to the Royal College of Physicians of London in 1891.[4] He was a member of a White Lead Commission in 1892-3, which was largely responsible for the prohibition of female labour in the white lead industry in the UK. In 1898 he took part in an enquiry which resulted in a reduction of the risk of poisoning from lead glazes in British potteries, and he visited similar industries in France and Germany with resulting changes in their practices, which reduced the occupational risks. He also established preventive measures in relation to the making of lucifer matches. He edited and contributed to *Dangerous Trades* in l902,[5] and wrote *Diseases of Occupations*[6] in 1908. The former is a volume of 891 pages in which Oliver writes substantially on a wide range of subjects. His own copy has interleaved blank pages and is therefore in two volumes and contains his notes for a further edition (which never materialised). Tucked into it are two letters; one from the radical Member of Parliament for Chelsea, and later Forest of Dean, Sir Charles Dilke, dated 25th March 1907, which seems to be a reply to a query from Oliver about his writing on a matter which related to a Departmental Committee with which Oliver was connected either as a member or as a witness; the other is from a Dr Arthur Sansom (1838-1907) who was a physician *to* the London Hospital and primarily a cardiologist but lectured on medical jurisprudence and public health. He was also an examiner in medicine to the University of Durham. Oliver was clearly an influential figure both locally in the north-east of England, nationally and internationally, and he is described as an imposing figure at public functions and a conscientious teacher and physician. He was well remembered in Newcastle in the late 1940s but it was clear that he was not universally liked by those who knew him. His portrait in the robes of Vice Chancellor of Durham University (Fig I) was painted by Thomas Bowman Garvie (b 1859) in 1890, an artist who had studied in Paris, and who exhibited in Morpeth and later Rothbury in the north-east of England, which suggests a local connection. His picture of Oliver portrays a rather arrogant-looking man. It was said that a Dr Parkin of Newcastle who had written an MD thesis on Compressed Air Illness was on holiday in Paris and saw an advertisement for a lecture by Sir Thomas Oliver on the same subject. Parkin slipped into the back of the lecture theatre unnoticed by Oliver and heard a talk based on his thesis but without any acknowledgement of its author. Nevertheless in a contribution in *Dangerous Trades on Diseases Due to Work in Compressed and Stagnant Air* (Chapter LIV; pp 728-748) and in Diseases of Occupation (pp 88-114), Oliver shows a practical familiarity with the medical problems of compressed air work and made hand-written notes on two patients with paraplegia after decompression under his care in the Newcastle Infirmary. One patient in 1904 was a 27 year old electrician with a severe paraplegia from working in compressed air on the construction of a pier for the King Edward VII Bridge across the River Tyne at Newcastle.[7] He was one of five with decompression illness and was described by Parkin that year.[8] In the preface to the first edition of *Diseases of Occupation* Alfred Parkin is amongst others thanked for help 'always cordially given', is mentioned as having assisted Oliver in experiments with mice at high atmospheric pressures of oxygen (pp 98-99), and Oliver quotes from his thesis (p 109).

## THE ANTIMONY INDUSTRY

Antimony is an element which is widespread on the surface of the earth and has been identified in at least I 14 different ores, and has even been found in meteorites.[9] Mining for antimony has been carried out extensively in many countries including Britain[10] but there are a limited number of sources which are economic to exploit. Oliver was brought up in a part of Scotland which is well known for its metal mines, mainly lead. Antimony was mined near New Cumnock, about 25 miles east of St Quivox where he was born and brought up, and also farther east at Eskdale in Dumfriesshire in 1788, but it was not worked there regularly until 1793; by 1798 it had produced 100 tons of sulphuret of antimony yielding about 50% regulus (metal).The major sources of antimony ores processed industrially in the UK in the 20th century have been China, South Africa and South America (Bolivia). The toxicity of antimony and arsenic are somewhat similar although differing in severity. Arsenic, like tin and bismuth, forms an azeotrope or solid solution with antimony and is therefore difficult to separate." Antimony has been known for centuries from the Sumerians who made pure antimony metal,[9] *to* the Egyptians, who used antimony eye ointments, and occasionally in cosmetics and for decorative objects. Alchemists from the 14th century were obsessed with antimony because it could be used to purify gold and by analogy cleanse the human body, so that it had for them religious and mystical significance, an aspect revived by the anthroposophists under Rudolf Steiner in the 20th century.The development of printing in the 15th century must have boosted the demand for antimony metal as printing type contained antimony to make the lead harder and because it tends to expand on cooling, thus giving a more precise impression. Johannes Gutenberg (1400-1468), who probably invented printing, was a goldsmith and one can assume that he would be very familiar with the properties of antimony from its use in the purification of gold. The traditional method of treating antimony ore (usually stibnite, the sulphide SbiSs) is to roast it with charcoal or coke and collect the volatile oxide fume (SbiC^) from which, by further refining, a pure antimony metal can be obtained.Agricola (1494-1555) described and illustrated the separation of silver from gold using antimony sulphide, in which the antimony alloys with the gold and settles.[12] Historically, apart from medicinal use which was popular for over 500 years, antimony has been a constituent not only of printing-metal but also of lead acid batteries, pigments, an opacifier under glazes and enamels (the white oxide), and in the present day it has been used widely as a flame retardant in fabrics. Large-scale industrial production began in the early 19th century.

## ANTIMONY PROCESSING IN THE NORTH EAST OF ENGLAND

It is not certain when the smelting of antimony began in north-east England but it was probably at least by I864.[13] The process carried out at Willington Quay (Howdon), about 14 miles west of Newcastle, by Cooksons became eventually the only such plant in Britain. The name Cookson was established in the early 18th century primarily in glass manufacture.[H] William Isaac Cookson moved from this into chemicals by 1844, setting up a company to make pigments, especially Venetian Red (ferric oxide) in 1847, and refining antimony for pigments. Lead manufacture was added in 1851 when a locomotive works was bought at Howdon, Willington Quay to produce lead and silver, and the antimony and colour works was moved there from Gateshead in 1871. Production of antimony was more profitable than Venetian Red, which depended on by-products of antimony smelting. In the late 19th century 'chilled shot', which was lead hardened by addition of antimony, was a very successful product. Antimony metal and compounds were produced continuously at Willington Quay from 1890, with a gap between 1920 and 1936 when the metal market became dominated by imports from China so that only a little oxide was made. The invasion of China by Japan allowed the process to be restarted and by 1973 Willington Quay was the largest producer of antimony products in the world and the company had factories in Italy and Spain as well.

## OLIVER AND THE ANTIMONY WORKS

It is not surprising that Oliver was interested in antimony. Not only was the industry on his own doorstep but it is likely that his childhood background had already familiarised him with lead and antimony mines in Ayrshire and Dumfriesshire. But his view of the possible deleterious effects of the process on the health of the workers seemed to vary from time to time. He first visited the Willington Quay antimony works sometime before 1902[s] and described it as one of the largest in the country. At this time it was processing ore from Japan. He concluded that there were no ill effects on the process workers from doing this work apart from skin rashes, which led him to recall the medical use of antimony tartrate to produce a pustular eruption as a counter irritant. In *Dangerous Trades* (1902) however he classes antimony with other chemical substances such as arsenic and barium as very poisonous (p 592). In *Diseases of Occupation* antimony is given a brief mention as a metallic poison but this is in an Addenda section (pp 454-455) which has been added to the third edition of 1916 and not in the main text under 'Metallic Poisons, Dust Fumes etc'. In 1916 Oliver commented that little was known of the effects of antimony on the workmen exposed to it.[6] He describes antimony smelters as working 'with their shirts open in front and with the sleeves rolled up, and as they perspired freely, there appear on the front of the chest and arms crops of pustules which are extremely irritating. The men also suffered occasionally from headache, abdominal pain and constipation.' Other symptoms attributed to antimony at that time were colic, distaste for food, loss of appetite and small mouth ulcers with salivation; dizziness, loss of weight, albuminuria and glycosuria. He thought that in some respects the symptoms resembled lead poisoning. These comments were presumably from his own observations at the works at Willington Quay and do not suggest that the work was without hazards. In 1933 in a short paper in the British Medical Journal[15] Oliver was concerned primarily with antimony oxide (Fig 2), large-scale commercial production of which had started only after the First World War, and its possible toxicity. He remarks that the smelting of antimony ores had never been regarded as a dangerous occupation, and that antimony spots were the only malady from which antimony process workers suffered. However he found that the production workers looked a year or two older than their stated ages, were swarthy in appearance with thin chest walls, but had no respiratory disease, and that they had low blood pressure for manual workers. He concluded surprisingly that the men were healthy and that there was no industrial hygiene problem or risk, and that this applied to workers in other industries who handled antimony oxide. While he notes that no special hygiene precautions were taken at the works, nor did they appear to be necessary, overalls and respirators were provided, but that the regular use of the latter was difficult to enforce. The amount of skin irritation was small perhaps because the work was at normal temperatures, antimony spots being more severe in warm surroundings. Six men were employed as packers, all of whom had many years of service with the company, four having been smelters. Antimony was detected in the faeces but not the urine of these men. SirThomas Legge,the first medical inspector of factories in Britain, followed Oliver in 1934[16] in remarking that the industrial use of antimony was limited and that it is 'not known to have injurious effects' although he did refer to local skin irritation (described as antimony lumps or pocks) as being similar to arsenic rash. Oliver quotes Legge as giving evidence to the Home Office Departmental Committee on Paints that antimony oxide was only a mild irritant and could not be described as a poison at all. Both Legge and Oliver are somewhat ambiguous in their comments and unconvincing as to the lack of medical problems arising from the work. It is interesting that even in 195 I, Mr C T Cooper then the manager of the antimony works, was concerned about a skin rash 'antimony spots' which was troubling the process workers.

## THE OCCUPATIONAL HAZARDS OF ANTIMONY PROCESSING

The toxic hazards of refining antimony ores were described by Ulrich Ellenbog[17] physician to the Bishop of Augsburg from 1470 to 1478, in what has been called the first work on occupational hygiene. It was written in 1473 but not published until 1524. In it he refers to'the poisonous evil vapours and fumes of metals...' used by goldsmiths and others when treated by fire. Antimony he describes as of a 'cold nature' like mercury, silver, and litharge so that their vapours chill the man who works with them. Ramazzini (1633-1714) was aware of the hazards of smelting antimony and described it as affecting the lungs of workers making antimony glass (oxysulphide).[18] Not only had antimony processsing a bad reputation from at least the 15th century, but in spite of Oliver's reassuring account of the 1930s it was far from being a healthy working environment. In fact even in the 1940s the working atmosphere could be described as Dickensian. Until the 1960s processing the ore has been associated with high levels of dust in the factory air, which contaminated the skin of process workers and could easily be inhaled.[19] Sore eyes, upper respiratory tract and gastrointestinal irritation, nose-bleeds, perforation of the nasal septum (probably due to arsenic) and discolouration of the teeth had been observed in process workers. Arsenic has been present in small quantities in some ores but has been used at times in much larger amounts in the manufacture of an antimony/arsenic alloy. Antimony spots, an irritating skin rash affecting the trunk and limbs, which is much worse in warm weather, have been a major nuisance but quickly resolve on ceasing exposure for a few days. A form of simple pneumoconiosis with few or no symptoms and usually no measurable lung function deficit, but none the less undesirable, has been common in the past. More recently the antimony process has been associated with an excess of lung cancer and antimony compounds have been under suspicion as carcinogens. It seems more likely that the lung cancer is related to the use of arsenic in making alloys. Since the 1960s there has been a continuing epidemiological survey to monitor the prevalence of lung cancer in this group and it is possible that recently the risk was no longer present.[20] It is clear that Oliver's description of the antimony workers' health has to be taken in its chronological context. Working conditions, whatever the industry, and the level of health, were at the time generally poor by present day standards, not only in an industrial area such as the north east of England, but elsewhere in Britain. The antimony process was until recently a very dirty one and dust from the sulphide ore and from the oxide which was produced, covered everything including the men. Changes in the process over the last 40 years, beginning in the 1950s, have been radical so that the industry had been transformed to the point at which it was controlled by men in white coats and electronic devices, with a corresponding reduction in numbers of process workers and in exposure to dust.

**THE INDUSTRY TODAY**

In spite of a decline in its use in batteries and print metal, antimony and its compounds still have important applications. The oxychloride (SbeCXCn) is widely used as a flame retardant in which the reaction with [H] and [OH] radicals reduces the rate of flame propagation so that the treated material will smoulder rather than burst into flames. The belief that antimony in flame-proofed cot furnishings was a cause of cot deaths has been shown to be entirely without foundation. Other uses are in semiconductors, pewter, Babbitt metal, and as pigments in paints and lacquers, glass and pottery. Since Thomas Oliver's day not only had the factory environment seen a major change for the better but the process itself had changed and modern occupational hygiene practices and automation had virtually controlled the dust. Sir Thomas Oliver's over-optimistic view of the safety of the antimony process had at last been realised atWillington Quay.

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# THE HEALTH OF ANTIMONY OXIDE WORKERS

SIR THOMAS OLIVER, M.D., F.K.C.P.

The smelting of antimony ris, and the production of antimony métal, has been practised in England for at least two centuries, but th> commercial production of pure grades of antimony oxid« for pigmentary and similar purposes has been in opération only since the war. Antimony trioxide (Sb^O,) i*. now manufactured in large quantifies, and this material, which is in the form of an extremely finely divided white powder, is much used.

The smelting of antimony ores has never been regarded as a dangerous occupation, and the only malady from which antimony smelters suiïer (and then only occasionally) is an irritation of the skin, which results in blotches or minute pustules—sometimes extremely unpleasant owing to itchiness. The parts of the body most affected are the front and back of th* forearms, the front of the chest, and the epigastrium. The irritation appears to be caused when du^st falls on a skin damp with perspiration, but it is noteworthy that many workers are not affected, and that in this connexion personal cleanliness is an important factor. It is found îhat the irritation invariably disappears completely in the course of a few days if the worker ceases to hâve contât t with ajitimonv dus* In view of the increasing use of antimony oxide *m* mdustry, it was felt désirable in the interest of the worker to ascertam whether or not the handling of this material demands spécial hygienic précaution Feeling that the conditions of exposure of workers engaged in the manufacture of the material are likely to be more severe than those involved in its use, I made an inquirv into th<- health of some workers who had been **«.-\ged in ils' manufacture for a period of thirteen veajfr which period covers the prcxluction of this material rrti a commercial scale in England. Shortly after its manufacture was commencée! the question was raised as to the possible toxic

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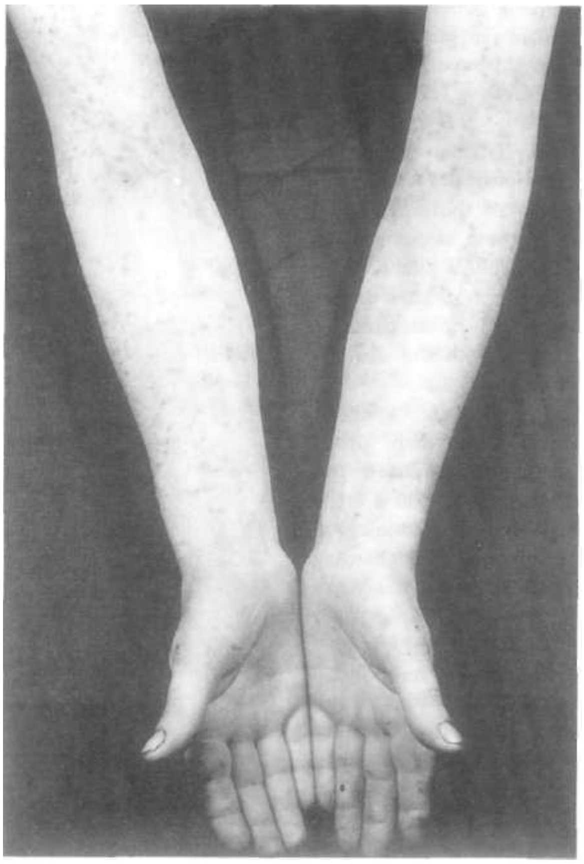
*Oliver's Lancet article on the health of antimony workers. 1933; a personal reprint signed by him.*

*Antimony process worker in the 1960s showing the oxide fume from a furnace. Conditions were later markedly improved.*



*Antimony spots in a process worker; 1958.*