THE MORE IMPORTANT SOURCES OF AIR POLLUTION IN THE REPUBLIC OF SOUTH AFRICA AND THE MOST RECENT CONTROL POLICIES ADOPTED BY THE AUTHORITIES

Lecture delivered by the Director of NACA,
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at the 2nd IUPPA regional Conference in Seoul, Korea
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ABSTRACT:
The main sources of air pollution in South Africa are described together with the basic reasons for their occurrence. Also described is the policy adopted by the authorities to maintain air pollution in the R.S.A. at levels considered safe for man and the environment bearing in mind the "best practicable means" philosophy of the air pollution legislation which was promulgated some 25 years ago and the need to see that a delicate balance is maintained between what is essential for a safe and healthy environment and what can be afforded in a developing country with a fast growing population.

INTRODUCTION:

The Republic of South Africa covers an area of a little over 1,2 million sq. kilometres. It is characterised by an eastern seaboard with warm ocean currents and a western seaboard with cold ocean currents. It is a relatively arid country with limited water resources, only the low-lying areas to the east receive an average rainfall of over 750 mm while areas in the west of the country receive less than 100 mm annually.

The interior of the country is formed by a vast high level plateau separated from the low lands by mountain ranges. This internal plateau or "highveld" is some 1500 metres above sea level.

South Africa is one of the more highly developed industrial countries in the South Hemisphere and is the most highly industrialised in Africa south of the equator.

Unlike countries in the Northern Hemisphere there is no air pollution from its neighbours. There are however conditions which have brought about areas of pollution which are unique and the control of this pollution has to be viewed in the light of the need to provide economic conditions to support a fast growing population the vast majority of whom live below the poverty line.

The population composition of the Republic consists of 70% Black people comprising a number of discrete ethnic groups each with their own traditions and social customs; 16,5% White people or people of European descent, 10,5% people of mixed descent and 3% Asians. The population growth projection for these groups differ considerably and whereas there are today some 24 million Black people by the year 2010 it is expected that there will be some 45 million. The growth of the other groups will be small from some 9 million today to ± 10 million in 2010 (FIG 1).

The economic problems to ensure the employment and housing of this huge increase in population are large and the authorities realise the need to evaluate what has to be done to protect the environment and yet sustain development.

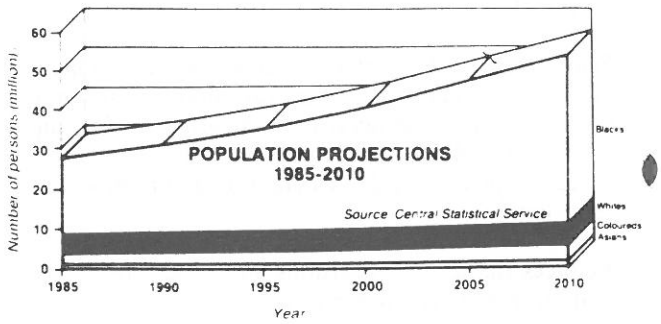

Figure 1

AIR QUALITY LEGISLATION IN SOUTH AFRICA:

Environmental protection legislation in South Africa has been designed independently for air, water and land and each piece of legislation is administered by the Government Department allocated the responsibility for that legislation. The shortcomings of this arrangement have been recognised and some two years ago the president's Council undertook an investigation with the objective of making recommendations on a policy for a National Environment Management System taking into account the ecological, economic, social and legal implications.

Three committees of the President's Council are attending to the following aspects of the investigation.

Committee for Constitutional Affairs -

All legal matters administered by Government Departments, provincial administrations and local authorities.

Committee for Social Affairs -

All social, demographic and geological aspects of the investigation.

Committee for Economic Affairs -

All economic implications of production methods by mines, industries and power generation, in order to prevent pollution and/or damage to the environment.

Interested parties were invited to make submissions to the Council and many institutions and organisations have done so including the national Association for Clean Air. The Council is expected to make its report in the latter half of 1991.

The Air Pollution Prevention Act of 1965 calls for control through the Best Practical Means (B.P.M.) which leaves a certain degree of flexibility to the authorities who can take account of all the parameters involved in any process subjected to control by registration as defined in the schedules to the Act. There are no air quality standards and the authorities have adopted the following guidelines for the more general pollutants:

TABLE OF AVERAGE CONCENTRATIONS

POLLUTANT	PERIOD		
Micrograms/m^3	1 Hour	24 Hour	Year
Sulphur dioxide	780	265	80
Nitrogen Oxides	1080	540	270
Ozone	240	100	-
Lead	-	-	2,5
Dust particles	350	150	-
Smoke (Sm^3)	-	50	30

For another pollutants the general guideline adopted is "The environmental level for a pollutant must not exceed 1/50 of its threshold limit value (TLV) (TLV is the "Threshold Limit Values for Substances in Workroom Air" of the American Governmental Industrial Hygienists)".[1]

For stack emissions guidelines for the pollutant levels exist for different processes. For example the concentration of HCI, SO3 and NH3 must not exceed 35 mg/m^3. The general guideline for particulate matter is 120 mg/m^3 unless otherwise stated. For instance the current limit for power stations is 100 mg/m^3.

The Act contains six parts which are as follows :-

Administration
Control of noxious or offensive gases
Smoke control
Dust control
Control of emissions from vehicles
Penalties

A schedule of the Act for the control of noxious and offensive gases defines sixty nine processes which range from brickmaking to the petrochemical industry and these scheduled industries are controlled by a small inspectorate falling under the Chief Air Pollution Control Officer.

In respect of smoke control the Act is largely enforced by local authorities which may apply to the Minister to have areas declared smoke control zones. If their request is granted they become responsible for controlling all smoke generating processes in their area. Most of the larger local authorities have applied for this control but of course it is not practicable for some of the large urban settlements housing large numbers of low income earners to have smoke control in the residential areas.

Traffic authorities in the smoke control zones control the smoke emissions from diesel vehicles.

In the case of mine dumps the Government Mining Engineer is responsible for dust control. This includes gold mine and asbestos mine dumps. He is also responsible for the control of smoke emissions from coal discard dumps.

NATIONAL AIR POLLUTION PROBLEMS

Residential Pollution:

Prior to the 2nd World War there was little secondary industry in South Africa. Machinery and equipment for the gold and diamond mines was imported from Europe. However, the war effort saw the birth of a large number of factories which with the post war boom brought about a flood of labour to the urban areas which overtaxed community services with uncontrolled squatting and conditions of squalor. This brought about the development of housing developments such as the dormitory city of Soweto to the South of Johannesburg and other such developments to serve industry.

The matter of the provision of suitable housing for the majority of the population remains a huge problem today and squatting remains a problem. Economically the residents of such townships are forced to use coal for cooking and space heating creating severe localised air pollution problems.

This pollution problem is particularly severe during the winter months due to temperature inversions in the evening and early morning as the people return and leave for work. It is an intractable problem which is unlikely to be solved until there is an economic upliftment which will permit better housing with adequate insulation such as ceilings and brick walls.

Efforts have been made to supply electricity to all houses and this is progressing at a very fast rate. However, the cost of electricity for heating is very much more than that of coal and not as effective for the heating of all rooms in a small home as is a coal stove. This is particularly severe in the black township areas (low income).

Efforts have been made to encourage the use of "low" smoke stoves which due to improved combustion have a 40% reduced smoke emission. These stoves are more difficult to light as is the "Scotch" fire or upside down fire with the coal placed at the bottom of the brazier and the kindling on top which discourages their use.

In order to attempt to combat the pollution from braziers which are used for heating and cooking in the squatter camps videos have been made to illustrate the advantages of the "up side down" fire and the health authorities in these dormitory towns are requested to show these in the health clinics and schools in an effort to encourage the

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use of this method of fire making with its lower smoke emissions.

INDUSTRIAL POLLUTION

South Africa is relatively well endowed with coal deposits which are low in sulphur in comparison with European and American coals although of a very high ash content. These coal fields are situated in the area in the interior of the country covered by the high level plateau into which falls the Eastern Transvaal Highveld. This area is at an elevation of 1700m above sea level and covers some 40000 sq. kilometres.

The climatic conditions in the area are highly adverse to the dispersion of atmospheric pollution. The subcontinent has a high level anti cyclone in circulation during the whole year and although troughs develop during the summer months the winter is characterised by a high pressure system with clear skies, low wind speeds, and a highly stable climate. These conditions are conducive to the formation of surface and high level inversions which bring about an accumulation of atmospheric pollution under the inversion layer.[2]

South Africa has some 34000 MW of installed electrical generating capacity of which some 30000 MW is coal fired the major portion of which is generated in large power stations situation close to the coal fields of the Eastern Transvaal Highveld with emissions of SO_2, NO_x and particulate matter.[3]

Also situated in this area are three petrochemical undertakings which produce a large proportion of the liquid fuel consumed in the country.

Some 4 tons of coal per second are consumed, 3 tons in electricity generation and 1 ton in the petrochemical industry.

Also associated with the coal mines are burning discard coal dumps, ferro alloy smelters, steelworks, brickworks, foundries and fertilizer plants all of which give emissions close to the surface which tend to be trapped below the surface inversion.

In the case of the petrochemical industry desulphurisation is practised however in respect of power generation only the particulate matter is removed, by means of electrostatic precipitators. The SO_2 and NO_x is discharged above the surface inversion by means of high stacks of the order of 300m in height and dispersion obtained in the unstable air above the surface inversion.

The quantity of SO_2 and NO_x discharged by power stations is 1.2 million tons and 0.4 million tons per annum respectively[4].

It is estimated that some one billion rand has been spent on the installation of electrostatic precipitators in the power generating industry and that a similar amount would have to be spent on each 3600 MW power station in order to introduce desulphurisation. This does not take into account the running costs of such plants and indicates an increase of between 25 and 30 percent in the cost of power generation.[4]

There is no doubt that the retrofitting of the power stations would be an expenditure which would severely tax the economy of the country and could make industries such as the ferro-alloy industry uncompetitive on world markets. It would appear that far greater benefits could be obtained by expenditure of such sums on the electrification of the dormitory towns which do not yet have electricity and on capital works to provide employment to the masses of unemployed. It is estimated that the cost of a desulphurisation plant for a 3600 MW power station would pay for the electrification of some 420000 homes.[3]

DUST FROM MINE DUMPS

South Africa is richly endowed with minerals and its past economy has largely been supported by the exploitation of these minerals.

In 1988 the South African percentage of world production of the various minerals were as follows[5] :-

Mineral	% of World Production
Gold	33
Vanadium	44
Manganese	53
Ferromanganese	10
Chrome ore	36
Ferrochrome	29
Antimony	9
Platinum group metals	49
Fluorspar	6
Zirconium	16
Asbestos	3
Coal	5
Lead	3
Andalusite	46
Titanium Minerals	21
Vermiculite	40

As is usual economic growth takes place adjacent to areas of mineral exploitation with the services and secondary industry which are required to support the mining. Johannesburg grew up amongst the mine dumps of the gold mines; Witbank alongside the coal mine dumps.

The dust nuisance on windy days from these dumps to the urban population caused the inclusion of a full section in the Act.

Resulting from in-depth research by the Chamber of Mines of South Africa methods of leaching the dumps and establishing a vegetative cover were developed which have been very effective. The research has also assisted in allaying the considerable health hazard of asbestos dust blown from dumps in the asbestos fields of the North Western Cape and Eastern Transvaal.

The cost of vegetating mine dumps at the time of mine closure is borne by the mining company from funds accumulated during the life of the mine and by the State in the case of defunct mines.

VEHICULAR POLLUTION

Traffic densities in south Africa are not high by world standards. However, in the urban areas where there is a traffic concentration photochemical smog does occur due to a high level of solar insulation and the poor conditions for dispersion. As traffic densities increase and with the addition of alcohol in the blend of petrol used it is anticipated that a greater incidence of such episodes will occur.[6]

The smoke from diesel vehicles is a nuisance on the interior plateau in particular. The majority of the engines imported into South Africa come from countries which tax the size of the engine which have also been designed to operate at altitudes close to sea level. The engines are thus basically under-powered for the work they are expected to do and when operated at some 1500 m above sea level there is a tendency for the operators to vary the setting of the fuel injectors to obtain more power with a resultant increase in smoke emission.

The method of control is for traffic officers to issue a notice to the effect that the vehicle is not road worthy and the owner is given a specified time to rectify the nuisance and then submit his vehicle for further test.

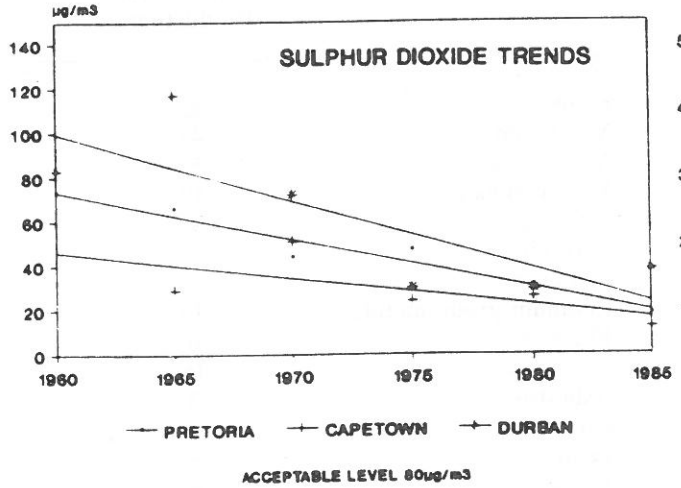
The lead content of petrol in South Africa is governed by a maximum legal limit which prior to 1985 was 0.84 gms per litre. Early in 1985 the limit was reduced to 0.6 gms/litre and in 1989 to 0.40 gms/litre.[7]

AIR POLLUTION CONTROL POLICY

The Department of National Health and Population Development which administers the Air Pollution Prevention Act has recently reviewed its policy as air pollution as applied to South Africa.[1]

The Department has looked at the long term trends for sulphur dioxide and smoke which is given in graphs 1 and 2 respectively. These show a reasonable improvement since the promulgation of the Act.

GRAPH 1



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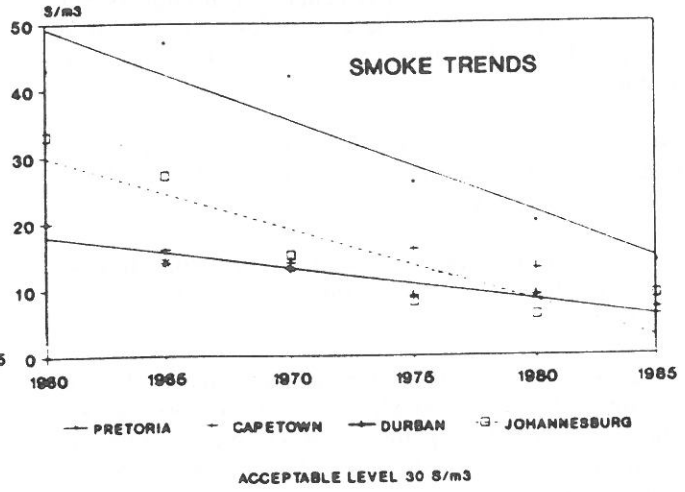

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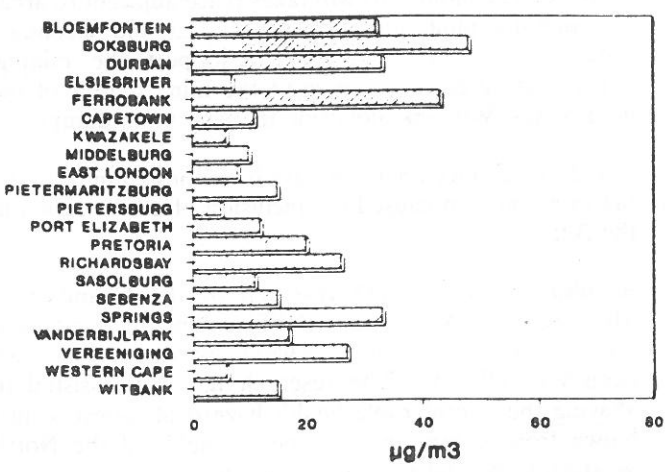
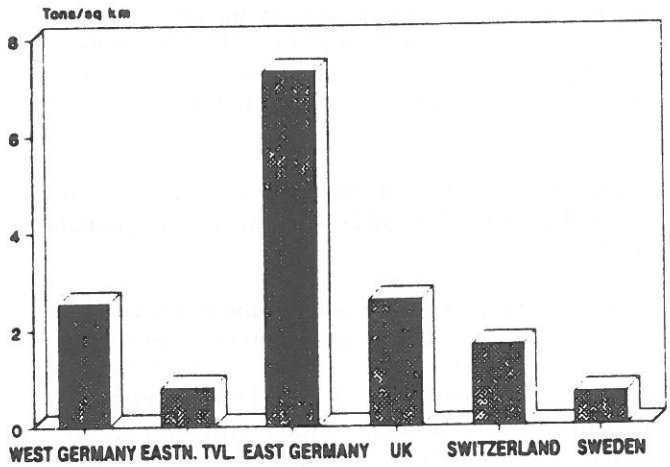


GRAPH 4



Graph 3 shows the average winter concentrations of SO_2 in several urban areas none of which approach the 80 micrograms/cubic metre set as the maximum acceptable level for the period of one year. As the winter conditions would indicate the worst seasonal dispersion conditions the annual concentrations would be well below those shown.

The SO_2 emission densities in the Eastern Transvaal Highveld have been compared with some of the worlds' highly industrialised regions in graph 4 and it can clearly be seen that South Africa is close to Sweden in tons/sq km and a great deal better than others. In the light of this information the Department has decided that the key elements in the application of the air pollution control policy are[1] :-

"All new coal based industries must remove at least 75% of the sulphur present in emissions.
All new burners must be fitted with "low NOx" burners.
Sound physical planning practices for siting of new industries.
The installation of air cleaning equipment of the latest design in all new plants.
The regular reviewing of emission standards imposed by the Department.
A programme for the upgrading of existing equipment. the availability of at least 96% for control equipment.
Regular inspections of all industries.
The holding of conferences, seminars and meetings in order to educate and inform industrialists and the public.
Research to identify potential problems and to suggest solutions."

As air pollution varies from area to area and not all industries create the same problems both area and process priorities have been determined as follows[1] :-

Area Priorities:

"1) The Pretoria Witwatersrand Vereeniging area
2) The Eastern Transvaal Highveld
3) The greater Durban area
4) The Western Cape"

The latter two take account of the major coastal industrial areas :-

Process Priorities:

"Residential areas without electricity
Emissions by power stations
Dust from mine dumps
Paper industries (kraft process)
The petrochemical industry (odours)
The metallurgical industry
Wood processing plants
Lead in petrol
Smoke from small industries and
Motor vehicle emissions."

In respect of international priorities the Department wishes to participate in international treaties and has taken the step of seeing that South Africa complies with the stipulations of the Montreal Protocol. It is intended that the phasing out of CFCs and related compounds be done according to the following time table :-[8]

"1 January 1992 : Consumption of CFCs and Halons restricted to 1986 levels
1 January 1993 : Consumption of CFCs and Halons reduced to 80% of the 1986 levels and the consumption of carbon tetrachloride, methylchloroform and fully halogenated CFCs restricted to the 1989 levels.
1 January 1995 : Consumption of CFCs and Halons restricted to 50% of the 1986 levels and the consumption of carbon tetrachloride reduced to 15% of 1989 levels.
1 January 1997 : Consumption of CFCs reduced to 15% of the 1986 levels.
1 January 2000 : CFCs, Halons, carbon tetrachloride and fully halogenated CFCs phased out completely and the consumption of methylchloroform reduced to 30% of 1989 level.
1 January 2005 : Methylchloroform phased out completely
1 January 2040 : Possible phase-out of HCFC'S."[8]

The phasing out programme will be based on the best practicable technology and the relative impact on the economy will be monitored. Measures to reduce unreasonable economic impacts will be considered.

Alternative substances will require individual decisions to be taken in each case.

CONCLUSION:

There is no doubt that we are faced with an air pollution problem in South Africa which is going to escalate in the future. However, we are also faced with a huge unemployment problem and a rapidly increasing population. Industrial growth is of utmost importance to absorb the work force and stability is required to attract the capital to bring about this development. This has to be done against a retracting gold mining industry which has historically been the flywheel of the economy.

The air pollution authorities face this dilemma in the knowledge that air cleaning equipment adds some 10-35% to the capital cost of an industrial factory, that there are high running costs in its operation and that in most cases it is unproductive! However, if the environment is to be protected for the future generations steps have to be taken to prevent damage and a delicate balance must be maintained to steer a course which achieves this objective and yet brings about sustainable development.

The policy of adopting a flexible attitude to air pollution by sticking to the "best practicable means" philosophy would appear to be the only way to achieve this end and the policy adopted by the authorities in South Africa would appear to meet the needs of the country. However, care will have to be taken that they are not criticized for not taking stricter action particularly in the modern world with its awakening to the damage already done to the

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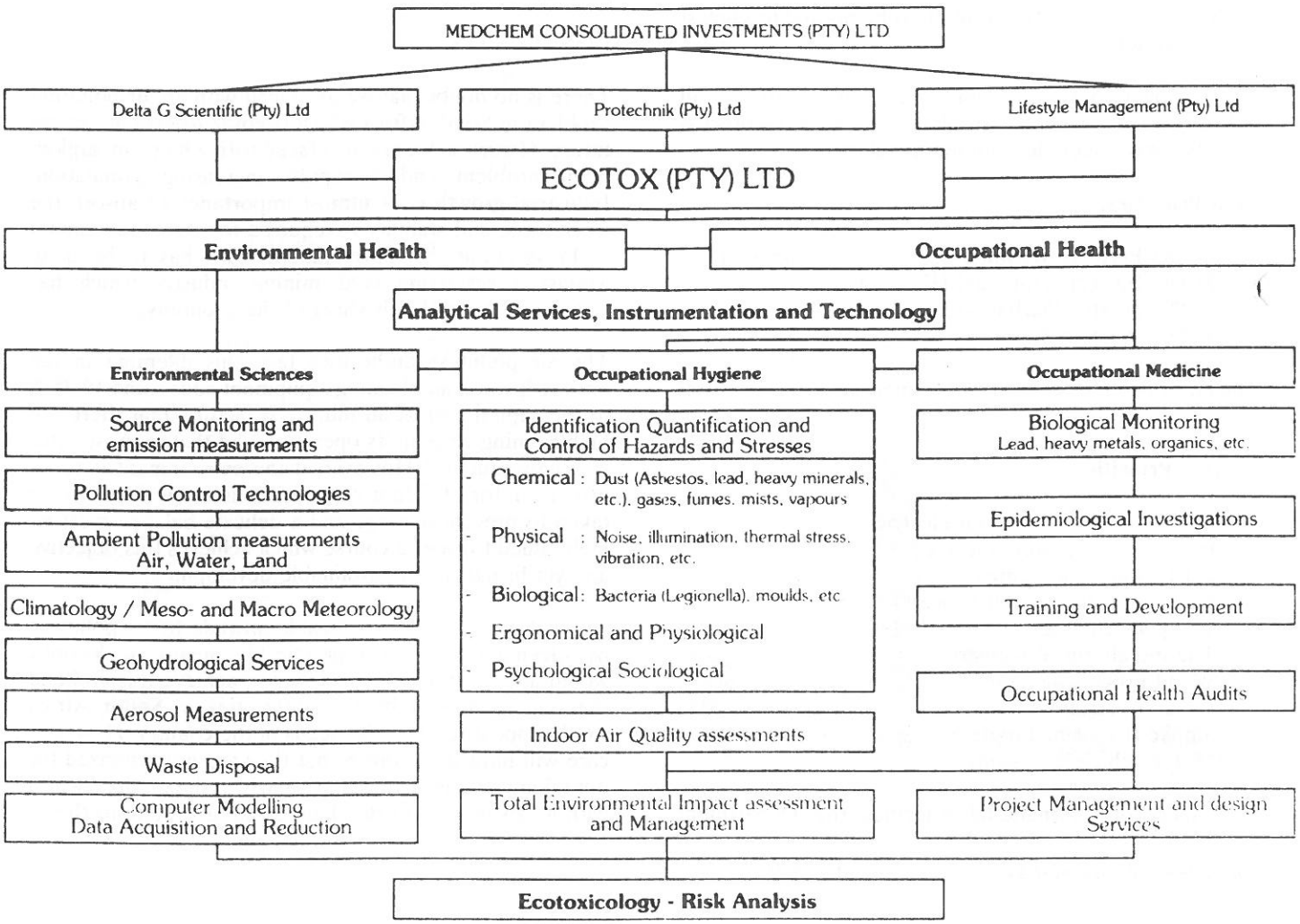

planet and the awakening of environmental awareness of the population.

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TECHNICAL NOTE:

ENVIRONMENTAL MYCOLOGY AND ITS IMPORTANCE TO PUBLIC HEALTH

The XIth Congress of the International Society for Human and Animal Mycology (ISHAM) in Montreal, Canada, was recently attended by Hester F. Vismer of the MRC. Environmental mycology and its importance to Public Health, featured for the first time at a medical mycology congress, and the following points were noted.

The above mentioned section covered subjects such as the role fungi play in the Sick Building Syndrome and occupational health; airborne fungi commonly associated with respiratory allergy and diseases as well as recent developments in food mycology. From the presentations it was clear that the field of fungal allergens is relatively unresearched, even though they are often implicated in cases of respiratory and other illnesses. Dampness in the home and work place that promotes fungal growth, has become an important health issue especially in countries where there is no natural ventilation of buildings. Inhaling volatile metabolites produced by xerophilic and other fungi, and that may have carcinogenic properties, has become an important new field of investigation. Airborne opportunistic fungi in hospital areas at risk, eg. Intensive Care Units, received some attention, and the importance of the presence of these fungi, was pointed out. In general it was felt that type III fungal allergies must not be underestimated. Furthermore, adjunctive therapy of allergic bronchopulmonary aspergillosis (ABPA) with Itraconazole was viewed with much interest as this drug appeared to induce remission in ABPA and to reduce prednisone requirements in these patients.

Mycological air monitoring in Southern Africa has been identified by the MRC as an area lacking information and data, and which perhaps needs large scale investigation. Preliminary indoor and outdoor fungal conidium air monitoring is currently being done by the Medical Research Council as part of an Air Pollution Study in the Vaal Triangle (Vanderbijlpark). A monitoring period of at least three years is necessary to validate the findings in varying climatic conditions, for example time, temperature, prevailing winds, season and atmospheric humidity, and to confirm the absence of seasonal incidence for the more prevalent fungi, and is being planned.

Further particulars may be obtained from Vismer or dr Petro Terblanche at the MRC, Private Bag X385, Pretoria.