original argument that Cape Point meets the requirements for a baseline station.

The analytical instruments are housed in a little building kindly rented to the CSIR by the Department of Transport, whose lighthouse generator also supplies the electricity for the analysing equipment. After a very modest beginning the work which was in progress attracted the interest of Dr W Seiler of the Max Planck Institute for Atmospheric Chemistry in Mainz, West Germany. This resulted in the development of a collaborative project with the Max Planck Institute supplying a large portion of the equipment. The project has now been running for seven years and the research team comprises two scientists, one technician and a data handler. The headquarters of the team, with laboratory, office and computer facilities are at the CSIR's National Accelerator Centre at Faure, near Cape Town.

At present CO and O_3 are being monitored continuously, while F-11, CCl_4, CH_4, and N_2O are being measured on a semi-continuous basis. Recently, work was also started on the measurement of atmospheric HCHO and Kr^{85}. It is also planned to add CH_3CCl_3 to the list of parameters in due course. The importance of CH_4, N_2O and F-11 is that they are infra-red absorbers, while CO and CH_4 are strong OH removers. Freon-11, CCl_4, CH_3CCl_3 and N_2O are potential destroyers of stratospheric O_3. It is hoped that the Kr^{85} results will throw light on air-exchange processes between the northern and southern hemispheres.

The trace gas measurements are supplemented by meteorological data. An automatic anemometer records wind velocities and directions on magnetic tape. Air temperatures and pressures are obtained from the lighthouse staff, who collect this information for the Weather Bureau. The hourly averages of all the parameters being measured comprise about 78 000 data points per year, and are being handled by computer.

The actual instrumental monitoring work is not without challenges and difficulties, especially since the equipment is very specialised. The concentrations of some trace gases are being measured down to the pptV range (1 pptV = 10^{-12}), where contamination is always a potential problem. Spare parts for some of the more sophisticated instruments are often not available in South Africa and have to be obtained from overseas. Every instrumental breakdown, even a power-failure of two minutes, may mean data loss of a few days. The question of reliable and stable calibration gases is vital to all meaningful long-term monitoring work. In order to achieve this aim, inter-laboratory calibrations, particularly with the Max Planck Institute in Mainz, are carried out on a regular basis.

The Cape Point programme is a long-term project, whose primary aim is to collect reliable trace-gas data over many years. Such continuous monitoring forms the foundation on which all other air-chemical research is based. This includes the quantification of the sources and sinks of a trace gas and the estimation of its atmospheric residence time.

There are only a few baseline stations in the Southern Hemisphere (for example: American Samoa, Tasmania and Antarctica), so Cape Point forms a vital link in the chain of global stations. The growing international interest in Cape Point is manifested by the co-operative ventures, which other research institutes world-wide have launched there. In this respect it is worthwhile to mention the Global Precipitation Project (Prof. Keene, Virginia, USA), which is a study of acid rain in the 'clean' troposphere, the Krypton Project (Dr Weiss, Freiburg, W-Germany) and the exchange of air samples between Cape Point and Oregon, USA (Prof Rasmussen) for the comparison of halocarbon analyses.

Some of our interesting results on the seasonality of CO and the growth rates of F-11 and CCl have already appeared in international journals and more are to follow.

THE MEASUREMENT OF NITROGEN DIOXIDE BY SIMPLE DIFFUSION TUBES

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Nitrogen dioxide is a major component of atmospheric pollution. It and associated oxides are the precursors of photochemically produced pollutants (ozone and -oxyacetyl-nitrate). Recently the European Community has examined the problem in depth, and it is anticipated that an EC Directive will shortly be approved.

Nitrogen dioxide has mainly been monitored by means of chemiluminescent NO_x analysers. This method is both expensive and requires technical expertise, thus large scale surveys are impractical. Researchers at the United Kingdom Atomic Energy Authority at Harwell have recently started measurements of NO_2 by use of simple diffusion tubes, based on the design by Palmes et al. (1976). Originally deployed for investigations of indoor pollution (gas cooking, domestic heaters) the technique is now finding widespread use in the UK for environmental monitoring (Atkins et al., 1978, Atkins, et al., 1980, Brice et al., 1985).

The tubes are constructed from perspex, 71 mm long and with a 12 mm internal diameter. They are sealed at one end by a coloured cap containing two or three triethanolamine coated stainless steel mesh discs. The other end is

sealed with a removable cap, which is subsequently removed on the tube being exposed. After exposure the discs are analysed by the Greiss/Salztmann colorimetric method.

Exposure of the tubes concurrently with measurements by chemiluminescent NO_x analysers have produced good correlations (Atkins et al., 1978).

The advantages of using these diffusion tubes are that they require no electricity supply and are consequently relatively free from maintenance. The low cost and simplicity of each unit allows for large surveys to be easily undertaken. The disadvantage is that they are unsuitable for short-term measurements and therefore cannot measure peak concentrations.

A number of these tubes have been purchased and from the middle of July to the end of August a series of verification experiments have taken place. The measurement site, on the corner of Beatrix and Park Streets, in Pretoria is an established monitoring station for the measurement of motor vehicle pollution. The tubes were deployed in a circle around the measurement inlet of the monitoring caravan at a height of three metres.

The aims of the study were:

(a) To determine if daily variation in NO_2 concentrations can be measured.

(b) To determine the weekly concentrations over a period of seven weeks.

(c) To determine the accumulative effect of exposing the tubes for up to seven weeks.

(d) To determine if storage after exposure affects the results.

For each sample there were three exposed tubes and one control (deployed but unexposed). The analysis was undertaken immediately after collection (except in the study on the affect of storage). The blanks consistently indicated less than 0,02 μg NO_2^-. The samples were analysed on a Perkin-Elmer Coleman 54 spectrophotometer at a wavelength of 540 nm.

The samples were collected on a daily basis for the first fortnight, and on a weekly basis for seven weeks (with exposure times of a week or accumulative exposure up to seven weeks). In addition to these samples, a further set was exposed for a period of a week, and then sealed, after which subsequent analysis was undertaken at intervals over the following fortnight. The results are calculated according to the procedure used by Atkins et al. (1978).

From the results (Table 1 and Figure 1) a number of observations can be made:

TABLE 1

Results from NO_2 diffusion tubes

Daily		Weekly		Accumulative	
Date	pphm	Date	pphm	Date	pphm
15-16/7	3,03	15/7-22/7	4,06		
16-17/7	4,77	22/7-29/7	3,80	15/7-29/7	4,19
17-18/7	5,03	29/7- 5/8	4,71	15/7- 5/8	3,90
18-19/7	5,02	5/8-12/8	4,26	15/7-12/8	4,27
19-22/7	4,02	12/8-19/8	4,37	15/7-19/8	4,29
22-23/7	4,00	19/8-26/8	4,02	15/7-21/8	3,78
23-24/7	4,55	26/8- 2/9	4,94	15/7- 2/9	3,71
24-25/7	4,30				
25-26/7	5,40				
26-29/7	3,65				

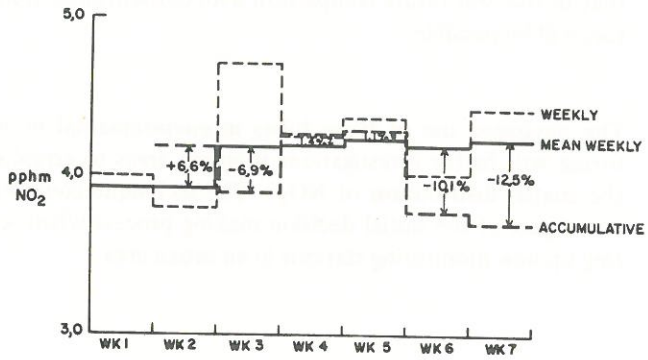

FIGURE 1

Comparison between sampling periods

(1) The daily mean NO_2 concentrations as measured over a two-week period is 4,38 pphm. The measurement of daily concentrations is difficult because the concentrations are low.

(2) The weekly mean NO_2 concentrations, as measured over seven weeks, is 4,24 pphm.

(3) There is reasonable agreement between the results obtained on a weekly accumulative basis as compared with the mean of the weekly results for a period of up to five weeks. This suggests that the tubes may be usefully used for periods up to a month in duration.

(4) There is a tendency for the measured concentrations to increase on storage (Table 2). Although this is not statistically significant, analysis should preferably take place within a week.

TABLE 2

Effect of storage prior to analysis

Day	1	2	3	6	9	10	13
Concentration pphm	3,95	3,49	3,85	3,90	4,00	4,10	4,21

No comparison with results from the NO_x chemiluminescent analyser was possible, since the latter and supporting equipment experienced a number of technical problems during the duration of this study. However, reference to data from previous years (Henning et al., 1983, Hair et al., 1984) indicate the concentrations of NO_2, as determined by the diffusion tubes, are within the expected range for the city of Pretoria. This work is continuing and it is hoped that in the near future comparison with conventional monitors will be possible.

The envisaged use of these tubes in environmental monitoring will be for investigations in urban areas to establish the spatial distribution of NO_2. The technique could become part of the initial decision making process when setting up new monitoring stations in an urban area.

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