

Asbestos Mining in Southern Africa, 1893–2002

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Asbestos has been mined in Southern Africa for more than a century. Chrysotile from the mines of Swaziland and Zimbabwe was marketed around the globe, while South African mines produced almost all of the world's amphibole fiber. The major mines were owned and operated by British firms that in the United Kingdom from 1931 were subject to occupational health and safety legislation. The failure of those companies to apply knowledge of the dangers of asbestos to their Southern African operations saw men, women, and children labor in conditions that would have been unthinkable in Britain. The result has been a legacy of disease and environmental pollution. *Key words:* asbestos; mining industry; Southern Africa; environmental pollution; legislation.

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The mines of Southern Africa produced all three commercial varieties of asbestos, namely chrysotile, crocidolite and amosite.¹ Chrysotile, or white asbestos, was mined in South Africa and Swaziland, and is still mined in Zimbabwe, where a single company, African Associated Mines, operates mines at Zvishavane and Mashava and exports asbestos fiber to more than 30 countries. In South Africa the crocidolite or blue asbestos fields of the Northern Cape stretch over 450 kilometers from just south of Prieska on the Orange River to the Botswana border. The Pietersburg fields of the Northern Province are less extensive and the seams that contain amosite (brown asbestos) and crocidolite are sparse except at Penge, where they can be several feet thick. The first crocidolite mines opened near Prieska in 1893. Msauli, the last of South Africa's chrysotile mines that lies near the Swazi border, closed in 2002. The Swazi chrysotile mine at Piggs' Peak, which was operated by the British firm Turner and Newall (T&N), closed in 2001 leaving Zimbabwe as Southern Africa's only producer. The poverty and isolation of the mining regions, the ruthlessness of employers, and the quiescence of the regulatory authorities allowed British companies and their subsidiaries to enforce work conditions that would have been unthinkable in an OECD state. In the absence of alternative forms of employ-

ment or knowledge about the risks they faced, laborers accepted the conditions offered by employers.

Even at its peak South African output fell well behind that of Canada and the USSR, with asbestos never representing more than 3% of the value of South Africa's huge minerals output. South Africa was, however, the major producer of amphiboles, accounting for 97% of global production. Fiber from South African mines, which was marketed in more than 50 countries, damaged the health of the men, women, and children who mined asbestos; it injured those who handled fiber on its journey to the ports of Cape Town and Durban, as it did those who worked with fiber in factories in dozens of countries, including Italy, Britain, The Netherlands, France, and the United States. It also injured consumers who bought asbestos-based products. The waste dumps from the now-closed mines in South Africa and Swaziland continue to damage the health of those who live in adjacent communities.

THE MINES

It is difficult to recover the story of the asbestos mines. The official record is incomplete and the accounts from the mining companies and to a lesser extent the Departments of Mines in South Africa and Zimbabwe often give a distorted picture of the structures of workforces, dust levels, rates of pay, and living conditions endured by black and coloured laborers. Those who worked on the mines left few records, and we can assume with some certainty that many died prematurely from asbestos related disease (ARD).

The large mines were owned and operated by subsidiaries of the British firms Cape Asbestos Pty, Turner & Newall, (T&N), and the Griqualand Exploration and Finance Company Limited (Gefco). Cape Asbestos was founded in London in 1893 and acquired land in the northern Cape. The company began mining with capital of only 50,000 pounds and initially had so little success that it issued no dividend to investors until 1916. The mineral lay close to the surface, and during the early or tributer period the basic labor unit was the family. Using simple tools, men dug fiber from surface deposits, which was then hand processed or cobbled by women, while children helped by sorting the fiber into lengths and stuffing it into bags. The fiber was then sold to company stores. Cobbing was social work and women would operate in groups, sharing food preparation and child minding. Part of the attraction of such

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work was that it could be done while women cared for infants or young children, thus enabling some families to stay together and avoid the harsh conditions of migrant labor, one of the pillars of apartheid. It also meant that small children were exposed to the risk of mesothelioma, a disease that has a latency period of up to 40 years. In South Africa females comprised around half of the labor force: their employment was usually in contravention of various Mines acts that from 1911 specifically forbade women from working in dusty or dangerous occupations. Women and juveniles were also employed at T&N's Havelock mine in Swaziland, where they constituted around 10% of the work force. Few women were employed in Southern Rhodesian mines, where the pattern of labor followed more closely that found on the Rand.

The demand for asbestos was erratic during the first decades of the twentieth century, and the Great Depression saw the U.S. market collapse. Recovery was slow, and it was not until World War II that the industry's position improved. With the outbreak of the war asbestos became a strategic material and the demand for amphiboles was virtually unlimited. By the end of the war Cape had mines over an area of 250 miles stretching from Prieska to Kuruman in the north. Cape's success in the post-war era can be gauged by the dramatic rise in its capital base. In 1938 the company had assets of 589,000 pounds; by 1945 that had doubled. Six years later Cape's assets were in excess of 4,000,000 pounds.² Dividends to shareholders reflected that growth.

The tributer system offered the mining companies a number of advantages, and until 1950 Gefco and Cape felt no need to construct industrial mines. In an unstable marketplace tributing or small-scale production reduced the commercial risk. When the price fell or the market contracted, Cape and Gefco stopped buying fiber from tributers. Miners were paid piece rates and so the costs of "dead mining" were borne by labor. The system required only a small permanent staff of whites who checked the fiber grades and issued stores, thereby further reducing the costs of production. Most important of all, the informality of the system meant that miners and their families fell outside the provisions of the Mines acts, and as a consequence the companies avoided the cost of providing compounds, rations, or medical care for their workers.

Mining methods varied from place to place. At some sites cross-cut adits or small shafts were driven into hill-sides, at others there were incline shafts, and occasionally open-cast methods were used. Because of the hardness of the host rock, the amphiboles were more difficult to process than chrysotile and milling often accounted for more than half the cost of production.³ The abrasive ore tore holes in ducting, damaged machinery, and filled the mills with dust. Mining companies found it an advantage to feed cobs or semi-

processed ore into mills so that little host rock entered the grinders and crushers. That method saved the machinery and it also produced a more valuable product as less dust was driven into the fiber. After World War II the exhaustion of surface deposits and the increased demand for asbestos saw a shift to industrial mining, with the bigger companies sinking deep shafts, building new mills, introducing wage labor, and constructing compounds. Industrial mining also saw a fall in the number of producers.

Between 1950 and 1960 the value of South African output almost trebled.⁴ By 1960 the mines were employing 1,000 white and more than 20,000 black and Colored workers. Production reached almost 200,000 tons per annum, of which half came from the north-west Cape. Each year in the period from 1950 until 1965 Cape Asbestos returned to its shareholders a dividend in excess of 20% per annum, but the most bountiful years were the two decades until 1976. It is ironic that the industry's profits and levels of production were greatest in the period after medical research had established conclusively the dangers of exposures to crocidolite and amosite. South African production peaked at 379,000 tons in 1977, but thereafter fell dramatically: by 1985 only 163,000 tons of asbestos were mined.⁵ South African producers as well as the Department of Mines dismissed medical evidence about the dangers of asbestos and blamed Canadian and Russian interests for seeking to have their chrysotile take over the markets vacated by amosite and crocidolite.⁶ Cape Blue Mines ceased production in 1979, while Gefco continued to mine crocidolite, which it sold to dwindling markets in the Middle East and North Africa until 1996. Gefco's demise was made inevitable by the collapse of the Japanese market for amosite.

OCCUPATIONAL AND ENVIRONMENTAL DISEASE

Unlike other minerals, asbestos is milled dry, thereby creating clouds of dust. The host ore, banded ironstone, is particularly abrasive, which meant that as production levels rose so too did dust emissions. It was not until after World War II that the issue of dust in mines appeared with any regularity in official correspondence. In 1949, as part of the first survey of the northeast Transvaal, Gert Schepers of the Silicosis Medical Bureau visited Penge mine. He found the labor conditions appalling.⁷ Children were working in clouds of fiber and no attempt was being made to control the dust. Casap, a subsidiary of Cape Asbestos, which ran Penge, was British owned and therefore, in Schepers' view, had reason to be aware of the dangers of asbestosis. Schepers' report had no effect, and the men and women who worked on the asbestos fields remained unprotected by labor legislation. They did not qualify as tenant farmers, and until 1956 the mining compa-

nies were successful in arguing that their employment fell outside the various Mines and Masters and Servants acts. The Departments of Mines, Health, and Native Affairs made little effort to force employers to provide safe work conditions, health care, housing, or rations. When a man or a woman became ill he or she was fired and another worker hired. The companies had reason to fear that state regulation would reveal the levels of disease among workers, thereby further increasing the costs of production. Mining companies had no desire to invest in dust-prevention equipment. In any case they lacked the technical expertise to engineer dust out of the mills.⁸ In the absence of dust readings for that period we can only gauge what work conditions were like by reference to the prevalences of other diseases. In the 1950s and early 1960s, for example, there were regular outbreaks of scurvy and pellagra at Cape mines, and many workers were hospitalized: a number of men and women died.⁹ If the mining companies were unwilling to prevent such easily avoidable diseases, they were even less likely to address the problem of pneumoconiosis, which would have required reorganizing the entire production process.

There were some improvements in work conditions during the 1960s as the major companies invested in dust-extraction equipment. Even so, the references to asbestos mining in the Department of Mines' annual reports are disturbing. In 1978 the department noted that efforts were being made to prevent the escape of dust from mills and some mines had special maintenance crews to keep dust-suppression machinery in order, but such measures were of limited value.¹⁰ The first major improvements in health standards came only with the emergence of black trade unions in the 1980s, by which time the industry was already in its twilight. Subsequent research has confirmed that those in the industry continued to contract asbestosis until the mines closed.¹¹

In terms of ARD, every part of the labor process was dangerous, but the most dangerous jobs were in the mills. As mines became deeper, the relative risks of working underground diminished. Deeper shafts were often wet, and the moisture reduced the amount of airborne fiber, thereby probably reducing the incidence of asbestosis. Once asbestos was brought to the surface the problems of dust became acute. The dry milling of asbestos meant that the further into the process of production the greater the risk: the most dangerous work of all was done by women and juveniles. Women cobbled and sorted ore, while juveniles packed fiber into bags and swept the mills. Consequently one would expect them to have higher rates of asbestosis and lung cancer than men. The incidence of such diseases in South Africa was masked by a number of factors. Mines were infrequently visited by Department of Health officers and before the mid-1950s few records were kept of employees. Most miners were black and under the sway of apartheid the state inspectorate had little interest in

protecting them from occupational injury. On the Pietersburg fields only one in five workers was a local man or woman, and no checks were made of the fate of migrant labor. Finally, the practice of sacking workers the moment they became ill removed the most obvious cases from the gaze of the Department of Health.* As a result we can only guess as to how many died because of their employment.

The risks posed by the industry extended far beyond the workplace to those who lived in adjacent communities. Dr. C. A. Sleggs recalled his first visit to Kuruman in 1948: "When I first saw it, the land was blue for miles around the asbestos settlements. The mills indiscriminately spewed blue dust clouds over the countryside, and whenever the wind rose, a blue haze hovered over the dumps. Dust concentrations in some houses near the mills were so high that konimeter samples could not be analysed because the fibers were too dense to count."¹² Marianne Felix has identified the numerous ways in which communities came into contact with asbestos on the Pietersburg fields, where although mining ceased in late 1970s the dumps survived, as did the threat to community health.¹³ During the first 30 years of mining in the northeastern Transvaal, main roads were surfaced with tailings, and fiber can today still be seen as bright blue strips that line the roadsides. Waste from milling was dumped close to villages. Domestic animals grazed freely during the day around asbestos waste and at night were housed at kraals adjacent to living quarters that brought more fiber into homes. When Felix first visited the area in the 1980s she found 19 tailings dumps in the villages of Mafeke, nine of which extended to the banks of the Mohlapi River. Women washed fiber-impregnated clothes in the river, the main source of drinking water for those living downstream. Women mixed tailings with mud to plaster the walls of their homes and the floors of courtyards. Children used the tailings dumps as play areas. Tailings were also preferred to river sand in making cement bricks. At the now-closed Havelock mine in Swaziland, huge fiber-rich dumps dwarf the school, which is less than two hundred meters from the old mill.

There are hundreds of un-reclaimed mines in South Africa that have made large areas of the northern Cape permanently hazardous. As fiber moves about that hazard has become the center of an ever-widening circle of risk, with successive dust storms bringing asbestos closer and closer to the major population centers of Gauteng. The Department of the Environment has a budget of R100 million to clean up the mines but far more will be needed before the landscape is made safe. South Africa is a poor country with glaring disparities of wealth and poverty, and the money being spent

*Report on Health Conditions at Asbestos Mines, Pietersburg, Dr. G. B. Peacock, assistant health officer, June 1952. NTS 2258 695/280, volume 1, p. 7.

on reclaiming mines abandoned by British companies is sorely needed to build schools and houses and provide health care. The Swazi state is even poorer, and it is unlikely that the dumps at Havelock left by T&N will ever be reclaimed.

The governments of South Africa and Southern Rhodesia were directly involved in the development of the asbestos industry. During the first decades of mining, the state recruited labor for the mines, and it subsidized freight charges. Asbestos was classified as a strategic material during the two world wars, and governments supervised every shipment of fiber. The state was also complicit in the harsh and dangerous work conditions characteristic of the industry. Throughout the twentieth century the asbestos mines were under-regulated. There was no state inspectorate in Swaziland and in Zimbabwe there was no specific legislation covering asbestos mines. The situation in South Africa, where from 1948 labor relations were shaped by apartheid, was not much better. The mines were in remote and poor regions, and in terms of South Africa's minerals industry they were of little significance. The political skills of Cape and Gefco were also important in keeping state inspectorates at bay. Over a period of 50 years junior officers from the Departments of Native Affairs and Health queried the incidence of scurvy, the lack of rations, the lack of medical care, and the housing provided for African workers, but senior officers in the Department of Mines invariably sided with capital. When threatened with regulation, the bigger companies always threatened to close their mines, which were sited in areas of high unemployment. Cape and its competitors argued that although conditions were poor the benefits in terms of employment, taxation, and export earnings far outweighed the costs. When the risks of asbestosis and later mesothelioma were identified, the same rationales were used to justify filthy mills and hazardous waste dumps. In contrast to the gold mines, there were few white miners and no trade unions and that eased the pressure on employers to conform to the mines acts. The composition of the labor force, the latency period for mesothelioma, and the diseases of poverty, such as tuberculosis, which were rife on the fields, all masked the effects of ARD on mine workers and the communities in which they lived.

CONCLUSION

The mid 1950s was the crucial point for occupational health and safety on Southern African mines. It was the point at which industrial mining began in earnest; when evidence of asbestosis among miners was identified, and when Dr. Chris Wagner from the National Centre for Occupational Health (NCOH) in Johannesburg began uncovering the link between mesothelioma and asbestos.¹⁴ The failure of state authorities at that time to

reduce dust levels sealed the fate of miners and those who lived in mining communities. After 1960 the production and sales of crocidolite and amosite reached record levels, so that failure had an impact upon the health of asbestos workers and consumers of asbestos-based products around the globe. The consequences are currently being played out in British and South African courts. We can only guess at the incidence of ARD in Southern Africa. The sole study of women cobblers has found that over 90% of those who did such work have asbestosis, while continuing research by Danuta Kielkowski from the NCOH will hopefully provide a more accurate picture of mesothelioma in South Africa.¹⁵ Political conditions in Zimbabwe mean that it will take much longer for an accurate picture of pneumoconiosis to emerge from north of the Zambezi.

At what point should British companies such as Cape and Gefco have addressed the problem of exposure to airborne fiber and what standards should they have used in their mines and mills? From 1931 T&N, Cape, and Gefco were obligated to comply with British industrial law regarding the exposure of factory workers in Britain, laws they could well have used as a guide to the operation of their Southern African mines. There was also the precedent of the gold mines that had addressed the problem of silicosis, however imperfectly, by the second decade of the twentieth century. Cape and T&N could easily have drawn upon that knowledge in making their mines safer. We know that asbestosis was identified among Penge miners in 1955 and one or two years earlier on the fields of the northwest Cape. Industry's response was to increase the levels of production while making no attempt to reduce dust levels or provide a safe work environment. The mining industry's years of greatest success were from 1955 to 1975, which meant that employers had ample resources to invest in ventilation, automatic bagging machines, and leakproof packaging. They chose not to do so.

There were a number of interlocking factors that determined the conditions of work on the mines. The apartheid state in South Africa deprived black and Coloured laborers of basic rights in regard to occupational health and safety. There were no trade unions or social movements to represent the interests of workers and thereby act as a break on the worst excesses of British-owned companies. Conditions under the minority regime in Southern Rhodesia were little better, while in Swaziland there was not even a mine inspectorate for most of the life of Havelock. The regions in which asbestos was mined were poor and isolated, which made state regulation even less effective. In the absence of legislative encouragement, the major companies chose not to apply in Southern Africa the knowledge about the risk of airborne fiber already gained in their British factories. Reducing dust levels would have been expensive, and management chose profits above the health of employees.

Over the past three decades South Africa has stood outside the drama being played out in U.S., British and Australian courts. The men and women who mined asbestos have rarely been mentioned in the multi-million dollar cases involving U.S. workers or consumers injured by Southern African chrysotile and amphiboles. In the past two years, however, South African mining communities have slowly moved to center stage. The out-of-court settlement reached between Cape plc and 7,500 former miners and their families in December 2001 may prove to be a turning point in the history of occupational health and safety. As well as bringing relief to the plaintiffs, it raises the possibility that in the future multi-national companies may be held responsible for the behaviors of their subsidiaries in the developing world. It is possible that parent companies operating abroad will have to conform to the standards of occupational health and safety that apply at home. At present the variations in such standards are one of the major incentives for moving offshore. The success of the plaintiffs against Cape plc has been followed by a second suit filed in South Africa in August 2002 against Cape's major competitor Gencor, the holding company for Gefco. It is the first time that a claim for health injuries sustained in the mining industry has been brought before a civil court in South Africa and if successful it may well change the way in which that industry conducts itself.

Endnotes and References

¹ There are six types of asbestos, namely, chrysotile, crocidolite, amosite, anthophyllite, tremolite, and actinolite, but only the first three have been mined on a large scale. Crocidolite and amosite belong to the group known as the amphiboles. Crocidolite was mined in South Africa and Australia only, while South Africa was the sole source of amosite or brown asbestos.

² Cape Asbestos: The Story of The Cape Asbestos Company Limited, 1893–1953. London, U.K.: The Cape Asbestos Company Limited, 1953: 80.

³ Stander E, La Grange JJ. Asbestos. Pretoria, South Africa: The Government Printer, undated (1963): 34.

⁴ Annual Report of the Department of Mines for the year ending 31 December 1960. Pretoria, South Africa: Government Printing and Stationary Office, 1961: 40. Sale of South African asbestos from 1911 to 1960: all values in British pounds.

1960	10,795,883
1959	9,696,590
1958	9,573,348
1957	9,543,623
1956	7,674,389
1950	3,623,589
1940	497,016
1930	304,795
1920	114,195
1911	20,839

⁵ Snyman PHR. Safety and health in the northern blue asbestos belt. *Historia*. May 1988; 33(May): 32.

⁶ The Department of Mines also attributed the fall to the activities of "the international anti-asbestos movement which had singled out South African amosite and crocidolite," the fibers that made up 70%

of exports. See Report of the Department of Mines for the year ending 31 December 1978. Government Printer, Pretoria, South Africa, 7.

⁷ Schepers GWH. Asbestosis in South Africa: certain geological and environmental considerations. *Ann NY Acad Sci*. 1965; 132: 246-7.

⁸ The Wittenoom in Australia, the only crocidolite mine outside South Africa, had similar problems in reducing dust levels and as a result there has been a pandemic of ARD among its former employees. See McCulloch J. Asbestos: Its Human Cost. St. Lucia, Australia: University of Queensland Press, 1986.

⁹ McCulloch J. Asbestos Blues: Labour, Capital, Physicians and the State in South Africa. London, U.K.: James Currey/Bloomington, IN: Indiana University Press, 2002: 105-112

¹⁰ Annual Report of the Department of Mines for the year ending 31 December 1978. Government Printer, Pretoria, South Africa: 21.

¹¹ See for example Botha JL, et al. Excess mortality from stomach cancer, lung cancer and asbestosis and/or mesothelioma in crocidolite mining districts in South Africa. *Am J Epidemiol*. 1986; 123: 30-40.

¹² Sleggs GA. Personal correspondence, 1989, quoted in Marchand PE. The discovery of mesothelioma in the northwestern Cape Province in the Republic of South Africa. *Am J Ind Med*. 1991; 19: 244.

¹³ See Felix MA. Risking their lives in ignorance: the story of an asbestos-polluted community. In Cock J, Koch E (eds). *Going Green: People, Politics and the Environment in South Africa*. Cape Town, South Africa: Oxford University Press, 1991: 33-43. See also Felix MA. Environmental Asbestos and Respiratory Disease in South Africa. PhD thesis, University of the Witwatersrand, 1997.

¹⁴ Wagner JC, Sleggs CA, Marchand P. Diffuse pleural mesothelioma and asbestos exposure in the north west Cape Province. *Br J Ind Med*. 1960; 17: 260-5.

¹⁵ Davies JCA, Williams BG, Debeila MA, Davies DA. Asbestos-related lung disease among women in the Northern Province of South Africa. *S Afr J Sci*. 2001; 97: 87-92. Also Kielkowsk D, Nelson G, Rees D. Risk of mesothelioma from exposure to crocidolite asbestos: a 1995 update of a South African mortality study, *Occup Environ Med*. 2000; 57: 563-67.

Selected Bibliography

Unless otherwise indicated all archival materials cited are from the National Archives of South Africa, Pretoria.

Books, Articles, Theses and Monographs

Baloyi, R. Exposure to Asbestos among Chrysotile Miners, Millers and Mine Residents and Asbestosis in Zimbabwe. PhD thesis; Institute of Occupational Health, University of Kuopio, Helsinki, 1989.

Cape Asbestos. The Story of The Cape Asbestos Company Limited, 1893–1953. London: The Cape Asbestos Company Limited, 1953.

Castleman BI. Asbestos: Medical and Legal Aspects. 4th ed. New Jersey: Aspen Law and Business Books, 1996.

Council for Scientific and Industrial Research. Field Survey in the North Western Cape and at Penge in the Transvaal (Asbestosis and Mesothelioma). Report No. 1/64. Pneumoconiosis Research Unit, Johannesburg, 1964.

Davies, JCA, Williams BG, Debeila MA, Davies DA. Asbestos-related lung disease among women in the Northern Province of South Africa. *S Afr J Sci*. 2001; 97: 87-92.

Felix MA. Environmental Asbestos and Respiratory Disease in South Africa. PhD thesis, University of the Witwatersrand, 1997.

Felix, M. Risking their lives in ignorance: the story of an asbestos-polluted community. In: Cock J, Koch E (eds). *Going Green: People, Politics and the Environment in South Africa*. Cape Town, South Africa: Oxford University Press, 1991: 33-43.

Felix M, Leger J-P, Erlich R. Three minerals, three epidemics: asbestos mining and disease in South Africa. In: Mehlman M,

- Upton J (eds). *The Identification and Control of Environmental and Occupational Diseases: Asbestos and Cancer: Advances in Modern Environmental Toxicology*. Vol. XX1. Princeton, NJ: Princeton Scientific Pub. Co., 1994.
- Field Survey in the North West Cape and at Penge in the Transvaal (Asbestosis and Mesothelioma). Pneumoconiosis Research Unit Report No 1/64, South African Council for Scientific and Industrial Research, Johannesburg, 1964.
- Flynn L. *Studded with Diamonds, Paved with Gold: Miners, Mining Companies and Human Rights in Southern Africa*. London, U.K.: Bloomsbury, 1992.
- Hall AL. *Asbestos in the Union of South Africa*. Geological Survey Memoir No 12, Pretoria, 1918.
- Hocking A. *Kaiaas and Cocopans: The Story of Mining in South Africa's Northern Cape*. Johannesburg, South Africa: Hollards, 1983.
- Jacob N. *Environmental Management and Food Production in Kuruman, South Africa, 1886-1935* PhD thesis, Indiana University, 1995.
- Kielkowski D, Nelson G, Rees D. Risk of mesothelioma from exposure to crocidolite asbestos: a 1995 update of a South African mortality study. *Occup Environ Med*. 2000; 57: 563-67.
- Marchand P. The discovery of mesothelioma in the Northwestern Cape Province in the Republic of South Africa. *Am J Ind Med*. 1991; 19:241-6.
- McCulloch J. *Asbestos Blues: Labour, Capital, Physicians and the State in South Africa*. London, U.K.: James Currey/Bloomington, IN: Indiana University Press, 2002.
- McCulloch J. Asbestos mining in South Africa. In Peters GA, Peters BJ (eds). *The Current Status of the Asbestos Health Problem*. Vol 15. Charlottesville: Lexis Law Publishing, 1997: 373-402.
- Mostert C, Meintjes R. Asbestosis and mesothelioma on the Rhodesian railways. *Central Afr Med J*. 1979; 25:72-4.
- Packard RM. *White Plague, Black Labour: Tuberculosis and the Political Economy of Health and Disease in South Africa*. Berkeley, CA: University of California Press, 1989.
- Peacock GB, assistant health officer. Report on Health Conditions at Asbestos Mines, Pietersburg. June 1952 NTS 2258 695/280. Vol 1, p. 7.
- Report of the Commission of Inquiry into Occupational Health. Pretoria: Government Printer, 1976.
- Shapiro HA (ed). *Pneumoconiosis: Proceedings of the International Conference, Johannesburg 1969*. Cape Town, 1970.
- Sleggs CA, Marchand P, Wagner C. Diffuse pleural mesothelioma in South Africa. *S Afr Med J*. 1961; 35: 28-34.
- Snyman PHR. Safety and health in the northern blue asbestos belt. *Historia*. 1988; 33(May): 31-52.
- Tallent JM, Harrison WO, Solomon A, Webster I. A survey of black mineworkers of the Cape crocidolite mines. In Wagner JC (ed). *Biological Effects of Mineral Fibres*. Vol 2. IARC Scientific Publications, No 30 International Agency for Research into Cancer, Lyons, 1980.
- Wagner J, Sleggs CA, Marchand P. Diffuse pleural mesothelioma and asbestos exposure in the north west Cape Province. *Br J Ind Med*. 1960; 17: 260-5