A HISTORY OF SILICOSIS ON THE WITWATERSRAND GOLD MINES, 1910-1946

by

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CHAPTER 4

THE PREVENTION OF SILICOSIS

Since its appointment in 1912, the work of the Miners' Phthisis Prevention Committee, appointed by the state, had been largely centered on carrying out numerous experiments to determine the quantity and nature of the dust formed in mines, and carried in suspension in the atmosphere. In its investigations, the Committee considered the best methods of preventing the formation of dust or of laying it, when its formation could not be prevented, and to safeguard miners against its inhalation. Attention was also paid in medical research and how this avenue of investigation could contribute towards prevention and reduction of silicosis incidence.

4.1 THE PERIOD PRIOR TO 1910

The silicosis problem involved the three participants, namely the state, the mines and the workers. The first to be aware of silicosis incidence was the Chamber of Mines, by receiving collective reports submitted to the organisation through their member's respective mine managers' reports. Although alarmed at the increasing high incidence rate, the industry in general did not initially adopt sufficient preventative measures, until compelled to comply with state legislation. To recover from the standstill period 1899-1902, due to the Anglo-Boer war, the industry was further influenced by economics to regain lost income and profits, which took precedence over all other considerations. Machine drilling provided that incentive, but by its implementation, mine workers became subjected to new highly dangerous levels of dusty underground conditions. The Chamber once aware of the health problem affecting its underground workers, did respond by independently introducing limited inexpensive preventative measures, using the two-tier system of controlled mining operations and limited medical examinations, but the results that ensued did not achieve the necessary success hoped for. The incidence rate for silicosis for whites in the first decade of the 20th century stood at 320 cases per 1 000 per annum, whilst the black annual death rate stood at 57,7 per 1 000[1].

The initiative in adopting positive steps was taken by the ruling party of the day from 1907 to 1910, who recognised the disastrous effect silicosis was having on the work force in the gold mining industry on the reef, and introduced limited legislative measures to control and curb this scourge. This included the use of clean water to be laid on at every development face and at all dry and dusty stopes. Improved ventilation systems were to be introduced and the wearing of respirators encouraged. The prohibition of blasting "cut and round" in separate operations on the same shift proved a great step in saving life amongst "developing" miners. Powers were granted to mine managers to insist upon disciplinary measures for breaches of mining regulations[2].

The worker is the centre core in the study of this thesis, yet as the most important and affected participant, the miner had the least influence or control in solving his own occupational health problem, which was regulated by the state and implemented by his employer. As the least aware or educated member within the tripartite enclave, the worker had to rely on his superiors at state and industrial levels to act for him in his best interests towards the protection of his wellbeing.

In the first decade of the 20th century, by the publication of government, industrial and medical reports, and through the media, the affected mine worker slowly began to realise the dangers of silicosis.

It was not until the Government Mining Engineer of the Transvaal Mines Department in his 1902 report, introduced the subject of health of workmen, that any attention was given to the problem[3]. Silicosis was mentioned as a disease peculiar to miners employed on rock drills. As a result of the follow-through Milners Commission's report (1903), recommendations were made towards the prevention and possible curative measures of silicosis, by controlling the discharge of dust particles, working places to be ventilated to sweep away all vitiated air, and the use of the 1 000 respirators specially imported by the Chamber for those workers actively engaged in rock drilling. Attention was also paid to dangerous exhaust fumes from air compressing machinery[4].

The Transvaal administration and the industry were compelled to recognise that there was a need for special legislation to enforce measures for the prevention of silicosis. The first step (1903) in a long series of silicosis legislation to control mining operations, lay in preventative measures enacting four regulations on ventilation, placing responsibility on miners and officials[5]. It was at this stage that the industry was confronted with hostile conservatism from the miners, by the industry using water allaying methods. The men objected to sprays on the ground that made it too damp and cold, claiming it gave them rheumatism[6]. In 1907, the Mining Regulations Commission (1907-1910) reported on the working of the Mines Works and Machinery Regulations with special reference to ventilation, and better protection of the health and safety of underground workers. By amending the 1903 legislation, mine managers were now responsible for supplying the necessary water and the miners for using it, with regular monitoring by inspectors of the Mines Department[7]. The supply of water had to be continuous and all working areas were to be watered down and kept damp. Blasting had to be arranged so that men working elsewhere were exposed to as little dust and smoke as possible[8]. Further enforcement demanded that suitable mechanical appliances be erected and operated to direct ventilating currents out of the mine, and that old workings be closed off. In development work where machines were operating, suitable arrangements were to be furnished for removing dust, smoke and gases after a blast, and no worker should return until the air was clear[9]. The original book of 52 pages of regulations, was now extended to 136 pages[10].

Inquiries in other countries appointed to investigate mortality then prevalent amongst men working in metalliferous mines, was the Royal Commission (1862) in England, whose findings did not identify silica dust as the cause of silicosis, a Royal Commission (1904) in Western

Australia to report on ventilation and sanitation, Dr. Summons report (1907) into silicosis at Bendigo Australia and Dr. Purdeys report on silicosis amongst quartz miners at Waila in the Mathiannia district of New Zealand. Other investigations in various countries on the subject of silicosis all confirmed that silicosis was caused by silica dust resulting in a chronic fibrosis of the lung, followed by various recommendations for the prevention of dust inhalation in machine drilling, blasting and shovelling and crushing of broken rock". As early as 1902, the Chamber offered prizes to encourage inventive enterprises for best practical suggestions and devices for combating silicosis, but although 229 replies were submitted by entrants from various countries, the competition was not a success[12].

By 1910, the then existing mining regulations, basic as they were at that time in comparison with the complicated sets of rules established by 1919, should have had some effect to start reducing the incidence rate of silicosis. Yet such was not the case, because the spirit of the law was not being implemented by the worker or the industry. Many a miner through stubborn resistance and carelessness was not prepared to accept or comply with new unfamiliar procedures which altered and interrupted his traditional working routine[13]. His attitude towards certain health risks was not given serious consideration. He resented the new regulations compiled by legislators, whom he considered ignorant of mining techniques. Those miners employed on contract work mostly ignored the rules, which if fully complied with, would reduce their performance output and bonus[14]. The men found the compulsory wearing of dust masks uncomfortable and inaffective[15]. All these negative attitudes towards mining regulations were openly displayed to the black workers, who themselves were least likely to conform to disciplinary procedures, if their superiors themselves chose to neglect such duties.

From a medical point of view, those miners with lengthy underground service were already progressing to an advanced stage of silicosis, where little more could be done for them[16]. There existed no continuous medical examinations other than the initial medical test conducted by part-time mine doctors. Many a borderline case of unsuitable applicants were given clean bills of health, qualifying them with red tickets for underground employment, thus adding to the danger of silicosis for these men.

In deep level mining, lack of sanitary latrine facilities created unhygienic conditions, which at best could be described as dangerous and disgraceful, causing miners to become liable to bacterial infection[17]. As the bucket system of privies were located some distance from working areas, both black and white workers often soiled disused sections. Human excreta found its way among loose rock and water puddles resulting in enteric fever, dysentry, tuberculosis and bacterial disease[18]. Black latrines were inferior to those provided for whites. They were poorly maintained, cleaned or disinfected, seldom screened with no privacy, causing blacks to dislike using their facilities and had to be policed to apply them[19]. Mine management and health officials were disappointed by the black man's lack of compliance or carelessness in using their privies, claiming black's indifference was due to their filthy habits and ignorance[20]. As early as 1903, the industry was legally obliged to introduce underground latrines[21]. The industry blamed white employees for not instructing their black subordinates in elementary hygienic proceedures[22]. Management often failed to ensure excreta was covered with earth or sawdust, or supervise disinfecting open buckets[23]. Medical evidence at the Select Committee report for Miners' Phthisis in 1915 reported widespread contamination by dejecta containing tubercle bacilli affecting both healthy and silicotic persons[24]. Only by 1918 did detailed legislation enforce stringent mine sanitary regulations, with vastly improved results.

What further deteriorated the situation was the attitude of certain mine managements in co-operating with silicosis legislation. Not all shift bosses and mining officials were prepared to discipline the workers, rather choosing to accept contraventions of regulations in favour of better production performance at the expense of workers health. Owners of low-grade mines silently approved and encouraged workers to adopt cost cutting measures, rather than complying with expensive mining regulations. As government mining inspectors usually gave prior notice of their visits, it was not difficult for management and workers to "get their house in order" for such inspections and thereafter revert back to the old procedures[25]. All these irregularities, blatantly conducted by workers and the industry were thus defeating and eroding the process of silicosis prevention.

4.2 PREVENTION BETWEEN 1910 TO 1919

The investigation conducted by the Miners' Phthisis Prevention Committee (1912-1919) was addressed at two levels. The first lay in the field of engineering, where mining operations were made safer by water applied at drilling points, spraying rock surfaces and by ventilation. Two methods were adopted to eliminate dust, the "wet" method involved the use of water at the source of dust production. The "dry" method was achieved by the introduction of powerful ventilation fans to dilute the air, and filtration units to catch and extract most of the dangerous residual particles. Other precautionary measures concerned blasting operations by removing all personnel from highly dangerous dust areas and the imposition of restricted re-entry periods[26]. These techniques for dust suppression, dilution and extraction took several years to reach positive fruition, but by 1916 the efforts and achievements in this field could be reflected by the reduced incidence of silicosis on the Witwatersrand[27].

The second level of controlled prevention lay in the medical examinations of all underground workers. Prior to 1916 there existed no uniformity in the standards adopted by mine doctors or any co-ordination of case reports between mines[29]. Thus men rejected for employment for health reasons on one mine had been known to have been accepted at another, which included individuals already suffering from silicosis contracted elsewhere.
In the case of white miners, once they obtained an underground certificate, they were not legally bound to be re-examined medically during their time of employment on the Witwatersrand.

With regard to black labourers, they were medically processed under a double system, first at the recruiting areas from whence they resided and later at the compounds of either WNLA or GNLB. The standard of medical tests were not high, more like parades where doctors briefly examined the men, rejecting obvious individuals of poor physique. Under such conditions, many unfit blacks were passed for employment. This system of medical examinations did not apply to labourers offering themselves directly for employment at the mines, thus avoiding the recruiting agencies.[29]

With the growth of knowledge, further legislative measures were adopted to enforce prevention by taking a line of action towards eliminating silicosis amongst workers. By 1916, the Miners' Phthisis Prevention Committee was able to compile an accurate schedule of recommendations, which were mostly incorporated within further silicosis acts. The most important suggestions were the careful selection of recruits amongst white and black employees, water allaying to be extended from 3 to 8 meters, black workers to be acquainted with dust prevention regulations, "cut and round" to be blasted separately in the same shift in the same development end, an official to be appointed at each mine to report on water services, ventilation and prevention of dust[30]. Parallel to the progress made in combating silicosis, the Chamber of Mines in 1914 appointed its own Standing Committee on dust sampling to standardise methods for determining dust in mines by periodic dust surveys of all scheduled mines, and create a laboratory for accurately determining dust samples and continued research work[31]. A ventilation expert attached to the Committee delivered lectures to mine dust inspectors to improve the standard of knowledge[32].

The Chamber also introduced in 1915, on its own initiative a scheme for annual holiday leave of 14 days for white miners as a health break[33]. Mine managers as a more responsible active body now insisted upon the best known methods of dust prevention being strictly enforced. They also endorsed a systematic examination of physical fitness of men engaged in underground work to be established[34].

The Prevention Committee realised that by 1916, its surveys required further years of practical investigation, which could not be fully concluded by statistics alone[35]. By examining the principle operations giving rise to dust in mine air, the Committee carefully sub-divided mining procedures into four classes, namely drilling which produced large amounts of dangerous dust, blasting which spread such dust throughout the mine, and transporting, breaking and crushing rock which again disturbed dust[36]. W. Morgan, president of the Transvaal Mine-workers Union in giving evidence to a Select Committee in 1912, claimed that since the starting of deep level mining operations, the men had no control over conditions underground. He agreed that rock drills were the cause of silicosis. He accused the mine owners of not providing a proper system of watering, with no pressure in the pipes and insufficient water to allow sprays to be adequately applied to all drives and shafts throughout each mine. Therefore men could only use water when available, and were unable to comply with regulations. A better system of mechanical ventilation would reduce humidity and improve health conditions underground. Contract men were at a disadvantage because of time lost in watering and dust allaying. This encouraged contractors to neglect regulation precautions. The miners had no control over the appointment of experienced mine inspectors whose numbers were inadequate to visit all scheduled mines on a regular basis. Most men were more aware of complying with mining regulations to reduce dust, but feared victimisation if irregularities were reported to inspectors. Many newly employed miners were inexperienced and unfamiliar with working conditions, thus breaching rules through ignorance and carelessness. The men objected to the idea of periodic medical examinations, except in the case of newcomers, however the MWU believed all blacks should be medically examined regularly as they were rife with tuberculosis, syphilis and other infectious diseases, which it was claimed made them a health risk to the white miners[37].

When the Union government took over control from the Transvaal administration in 1910 it also inherited the problem of silicosis on the Witwatersrand gold mines[38]. The two previous Transvaal "silicosis" Commissioners of 1903 and 1907 became the forerunner of many investigations, as a basis from which the Union government could evaluate the findings and recommendations of future commissions and committees to shape state policy to combat silicosis[39]. Up to that period, the medical profession had been largely responsible for most of the research on silicosis. A fresh approach marked a new departure, whereby members from many other professions joined together for the purpose of silicosis prevention. To succeed, this required the need for collaboration between doctors, scientists and mining engineers[40]. This led to the establishment of the Miners' Phthisis Prevention Committee instituted in 1911, jointly funded by the state and the chamber. Its members drawn from the public and private sector[41] were commissioned to enquire by experiments and other investigations upon improvements of methods for prevention of silicosis, and advise upon a systematic and uniform policy to combat disease[42]. This policy marked the first energetic step towards stamping out silicosis[43]. The Committee included in its investigations independent inventions, patents and suggestions from various sources. The few which appeared feasible and practical were submitted to tests and analysis, from which in some cases useful knowledge was gained[44].

There were many anomalies at both levels of silicosis prevention which led to objections and criticism by the Chamber and the workers. However by the introduction of the Miners' Phthisis Act no. 44 of 1916, a major improvement in mining regulations took place. This had the effect of diminishing the intensity and prevalence of the disease by applying greater stringency measures in underground operations and mining procedures.

4.2.1 Dust Reduction

4.2.1.1 Use of Water

By 1911, water was linked throughout the mines to all drilling machines and made available for use to spray all rock surfaces. If properly applied the system should have worked well at that time but failed because it was used irregularly[45]. Sprays were often out of

order and a tin can was frequently used by workers to keep down dust at drilling operations. The majority of miners were against the use of water, saying they preferred to die of silicosis, than of pneumonia or rheumatism[46]. Many mine officials regarded the use of water an unnecessary waste and a nuisance. At that time ½" (12,5 mm) diameter water pipes were used. Their narrowness often resulted in clogging, which was considered a good excuse by all miners and most officials for not using water[47]. Invariably no special effort was made for speedy repairs, when such faults were reported. The quality of water originally was supplied from pumps in a filthy condition. The water was neither filtered nor chemically treated. Some mine managers did try to supply pure water but in most cases this correction was often neglected[48]. No sprays were used at shaft boxes which were very dusty. Little attempt was made to keep sides and roofs of drives moist. Water was rarely applied in stopes and loose rock was removed regardless of dust. Water blasts were few in existence and rarely found in working order. The miners regarded these apparatuses as curiosities[49].
The water supplied in most cases was wasted. Taps and joints were often found leaking. Better supervision should have been exercised by miners, as blacks were shovelling rock which was insufficiently dampened, thus creating unnecessary dust. Hygienically treated drinking water was not provided, forcing workers to use impure water wherever available, with the risk of contamination[50].

The old method of dry drilling became prohibited by law in 1916 as sample tests taken using rock drills gave results of between 10 000 to 20 000 million particles (2,7 average in diameter) of dust per cubic meter of air, weighing between 50 to 70 mg[51]. The effectiveness of compulsory water laying by the introduction of sprays and general improvement of water reserve shown by sample testing, reflected very small quantities of dust. At Brakpan mines, the average of 13 experiments was 1,6 mg per cm of air[52]. From these above figures it will be seen that drilling of holes dry invariably resulted in the formation of very large quantities of injurious dust.
After rock had been blasted, its removal by shovelling, loading into trucks, taken to the shaft and tipped into shutes for filling into the skip resulted in raising large quantities of dangerous

dust. Investigations carried out by A. Johnston for Consolidated Gold Fields of South Africa Ltd in 1911, confirmed such results[53]. Conditions were practically the same as those generally prevalent before the introduction of methods of dust control by means of applying water at all points where dust was created. The operation of breaking and crushing ore was usually carried out on the surface. Experiments of dust levels in the air of crusher-stations, sample crusher-rooms and assay offices were found to be exceptionally high[54]. The Committee made representations to the industry, whereupon dust allaying appliances were installed. After the necessary improvements had taken place, by the use of water, further tests revealed that little dangerous dust then existed. Samples taken before dust laying precautions were adopted, gave results varying between 25 to 100 mg of dust per cm, containing from 380 to 1 100 million particles (average 3,7 microns). After dust allaying by means of water application results showed 1,5 million, a condition better than street dust levels on a windy day[55].

4.2.1.2 <u>Ventilation</u>

Ventilation had a direct bearing on the question of silicosis incidence by removing vitiated and dust-laden air from the mine. Defective ventilation had a lowering effect on general health and reduced power of resistance to disease, especially in those whose lungs may already have been weakened.

Ventilation fans were first installed in 1909, and by 1915, there were 42 fans in operation[56]. Air supplied per person in mines with forced ventilation showed great variation, as some had an abundance of air, whilst others were insufficient for adequate dilution and displacement in underground workings due to products of explosion combustion. Theoretically approximately 3 cubic meters of air per minute per person were called for under then "present" regulations, which was not the case in many working areas of certain mines. Out of 52 mines, 41 were above the legal standard of 3 cubic meters per man per minute, with an average of 5,5 cubic meters, while 11 were below standard with an average of 2 cubic meters. On the whole, ventilation on the mines could be considered good due to large

expenditure by the mines on dust allaying and ventilating appliances[57].
Humidity was another fact to be considered where in deep mines, the rock temperature rose to over 80^{0}F, producing discomfort and exhaustion[58].

The first systematic survey of the ventilation of all mines was conducted by the Miners' Phthisis Prevention Committee in 1913. The average result revealed 5,4 mg cubic meter of air, with highest readings found in raises, drives and ore-bins[59].

A test case in 1916 was illustrated in the table below, where blasting at a particular mine took place at 3:15 pm. The velocity of air current near an exhaust fan was approximately 500 meters per minute. Smoke appeared at the fan at 3:55 pm.

TABLE 13 DUST CONCENTRATION AT DIFFERENT TIMES AFTER BLASTING

TIME OF SAMPLING	MILLIGRAMS OF DUST PER CUBIC METRE OF AIR
09:00 to 11:00	3,5
14:00 to 14:40	3,5
14:40 to 15:15	1,0
15:15 to 14:40	9,0
16:40 to 17:45	12,5
17:45 to 18:40	9,0
18:40 to 19:20	5,5
20:45 to 21:37	3,0

From the above it will be seen that when blasting took place there was a sharp rise in dust maximising to about four times the normal level. After about two hours, gradual reduction occurred until after 8 pm normal dust conditions resumed[60]. Another test in 1916 near a drive, immediately before firing began, contained 6 mg of dust per cm. Five minutes after blasting 86 000 cm of silica particles (average 2,3 microns) was sampled of which 93,5% contained injurious particles[61]. These samples show the enormous quantities of very fine dust produced by blasting and the necessity of preventing inhalation by any mine worker.

In 1911, little attempt was made to course the air by artificial ventilation. Doors were rarely kept closed to keep out dust and the air in stopes was sluggish, and in some places the temperature appeared unduly high. Planning for ventilation improvements was not high on the list of mine-owner's projects. In most places the air current was so feeble as to be unable to move smoke, and air did not circulate in the ideal way as shown on some of the plans. Admittedly it was very difficult to ventilate a mine, particularly the old mines which were haphazardly developed.
As crusher houses were situated on the surface, little attention was paid to the health of those workers employed therein. This source of dust danger was only included in areas of dust prevention after 1911. Installed ventilation fans were not working properly and even those water sprays in use did not reduce dust levels in the air. Equipment intended to eliminate dust was not effectively inspected or maintained[62].

The monitoring of dust content underground during mining operations required the use of a reliable and simple portable instrument as part of the dust sampling exercises. The introduction of the earliest instrument, made use of on the Witwatersrand was the gavimeter in 1911. The principle applied was of drawing a known quantity of mine air through a column of pure sugar which was then dissolved in distilled water, the dust filtered off, ignited and weighed. Up to 1913 all dust found in the sample was regarded as dangerous and submitted as total dust, but research by J. Mac Crae proved ash in a silicotic lung only contained fine dust ranging from 12 microns downwards[63]. In 1916 Sir Robert Kotze, chairman of the Miners' Phthisis Prevention Committee devised his Konimeter consisting of a valveless cylindrical suction pump where air was sucked in and impinged on a glass slide coated with an adhesive substance, where particles of dust were counted under a microscrope[64].
Imperfections noted were, as the heavy cumbersome gavimeter collected all dust in the air, irrespective of size, so did the

lighter portable konimeter collect dust irrespective of kind or size. Furthermore konimeter readings showed considerable errors due to particle counting of under 5 microns in size under ordinary reflected light. This method could not distinguish spots of salts of sodium, calcium or iron. However experiments conducted by Drs. Mavrogordato, Moir, Ray and by Dr. Mc Ewen and Thompson in 1927 removed most of the soluable particles by the action of hydrochloric acid vapour which did not affect the silica. Particles examined under microscope shone up clear and bright without trace of contamination by either carbon or soluble salts[65].

4.2.1.3 Dust Sampling

The role of government dust officials and mine dust inspectors played an important part in monitoring and controlling dust incidence underground as well as inspecting surface crusher houses and assay offices[66].
Regulations 161(10), section 2 of Act no. of 1912, specified that the object of dust officials was to provide greater efficiency and better control of measures taken to reduce and suppress silicosis. These officials were trained and instructed to promptly discover and remedy as soon as possible any condition in the mine, which was conducive to the disease, such as the existence of dust conditions, a deficiency of the water supply, defective ventilation or exposure of men to dust and fumes from blasting.
It was the duty of the dust official to point out any worker contravening any of these regulations, and if necessary report to the shift boss or a higher official. Any defective equipment was to be reported and rectified immediately. In addition, the dust official was also required to periodically inspect crusher stations and ore sampling rooms to ascertain that proper measures were taken to suppress dust and that fans, sprays and other appliances were in good order and utilized[67].

Regular dust sampling, control and recording became standard procedure on all scheduled mines from 1911. Sampling was carried out by government inspectors using the sugar testing gavimeter up till

1917, from whence the Kotze konimeter became the standard dust measuring instrument. However the mining industry was reluctant to rely on the konimeter itself and as a compromise between the GME office and the industry, both instruments were used from 1919.[68]

Under the aegis of these controls, devolved the special duties of shift bosses who were responsible for the correct observance of these regulations and report to the mine manager or mine overseer any irregularities so found. Every shift boss was expected during his shift to inspect every portion of his section in order to secure the safety and health of his men were protected against excessive dust levels, as well as noting all equipment and appliances used in mining operations, conform to regulations so stipulated. A record book covering each shift was to be signed by the shift boss, presented, examined and countersigned by the mine overseer[69].

Mine mangers were expected to provide sufficient water underground so that all mining operations requiring the use of water could be complied with.
No person drilling with percussion machine, to drill without water, in collaring with percussion machine the floors, roof and sides within 8 meters of the hole being drilled had to be wetted. Blasting to be done once in 24 hours, "cut and round" not be blasted on same shift in same end; no re-entry before fumes were dissipated; an interval of at least 30 minutes to elapse before returning to face after blasting in any close places. Miners could only blast at end of shift except by special permission, with water-blasts put into immediate operation. The manager to arrange times of blasting and remove all persons not engaged in blasting operations from fume exposure, and post notices at headgear of blasting times.
Broken rock wetted down before removal.
Regulations referring to silicosis concerning blacks be posted in compounds.
Complaints book initialed daily by mine overseer and monthly by manager.
Miners noting defects in water service to be logged in a complaints' book[70].

The manager was to see that no work of any kind be allowed in dusty air conditions unless all floors, roofs and sides were thoroughly wetted.
No drill sharpening underground in any place where such work would be detrimental to health.
All old workings to be closed off.
Ventilation to be provided at winces, cross-cuts, drives, raises, back stopes, and such direction of air currents and position of doors and stoppings, to be shown on underground places[71].

Such regulations and similar procedures planning the services of the above mentioned officials could be illustrated by the distribution of a booklet sent from the Ferreira Deep Mine to the Joint-Secretary and Actuary, Transvaal Chamber of Mines (accompanied by a letter dated October 4, 1918). The booklet was a fine example of how thoroughly controls were detailed to provide as much preventative cover as possible towards the welfare and health of underground workers[72].

4.3 THE MINERS' PHTHISIS PREVENTION COMMITTEE

The Miner's Phthisis Prevention Committee spent seven years investigating and evaluating the main principles to be applied in the prevention of dust and its alleviation[73].
As the work of the Committee progressed step by step, and further knowledge was gained, it became obvious that certain methods, omissions or practices existing in the mines were of such a nature as to cause danger to the health of workmen. Such detailed studies were submitted in the Committee's two lengthy reports published in 1916 and 1919, and proposals presented, formed the basis of mining regulations in subsequent silicosis acts from 1916 onwards.
Recommendations made pointed out that if, after a few months trial the suggestions should prove effective, they be fully adopted and enforced by additional regulations under the Mines and Works acts[74].
For greater efficiency and better control of measures taken, permanent dust officials were appointed under Regulation 161(10). Their duties were to monitor the existence of dusty conditions, deficiency of water supply, condition of water used, wetting of drives, defec-

tive ventilation, exposure of men to dust and fumes from blasting, inspect crusher-stations and ore sample rooms.
In the Committee's Final Report in 1919 chaired by Sir Robert N. Kotze, Government Mining Engineer, concluding statements mentioned that the danger of dust was now well understood by the manual workers on the mines[75]. Miners were not now so anxious to earn money paid as silicosis compensation, and readily utilised dust prevention methods placed at their disposal. Workmen in 1918 frequently protested when dust levels became noticeable, yet the industry had not reached a stage when industrial unrest ensued because conditions underground became unhealthy. A slight increase of pay was still looked upon as more important than one affecting the health of all concerned[76].

The principle questions dealt with since 1916, were conditions in crusher-houses and sample crusher-rooms, the amount of dust permissible in mine water used for feeding water-drills, the ventilation of mines, experiments with various types of drills, and improvements in the sampling and determination of dust in mine air[77]. The results of the first four years (1912 to 1916) as submitted in the General Report of 1916, gave a comprehensive survey of the principles and methods of dust prevention. The next three years (1917 to 1919) did not produce specific striking or important results, but the discovery of new methods and designs of new forms of apparatus for dust prevention was to be carefully considered[78]. Generally speaking, the mines were well equipped with water and the necessary appliances, but there were still too many cases of carelessness and lack of proper precautions in using these appliances, particularly with black workers. The joint responsibility fell equally on employers and workmen. The management of a mine was responsible for the provision, maintenance and efficient appliances, but at the same time, workers were obliged to apply such equipment in use where their use was called for[79].

In summing up this sub-section it can be stated that the gold mining industry accepted responsibility for the health care of its workers. Its ignorance to this problem could be considered excusable in the early days prior to the Anglo-Boer War, but once having been confronted with irrefutable proof of the health danger to its employees, the mine-owners should have addressed the issue promptly. Bearing in mind the prevailing attitudes of the day, worldwide mining operating standards were appallingly low in regard to worker's health conditions. Management, officials as well as workers, accepted the old traditional hardships as applicable norms which both owners offered, and workers accepted in management labour relationship. The industry definitely dragged its feet in not providing for sufficient improved working and health arrangements to its employees, as only those improved services requiring little expenditure were adopted. All other considerations hinged on the cost factor, because reduced profits would lower dividends to stockholders whose support would wane in financing further development. It required an active government to firmly legislate sufficient regulations with improved amendments to gear the gold mining industry into positive action. Notwithstanding mine-owners objections to saddling the industry with what the owners believed to be excessive unbearable financial burdens, the state by its bold preventative policies in the long run proved correct in their policy of reducing silicosis. The industry still continued to remain healthy, make comfortable profits, accept wage increases, reduce working hours and sustain gold production with profits to the present day.

4.4 NEW KNOWLEDGE REGARDING PREVENTION

One of the most obvious and successful methods of acquiring new knowledge and data was by means of mining and medical research and findings, coupled with studies taken from reports submitted by government appointed select committees and commissions of enquiry.
Between 1919 to 1946, there were 3 commissions of enquiry chaired respectively by Justices J. de Villiers in 1921, J. Young in 1930 and J.R. Stratford in 1942. During the next 13 years, 6 select committees comprising of well known personalities such as Cresswell, Sampson and Hattingh for workers welfare, Kotze and Mac Neille for government interests, and Duncan and Oppenheimer for the gold mining industry investigated the problems concerning silicosis in published select committee reports in 1919, 1920, 1924, 1929, 1931 and 1932.

Running parallel with these findings were continual periodic reports of the Miners' Phthisis Prevention Committee and independent sub-committees of the Chamber of Mines investigating appliances and methods to improve mining practices with the aim of reducing dusty air conditions underground to protect the health and safety of underground workers.

The Government Mining Engineer's Department headed by Sir Robert Kotze for 14 years, later succeeded by P.C. Pirow in 1925 monitored mining regulations by teams of Dust Sampling Inspectors to prevent neglect or carelessness by labour or management.

In the field of medical prevention and control, was the splendid research undertaken by the S.A.I.M.R. whose staff comprised of highly qualified specialists like A. Mavrogordata, S. Lister, I. Simson, H.S. Southerland-Strachen, L.G. Irvine and W. Watkins-Pitchford. The last two personalities were also chairman of the Miners' Phthisis Medical Bureau which included the valuable services of C. Hurwitz, F.S. du Toit, M. Becker and A.S.W. Verster to name a few.

The Mine Doctor's Association added strength to the silicosis problem at grass root levels for the control and health of all black labour on the gold mines. In this field the most prominent personality was A.J. Orenstein, supported by H.T.H. Butt, A.I. Girdwood, A.S. Smith, C.B. Stoney and E.L. Ferguson.

The state's concern towards the problem of prevention of silicosis in the gold mining industry did not rest after each report was tabled for examination. The policy was rather to appoint further committees with the view to acquire fresh knowledge for the improvement of worker's health in the industry. The De Villiers Commission[80] appointed in 1920 stated in its second term of reference that "its function was to enquire and report on the steps taken for the prevention of the disease". This subject was deemed of supreme importance particularly whether any improvements were possible. Inspections made by officials of the Government-Mining Engineers Department of the Witwatersrand and the Van Ryan Gold Mining Company, strongly condemned the laxity displayed in certain instances in the observance of silicosis regulations[81]. There could be no reasonable hope of eradicating the disease as long as laxity was permitted by mine officials.

4.4.1 Drilling Machines and Water Application

In the methodology of mining operations the main target of investigation was in the use of rock drills. By 1920, reciprocating and hammer type machines were mainly in use. Both applied water under pressure which provided reasonably satisfactory dust prevention. On evidence presented before the De Villiers Commission, the Leyner type of drill was acknowledged as the most efficient on the market. Yet in the opinion of the Government Mining Engineer it was also the most dangerous[82].

This view was also shared by a previous report (1919) of the Miner's Phthisis Prevention Commission[83]. Using both air and water the Leyner drill was satisfactory when in perfect order. However when certain internal fragile parts broke, its performance did not diminish drilling capacity, but interfered greatly with dust prevention, as its operator was unaware anything was wrong and continued drilling as if nothing was happening. Furthermore it was beyond the capacity of an ordinary miner to put right when out of order[84]. The machine constituted a danger to health and should be discarded in favour of safer drills, even if speed and economy of drilling suffered.

The Commission stated in its report to have been pressured to recommend the prohibition of such machines, but hesitated to take this drastic step, owing to the large number of this type of drill in use. It believed such a move would cause a serious dislocation within the industry[85].

This decision, although extended for a limited period, could be sited as a clear example where financial consideration superseded worker's health issues. However what the Commission did recommend was that no further installation of these machines be allowed, unless improved upon to the satisfaction of the Government Mining Engineer's Department. Further objections were raised against the use of solid steel drills, as the laying of dust depended entirely upon the human factor in the form of black labour applying water through a hose to the hole to be drilled. Not only was the black worker unaware of dangers due to his neglect in not using water, but often his attention was diverted to other matters, such as attending to drills stuck in holes. Blacks working under contract were paid according to performance and results, and without direct supervision during most of the drilling shift. These facts were borne out by witnesses appearing before the Commission[86].

A committee of the MWU examining the merits of the Swift Drill Attachment were impressed with its efficiency, simplicity and solidity claiming it to be superior to the water Leyner drill. As a result of a joint meeting of representatives of the Chamber of Mines, the Mine Worker's Union and the Department of Mines, it was proposed to carry out tests with 100 of these attachments until results carried out were completed. The Swift appliance could convert solid steel drills into waterfed machines at fairly low cost. Until then all jackhammer drills were to be converted into water feed machines by March 1921, but this ruling only became effective in 1926. Also in future no drill be used on a scheduled mine without the prior approval of the Mining Department[87].
A machine stopping device had been invented for cutting off compressed air from the machine when water supply failed, thereby stopping the machine automatically. This device was not yet in service as the inventor was withholding its use pending a reward. The Commission suggested this or any other similar appliance be made available at an early date by offering suitable remuneration.
The problem of excessive large quantities of dust caused by collaring or starting holes by all types of drilling machines could be further reduced by supplying extra water hoses. The expenditure involved was trivial compared to the benefit derived[88].

During the years between 1920's and 1940's, improved designs and performance of rock drills played an important role in the control of "drilling" dust. The De Villier's Miners' Phthisis Commission's interim report claimed the use of water for dust allaying was nearing the limit of its effectiveness and additional methods of ventilation would have to be relied upon for further progress in that direction. This information was passed on to the Commission by the work of the Joint Committee of members of the Mines Department and the Chamber of Mines Dust Sampling Committee who had investigated the efficiency of water blasts in development ends and the amount of air required after the blast to clear the atmosphere of dangerous dust particles[89]. This work was extended into 1923 to evaluate the quality of air intake in the control of health conditions of the operators[90].

A permanent committee with representatives from all bodies of white workers was appointed in 1925, to monitor the methods of preventing silicosis already in force, and to investigate any new ideas[91]. The G.M.E. advised the industry that all machine drills passing air down the hollow jumper would be prohibited and that only machines approved by him would be permitted in all classes of work[92]. The accustomed use of generously "slopped about" water, with no effort made to prevent mine air becoming water saturated, was by the late 1920's adjusted, particularly in deep level mining, to reduce excessive and unnecessary use of water. This meant having to re-educate all operatives from encouraging its full use by many contrivances, to limit the use without endangering the effectiveness of then present mining procedures[93].

At the 33rd annual General Meeting of Mine Mangers (1928), M.O. Tillard remarked on the latest developments as a result of perfecting designs and methods of application of drilling machines together with a close study of methods of handling broken ore[94].

Research work continued under the supervision and control of the Investigations Committee. Numerous tests of various kinds were made in connection with drill steel, particularly with sharpening and hardening of drill bits. The introduction of improved materials to spare rock drill parts had been carefully studied and by reducing the diameter of round and hexagon shanks to 3 cm for stoping, greater economies were affected in drilling costs with increased meterage drilled[95].

The problem of leakage of air down the drill steel of axial water-feed drills had still not been fully corrected. As late as 1937, the Miners' Phthisis Prevention Committee requested its further investigation[96].

The United States Bureau of Mines reported (1938)[97] that drilling machines were known as one of the worst producers of air dustiness in metal mining operations. By the elimination of dry drills by mining companies, this particular problem could be solved, yet wet drills did not entirely eliminate dust. In fact more dust was created with sharp drills than dull drill bits. The use of foam and

so called wetting agents in drilling had been studied, but results have not yet proved satisfactory and further studies along different lines should be considered. Tests on the effect of angle depth of the drilled hole were conducted to determine the concentration of dust in the air. Steep up-angles had higher concentrations of dust in such places and rises.
It was found that the rate of water and higher pressure could be increased through a larger diameter in the drill steel giving better contact between the water and face of the drill hole. In the first 60 cm in drilling, greater concentration of dust was thrown into the air, but thereafter this was greatly reduced as the depth of the hole increased[98].

Another level of investigation in 1927 probed into an improved assortment of tools for handling ore and timbering. It was pointed out that better facilities for maintaining tools in working condition should greatly increase efficiency. An example was given of 100 axes in use in one shaft, all of which were in a bad condition, but no mine had a grindstone underground. There were not sufficient water and air hose pipes in mines and the continual dragging of rubber hoses from one place to another was false economy[99].
Coupled with these investigations were mechanical improvements in handling and transporting ore underground with mechanical loaders, muckers, scrapers and shaker conveyers[100].

The main technological advance in the field of improved drilling machines lay in more efficient mechanical functions giving less breakdown problems and coupled with the changing shapes and sizes of steel drill bits, to which could be supplemented a water and air induced system attached to the whole mechanism[101].

Extracts from the National Board of Occupational Safety and Health (Sweden) on "Dust Control in working Environment" (Silicosis) believed that noise and oil mist produced by drilling should be considered a greater problem to occupational hygiene than the dust. It was suggested that the drilling unit be designed to be controlled from an isolated and ventilatory cabin, as could be ore-loaders. What would happen to other workers elsewhere was not mentioned.

The report did claim that between 30% to 50% reduction of dust during driving and secondary blasting had been achieved by stemming the charges with water filled plastic bags or water cartridges[102].

Drilling dust problems were further mentioned by Reed who commented that some mine managements allowed this issue to take a back seat in preference to other "urgent" matters. This wrong impression was proved that in 1939, 230 new cases of silicosis in whites and 512 in blacks were detected[103].
A.V. Lange drew attention to the advantages of long-piston drills having smaller bore resulting in little air passing through front-head with practically no fogging. On recommendations of the Miners' Phthisis Prevention Committee to Government Mining Engineer at the end of 1938, the standardisation of size of tube and bore in pistons became law in 1940[104].
G. Hildick-Smith, manager of the Modderfontein B Gold Mines, expounded the danger to health of underground workers was due to inhalation of solid and soluble silica by the atomisation of mine water, but K.J. Mac William advised caution to this theory suggesting further investigation under properly controlled conditions inviting government observers to participate to these tests[105].

4.4.2 <u>Ventilation</u>

At the turn of the 20th century, the mine-owners believed ventilation in mines were cool, comfortable, free from natural noxious gases (as in coal mines) and conducive to maximum worker productivity[106]. This theory backed by R.E. Brown, an overseas consulting mining engineer, strengthened the complacency and scant attention mine-owners gave to this problem.
However, most miners disagreed with this attitude of mine management. At the Weldon Commission (1906) on silicosis, representatives for the Transvaal Miner's Association gave evidence that "ventilation and sanitation was bad on the mines"[107].
The first silicosis commission in 1903 recommended each mine have two shafts, one for entry of cold fresh air from the surface into

the mine by way of the downcast shaft. Sweeping through the hotter atmosphere of the mine, cold current would push up hot polluted light air through the upcast shaft to the surface[108]. The access of two shafts would also provided a safety measure in case of accidents.

However as mining depths increased, giving rise to humid hot temperatures, mechanical fans had to be installed to provide for safe comfortable working areas for miners. Ventilating fans were first installed in 1909, and by 1915 42 fans were in operation[109].

Air supplied per person in mines by forced ventilation showed great variation, as some mines had ample air, whilst others were insufficient for adequate dilution and displacement in underground workings due to production of explosion, respiration and combustion.

The 3 cubic meters of air per minute per person called for under these regulations in the 1916 act was not consistent in many working areas of certain mines. Out of 52 mines, 41 were above legal standard, with an average of 5,5 cubic meters, whilst 11 were below standard with an average of 2 cubic meters. On the whole, ventilation on the mines could be considered good, because of large expenditure by the mines on dust allaying and ventilation appliances[110].

By the 1920's, the importance that ventilation played in preventing silicosis became apparent and appreciated. Among the various branches of mine engineering, the subject of ventilation had in recent years attracted much attention, chiefly because great advances made in research into physiological conditions of work underground demanded the need for an exact control of atmospheric conditions below ground[111].

Apart from the development in practical methods, there were problems requiring investigation from scientific and economic aspects involving partly laboratory work, and partly large-scale experiments in the field[112].

The Witwatersrand mines had by then advanced further in the practical application of ventilation improvements than elsewhere. An example was the New Modderfontein mine which could afford to sink a special shaft 600 meters deep for ventilation purposes costing over R200 000[113].

Such newer mines had the advantage of suiting their layout to ventilation requirements with fairly satisfactory results, whereas older mines because of their unplanned tunnels found such improvements impractical and uneconomical[114].
In research work it became necessary to make use of instruments of a practical nature capable of giving readings of a high degree of accuracy. Then "present day" instruments such as wind-vane anemometers and simple U-tube water gauges were not good enough for routine purposes. By the application and proper use of modern recording instruments, the whole subject of ventilation would be better understood resulting in increased efficiency and economy[115].

According to the experience of C.E. Hutton, an inspector of mines at Brakpan, stated in 1924, the principle methods used to cause ventilation current to circulate along the working face was the use of portable blowers operated by compressed air or electricity where mine air current was deviated from the centre of the stope and directed towards the face. The application of brattice cloth produced good results, but was troublesome and costly to maintain in good order. Furthermore concrete or masonry brattice walls built across top and bottom of stopes would force air currents towards the stope face, and also serve as a barrier to prevent rock from the blast being scattered far from the face, enabling sweeping and washing to follow closely on stoping operations.

The De Villiers Commission of 1921 in its letter to the Government Mining Engineer expressed approval to the systematic inspections made by its staff on all scheduled mines as outlined in section VIII of its annual report for the year 1919. It further suggested that more inspectors could evaluate whether regulations were observed or not with regard to dust and ventilation and what steps should be taken to improve conditions. Where costs were considerable, an estimate would enable the Commission to judge what measures could be adopted[116].
In an article "Rock and Air Temperatures in Deep Level Mines" by M.O. Tillard and E.C. Ranson published in 1926 it was stated that ventilation of mines on the Rand had four main objects, namely to supply pure air chemically, the mitigation and removal of the danger

from siliceous dust, the supply of cool air to deep mines and the removal of dust and fumes produced by blasting[117].

F. Heise of Bochum, Germany, suggested the use of exhaust steam to ventilate mines, but ventilation furnaces at the bottom of the up-shaft was regarded as an antiquated method, as the heating effect of steam pipes laid in shafts had only a very restricted result, added to which was the drawback of filling the shaft with irrespirable or even poisonous gases[118]. Dr. Dobson stated that the economics of chemical refrigeration both on surface and underground had been thoroughly explored, but proved impractical[119].

C.F. Raney found that splitting of air with resulting reduction in temperature could succeed if the mine was divided off into different splits and deflected to workings by proper doors and brattices[120].

The above views and experiences of mine inspectors, mining engineers and professionals, whose work emcompassed the mechanics of mining operations could also be supported or discarded by other researchers who either accepted or rejected certain theories made known, or mining methods applicable at that time.

As late as 1927, despite great strides made in improved technology, excuses were made for inadequate provision for ventilation that work would have to be stopped for a few days or weeks. C.E. Hutton an Inspector of Mines at Brakpan stated management did not realise that in order to combat silicosis it was essential to have low dust counts at all places in the mine at all times when persons were working there[121]. Least satisfactory conditions were found in subsidiary development ends, such as cross cuts, box-hole rises and secondary development in unpayable blocks.

Although natural ventilation still played an important role in producing the flow of air through the mine induced by the use of water underground, it was universally acknowledged that large fans provided additional beneficial results. Some mines had shafts which were only used to return air to the surface. Larger mines circulated over 6 000 cubic meters per minute. R.A.H. FLugge De Smidt produced a paper on the application of the air-screw propeller fan to mine ventilation. The original sceptical approach to this matter later revealed that after 200 separate tests recorded, the results of investigation proved this type of fan efficient, in spite of resistance commonly met with in mines[122]. In 1924 only one fan was in

use, by 1931 25 fans were working on the Witwatersrand.
Further supportive proof was expressed in 1932 by J.P. Rees and E.C. Whittaker who commented that by very large fans producing heavy ventilation pressures at deep levels, the knowledge of distribution of fan pressure became an important factor in the economic use of power output of the fans. With fans taking up to 1 000 hp, a clearer knowledge of power distribution became urgent, so that if excessive loss existed, it could become apparent and remedied, as such losses may have occurred even though the efficiency of the fan was high[123].
In the 1930's refrigeration plants became standard ventilation installations, where the largest unit in the world was designed to provide over 4 070 cubic meters per minute[124]. A new ventilation pipe that was introduced, carried as main features the reduction of wastage in air delivery, coupled with minimising its damage in transport and usage as well as ensuring simplicity in conveyance and installation[125].

Due to the systems of mining in vogue on the Rand during the 1930's and the layout of many mines, the application of fiery mines' method of ventilation was not a practical proposition, but recent results in extracting dust from mine air by filtration and precipitation proved to be a deciding factor in making work in scheduled mines a reasonably healthy occupation.
Types of filters used were flannel bags and boxes fitted with removable sides of sawdust held in place by wire gauzes, used in ore passes and ore-bins which were prolific producers of dust and usually situated in a main intake of a mine. Subsequent tests showed that 90% of dust could be extracted from the air.
However K. Leinberger, Inspector of Mines reported in 1940 that then present-day (1935) filters, both flannel bags and sawdust, were bulky, had limited use where space was available or where special excavations were cut. The answer was to reduce the size of the filters without impairing their filtering efficiency. His report observed that generally conditions were satisfactory, but certain irregularities such as defective ventilation in some mine areas, inadequate ventilation at certain dead ends, insufficient control of dust from sand dumps and unsatisfactory state of underground

sanitary conveniences were found wanting. When these matters were presented to the mine manager, immediate and personal attention was given, and the ventilation system had since been reorganised in certain sections of the mine[126].
Papers delivered by E.P. Cowles and R.P.H. Flugge de Smidt, and D.G. Malherbe, an Inspector of Mines, Brakpan, likewise reported similar such above conditions and corrections made by mine managers. Most mines have continually upgraded their ventilation systems at considerable cost[127].

By the 1940's, the Miners' Phthisis Prevention Committee reported that progress had been made in a number of important investigations on the efficiency of dust filters and respirators. The factors affecting dust was produced by rock drills, purity of water used for dust control, and dust produced by scrapers. Further problems of heat and humidity in deep mines, was the dust produced by diamond drilling and the foaming solutions designed to replace water for suppressing dust created during drilling. Also to be considered was dust in change houses, efficiency of water blasts in removing the products of blasting in development ends, design of apparatus for testing rock drills to ascertain quantity of air passing down the drill steel with water, efficiency of electrical precipitation of dust from mine air, modifications adopted in technique used in treating and counting thermal precipitator samples[128].

Credit should be given to the technological advances made in ventilation systems underground, to extract as much dust content as possible. By the practical application of costly new, bigger and better ventilation equipment financed by many gold mining houses, such as up to date propeller type fans supplemented by refrigeration plants made working conditions underground more pleasant, bearable and healthier for the workers. Most of these improvements had been implemented by the late 1920's and early 1930's, as from then onwards, there were few new invented systems that could be installed to replace the existing proven satisfactory appliances.

Even sewerage miners engaged in trenching, drilling, tunneling and blasting in construction of sewers on the Witwatersrand became highly exposed to inhalation of siliceous dust[129]. By arrangement with the Miners' Phthisis Medical Bureau all such workers were medically examined every six months[130]. Wet drilling was introduced with regular inspections from the Government Mining Engineer's Office[131]. Between 1932 to 1936, 48 municipal workers so examined revealed 22 cases of varying degrees of silicosis[132]. The exposure rate for such workers was between 9 to 17 months as against an average of 17 years for Rand gold miners[133]. However, black labourers were not examined or traced after leaving such employment so no accurate assessment could be made in their case[134].

4.4.3 Dust Sampling

By 1938 the gavimeter was finally abandoned. In 1935 the thermal precipitator introduced by Patterson proved a far more accurate dust sampling instrument. Up till 1930 both sample methods using the sugar gavimeter and konimeter instruments could not claim any scientific accuracy. Besides its faults and errors, the average dust content recorded had shown a fall of 5,5 mg per cm in 1915 to under 1 mg per cm in 1941[135]. Despite inaccuracies of sample results, reasonable readings obtained supplied useful information regarding conditions and improvements in the dustiness of mines.

Investigations made indicated no single method of collecting dust samples was able to fulfill all desired requirements. The ideal method of dust sampling as expounded by the Medical Research Council was to estimate the number and size of dust particles in a unit volume of air, identification of mineral constituents of dust, its chemical analysis, and the use of light portable instruments to take samples quickly, and with reliable results by any person capable of handling ordinary instrument work[136].

More knowledge was required about dust clouds and their formation, where the really dangerous spots were at a particular working area could provide further breakthroughs in mining technology.

The Miners' Phthisis Prevention Committee had, since its inception in 1911, carried out tests and experiments for many years on methods of controlling and reducing dust production made by the rock-drill.

Investigations had been made with the water tube, its correct size, clearances and water pressure as applied to its delivery to the drill bit, which resulted in the prohibition of using the lateral hose during collaring, and encouraging use of a combined air and water-tap. The Committee supported the efforts of the industry to improve ventilation of development ends to reduce dust levels. Tests on the effect of dirty water on dust production during drilling recommended a cell count not to exceed 10 million particles per cc. By observing the filtration of dusty air, particularly at tips and ore-passes, endorsement was given to the use of flannel and sawdust-filters, and recommended the disuse of water where filtration was successfully applied. The Committee investigated the dust conditions in change houses, drill-sharpening shops and welding shops with the object of dust prevention. Dust sampling techniques were standardised with the thermal precipitator in use to a large extent. The Propaganda Sub-Committee which, by posters, slogans and broadcasts in compounds where blacks were housed, had endeavored to publicise methods of preventing silicosis. New ideas and suggestions were welcomed, but most of this work led to negative results. In 1937, the Committee published a report on the Prevention of Silicosis in the mines of the Witwatersrand, which contained a great deal of valuable information[137].

4.5 MEDICAL CONTROLS

Parallel to the engineering aspects of silicosis prevention, were the medical investigators to the problem. Although there were concerned doctors who recognised the dangers of silicosis, they carried little influence, until the early Transvaal commissions revealed such evidence in the first decade of this century. The impact of accelerated silicosis in the Transvaal became known because of the magnitude of the industry, the vast number of miners employed and the unique concentration of the Witwatersrand gold deposits in a comparatively small area[138]. World wide indifference and ignorance of health officials to chronic silicosis and its cause, as well as disregard for industrial hygiene and failure to issue cautionary warnings, contributed to the high incidence rate[139]. Certain Transvaal health officers claimed miners received little exposure to injurious dust in the early days of mining due to open air cast workings, comparative softness of friable rock in underground workings and hand drilling methods[140]. Health measures were not as successful as they could have been due to lack of unity amongst individual mines in tackling the health problems of its workers by taking cost factors into consideration. Its failure lay in not affectively implementing sufficiently stringent regulations, to reduce incidence rate of silicosis during the first decade of the 20th century, which then stood at an average of 320 per 1 000 per annum for white silicotics, whilst the annual death rate for tuberculosis in blacks stood at 57,7 per 1 000[141].

The gold mining labour force was comprised of two separate groups of workers, namely skilled and semi-skilled white miners and black labourers. Because white miners were mainly affected by silicosis, a non-infectious disease and the black man was primarily susceptible to infective tuberculosis, two varying health measures had to be applied in each case. In addition to the medical precautions as applicable to whites, further preventative measures, by way of sanitation and hygiene had to be introduced for the black worker[142].

Most black recruits from rural areas, who passed medical fitness tests were found to be undernourished when first arriving at the mines. They all required a few days rest with proper dietary meals to restore them to full working conditions[143]. Those from Mozambique conveyed by sea, and the manner in which they were accommodated and fed, in the days before 1912 made them more susceptible to infection by being overcrowded in close quarters[144]. In 1913, the Chamber extended an invitation to an American health delegation led by Col. W.C. Gorgas (of Panama Canal fame) to investigate and advise sanitation mining conditions and prevention of high mortality amongst blacks[145]. After two months investigation, Gorgas presented his report, which today can be regarded as basic routine health procedures, but at that time, his proposals seemed revolutionary and expensive[146]. His two main recommendations were that hospital services be provided by the mining companies, and more spacious accommodation in the compounds

would reduce the danger of infections from diseases such as pneumonia, tuberculosis and meningitis. Compound diet could be improved with more vitamins and less carbohydrates (mealie meal). The bucket system of sanitation used in compounds to be replaced by water-borne sewerage. Sixty two mine hospitals poorly staffed and manned by black inexperienced nursing staff to be brought together under one centralised hospital, run by the best qualified doctors and trained nurses with first class surgery, would cost less than the then present system[147]. Although not all these recommendations, particularly the expensive projects were adopted in full, the report did mark a turning point in the history of preventative medicine on the mines in the Witwatersrand.
The recommended appointment of Dr. A.J. Orenstein (1914) (a protegee of Dr. Gorgas) took up the position as medical superintendent of the Rand Mines Group with wide powers of authority[148]. By the end of 1915, he had set up a central sanitation and safety committee acceptable to all mines, with the introduction of water-borne sewerage. Recommended antiseptics and more use of soap and water were adopted. He established a laboratory, engaged a full-time sanitary inspector, improved cooking of food in compounds and upgraded sleeping accommodation. Full time medical officers were appointed by the mines to replace the part time system of doctors on call at an "as and when" basis. His annual reports were widely received and acclaimed by the mining industry. The total mortality rate for blacks from all diseases had fallen from 31 per 1 000 in 1910 to 8,5 per 1 000 in 1917[149], which was due to the effectiveness of mining preventative policies in reducing health hazards. Not only was the black worker the fitter person as a result thereof, but his productivity rate as an employee became an added bonus to the industry.
Until 1916, certification of blacks was by Medical Inspectors of Mines, with no radiographic facilities. Under the new law mine doctors became the examiners with prescribed duties, amongst which was to exclude the employment of any blacks suffering from tuberculosis or silicosis[150].

The government appointed Miners' Phthisis Prevention Committee in 1912, was the first serious investigation of the silicosis problem undertaken. At that point in time, knowledge of the disease, both

at clinical and pathological level was extremely limited. The Committee's task was to investigate the dimensions of the menace, suggest ways of prevention, and advise on a uniform policy with the aid of enactments to the Mining Regulations to combat the disease[151].
In the same year the SAIMR was established and amongst its varied investigations was the basic studies of the silicon particle, the pathology of the silicotic lung and other aspects of the disease, particularly its association with tuberculosis. The Institute's findings claimed it was never safe for a silicotic to resume underground work, as the danger remained that once the lung fibrosis had progressed to a certain stage, tuberculosis infection also invariably followed[152].
Over the next four years, a reasonable amount of medical research into silicosis prevention, gave the authorities sufficient knowledge to confidently enact further legislation towards safeguards in occupational health prevention. The Miners' Phthisis Medical Bureau was instituted under the Miners' Phthisis Act no 44 of 1916. This body was solely a government institution within the Department of Mines and all staff appointments were made by the Minister of Mines and Industry. The examining medical officers at first numbered six, but later as the amount of work increased, the number rose to eight. An official pathologist and part-time radiologist was also employed. The Bureau also had the advantage of independent pathological opinions from the staff of the SAIMR. A secretary, technical and clerical staff of 19 completed the establishment[153].

In respect of white, coloured and asian miners, the chief duties of the Bureau was to conduct four classes of medical examinations. <u>The initial examination</u> was for all persons who applied for first time employment underground on scheduled mines. From 1916 all such applicants were strictly screened and only candidates found medically fit were accepted. Also rejected, were those of poor physique, who although not actually diseased, had a low resistance to chest infection and thus a potential danger to themselves and a liability to their employers[154]. On an average less than 50% of the examinees passed the test, but those rejected could re-apply later and of this group a considerable proportion of such candidates eventually succeeded in obtaining an "initial" certificate. Complaints had been lodged against the Bureau's high standard of fitness, which needlessly deprived the industry of recruits and unjustifiably inflicted hardship on many of those seeking employment[155]. Certain miners from overseas were assured by their doctors that they were physically fit, yet found themselves rejected by the Bureau on their arrival[156], which entailed disappointment and in some cases hardship. In reply to such criticism, the adoption of a high standard was in the interests of the candidate, for no employment, however lucrative could compensate for the loss of health or life. The lowering of the medical standards was not called for on economic grounds, as only 51% of those who passed the examination, secured employment underground[157].

The six-monthly periodic examinations included all "full-time" miners working underground, including all persons employed on or about crusher stations, sample or assay offices or change houses[158]. The "periodic" certificate issued by the Bureau simply certified that the holder was not suffering from tuberculosis and could continue underground work. If found to suffer from any form of tuberculosis the miner was obliged to relinquish underground work immediately. If found to have simple silicosis, it was optional for him to apply to the Miners' Phthisis Board for compensation and leave underground work, or remain at work and postpone taking an award[159].

The special certificate was granted by the Bureau to those persons whose work occasionally took them underground, but were not "full-time" miners. Very few cases of silicosis or tuberculosis was detected from this group of workers[160].

Benefits examinations were carried out in claims for awards made by or in respect of living miners. The main object was to re-examine existing beneficiaries to ascertain whether they had progressed to further stages of disease and entitled to further awards[161].

The last category of medical examination was to investigate and decide all claims made by dependents of deceased miners who had been subject to silicosis or tuberculosis[162].

Black labourers underwent as in the case of white miners, an initial and periodic examination, but also a final examination on termination of underground employment. These examinations were not carried out directly by the Bureau, but by mine doctors holding full-time appointments, as examiners under the 1916 Act. The Bureau however exercised general supervision and control over this work by periodic visits of inspections to all scheduled mines several times a year. The initial and periodic examinations had already been explained earlier and the final examination involved a full clinical test. The worker was only discharged if found free from silicosis or tuberculosis. If not, suspect cases were transferred to the Central Hospital of WNLA, where the final decision was made to award the necessary compensation[163].

4.6 POLITICS AND PREVENTION

Because of the important position the mining industry held in the South African economy, many of its leaders believed they should have an equally important voice in public affairs. They claimed their interests only lay in the industrial field, but many outside that industry were not convinced, believing "mining" pressure would eventually favour the mine-owners to the detriment of the rest of the community. The first few years after the Anglo-Boer War, saw the mine-owners at the peak of their political influence, particularly during the Milner administration which often pampered to the needs of that industry, to derive the quickest and greatest single source of state revenue required to rebuild the country[164].
After self government in the Transvaal in 1907 and Union in 1910, this advantage had receded and the political impact of "gold mining" power, although important, was viewed more as a regional issue within the overall South African political scenario. The Union government still needed the co-operation of the mining politicians and where possible avoided introducing contentious legislation on white labour, but at the same time could not indefinitely ignore the serious high incidence rate of silicosis on the gold fields[165].
The first public statement by the government on the question of silicosis prevention was made in parliament by General Smuts in 1911, as the then Minister of Mines, who called it "a blot on the

conscience of South Africa if the government did not do something real and substantial in this matter"[166].

In the ensuing debates that followed over the next few years many divergent opinions were expressed from the floor by the legislators. These resulted eventually on the issue of who was responsible? who should pay compensation to silicosis victims? and what controls were required to reduce and eliminate this scourge?.
As the South Africa Party formed the government during the 1910 to 1915 parliamentary period, holding 68 of the 131 seats, with strong support from the Labour Party, it was able to implement its silicosis legislative policies for the benefit of white miners. Even when the political structure altered during the next parliament from 1915 to 1920, the South Africa Party still enjoyed the support from the majority of the House in drafting its subsequent silicosis acts. During this period, political support could be grouped as follows:
The workers had the interests of the Labour, South Africa and National parties on their side, whilst the employer's support stemmed mainly from the Unionist party, with the state enjoying South Africa and National party sponsorship[167].
On the question of which group placed responsibility and liability against each other, various conflicting opinions emerged. The employers and workers both claimed the state was responsible. Yet both the state and workers believed the employers should carry full liability, whilst the employers laid responsibility upon the state and workers[168].
However, within the ranks of the legislators, responsibility and liability levied against both employers and workers came from legislators representing constituencies outside the Witwatersrand areas, whilst blame levied against state and workers were those members associated with mining interests, and finally liability was laid against the state and employers by those members supporting white labour.

Parliamentary debates during 1911 to 1918 on successive silicosis bills introduced in the House, reflected various political opinions on how best to solve the prevention problem on the gold mines of the

Reef. The newly created Union government became aware of international criticism, which had built up during the preceeding decade, on occupational health hazards in South Africa's gold industry.
J.X. Merriman (MP) stated in the House of Assembly on April 15, 1912, that 3½ times as many gold miners died in South Africa, as there were in the whole commonwealth. Little was done for blacks who did all the hard work in the most dangerous places, received low pay and knew nothing of disease or medical care[169].
W. Runciman (MP) drew attention in the House on June 16, 1913, that public opinion in England had been awakened to the importance of the matter and expected something to be done. The British public through its press looked upon the Union government to see that this horror was removed for the good of the suffering victims[170]. The Minister of Mines, F.S. Malan, replied that an impression had been created that the government was not doing enough to prevent and solve the silicosis problem. He assured the House that nothing would be neglected to see regulations carried out[171]. L. Phillips (MP), a powerful mine-owner stated that silicosis prevention should be linked up with workers' contributions towards their compensation, believing that if miners contributed, they would be anxious to take precautions and assist in eradicating disease by ensuring fellow workers observed rules[172]. Other parliamentary representatives supported the view that many workers acquired silicosis before they came to the mines. Tuberculosis was cited as not being an occupational disease, as it was prevalent country wide. The state did nothing to prevent tuberculosis, when steps should have been taken to control it long ago[173].

Sir J.P. Fitzpatrick (MP) stated that the mines were doing everything possible to eradicate the disease at great expense to the industry, yet there appeared to be strong adverse feelings against the industry, and unfair criticism of the mine-owners by the non--mining community. Admittedly there were some callous employers, but the industry should not be penalised because of a small minority[174]. As early as 1911, J.C. Smuts discussed the problem of worker co-operation in silicosis prevention. Resistance to compulsory medical examination by miners in New Zealand, discouraged the South African authorities from introducing such measures in the 1911 Act[175], but this regulation had to be enforced for the protection of the worker from 1912 onwards. The reasons given by miners then, was their fear they might have silicosis and did not wish their death sentence pronounced. The men preferred to work until the final stages of the disease. Most of the miners were Cornish whose attitude was that dust came with the job, and South African born miners accepted this attitude to danger as an occupational hazard[176].

The sympathy of the House generally fell in favour of the plight of silicotic sufferers, but it was the few Labour Party members who persistently pressed forward their arguments for improved prevention and compensation within the silicosis acts. Particularly prominent were F.H.P. Cresswell (MP), leader of the Labour Party, W.B. Madeley (MP) and H.W. Sampson (MP) who championed most grievances of the workers in the House for over three decades.

F.H.P. Cresswell (MP) outlined further miner's objections to legal preventative measures as inconvenient and troublesome, taking up too much time to implement and reducing earning capacity particularly from contract miners[177].

Cresswell added that working conditions producing silicosis was beyond the control of workers. The introduction of rock drills resulted in greater profits for the owners. The men were instructed to use the machines by the owners who should bear the cost of compensation.

The way to prevent carelessness lay in increased inspection and legislated responsibility on mine owners to apply dust allaying and ventilation[178].

W.B. Madeley (MP) claimed the owners were not doing enough to protect workers. Mine managers first consideration was to show greatest possible profit. Neglect by a mine manager at City Deep mine was fined, because no water was laid in the mine. A previous manager was dismissed for suggesting this measure[179]. Certain mines supplied no water. H.W. Sampson (MP) challenged L. Phillips' (MP) statement of the 4th June 1912, that unfair burdens would close down poor mines, as only 170 stamps were idle out of 9 400 and only 3 mines showed no profit[180].

Both Cresswell and Sampson declared miners were responsible people. Whenever miner's suggestions based on practical experience, were submitted in evidence at Select Committees, Commissions of Enquiry or to mine management, such recommendations were not considered or accepted by the owners because of costs involved. Sampson disagreed with the Minister of Mines that if miners took proper precautions and used appliances provided, the miners would not contract the disease[181].

Madeley brought up the question of victimisation on the mines. Employees had to conform to mine management rulings, even when these were contraventions within the silicosis acts. Failure to do so usually ended in dismissal. Mine managers were unwilling to discuss this grievance[182]. Sampson, in reply to Phillips' statement on April 12, 1912, said it was a fallacy to claim that because of worker's carelessness, their contribution would move them to more caution and so reduce the disease[183].

Although recorded "silicosis" debates in the House indicated an active interest on this subject in the early days of silicosis acts, there was a noticeable indication of empty benches on both sides of the House. Members not directly involved with the silicosis problem, namely from farming and business interests in regions far removed from the Reef, did not display an interest or participated in such debates, yet there were a few members from this group who did attend discussions and gave their support to this issue. In 1911, when this subject was first introduced in the House many hours were devoted in attempting to solve the silicosis problem, as divisional results recorded 90 members present. During the 1912 sessions, the debates became more heated and longer with divisional numbers of 102. From 1913 onwards the amount of time spent on silicosis debates steadily declined, as only 61 members were present at division time, whilst in 1914 only 55 members were present[184]. These reductions in attendance figures indicated that the interest in silicosis was minimal and that other pressing matters, particularly during the war years of 1914 to 1918, had become a priority. Six silicosis acts namely in 1911, 1912, 1914, 1916, 1917 and 1918 had been legislated, involving two commissions of inquiry (1912 and 1918), and five select committees (1912, 1914, 1916, 1917, 1918) all intended to correct overlooked anomalies and upgrade silicosis prevention towards improved health care for the employees of the gold mining industry.

4.7 SUMMARY

The silicosis problem could be categorised into successive time slots of ignorance, awareness, investigation, control and prevention.

The period of ignorance of the disease and its causes relating to dusty mining operations, had prior to 1902, been accepted by society as part of occupational mining. Little was known or understood of the true causes of the disease, except to the few who medically researched this issue[185]. Once the problem became exposed in 1902 within the gold mining industry on the Witwatersrand, investigations began and continued to be researched from that time onwards.

For the purposes of historical record and comparison, regulations were enacted during the Crown Colony period of the Transvaal in Ordinances no. 54 of 1903 and no. 31 of 1905. These were replaced by the Transvaal Act no. 32 of 1909, and replaced by the Union Mines and Works Act no. 12 of 1911[186]. However these preventative measures lack sufficient strength and observance by both the industry and the workers to effectively reduce the intensity and frequency of sillicosis incidence.

It required further investigation and research at mining and medical levels during the second decade of the 20th century to show positive and acceptable reductions in silicosis incidence. This was the period when the disease became common knowledge not only to the state, industry and the workers, but also to the public in general. The seriousness of the disease was strongly imprinted upon all who received knowledge of it, but in the process, many misinterpretations created misunderstanding, suspicious, and distrust.

Unlike tuberculosis, which was also an occupational health hazard on the mines, silicosis was not an infectious disease, and could not be transmitted from one person to another. The mineworkers believed they were victims because of an indifferent and uncaring industry whose priorities lay in greater profits at the expense of worker's health.

As the work of the investigating committees established by the Union government progressed and further knowledge had been gained, it became obvious that certain methods, omissions or practices existing in the mines were of such a nature as to cause danger to worker's health[187]. Recommendations were made with the object of immediate assistance in the prevention of silicosis to be enforced by means of additional regulations issued under the Mines and Works Acts. It was found that for each class of mining operation, certain appliances if properly used, were capable of reducing dust to reasonably low figures[188].

The question of how far the measures taken to reduce dust had beneficial results, could not be fully answered by reference to statistics alone. The disease was so insidious and in the early stages the diagnosis so difficult and uncertain, that it would require some years before actual facts based in figures could be arrived at. By 1919, it became evident there was little to suggest in the way of further amendments of the regulations, but the commission did list additional safeguards[189]. After the main principles of dust prevention and medical controls had been worked out, there was little left to do but apply those principles in detail. However investigations did not ease at the time, as testing underground operations and new methods continued[190]. The large number of subordinate officials and workers had to be taught to apply new systems, and require fresh understanding of their value.

The greatest concentration and contribution towards preventative regulations took place between 1911 to 1919, but further improvements were expected mainly from better organisation, continued vigilance and improved appliances. Between the 1920's to the 1940's, preventative controls were being carefully monitored, but now the emphasis had shifted more towards compensation for silicosis sufferers, and the question of prevention played a minor role towards the silicosis problem.

The preventative programme owed its success to the sustained efforts of mine officials and workers. The moral and legal obligations fell equally upon employers and workmen. The industry was responsible for the provision, maintenance, and continued supervision of adequate water supplies and efficient appliances, but the workmen were obliged to use the equipment supplied where their employment was called for.

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