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Analysis

# Mining corporations and air pollution science before the Age of Ecology

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ABSTRACT

Smelter smoke was the origin of great social conflicts from the 19th century. Institutions, mining companies, and affected groups hired scientists to back their arguments in these disputes. The main objective of the experts was to determine the influence of dust, fumes and especially gases, such as sulfur dioxide, on health and vegetation. Controversies led to an intense exchange of experiences and theoretical proposals in some European and, from the first decade of the 20th century, North American mining basins. Thus, the smoke smelter debate represents an interesting precursor of atmospheric pollution science before the Age of Ecology. This article analyzes this research through the study of conflicts from the 19th until the mid-20th century while emphasizing the strong influence exerted by big mining corporations, which have decisively conditioned its evolution. The complexity of research on an international and long-term problem, such as smelter smoke, gave place to an early and intense controversy on the limits and possibilities of science. Therefore, the last part of this article compares the arguments used in the mining conflicts which have been studied to some of the ideas presented by critical theories on "normal" science, as Post-normal Science.



## 1. Introduction

Smelter Smoke became a serious problem for the mining industry from the 19th century.[1] Furnaces and chimneys of processing plants and smelters released gases, especially sulfur dioxide, which negatively affected health and ecosystems and caused social conflicts in mining basins. These "Smoke Wars," which spread into the European and American non-ferrous mining basins,[2] posed complex economic, political, technical and scientific problems for the companies. According to one of the most prestigious experts in the field at the time, R. E. Swain, Smelter Smoke was "probably the world's greatest trouble maker for the metallurgical industry" (Swain, 1939). For the mining corporations, as for the mining Conservationism movement,[3] atmospheric pollution (and mining waste in general) was a case of inefficient exploitation of resources: the solution had to be found in a set of technical and scientific measures.[4] Some American mining companies promoted extensive scientific programs regarding the consequences of sulfur dioxide emissions. R. E. Swain stated that, while research on atmospheric pollution related to coal smoke and chemical plants started in Great Britain, the German mining sector pioneered in the forefront of the studies on the effect of sulfur dioxide, and followed by the American mining sector in the first decade of 20th century (Swain, 1949). Thus, this proactive strategy was an interesting precursor of air pollution science (Quinn, 1989).[5]

Big mining companies were early to recognize their responsibility, but effectively biased research results in their own interest. In fact,

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[1] The three constituents of smelter (or metallurgical) smoke are flue dust, fume and gases. Flue dust consists of small particles of ore, flux, or fuel. Fumes are finer grains proceeding from chemical reactions within the furnaces, fundamentally lead compounds, arsenious oxide, zinc oxide, elemental sulfur, etc. The burning of fuel and some chemical process take place in diverse gases such as water vapor, nitrogen, carbon monoxide and dioxide, and the most problematic, sulfur dioxide (and sulfur trioxide) (Peters, 1911; Fulton, 1915).

[2] There is a specific type of pollution conflicts in coal mining, which is not dealt within this article and that has been studied in depth by Brüggemeier and Rommelspacher (1992).

[3] The movement was based on two main ideas: the consciousness of the limits of mining resources and the need to promote measures to improve processes and reduce mining waste (Leith, 1918).

[4] "Business men think of waste as synonymous with "inefficiency," connoting in turn all the hue and cry of the past ten years in pursuit of the goddess efficiency" (Chase, 1918). In fact, the American Institute of Mining Engineers (AIME), since its foundation in the 1870s, defended as its main task the study of the most efficient waste disposal mechanisms (Quivik, 1998). The principle "Smoke means waste" could synthesize this question (Stradling, 1999).

[5] The relevance of research in this field in the last of the big mining pollution conflicts before 1945, the Trail Smelter Case, is recognized, for instance, by the father of acid rain science in North America, Gorham and Gordon (1960), or, later, by Cowling (1982).

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companies exerted a strong influence on this research which would decisively condition its evolution. The influence of "smoke" on public health and vegetation was the main objective of this expertise. From an analysis of conflicts spanning from the 19th to the mid-20th centuries, this paper overviews the evolution of these scientific studies and the role that industry played.

## 2. Smoke Smelter and Health

The negative influence of mining activities on health has been known since Antiquity (Hypocrites, Pliny, Strabo, etc.). But with the Industrial Revolution, mining became one of the most hazardous industries. It is significant that the first professional diseases distinguished were pathologies related to mining activities (Bayer, 1998). But, although mining was a dangerous trade, smelter smoke did not only affect the work environment. Atmospheric pollution was also injurious to the population and ecosystems in the mining districts. In fact, the Smoke Wars during 19th century sometimes began with civic campaigns against heap roasting, the first smelting process, in which ore with high sulfur content was roasted by combustion of the sulfur. This process, cheap but highly pollutant, released a huge quantity of particles and noxious gases (especially sulfur dioxide). For this reason, their deleterious effects on all community were considered a serious public health problem.

However, the influence of smelter smoke on health was very controversial in academic circles. From the point of view of medical science, the triumph of germ theory from the 1880s favored research on pathogens to the detriment of that on environmental factors (Tarr, 1985; Sellers, 1994; Thorsheim, 2006). However, at the turn of the century, the negative impact of dust and fumes on worker's health began to be accepted.[6] In the case of the effects of gases, the question proved difficult. For Oliver (1908) or Thompson (1914), for example, experts were divided on this issue and there was a need for further research. On the other hand, what happened in the mining basins? This study centers on three important copper mining basins: Swansea Valley in the 19th century, and both Montana, and the Iberian Pyretic Belt at the turn of the century.

### 2.1. Practical Applications of Science to Public Health

In the prosperous village of Swansea, also known as "Copperopolis" and capital of Swansea Valley, there was special interest in "the practical applications of science to public health" (Miskel, 2003). As early as 1720 a proposal to build copper works encountered the opposition of neighbors due to the health problems it could cause. The construction of the plant was finally allowed, although at a safe distance from the town (Rees, 1981; Grant-Francis, 1881).[7] In 1797, a traveler noted the surprising frequency of respiratory diseases in smelter workers ("efrydd-dod") and, at the beginning of the 19th century, J. A. Paris, a Corwall physician corroborated his observation. An opinion, however, not shared later by most physicians. In fact, the prophylactic powers of copper smoke became a medical commonplace (Stradling, 1999), based on the testimony of experienced physicians such as W. P. Evans or G. G. Bird, who had been working for 15 years in this mining basin. Doctors Wilkinson and Bevan, the latter in a report sent to the Commission on Large Towns, also reported its health benefits in 1832 and in 1845 respectively. In 1854, an extensive study by T. Williams confirmed the disinfectant powers of copper smoke and minimized its harmful character in Swansea (Newell, 1997).

In 1858, W. H. Michael, Chairman of the Board of Health in Swansea, proposed the application of the legislation on smoke abatement contained in the Local Government Act. The negative and immediate response on the part of the industry shows, according to McLaren (1983: 219) that "the manufacturers were capable of mounting a successful lobby at the national level for restrictive interpretations of public health legislation."

The end of the century saw the publication of various critical studies on copper smoke. The prestigious metallurgist Percy (1861) also insisted on the harmful nature of sulfur dioxide for workers. In the 70s, annual reports by medical officer E. Davies also stressed the high ratios of mortality and their relationship with pulmonary diseases. But, in spite of all that, no legislation was passed that related copper smelter smoke to public health. The difficulty in finding a direct relationship between copper smoke and disease, and the presence on the Swansea Board of Health of representatives of the "copper masters" can explain the scarce attention that this question received since the end of 19th century (Newell, 1997).

### 2.2. The War of Wealth against Health

The Smoke War in the mining city of Butte (Montana) started as a public health problem (Smith, 1993): "The War of Wealth against Health," was the headline in a local newspaper. The roasting heap, located near downtown, was apparently the cause of a sudden increase of mortality due to respiratory diseases in the winter of 1890–1891. The alarm gave rise to an intense debate between pro-smoke and anti-smoke citizens. However, there were no relevant theoretical contributions, nor did the number of research studies increase significantly, as it had been the case in Swansea (or in Huelva, as we will see). Mining companies did not promote or fund research. On the part of the anti-smoke faction, the city council backed some studies made by the Health Department,[8] which in 1889 had hired H. Robarts as the City Health Officer (MacMillan, 2000).

Dr. Robarts is especially significant for his work, with Reverend Rounder, as a leader of the anti-pollution movement. Backed by Major Mueller, H. Robarts organized a "Smoke Committee," whose basic objective was to get the support of the mining companies to abate pollution. Their failure made him present to the city council a drastic smoke regulation in 1890: heap roasting would be prohibited three miles around the city. But, although emissions were reduced at the beginning of the century, the true reason was the technical change that was taking place in the sector: heap roasting became obsolete and the new large processing plants, for economic and technological reasons, would be built outside the city (MacMillan, 2000; Quivik, 1998).

The conflict reopened at the beginning of the century, although with completely different characteristics. As it will be seen below, the interest of researchers centered on the influence of smoke on vegetation and animals and air pollution problems were not considered a question of public health. The scarce research on health centered on the effects of dust or fumes on workers, not on the consequences of sulfur dioxide or other gases in the community (Morris, 1997; Harrington and Lanza, 1921).

### 2.3. Industrial Hygiene or Public Health Problem?

In 1873, the Rio-Tinto Company bought from the Spanish Government the mines bearing the same name. The company became the first World producer of copper pyrite by intensively using the traditional heap roasting ("teleras"). Protests against this system gave rise to one

[6] A classification of the effects of several dusts on health can be found in A. Smart (1883). The role of dust in occupational diseases is stressed, among others, by industrial hygienists such as Oliver (1908) or Hoffman (1906). Industrial hygienists, such as the doctor A. Hamilton in her work on plumbism, was key to understanding the development of an environmental rather than bacteriological point of view in this field in America from the 1910's (Sellers, 1994; Rosner and Markowitz, 2003)

[7] The policy of "zoning" would be continued in this mining district (Newell and Watts, 1996).

[8] The health departments of American cities at the end of 19th century were to become active organisms against smoke (Stradling, 1999).