7. OZONE

7.1. Introduction

At Halley, BAS has the longest continuous running ozone measurement programme in the Antarctic. In addition it has used the same techniques since the programme began in the IGY. This makes it particularly valuable in the measurement of long term trends associated with the formation of the Antarctic ozone hole, and hopefully its recovery in the 21st century. Supporting measurements at Rothera are important for understanding ozone depletion processes at the edge of the polar vortex. Ozone measurement is one of the ‘flagship’ BAS observing programmes.

The procedures outlined below in the numbered paragraphs are the definitive instructions for the ozone programme. The IGY, Komhyr and BAS Dobson Operating manuals can be used for reference when necessary.

The discovery of the Antarctic ozone hole has renewed interest in making ozone observations. To accurately follow the development of the "hole" it is necessary that the extra-terrestrial constant, L_O, of each spectrophotometer be well determined. Note that "extra-terrestrial constant" is a most misleading name. L_O is in fact only partly determined by the extra-terrestrial ratio of intensities. Transmission factors within the instrument must also be taken into account and these can vary, e.g. as dust accumulates on optical surfaces. L_O must be redetermined frequently, from both ADDS and CDDS observations.

By international agreement, ozone amounts are referred to ADDS observations with mu<2.8. (With mu>2.8 the ADDS method is less reliable since the sky near the sun then contributes an appreciable and highly variable amount of the energy received at A wavelengths; during the ozone hole it should be possible to make measurements down to mu=3.0.) All other measurements must be calibrated against ADDS. Below mu=2.0, ADZ, CDZ and CDDS can be calibrated by direct comparison. If Lo for CD is known, CDZ at higher mu's can be calibrated via CDDS or CDFFS or, as a last resort, via CDZ at lower mu's (assuming no diurnal variation in mean ozone amount).

Comparative observations are needed in addition to the routine observations and should be made over a range of total ozone and mu values during each season.

7.2.1. A beginner's guide

A. Write date, base and instrument number on form. (If you use a book, date only is needed; the base and instrument number should already be written down!)

B. Check that the microammeter and EHT (1-12) are at minimum sensitivity. Switch on power supplies, Dobson motor, LT and HT. The Ealing PSU should be turned to 1000 V (1.0). Never generate a current from the photomultiplier that is much larger than 20 microamps as this can damage the tube. Remember that when the shunt resistance is high, there can still be a large signal on the PMT, which is equally damaging.

C. Set Q-levers for correct temperature (15 °C for the left hand side, instrument temperature for the right hand). Check the position of the selector rods (S4 rod in, wavelength rod out).

D. Decide on ob type and position instrument. The sun should be to the observer's right for all observations, with the sun-director shadow lying along the Dobson. In cloudy conditions you should estimate where the sun is and align the instrument accordingly.

E. Obtain balance points at the wavelengths used, adjusting the EHT (1-12) switch if necessary. Note the time of the middle reading to the nearest 30 seconds, eg 12:30:40 would be recorded as 12:30^x. Note wavelengths and ob type on form; include the cloud type as in Komhyr page 31. Some thin cloud can be tolerated on ordinary DS obs, but they cannot then be used as part of an L_o determination, so it is important to note the presence of any such cloud, however thin it may be.

F. Sign your observation.

G. All observations are calculated by PC or Unix (See section 7.6.). Observations should normally be written down as they are made. If they are entered directly into the PC, they must be printed out as soon as they have been completed. Results do not need to be entered on to the ozone forms, but the original data must be.

H. You may use a notebook, and transfer data to forms if this is more convenient.

J. Turn down the galvo sensitivity, switch off the HT, LT and motor, turn down the EHT, switch off the PSU.

7.2.2. Health and safety

Due caution should be exercised when carrying out work on the instrument electronics or motor. The PSU should be switched off before carrying out any work on the instrument. The 1000 V EHT power supply should be treated with respect; always turn down the EHT to zero before switching it off. EHT can kill. Live working is discouraged, but if this is essential always have an observer present and connect to the mains via an RCD.

The standard and twin lamps are very bright and generate considerable heat.

The mercury lamp give out uv light and should not be looked at directly without protection for your eyes. The uv light from the lamp generates ozone, and it must not be allowed to run for long periods in an enclosed room. The body of the lamp can become quite warm.

The Nickel Sulphate filter contains a solution of Nickel Sulphate in water and methanol. As individual chemicals Nickel Sulphate is classed as ‘harmful’ and methanol is classed as ‘toxic’ and ‘highly flammable’. The COSHH assessment shows that in normal operation the residual risk is minimal.

Guidance material on lowering the Dobson from its cradle is available at Halley.

7.3. Routine Observations

Routine observations with sufficiently low mu should generally use the CDA observation types, however in patchy or variable cloud, separate AD and CD observations should be performed.

7.3.1. Types of possible ob

Mu	max Z	ADDS	ADZB/ZC	CDDS	CDZB/ZC	CDFFS
1.0 - 2.0	60.3	*	*	*	*	
2.0 - 2.6	67.9	*	*	*	*	
2.6 - 3.0	71.1	*	*	*	*	
3.0 - 3.5	74.1			*	*	*
3.5 - 4.4	77.7			*	*	*
4.4 - 5.8	81.3				*	*
5.8 - 6.5	82.5				*	*
6.5 - 9.2	86				*	

Max Z is the maximum solar zenith distance for the type of observation.

Mu	CDFM	
1.2 - 3.5	*	Full moon ± 7 days

7.3.2. Schedule

The times for routine observations are given in the Dobson instructions. The mutimes program, which reads data from the standard Dobson data input file, computes observing schedules, which are listed in text files: MONSTD.TXT - standard ob times, MONLOS.TXT - L_os, MONUMK.TXT - umkehrs and MONINF.TXT - general information (sunrise, LAN, mu at LAN, sunset). When umkehrs are not possible MONUMK.TXT gives times for the comparative high mu observations.

The schedule aims to give five observations a day at evenly spaced values of time, ranging from LAN to mu=9.2. The times are only guidelines and ten minutes either side is acceptable. If there is a brief gap in the clouds and a direct sun observation is possible, do try and make one. Note that every sun observation should be accompanied by at least one type of zenith observation. The two should be as close in time as possible. If necessary repeat a zenith observation to achieve this. Please make every effort to secure at least one satisfactory observation during the day, at any mu using the appropriate method, rather than miss the day out altogether. Routine direct sun observations, can be made with cloud in front of the sun; a guideline is that an observation is possible if the sun is casting shadows.

7.3.3. Priority of observations

A. ADDS whenever possible.
B. LAN.
C. Observations at the standard times.
D. Other intervals from the Lo, umkehr or comparison observation schedule. These are quite important, particularly if you have made some direct sun measurements during the day, to help calibrate zenith observations. A set should be done at least once per week if possible.
E. Moon obs.

7.3.4. Data scheds.

Every Wednesday, all the ozone observations should be sent to Cambridge by email. The file should be named according to the convention <base letter>ozo<mm><dd>.dat. Mean daily values will be computed, the data will be monitored, and any corrections to the instrument constant file sent as necessary. It is particularly important that the data should be sent weekly during the time of the spring ozone hole as mean daily values have to be forwarded to the WMO for inclusion in their weekly reports on the state of the ozone hole.

7.3.5. Coding

When filling in the observation form, enter the type of observation, e.g. ADZC, in the line labelled Wavelengths, and the code LS in the line labelled Sun or Sky.

(For CDAADC obs, the type of ob should be shown as $\mathrm{CDAADC}_{\mathrm{DS}}$ in the case of L_O tests, and $\mathrm{CDAADC}_{\mathrm{ZB}}$ in the case of umkehrs
The code LS is not required, and the line labelled Sun or Sky is used for one of the six readings. See section 7.4.1.)

The code LS is listed below:

L = 0	AD	S = 0	Direct sun
2	CD	1	Direct moon
6	CD focused	2	Zenith blue
9	CDA	3	Zenith high cloud
16	CD filter focused	4	Zenith middle cloud
		5	Zenith low cloud (inc Ns)
		7	Zenith fog
		8	Stratospheric cloud

The other values of S (6, 9), given in the full listing of the code, should not be used.

The various permutations are:

ADDS	00
CDDS	20
CDFS	60
CDADS	90
CDFFS	160
CDFM	61
ADZB	02
ADZC	03, 04, 05, 07
CDZB	22
CDZC	23, 24, 25, 27, 28
CDAZB	92
CDAZC	93, 94, 95, 97, 98

7.3.6. Monthly tests

The standard-lamp and mercury-lamp tests should be done regularly each month. The descriptions in the IGY manual need little amplification. The standard-lamp test should be carried out on A, C and D wavelengths on the same lamp each month, the second lamp being used only every three months unless the usual lamp gives anomalous results. The current used in the standard-lamp tests should always be noted on the form. The standard current is 7.50 amps. The MONTH program should be used to produce the routine tel of the results. Twice a year carry out the more comprehensive symmetry test.

Use tissue paper or equivalent to reduce the intensity of the mercury lamp so that the microammeter reading is about 20 at maximum.

It is best to have the mercury lamp in position over the inlet window before switching it on. If you must check visually that it is lit, a glance in reflected light is sufficient: do not stare down the barrel of the lamp housing, as the strong unfiltered UV can damage your eyes. Glasses afford some protection. Do not leave the lamp on in an enclosed room for long periods as it generates ozone. The mercury lamp will often look as if it is showing signs of deterioration (for example blackening in the interior), but this is perfectly normal for this type of lamp. The most frequent cause of failure is touching the quartz envelope of the lamp with bare hands. The normal lifetime of a lamp is ten years plus, so one spare should be fine.

Renew the silica gel in both halves of the Dobson at the end of the monthly tests, and also at other times during the month so that there are always ?? crystals present. Clean the ground quartz plate if necessary.

Signal the results of the monthly tests, using the format given by the MONTH program; averages should be quoted to 1 dp. The standard lamp results are for the A, C and D wavelengths and A-D and C-D. For the mercury-lamp test send five groups: the first gives the Q-value which you obtained in the test, the second gives the average temperature during the test in tenths of a degree Centigrade, the third the station pressure in hecto Pascals, the fourth the observed Q-value reduced to 15 deg C and the fifth the difference between the observed value and the value caclulated from the table which you are using currently. Earlier tables, of whatever origin, should not be quoted.

Monthly Tests on Dobson 031
Q-lever tables dated: 1980 DEC 01

Standard	16-1-96	C10	558 491 488 70 2
Mercury	839 167 988 837 1		

Keep a log of the results on base; as a guide the following are approximate tolerances:

```
Hg             ± 0.3 deg
Standard lamp ± 0.5 deg
```

Also keep a logbook of any work done on the instrument. Complete details should be included in the met/ozone report.

A check of the power supply output voltages should be made each month, though there is no need to signal the results back unless there is a problem. The EHT should be 1000 V (Use an AVO), the HT 115 V and the LT 2 V. The HT voltage drops when under load and should be measured both with the Dobson HT switch in the off position and in the on position. The HT current in BAS instruments should be around 25 mA, because the internal 4.5 V board draws significant current. The LT current should be around 200 mA, but on a digital meter may read around 135 mA due to the internal impedance of the meter.

After the test, gently clean the GQP with soap and water (not detergent) and dry off with medicinal cotton wool. Clean the inlet window in the same way.

7.3.7. Return of originals to Cambridge

The original copies of <u>all</u> ozone tests and observations must be returned to Cambridge each year, whether they have been signalled or not. Do not forget to send the twin-lamp tests and the GQP and filter tests. A duplicate copy of all test forms must also be retained on base.

7.4. Special observations

7.4.1 Determination of L_o

Plots of (NA-ND)/mu and (NC-ND)/mu against 1/mu are required. A hybrid observational schedule should be adopted: C-D-A-A-D-C measurements on direct sun (i.e. with ground quartz plate). This gives simultaneous ADDS and CDDS. If you pause a little after the first C reading, this will compensate for having to set the Q-levers for the final C reading and it should be sufficient to report the central time only as in ordinary measurements. Try to make observations at intervals of 0.05 (or less) in 1/mu and cover the range mu=2.5 to near LAN. (Since mu varies slowly near noon, one observation between 11 and 13 LAT should suffice.)

The sun must be definitely clear of cloud for all readings, but there is no need to wait for completely clear skies, and it does not matter if the sun is obscured between observations. We need at least 20 half-days per season to control L_o properly. Whole days (mu=2.5 to LAN and back again) are particularly valuable, but we cannot rely on these alone - there are rarely enough!

If possible take additional CDDS obs for 1/mu about 0.35 and 0.30. The minimum requirement for an L_o is two DS obs: at LAN with mu<2.0 and at mu=2.5±0.1. Obviously the more intermediate points you get the better. If possible do a C-D-A-A-D-C ZB observation at the same time as the L_o for calibration purposes.

The observations should be written on the form in descending order - the first C reading in the middle R_A or R_C space and the first A reading in the Sun or Sky space. The central A readings will normally differ by 0.1° at most. Note that you are required to make two <u>distinct</u> A readings - as a guard against error in reading the dial.

Results are sent to Cambridge on the data sched along with the normal ozone data. Any three or more DS observations separated by a large enough range in mu can be used to determine L_o, though the more observations the better.

7.4.2. Focused-sun observations

Focused-sun observations should be made on CD wavelengths only, and the nickel sulphate filter should always be used. Such measurements (CDFFS) can be made in the range 3.0<mu<6.5. In this range there should normally be no need to use the procedure of measuring the amount of skylight and scattered light. However do this occasionally when you have a long period of clear sun, as it gives a useful indication of the state of the spectrophotometer. Do not use the rhodium plate in CDFFS observations unless R goes off the scale. It is usually more convenient to rotate the Sun director in order to keep the image of the Sun centered on the slit, rather than rotating the whole Dobson cradle.

It is particularly important that CDFFS observations are made in the early spring.

7.4.3. Focused-moon observations

These can be made during the period about seven days either side of full moon and, if the spectrophotometer is in good condition, at values of mu up to 3.5. Use CD wavelengths, but do not use the filter. Use of the smoked plate for moon observations is suggested, since the signal is weak and you will be working in the dark to minimise the amount of stray light entering the spectrophotometer. It is usually more convenient to rotate the Sun director in order to keep the image of the Moon centered on the slit, rather than rotating the whole Dobson cradle.

These are the only means of measuring ozone amounts in winter. They should be attempted whenever possible.

The PC/Unix program calculates moon obs, though the calculation takes longer than normal obs as there are considerably more sine terms to evaluate. This may not be noticeable on a PC with a maths co-processor. If you should have to do it by hand remember to include parallax.

7.4.4. GQP and filter corrections

L_O applies to DS observations. When the ground quartz plate (GQP) is removed for focused observations, a correction must be applied. Similarly, a correction is required for the effect of the nickel sulphate filter when this is used. The corrections should be measured twice a year, once in the spring and once in the autumn.

The filter correction is easily found for C and D separately. Set up the sun-director for a focused observation (without GQP) and take readings on C in rapid succession with filter alternately out and in: 5 out and 4 in will do. Repeat using D.

The GQP correction should be found by alternating CDDS and CDFS (no filter) observations, say 3 DS and 2 FS in all. It takes so long to change from direct-sun to focused-sun observations that there is little point in trying to work on C and D separately.

The combined GQP and filter correction can be found by alternating CDDS and CDFFS observations. This is a useful check and should be done if time permits.

For the above, mu should be in the range 3.0 to 3.5. The measurements are simpler if mu is stationary, but can be done at any suitable time of year. The intensities will be high - start with the EHT right down.

Make these measurements once each spring and autumn. Significant changes must be investigated - check first that the GQP is clean. Note: the GQP correction varies slightly from plate to plate. If the spare is brought into use, the correction for it must be determined. Please ensure that the plates are clearly labelled. This test is also known as the focus test.

7.4.5. Zenith-sky test for Q-lever settings

This is test 15.1 in the IGY manual, Adjustment and Calibration section (page 108). Ideally it should be carried out near noon, while mu is almost stationary and less than 2.0.

Measurements are made at half degree intervals, for five degrees either side of the nominal value of Q1, first moving down the range and then back up; there is no need to adjust Q2, which should be set for the value at 15°C. Make sure that the Dobson is always orientated with the sun on the observers right. Record the time and pressure at the mid point of the test and compute the value for mu. Note the temperature at the beginning and end of the test. Plot the observed points (up and down) using a scale of one cm per degree for R and two cm per degree for Q. Draw a smooth freehand curve and select the minimum and maximum points on the absorption line (in the case of the C wavelength you may need to use the points of inflection). The observed Q setting is the average of these two values; check that they are in accord with the Q-lever tables. Signal the results in a similar form to the mercury-lamp test, with observed and tabulated settings, mean temperature, pressure and mu value eg:

ZENITH SKY TEST 1994 NOV 02 ON DOBSON 103
Q-LEVER TABLES DATED 1991 JAN 10

C	765	770	205	985	1195
D	1068	1078	203	985	1204

The test should be performed three times a year: as early each spring as possible, in December when the best results are usually obtained, and again during the autumn. The results of the test appear to depend on the ozone distribution and anomalous results are obtained at high mu values during the period of the ozone hole and its recovery. There is some evidence that the Q-lever setting decreases as mu increases, so please report the mu value of the mid-point of the test. These checks will suffice as long as the mercury-lamp tests show no change. If, however, significant changes are apparent in those tests, the zenith-sky test should be performed as soon as possible. Both sets of information are needed when revising the Q-lever tables. Details of revisions will be sent from Cambridge when necessary.

The test can also be done on uniform zenith cloud, and gives good results. This will however not usually be necessary as blue skies occur sufficiently frequently.

7.4.6. Umkehr observations

These should be made whenever time and conditions permit. For the present they are the only source of information on the vertical distribution of ozone. There should be no cloud within 10 degrees of the zenith; it does not matter if zenith cloud comes and goes between readings.

The standard solar zenith angles for which N-values on A, C and D wavelengths are required are: 60, 65, 70, 74, (75), 77, 80, 83, (84), 85, 86.5, 88, 89 and 90 degrees. Of these only 80 to 89 degrees are essential, but the rest should be included if possible. Bracketed values are not needed but could be included for completeness. There is no need to observe at these precise values: the procedure is to take sufficient readings so that N can be plotted against Z, and the values for the required zenith angles read off. It is important to define the curvature in the region of maximum N accurately; as a very rough guide, 5 points should be sufficient to define the rising (quasi-linear) section, 10 points enough around the maximum and 5 more enough for the tail. Komhyr page 58 shows a sample curve but he uses R and GMT rather than N and Z.

The readings are ZB (zenith blue) measurements. Observe C-D-A-A-D-C and record the central time only (cf. 7.2.2 above). The results are sent to Cambridge, along with the normal data, on the data scheds. The computation of the N values for the standard zenith angles will be done in Cambridge, though the final computation of layer thickness is done by the World Data Centre for ozone in Canada.

7.5. Test faults

The following are some checks that could be carried out if the TLT is giving problems.

1. Is there any dust/dirt on the optical components. If so clean with a blower brush or air squirt only.
2. Are any components loose or obviously out of alignment (most likely slits, but also prisms, lenses and mirrors). (Visual check only).
3. Are there any blockages to light paths (See also Test 8 IGY manual) or errors of alignment (eg sector wheel, silica gel dishes).
4. Visually check the condition of the wedges by removing the bridge unit. You will need to remove the S4 lamp housing before removing the bridge.
5. Check that the S4 lamp is correctly installed in its housing, that no light can escape except through the ground quartz plate and that the lead doesn't block the light path.
6. Can any fluorescent lights shine into the Dobson during the test - they should be off during the test as it can cause erratic readings.
7. The following is taken from an early edition of the Dobson handbook, but I haven't seen it in more recent ones:

Placing a small mirror near the second main lens check that the whole of S2 and S4 can be seen unobstructed from the whole of the prism and that the quartz plate completely covers S3. After the cover is replaced and the instrument ready for use, switch on the S4 lamp only, the galvo deflection will now be due to the light passing S4. Move the "clear-opaque-clear" lever to its two extreme positions and see if the galvo deflection remains exactly the same in each position. Should there be any difference, examine the beam with the little mirror as suggested before to see what is causing the difference in the two positions and remove the cause. Next fit the standard lamp and set the dial to make the galvo read zero when the rhodium plate covers S3. Now move the lever very slightly and see that a small movement of the rhodium plate does not affect the galvo. Should there be a change, it may mean that the light through S3 passes dangerously near the edge of the plate.

7.6. Single-lamp Calibration

This calibration is a replacement for the twin-lamp test and should be carried out every year. It is far easier to carry out than the TLT and should only take a few hours. Data is entered into an excel spreadsheet as you go, and the results are graphed. It does not give exactly the same results as the TLT, but will show up any relative changes in the wedges. If it looks as if these are significant we will ask you to carry out the full TLT.

Whilst the TLT uses a doubling of light intensity, this test uses a constant light intensity, but varies the position on the wedge by changing the voltage on the PMT. It assumes that the measured current from the photomultiplier is directly proportional to the light intensity over a range from 20 – 6 micro Amps.

Full instructions are given in the revised BAS ozone manual.

7.7. Ozone input, processing and display programs

Most programs provide some explanation of what they do in the source code, and this is listed as necessary when the programs are run. The full suite of programs is as follows; all can be run from a single program group operating under windows or from DOS. Some of the programs are still in the testing stage, so may have bugs in them. Programs modified from existing ones are less well designed, but more recent ones should be easier to follow. The only ones that need to be run for routine work are verhut, wdisplay, ozbackup, month and mutimes.

7.7.1. Programs

Please advise us of any changes that you think are required, and the date of any change that is implemented.

7.7.1.1. VERHUT

Observation input program. A derivitive of the Halley hut program, tailored for use at Vernadsky station, but which is designed to run at any station. It asks you what sort of ob you want to do, tells you the q-lever settings and allows you to enter a complete ozone observation after it has been completed. The data and output corresponding to the observation form is stored in a monthly holding file.

Parameters:	dobson mawspath
Input Files:	dn<nnn><v>.dat
	d<nnn><v>.dat
	q<nnn><v>.dat
	mawsdata.vax
Output files:	<b>oz<mon><yy>.dat
	<b>tx<mon><yy>.txt (notebook format data)

7.7.1.2. WDISPLAY

A program to display the past weeks ozone data, using data from the monthly files. On a colour VGA screen each obtype is displayed in a different colour.

Parameters:	none
Input Files:	pathfile.dat
	dn<nnn><v>.dat
	d<nnn><v>.dat
	<b>oz<mon><yy>.dat
Output files:	wdata.dat (ozone values)

7.7.1.3. OZBACKUP

A program to backup ozone data to floppy and produce the weekly datafile to send to Cambridge. Should be run once a week on Wednesdays.

Parameters:	None
Input Files:	pathfile.dat
	<b>oz<mon><yy>.dat
	last.inf
	counts.pnt
Output files:	last.inf
	counts.pnt

	<b>oz<yy><yy+1>.dat
	ozweekly.dat

At the end of the year, two copies of <b>oz<yy><yy+1>.dat should be returned by separate routes. A further copy of the yearly datafile should be retained on base.

7.7.1.4. MONTH

A program to enter the results of monthly tests and produce a tel to send to Cambridge.

Parameters:	none
Input Files:	rntab.txt
	wtemp.dat)
	stemp.dat) holding files for test results
	mtemp.dat)
Output files:	wtemp.dat
	stemp.dat
	mtemp.dat
	<dd>-<mm>-<yy>.txt (tel to send to Cambridge)

7.7.1.5. MUTIMES

Produces 4 files which give the times of standard, Lo and Umkehr (or comparison) observations, and general information on sunrise, sunset and LAN. It needs to be compiled with compiler options 8087 and Emulation set off if it is run on a computer without coprocessor.

Parameters:	dobson
Input Files:	dn<nnn><v>.dat
Output files:	monlos.txt
	monumk.txt
	monstd.txt
	moninf.txt

7.7.1.6. PROCOZ

A program to compute and check ozone data using the yearly data file. It is intended for use at HQ and produces a large number of output files.

Parameters:	None
Input Files:	pathfile.dat
	dn<nnn><v><yy>.dat
	d<nnn><v>.dat
	c3lmh.dat
	<b>oz<yy><yy+1>.dat
Output files:	xdata.dat (individual ozone obs)
	ydata.dat (daily mean values
	ldata.dat (lo n values)
	udata.dat (umkehr n values)
	zbdata.dat (C' zb n values)
	results.dat (sic)
	queries.dat (sic)
	lores.dat (lo results)
	comp.dat (AD and DC zenith comparisons)
	add.dat (ADZ/DS differences)
	cdd.dat (CDZ/DS differences)

cc.dat (CZ/DS differences)

7.7.1.7. ODISPLAY

A program to display data produced by PROCOZ. The results of Los, Umkehrs and routine ozone observations can be viewed. Routine observations can be viewed by the day, week, or month and daily averages can be viewed for the season. Comparisons between AD and CD zenith observations can also be displayed.

Parameters:	None
Input Files:	pathfile.dat
	xdata.dat
	ydata.dat
	ldata.dat
	udata.dat
	results.dat
	comp.dat
Output files:	None

7.7.1.8. QSET

Lists the q-lever settings when given the pressure and instrument temperature.

Parameters:	Dobson
Input files:	q<nnn><v>.dat
Output files:	None

7.7.1.9. RTON

Gives a Dobson n value for a given r value.

Parameters:	Dobson
Input files:	d<nnn><v>.dat
	dn<nnn><v>.dat
Output files:	None

7.7.1.10. WEDGE

Computes the Dobson wedge optical thickness from the results of the twin lamp test.

Parameters:	None
Input files:	d<nnn><v>.weg
Output files:	d<nnn><v>.tab
	d<nnn><v>.rtn

7.7.2. Parameter formats

Parameters are given on the command line following the program name. Dobson is <nnn><v> where <nnn> is the Dobson number and <v> its refurbishment letter. Mawspath is an optional parameter that gives the network path on which Milos data can be found. The path must end with a \.

7.7.3. Input file formats.

Note some files include constants for observation types which are no longer made.

7.7.3.1. Annual Dobson constants: dn<nnn><v>.dat or dn<nnn><v><yy>.dat

Latitude, Longitude, Dobson No
Lo Values for A, C and D using R-N table in d<nnn><v>.dat
GQP factors for C, D and C', NiSO4 factors for C, D and C', Rhodium plate N value
C' ZB constant, CDDS offset
ADZ, CDZ, CC'Z and CDZ high mu offsets
Year, month, day, hour, minute at which the above values change

Example:

-75.58 26.37 103
-0.250 -0.205 -0.195
-0.090 -0.105 0 0.340 0.625 0 0.505
0 0
24 -23 -65 70
1996 06 30 24 00

7.7.3.2. Dobson instrument constants: d<nnn><v>.dat

Description of file
Ozone absorption coefficients
C' ZB equation coefficients
ADZ equation coefficients
CDZ equation coefficients
CZ equation coefficients
CDZ high mu equation coefficients
R-N tables for A, C and D at 10 degree intervals.

Example:

```
Constant table for Dobson 103 at Halley
1.806 0.833 0.374 0.114 0.109 0.104
0 0 0 0
29 50.82 0 1911.0 -1812.0 0
-23 104.2 1662 0 0 0
-48 127.14 898.8 0 0 176.30
80 1033 393.2 -11.92 0 0
  0.000  0.098  0.195  0.300  0.407  0.512  0.624  0.737  0.848  0.961
  1.071  1.183  1.295  1.406  1.521  1.633  1.747  1.857  1.969  2.082
  2.191  2.303  2.415  2.528  2.641  2.750  2.863  2.970  3.080  3.199  3.318
  0.000  0.099  0.197  0.301  0.405  0.512  0.622  0.733  0.844  0.955
  1.065  1.175  1.284  1.395  1.506  1.616  1.728  1.837  1.944  2.054
  2.163  2.273  2.385  2.496  2.607  2.716  2.825  2.933  3.042  3.159  3.277
  0.000  0.094  0.193  0.296  0.400  0.507  0.617  0.726  0.836  0.945
  1.053  1.161  1.270  1.377  1.487  1.598  1.706  1.813  1.921  2.029
  2.137  2.246  2.356  2.466  2.577  2.683  2.789  2.896  3.004  3.117  3.234
```

7.7.3.3. Q lever constants: q<nnn><v>.dat

Value at 15 degrees Celcius

Temperature coefficient for A, C, D and Hg
Default pressure for station

Example:

48.2 76.0 107.1 83.5
0.110 0.160 0.155 0.160
990

7.7.3.4. Ozone datafile: <b>oz<yy><yy+1>.dat, <b>oz<mon><yy>.dat, ozweekly.dat

Year, month, day, hour, min, sec, ls, R1, R2, R3, R4, R5, R6, (R7, R8)
for ob type 9x: R1, R2 = A, R3, R4 = C, R5, R6 = D
for ob type 8x: R7, R8 = C'
other types: R1, R2, R3 = A or C, R4, R5 = D

7.7.3.5. C' zenith cloud correction chart

Three 7x8 arrays of numbers representing Chart C3 for low, medium and high cloud. Not used in present day observations and all values can be set to zero.

7.7.3.6. Pathfile

Path for ozone information files.
Base letter
Year for first half of ozone season

Example for Vernadsky in 95/96 season

c:\ozone\
v
95

7.7.3.7. Mawsdata

See Milos manual for documentation. Gives time of latest observation and values for the scanned channels.

7.7.3.8. R to N Tables: rntab.txt

Used by Faraday's month program to compute N values for the wedge test. Has n values for just the C wavelength at 1 degree intervals from 0 to 300. The program will be modified to use d<nnn><v>.dat.

7.7.3.9. Backup information

Last.inf contains the time of the last ob backed up to floppy (year, month, day, hour, min, sec).

Counts.pnt contains the number corresponding to the letter of the backup disc to use for the next backup (1 or 2).

7.7.3.10. Ozone values: wdata.dat, xdata.dat

month, day, hour, min, julian date, mu, zenith distance, ob code, ls, ozone value.

7.8. SAOZ

SAOZ (Systeme d'Automatique Observations Zenithales) is a spectrometer system, deployed at Rothera, that looks at uv and visible sunlight scattered from the zenith sky, in order to measure gases in the ozone layer (stratosphere). By comparing the observed spectra to laboratory spectra of gases that absorb in the uv and visible (O_3, NO_2, OClO) their total overhead amount (column) can be deduced. By measuring at twighlight, when sunlight traversing the lower atmosphere is scattered out of the beam by air molecules, the measurement is weighted to gases in the stratosphere rather than the lower atmosphere. Observations can be made at any time when the sky is light, independent of clouds or storms. The system is fully automatic, requiring only routine inspection for snow on the window and checking of disks and paper on the indoor computer than operates it. For further details see the manual "The SAOZ spectrometer" by Howard Roscoe, dated 1990 March 23, which describes the system at the time of installation at Faraday; and the additional notes by Derek Oldham made since installation in the "Engineering File" and "Bwian's Instructions".