

“PAH” carcinogens; what nullified early warnings

I cancerogeni “IPA”; che cosa ha vanificato i primi avvertimenti

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Summary

The carcinogenic effects of soot were recognized some 300 years ago and it was conjectured that the responsible agent was a volatile fraction. Identification of a specific chemical agent was not required for the appropriate intervention to be determined, nevertheless its implementation was delayed by political considerations. Awareness that work other than chimney cleaning was associated with excess cancer mortality followed: they had in common exposure to carcinogenic “PAHs”. In none of these exposures (coal distillation products including tars, pitch, asphalt, mineral oils, shale oil, metal working fluids) was intervention promptly legislated for that effectively eradicated the risks. The application of the Industrial Hygiene Measures of Containment and Personal Protection have provided limited protection, as the Substitution. Despite the development of a more compassionate national political philosophy, and the determination of the precise chemical agents that are the most potent carcinogens, industry has learnt how, by the employment of public relation experts and the commissioning of sympathetic scientists, its interests can be protected. Eur. J. Oncol., 14 (1), 5-14, 2009

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Riassunto

Gli effetti cancerogeni della fuliggine sono stati riconosciuti circa 300 anni fa e si è ipotizzato che l'agente responsabile fosse una frazione volatile. Per determinare un intervento appropriato non è stata richiesta l'identificazione di uno specifico agente chimico, tuttavia, la sua attuazione è stata ritardata da considerazioni di carattere politico. È seguita la consapevolezza che anche altri lavori, diversi da quelli dello spazzacamino, erano associati ad un eccesso di mortalità per cancro: tutti avevano in comune l'esposizione a sostanze cancerogene “IPA”. Per nessuna di queste esposizioni (compresi i prodotti della distillazione del carbone come catrame, pece, asfalto, oli minerali, olio di scisto, fluidi di lavorazione dei metalli) è stato prontamente legiferato per eliminare effettivamente tali rischi. L'applicazione delle misure di Contenimento e di Protezione Personale relative all'Igiene Industriale, così come la Sostituzione, hanno fornito una protezione limitata. Nonostante lo sviluppo di una filosofia politica nazionale più compassionevole, e la determinazione esatta degli agenti chimici responsabili, che sono tra i carcinogeni più potenti, l'industria ha imparato, assumendo esperti di pubbliche relazioni e conferendo incarichi a scienziati simpatizzanti, che i suoi interessi possono essere protetti. Eur. J. Oncol., 14 (1), 5-14, 2009

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Introduction

PAH is the acronym for Polynuclear Aromatic Hydrocarbon, but in practice it has become loosely applied to individual and variable mixtures of polycyclic aromatic hydrocarbons, cyclic hydrocarbons, and compounds containing elements other than carbon and hydrogen. Such mixtures are best designated as “PAHs” (1). The pure PAHs and the “PAHs” are biologically versatile, and may have multisystem effects with underlying mechanisms including, inflammation, immuno-suppression, endocrine mimesis, and carcinogenesis. The effects may be properties of the compounds themselves, but they may be expressed or amplified by their metabolites. The appearance of disease may depend on, the species, strain and sex of the dosed animal, the sex, ethnicity and longevity of the human exposed, as well as on the agents involved and their dosage.

Cancers have been observed successively in man in association with occupational exposures to a number of agents containing “PAH” mixtures, including: chimney soots and tars from domestic coal burning; coal distillation products (including tars, pitch/asphalt, mineral oils); shale oil; metal working fluids (MWFs). The rôles played by communication and use of scientific information in promoting the recognition of the cancer hazards of chimney soot and MWFs will be considered.

While it is intuitive that early warning of a serious public health hazard will lead to its prompt intervention and amelioration, it is not necessarily so. Aspects of political philosophy, the economy, the law and special interests that have led to the perpetuation of cancers caused by “PAHs” from various sources are reviewed.

Cancer in Chimney Sweeps

Discovery

From its foundation, wood constituted London’s dominant fuel for industry and domestic heating and cooking. Coal had been used in a small way in Britain as fuel from the bronze age onwards and it made a modest appearance in London in the 13th Century. By the 18th Century, the supply of wood for

shipbuilding and domestic fuel and for making industrial charcoal was no longer sustainable, so to meet the increased demand for fuel, the North East England coal mining industry expanded. With London’s expansion and the increased use of coal an army of sweeps was required to maintain the patency of its chimneys and to prevent fires breaking out in them and history repeating itself. The narrow domestic flues that proliferated called for an army of spare, agile operatives able to climb them and clean them by hand. Fortunately there was a large pool of 4-12 year old disposable pauper children available.

In 1775, Percivall Pott provided an importunate printer with a few unpublished surgical papers that he had had by him (2). Trading on the surgeon’s reputation, the publisher entitled the book: “Pott on the surgical management of cataract, nasal polyps, cancer of the scrotum and gangrene of toes and feet”. Pott’s contribution was a minor one in terms of its slim volume, but the publisher created a tome by bulking them out with papers by sundry authors dealing with chemistry, medical politics, and surgical topics. Despite appearing in this gallimaufrey, Pott’s article on cancer of the scrotum attracted attention and put the world on notice of a new occupational hazard:

“Ramazzini [sic] has written a book de morbis artificum;...but there is a disease as peculiar to a certain set of people which has not been publicly noticed; I mean the chimney-sweepers’ cancer.”

Pott’s priority in publishing a causal association between occupation and cancer was acknowledged, but he was subjected to the implied criticism that he probably did not pay much attention to the specific features or the severity of scrotal cancer as a disease, and further that he did not suggest preventive measures (3). This despite Pott’s short paper including this sympathetic account:

“...in their early infancy, they are most frequently treated with great brutality, and almost starved with cold and hunger; they are thrust up narrow, and sometimes hot chimnies, where they are bruised, burned and almost suffocated...”

His contemporary physicians were persuaded by Pott of the severity of this cancer, and advocated cleanliness as a preventive measure, but in the living conditions of the 18th Century urban Nether World, this was not reasonably practicable.

A redactor of Pott’s surgical works, described cases of his own, including a chimney sweeper with a “soot wart” on the face, an “apprentice” chimney sweep under the age of eight with scrotal cancer, and an environmental case arising in a man who had lodged in a room where the chimney sweep deposited his bags of soot (4). He concluded that this nearly proved that soot or perhaps the volatile parts of it have the power of producing disease, and not anything peculiar to the sweep’s occupation or manner of life. Perceptively, he considered that there must be a constitutional susceptibility as “...not one in many hundreds being injured by it [soot].”

Disease in 20th Century chimney sweeps

Some two hundred years after Pott, knowledge had accrued about cancers in a number of occupations where “PAHs” were met with, including: coke oven workers; cable layers; petrochemical workers; patent fuel makers; mule spinners; coal tar workers; shale oil workers. They had in common a prominent skin lesion, by way of a “wart” or a frank epithelioma, but in due course excesses of other malignancies were to come to be causally associated with these occupational “PAHs” exposures.

A mortality study conducted on 5,266 Swedish chimney sweeps employed for any period between 1918 and 1980 (5), whose exposures to combustion products it would be reasonable to conjecture would have been several orders lower than would have been experienced by the Victorian Mr Grimes and by his “apprentice” Tom (6), showed serious hazards to have persisted. That death was no longer reported from scrotal cancer in this population will have been due to advances in the technology of chimney cleaning and to the improved standard of personal hygiene of Scandinavian latter day sweeps. Unfortunately, the excesses of deaths from lung cancer, bladder cancer and haemopoietic malignancies that were observed, indicated that the mechanization of chimney cleaning notwithstanding, the ingestion and inhalation of soot had not been reduced adequately.

In the 20th Century, when industrial chimney deposits came to be prized for their content of such elements as vanadium and germanium, repeated reports of episodes of acute fever and distressing respiratory symptoms during their reclamation, indi-

cated that despite the availability of protective equipment, and notwithstanding a greater awareness of the extent of the cancer risks, a cavalier attitude to the inhalation of substantial amounts of flue dust could still prevail.

“Metal Working Fluids”

Their nature

While metal working has an extremely long history, the late 19th Century saw a major expansion in the use of machine tools and the introduction of metal working fluids (MWFs). These were applied to cool, clear and lubricate the tool/metal interface with a view to preserving the edge of the cutting tool and the surface of the cut metal. The basic coolant/lubricant MWF formulations, originally based on animal and vegetable products, changed to mineral oil sources. Commonly they consisted of a water-based emulsion to which were added a variety of chemicals for such special purposes as: emulsification; stabilizing; antifoaming; chemical buffering; corrosion inhibition; biocidal. Frictional heat generated in metal shaping, induces chemical change in the MWF, and it can become contaminated by: machine lubricants; hydraulic fluids; human dejecta; microbiological products; and metal particles, justifying the use of inverted commas when referring to used metal working fluids (“MWFs”).

Exposure to “MWFs”

In the process of machining, metal workers become splashed with “MWF” droplets, leading to protracted contamination of hands and arms, and by soaking through overalls, trousers and pants, the scrotum becomes poulticed with “MWF” for as many hours a week as personal hygiene and the wearing and changing of underwear permits. The machining process also leads to droplet dissemination by centrifugation, and to fumes as a result of the heating of the “MWF”. The breathing zone becomes contaminated by coarse spray, fine mist, and fume, and some of the “MWF” that is initially inhaled, subsequently is cleared from the airways and ingested.

Carcinogenic effects of "MWFs"

The diseases associated with exposure to "MWFs" are mediated by inflammatory, toxic, immunologic, genotoxic, cytotoxic and carcinogenic mechanisms. Insofar as individual "MWFs" vary in their chemical compositions as formulated and after use, and the extent to which skin contact, inhalation and ingestion occur, leaving aside considerations of ethnotoxicity one might expect the pattern of malignant and non-malignant effects to vary between different populations.

A recent independent review of the MWF problem made by the American National Institute for Occupational Safety and Health (NIOSH) for the purpose of determining a Recommended Exposure Standard, found evidence for a number of adverse effects in the various categories: straight oil, soluble oil, semisynthetic and synthetic (7). It reviewed 6 experimental animal studies on the tumorigenicity of MWFs and of "MWFs" (after varying durations of use), but as the varieties of such agents were not tested systematically, considered the reports of limited usefulness when interpreting the human data. Had they included a few more published studies and had access to unpublished "in-house" studies [personal communication Dr. Myron Mehlman] of the changes in the chemical, physical and biological properties of untreated and of regularly maintained "laundered" "MWFs" in prolonged use, they might have been more readily persuaded of its potential for human carcinogenicity.

Prevention of diseases from exposure to "MWFs"

Substantial evidence indicates that at least some "MWFs" were associated with increased cancer risk (larynx, rectum, pancreas, skin, scrotum and bladder). In metal working, the surface quality of the product, the economy of the process and the health of the operative, share common interests. The carcinogens that have been detected in the originally formulated MWFs based on mineral oils, serve no special function in the metal working process, so modifying the mineral oil by chemical or physical means serves to improve the technical properties of the MWF while reducing the amount of carcinogenic contaminant.

The total containment of "MWFs" as a method of eliminating the risk of cancer is not readily achievable. The provision of a translucent shield will go some way to blocking spray, but once well splashed it becomes opaque and is displaced for better inspection of the work in hand. The wearing of an impermeable apron protects the scrotum, the liberal use of barrier creams to an extent is protective of the forearm, and the provision of good washing facilities, and encouragement to change clothes regularly, go some way in reducing skin contact. As for the inhalation of mist and fume, in practice, their total elimination from the general environment of the workplace is not commonly met.

In an attempt to reduce contamination of the "MWFs", in the USA in the 1920s, the provision of cuspidors and their supervision in use was advocated: later disinfectants came to be added to prevent their microbiological degradation, but they were of limited value.

"Substitution" is the first consideration when faced with a chemical hazard. In the case of MWF this might be considered to have been effected to an extent, with the attempts to eliminate the carcinogenic fraction from MWFs that began in the 1950s. This would have been enhanced in the 1980s when nitrite was removed from formulations to reduce the nitrosamine content that built up in used fluid. In the late 1980s, a WHO agency concluded that the evidence for carcinogenicity to humans was sufficient for untreated and mildly treated oils and inadequate for highly-refined oils, and was a multi-organ effect (8). (In June 2008, new nominations for IARC Monographs included "Metal working fluids and lubricants", submitted by Dr. Franklin Mirer).

Shale oil workers

Mineral Oil was found to be extractable from shale in the late 17th Century. Its commercial exploitation to produce paraffin and lubricant was delayed until the mid 19th, and skin cancer began to be reported in Scottish shale oil workers in 1876. In due course skin cancer was to be reported in workers exposed to shale oil distillates.

Shale was processed widely until the development of the petroleum industry made it uneconomic. Peri-

odically when crises develop in the international oil supply and prices soar, proposals are made to revive the shale oil industry, leading to the possibility of history repeating itself.

Mule spinners

In 1906, some 30 years after the appearance of skin cancer in the Scottish shale workers, a Manchester hospital surgeon duly observed cases of scrotal cancer to be occurring among certain cotton workers (“mule spinners”). This coincided with the change from lubricants and machine working fluids based on vegetable and animal origin to shale oil. This job required the worker to stand with his thighs pressed against a horizontal bar situated 3 feet above the ground. Some of the lubricant thrown off from the spindles of the spinning machine coated this bar and rubbed off to impregnate the operative’s trousers. As a consequence, 70 per cent of the skin cancers of mule spinners were of the scrotum, while 30 per cent affected the skin of the face, hand, arm, leg and foot.

Coal distillation

The distillation of coal produces gas, coke, and tar, and fractional distillation of the tar yields a wide range of chemical compounds including “PAHs”. Retort workers at the gas works, the coke ovens or in the tar distillery, were exposed to carcinogens by inhalation and by skin contact. Not surprisingly they were found to suffer from excess of lung cancer and of skin cancer.

The decline in the coal industry and the substitution of another source for domestic gas, closed down a large number of “gasworks” leaving a legacy of, ageing workers awaiting their occupationally determined cancer, and heavily polluted land requiring remediation. As with shale oil, periodic petrol crises raise the question of reviving the process.

Patent fuel workers

In the manufacture of cheap smokeless fuel, anthracite dust was bound with coal tar pitch to form

dust free brickettes. In the process, workers became contaminated and developed *Tar Warts* and developed an excess of skin cancers. Lessons had clearly not been learnt from experience with exposures earlier to “PAHs”.

Identifying the carcinogenic fractions in “PAH” containing agents

It no more required the mechanism of cancer to have been discovered before effective intervention was possible, than the absence of the germ theory prevented Snow from suggesting how the cholera epidemic could be terminated. In due course Earle’s hypothesis of the action of “volatile parts [of soot]” was confirmed. Experimental support for causal associations with skin cancer was provided for coal tars and for shale oil. After chemical analysis, 1:2:5:6-dibenzanthracene was identified as a cancer-producing hydrocarbon, and by further analyses and by synthesis an increasing range of PAHs were isolated and tested for their carcinogenicity. “PAHs” studied include: Naphthalene, Acenaphthalene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, (k)Fluoranthene, Benzo(a)pyrene, Indo(1,2,3,c,d)pyrene, Benzo(a,h)anthracene, Benzo(ghi)perilene. A wide range of other compounds of animal, vegetable and mineral origin to which workers were exposed, were considered possibly to interact with “PAHs”. The chemical compounds causing skin cancer were identified, and later discovered to be multisystem carcinogens.

Longevity and cancer in workers exposed to “PAHs”

The life of the average worker had been brutish and short for centuries, and expectation had not increased by Pott’s time (9). In the UK, accurate life tables had to wait for the Registrar General’s analyses of the entries in the Death Register once compulsory death registration was instituted, but expectation of life in England at the start of the 18th Century has been estimated to have been 37 years; this fell by 1850 to 33 and reached 40 years in 1870.

The dose and the carcinogenic potency of an agent, will determine the length of the latent period between exposure and the recognition of a tumour. To varying extents, the longevity of the workforce will contribute to the likelihood of a recognizable number of cases occurring and their causal association being recognized. The recognition of scrotal cancer in chimney sweeps was unusual in that the latent period between exposure to the agent and the production of a tumour could be relatively short, short enough to occur during the brief lives of members of the exposed population, appearing in some when not long out of infancy.

Factors that militated against the amelioration of cancer in workers exposed to “PAHs”

Chimney sweeps

Social and economic factors and political ideologies in the UK militated against prompt and effective intervention on behalf of adults in the workplace let alone children. The Poor Law that operated in Pott's time had originated under Queen Elizabeth I, when responsibility for the relief of paupers was devolved on the Parish. Where parents did not sell their children and they became a charge on the Parish, the taxation of householders could be abated by the local authority “apprenticing” dependent infants and children to local Master Sweeps, or to textile mill owners in the North of England. Both careers exposed the young to depravity, disease, mutilation and death: Blake's description of “Dark Satanic Mills” was no poetic exercise of hyperbole.

The *laissez faire* attitude to the health and welfare of pauper children at work was in keeping with an extreme political philosophy that held that government intervention in conditions of employment was inexpedient in practice and wrong in principle. The case for accepting disability, diseases and premature death as the worker's lot was given quasi-transcendental support by such sentiments as: “The rich man in his castle/ The poor man at his gate/ He made them high and lowly/ And ordered their estate”. In contradistinction, humane initiatives to reform Society in the 18th and 19th Centuries were advanced by religious and by Utilitarian activists,

and while they may have succeeded in pricking the conscience of legislators, action had to wait on political will. When moved by the plight of the young innocents in 1788, Parliament proposed that children under 8 years of age should not be employed to clean chimneys, but declined to provide effective means of enforcement.

The victim as the cause of his disease

The young paupers were described as morally degraded black imps; some physicians even considering their scrotal lesions to be venereal in origin. This demonization of the victim and holding him responsible for his condition, by which the conscience was salved and the officious prevention of disease was averted, was not peculiar to the UK. It is a recurring theme in the history of Occupational Health internationally. In 18th Century Saxony, certain mines' medical officers were dismissive of diseased miners; in the latter part of the 19th Century Schneeberg medical officers described their miners as abstemious, pious and thrifty and yet they had a high mortality rate. In France at the turn of the 20th Century, it was held that the conscription of fit men of military age left weak and degenerate workers for industry, who, what with their tuberculosis and alcoholism, were prone to developing pneumoconiosis. An American textbook published in the early part of the 20th Century asserted that the thrifty home owner was not susceptible to disease, implying that the other sort was. A British textbook of the 1950s held that it was the careless worker who contracted asbestosis.

Legislating for health

After two attempts to bring about political reform, 1832 saw the successful passage of Earl Grey's Reform Bill. Although the primary purpose was to widen suffrage a little, more radical developments rapidly followed that had not been generally anticipated. George IV's government promptly promulgated an enabling Factory Act that empowered the Minister to appoint salaried officials with powers of inspection and prosecution of recalcitrant mill

owners. The combination of intellect and robust determination of the first four Factory Inspectors recruited, indicated that Government meant business. The 1834 Act improved the lot of the children in the mills and the minimum age for the apprenticeship of Chimney sweeps was raised to 10, and they were not to be employed to put out fires. In 1864, at Lord Shaftesbury’s initiative, the use of children in chimneys was outlawed, with fines of £10, more than a child cost. With chimney cleaning moving to external mechanical means, stunted children were no longer at a premium.

The observation of non-cutaneous malignancies in chimney sweeps had to wait for some 150 years, (5) and was consequent on the increase in longevity and the development of better data sources. In the meantime the reporting of deaths to the National Death Register established in the 1830s was being improved, though Dr William Farr’s proposals for the standardization of death registrations on scientific medical principles had still generally to be practised.

With the proliferation of the Factories Acts, disease in UK chimney operatives should have been swept into the dustbin of history, unfortunately a number of factors militated against the eradication of a readily preventable disease in this group of workers. The first 150 years of the Factories Acts concerned itself with employed persons; sweeps, the majority of whom would have been self-employed, were not legislated for until the Health and Safety at Work Act of 1974. Even in the absence of a legal requirement for protection, one might have expected that self-interest and an aversion to scrotal cancer and its surgical management in pre-anaesthetic and pre-Listerian days would have been sufficient incentive for taking care. Fastidious cleansing by the urban working class male after work was not social custom: with the limited facilities available in their hovels it was not reasonably practicable. Further, if their general perception of the risk matched Earle’s contention (1819) that: “...not one in many hundreds being injured by it [soot]...”, the long odds, fatalism and inertia would have ensured the perpetuation of the disease. Even when the mode of exitus from a disease is agonizing and protracted, the presence of a substantial number of survivors lends itself to insouciance and supports denial by persons

employed in hazardous occupations. In the absence of legislation vigorously enforced, such attitudes promote the perpetuation of disease.

A case has been argued in Parliament more than once, for continuing the employment of children in industry generally, it being in their best interests. Parents of the lower orders were stereotyped as savages who would turn brutally against a child rendered profitless.

The defence of carcinogens in general

Initially, soot and for that matter “PAHs” in general, did not require professional lobbyists to defend the continued exposure of workers to agents causing disability and premature death, as it was generally considered to be their lot.

Where the health interests of workers threatened an industry in the 20th Century, public relation agencies were commissioned by companies or Trade Associations to represent their commercial interests. They bought the services of sympathetic physicians, and scientists, and lobbied Members of Parliament to support their cause.

A number of strategies were employed to prevent or to delay health and safety legislation that industry deemed to be excessive. For example, where there was unequivocal experimental evidence for an agent to be carcinogenic it was denied as being relevant to Man, though “negative” studies were adduced to support safety. In the case of “MWFs”, where with the mixed exposures and variable compositions of aerosol consistent findings in population studies were not to be expected, nevertheless public relation experts asserted that without consistency of epidemiological findings there was no case for intervention.

Historically, English law has not been swift to offer protection from industrial disease. During and after the Industrial Revolution, disability and death were understood to be the common lot of workers, so that compensation was not recoverable because those employed in hazardous occupations were legally deemed to be volunteers to the risk. The introduction of the Workmen’s Compensation Act of 1897 was a step forward but it only covered “accidents” and not the delayed effects of toxic and carcinogenic agents.

Discussion

A study of the history of the recognition and acknowledgement of occupational and environmental carcinogenic “PAH” agents, and of the evolution of effective interventions to eradicate their effects, shows that even when their hazards and the means for their amelioration are known, the fate of workers waits upon Society’s conscience, and the evolution and exercise of political will. It was not for want of awareness that Pott’s Chimney Sweeps continued to be at risk of scrotal cancer, but rather that their living conditions militated against personal hygiene, and that meddling in conditions of employment was anathema.

When in the 20th Century it emerged that certain “PAHs” induced malignancies in other organs and tissues, the surveillance of workers exposed to “MWFs” still concerned itself solely with the skin. The detection of mortality from common malignancies in metal workers, and calculating the order of their excesses, depended on the emergence of epidemiologists with an interest in occupational populations.

Denial is commonly the first response to the allegations of a health hazard. Then physicians, hygienists and lawyers are commissioned to assist professional public relation experts refute the allegations, commonly claiming the existence of honest intellectual doubt. In the case of “MWFs”, inconsistency of findings in different studies has been cited to deny risk, despite this not excluding a causal association. With the exercise of a little ingenuity, a flaw can be claimed in the design, execution, analysis and interpretation of virtually all epidemiological studies, and scientists can be identified who are prepared to obfuscate the issue.

A strategy employed by “PAH” apologists, was to overstate the inconsistency of findings between studies by applying a different standard of critical rigour to those deemed not conclusively to demonstrate an excess mortality, categorizing them as “negative” rather than “non-positive”. When denial was no longer sustainable, the fall-back PR position was to attribute deaths and cancers to conditions that prevailed before there was awareness of risk, since when precautionary measures had been taken. For good measure, the question of confounding by cigarette smoke and other agents would be raised.

The decline in the reporting of scrotal cancers in the West Midlands suggests that the skin problem had diminished, presumably as a result of engineering design, as any benefit that might have been predicted from using refined oils and synthetic products would not be expected to have appeared yet awhile. From 1936 to 1976, despite the greater awareness at least of the skin cancer hazards of “PAHs”, a West Midlands Cancer Register included 344 cases of carcinoma of the scrotum, 61.9 per cent of whom had been exposed to mineral oil and 7.8 per cent to pitch and tar (10).

The US NIOSH Recommended Exposure Limit for “MWFs” was based on the evaluation of health effects data, sampling and analytical feasibility, and technological feasibility, and had as its primary aim the minimizing of non-malignant respiratory disease, supported by substantial evidence associating some “MWFs” used before the mid-1970s with cancer at several organ sites, and by the potential for current “MWFs” to pose a similar cancer hazard (7). It recommended medical surveillance of exposed workers, focusing on irritant and allergic dermatitis, and on signs and symptoms of non-malignant respiratory disease, but was silent on the subject of cancer.

Unfortunately, the favourable political climate for occupational health that established NIOSH and the Occupational Safety & Health Agency in the United States (11), and the Health & Safety Commission with its Health & Safety Executive in the UK (12) in the early 1970s, and supported their growth and influence, was to change and lead to their decline. In the American courts, industry has repeatedly been able successfully to challenge independent scientific authority and judgement.

Influencing the interface between economics, law and special interests

The answer to the question: “How could the information about PAHs have been used more forcefully in the interface between economics, law and special interests?” is, in the context of chimney sweeping, and of exposure to “MWFs”, not at all.

In the 18th Century and the early part of the 19th, while the plight of apprentice chimney sweeps was

recognized by some, Society and the Law were not inclined to intervene effectively. Young chimney sweeps were accepted as part of the social order, and any uncomfortable humanitarian promptings could be suppressed by demonizing them as precociously depraved. There was no union lobby to represent the interests of Chimney Sweeps: Parliament’s ineffectual response of inching up the minimum age at which it was proper to send infants and children up chimneys, and of prohibiting their incarceration in hot flues, may be considered as representing the “interests” of the rate paying householder contributing to what they saw as an unbearable burden of Poor Law costs.

In the 20th Century, other than when “positive” data and scientific reports were withheld, with the expansion of medical and scientific communication, no one needed be ignorant of environmental health hazards. At the start of the 21st, although access to published information is even easier, a highly experienced public relation industry exists able to devise strategies and to commission scientists and physicians, to obfuscate the issues in debates on public health policy, and to delay the implementation of life-saving interventions.

London that had experienced The Great Fire, might justify “inconvenience” to children engaged in chimney sweeping, by the greater good of it preventing a repeat of that conflagration, and by improving the lot of the children who were no longer a burden on their impoverished parents. When a change in chimney sweeping technique did away with the rôle of children in fire prevention, industrial expansion provided children with job opportunities in mines and mills.

The case that MWFs no longer present a health hazard, as a result of the use of barrier creams, machine shielding, personal protection, local and general exhaust ventilation, periodic medical examinations and changes in formulation, and that a more stringent exposure standard is uncalled for has been claimed, but remains to be validated.

Conclusions

In the case of the “PAHs”, whether soot, shale oil, coal tar/pitch or “MWFs”, early warning did not lead

to prompt effective intervention. Initially, this resulted from a political ideology that held that the State’s intervention in Social and Economic matters was wrong, but ultimately when society ostensibly became more caring, industry, government, and workers’ representatives would still agree to accept continued exposure of workers to carcinogenic agents rather than hazard jobs. The personnel policy that may be expressed succinctly as: “Never give a sucker an even break” (13) often rules, while the idealist striving to improve worker health and safety, may end up like Ibsen’s Dr Stockman anathematized as an “Enemy of the People”.

For all the long history of “PAHs”, in general their hazards are still with us and in the case of “MWFs” remain disputed.

Declaration of interest

The author has not been funded to produce this contribution. Five years ago he collaborated in producing an agreed statement of experts on the carcinogenic properties of “MWFs” for a UK Court.

References

1. Vainio H, Wilbourn J, Tomatis L. Identification of environmental carcinogens: the first step in risk assessment. In: Mehlman MS, Upton A (Eds). The identification and control of environmental and occupational diseases: hazards and risks of chemicals in the oil refining industry. Princeton, New Jersey. Princeton Scientific Publishing Co, 1984; Vol XXIII.
2. Pott P, Carnegy TJ for Hawes L, Clarke W, Collins R. London, Cancer Scroti 1775: 63-8.
3. Kirkup J. Percivall Pott. Entry in Oxford Dictionary of National Biography, 2004.
4. Earle J. The Chirurgical Works of Percivall Pott, FRS with notes by Sir James Earle, FRS. Philadelphia, James Webster, 1819 (as quoted in: www.mindfully.org/Health/Chirurgical-Works-Percivall-Potts.htm).
5. Gustavsson P, Gustavsson A, Hogstedt C. Excess of cancer in Swedish chimney sweeps. Br J Ind Med 1988; 45: 777-81.
6. Kingsley C. The Water Babies, a Fairy Tale for a Land Baby. Macmillan’s Magazine 1862-1863.
7. National Institute for Occupational Safety and Health. Criteria for a recommended standard: Occupational Exposure to Metalworking (NIOSH). 1998; Publications No. 98-102.

8. IARC. Mineral Oils: Untreated and mildly treated oils (Group 1) Highly-refined oils (Group 3). In: Monographs on the evaluation of the carcinogenic risks to humans. Supplement 7. Lyon, WHO. 1987: 252-4.
9. Nissel M. People Count. London, HMSO. 1987. Chart 11.3 [page 126]. Data derived from: Wrigley EA, Schofield RS. The History of Population in England, 1551-1861. London, Arnold.
10. Waldron HA, Waterhouse JAH, Tessema N. Scrotal cancer in the West Midlands 1936-76. *Brit J Ind Med* 1984; 41: 437-44.
11. LaDou J. The rise and fall of occupational medicine in the United States. *Am J Prev Med* 2002; 22: 285-95.
12. Greenberg M. Rise and fall of occupational medicine in the United Kingdom. *Am J Prev Med* 2002; 22: 310-1.
13. A cynical aphorism alleged originally to have been extemporized by W. C. Fields.