METEOROLOGICAL SERVICE

SOLAR RADIATION OBSERVATIONS 1980

U.D.C.
551. 506.3
551. 521. 12(419.6)

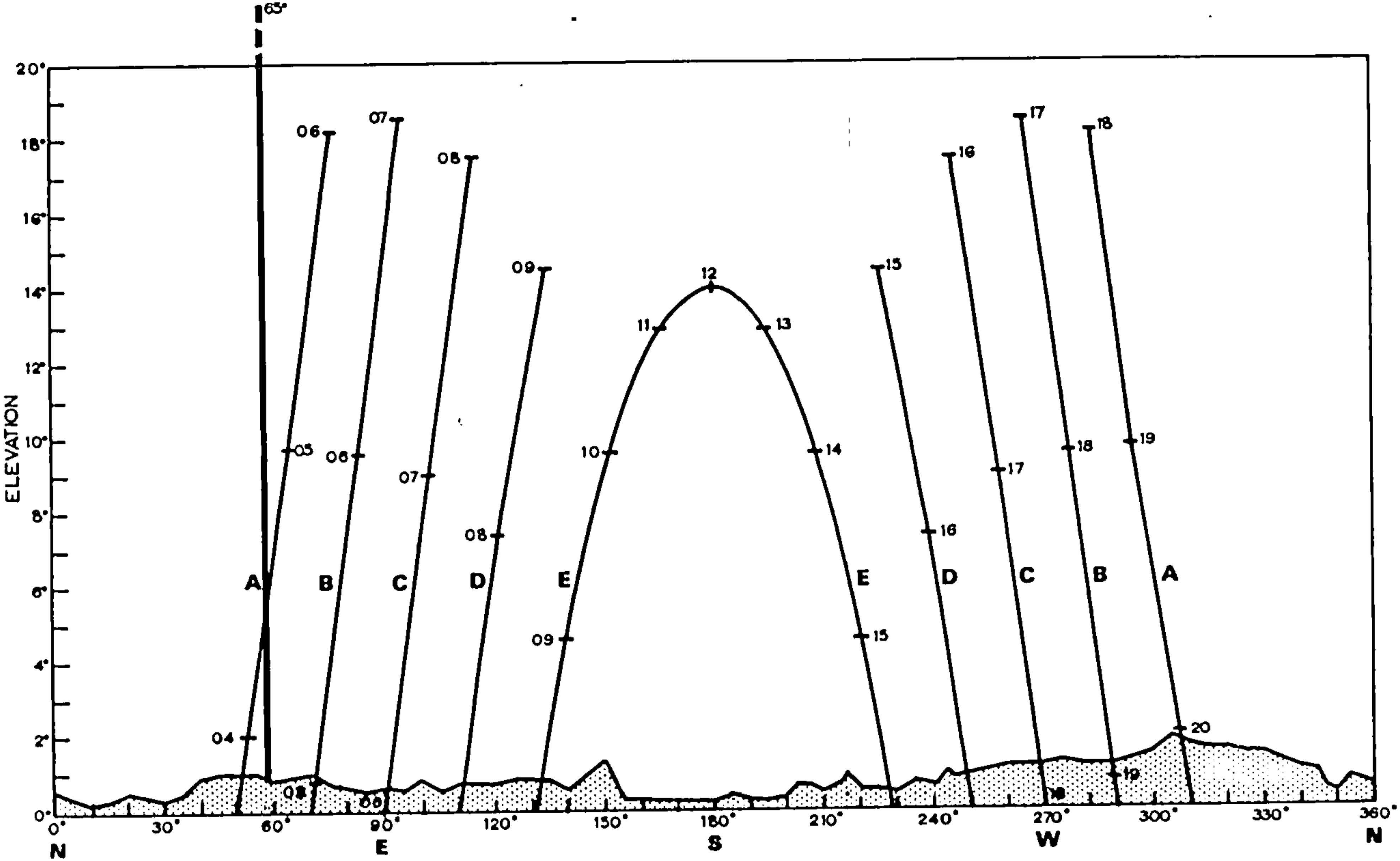
DUBLIN
1983
Price; £ 1·75

Errata 1979

Table 1 31st October 558 October Total 19690 Mean 635.2

Table 2 31st October 292 October Total 11087 Mean 357.6

Replace page 14 (Fig. 6) by attached page 14



KILKENNY

Fig. 6. Exposure diagram showing (1) azimuth and elevation of all objects which obscure pyranometer
(2) azimuth and elevation of Sun at various times of year as follows; (A) June 22, (B) April 21, August 23, (C) March 21, September 23, (D) February 18, October 25, (E) December 22.

CONTENTS

Page

SUMMARY

This volume contains a brief description of the site, equipment and observing procedures in use at the four stations in the Irish network of Solar Radiation measuring stations i.e. Valentia Observatory, Kilkenny, Birr and Dublin Airport.

In previous years hourly values were published but as and from January, 1976 only daily totals are published apart from the spot values of Direct Sun at Normal Incidence (Table 4).

The hourly values may be had on request from: The Director, Meteorological Service, Glasnevin Hill, Dublin 9.

All radiation values given in the following Tables are in the International Pyrheliometric Scale, 1956.

SOLAR RADIATION OBSERVATIONS AT VALENTIA OBSERVATORY

1980

1. Introduction

Solar Radiation observations were begun at Valentia Observatory in September, 1954. At that time a Moll thermopile pyranometer and a recording millivoltmeter were installed, and have, since then, provided a continuous record of Global Solar Radiation. A Linke-Feussner thermoelectric iron-clad Actinometer (Kipp and Zonen) was also brought into use at the same time and a schedule of routine observations on direct sunlight has been maintained when weather conditions permitted. In 1962, a second Moll thermopile pyranometer, fitted with shading ring, was installed to provide a record of Diffuse Solar Radiation.

Measurement of the Radiation Balance with a Funk type Net Pyrradiometer was introduced on a routine basis as from 1st. January, 1971.
Measurements of the Direct Sun radiation, using an Eppley Normal Incidence Pyrheliometer, and of Infra-Red radiation, using an Eppley Precision Radiometer (Pyrgeometer), were introduced on a routine basis as and from 1st January 1979.

Data derived from these instruments and the results obtained from the direct sunlight observations for the period 1954 - 1959 have been published in [1]. The data for 1960 and subsequent years have been published in annual volumes. This volume contains the data for 1980

2. Site of the Observatory

The observatory which is in the extreme south-west of Ireland, (Lat. 51° 56' N; Long. 10° 15'W), is situated on the south-east side of the narrow estuary of Valentia River, which runs from approximately north-east to south-west (Fig. 1). It is about 1.2 Km to the south-west of the town of Cahirciveen. To the north, across the river estuary, is a range of hills 120 to 360 m high. To the north-east, beyond the town of Cahirciveen, the estuary opens out considerably and the terrain is generally an open boggy basin with only a gentle gradient. To the south-east, however, the ground rises rapidly again to a range of hills 270 to 360m high, the highest peak (Bentee 375m) being only 1.5 Km from the Observatory. To the south, the country opens out to a distance of nearly 8 Km from the Observatory, where the Kilkeaveragh range of hills runs east west, varying in height from 120 to 390 m. There is an opening to the sea to the south-west between the mainland and Valentia Island. The hills on the Island rise to a height of 270 m. North of the island there is another opening to the sea, and the circle of hills is completed by a range to the north-west, 120 to 270 m high, separated by a narrow gulley from the range to the northward.

3. Measurement of Global Solar Radiation

3.1 Exposure of the Pyranometer

The layout of the Observatory is shown in Fig. 2. The sensor is exposed on the roof of the Radiation House and the recording instruments are installed inside the house. The pyranometer is at a height of 4 metres above ground level and 20 metres above Mean Sea Level. The nature of the exposure can be seen in Fig. 3, in which the outline of all obscuring objects is plotted on an Elevation-Azimuth diagram. Apart from one sector, the obscuring objects have an elevation of less than 5° so that their effect on the Diffuse Radiation is negligible.

In the sector 080° to 150° E. from north, the elevation of the obscuring objects lies between 8° and 10.5° approximately. The loss of Diffuse Radiation according to Blackwell's formula [2] works out at approximately 1%. This is also very small, so no corrections have been made to the data to allow for this loss. The loss of radiation due to the obscuring of the direct solar beam occurs mainly in the same sector (080° to 150°). During the period from the end of August to mid-April, the initial 30 to 70 minutes of the direct sun is cut off. This affects the hourly values given for the first and occasionally the second hour but the effect on the total for the day is negligible. No attempt has been made to correct the radiation data for this loss of direct sunlight.

3.2 Pyranometer Used

Details concerning the pyranometer and recording equipment are given in the Appendix

3.3 Calibration of the Pyranometer

The pyranometer, recorder and integrator were calibrated by means of the Actinometer and Millivoltmeter, described in paragraphs 7.1 and 7.2 below. The calibration was done by comparing the intensity of the direct sunlight as measured by the pyranometer with the corresponding intensity as measured by means of the actinometer.

3.4 Timing Control

To facilitate accurate timing, time marks were made on the chart, automatically, by standard clock, at each hour L.A.T. This clock, which also controlled the print-out unit, was adjusted daily to keep it within ½ minute of true L.A.T.

4. Measurement of Diffuse Solar Radiation

4.1. Exposure of the Pyranometer

The Diffuse Pyranometer is mounted on the same site as the Global Pyranometer, at a distance of 3.1 metres west of the latter. A description of the site is given in 3.1 above.

4.2. Pyranometer Used

See Appendix

4.3. Calibration of the Pyranometer

The shading-ring was displaced below the horizontal position. The pyranometer was then calibrated in exactly the same way as the Global Pyranometer (para 3.3 above). The calibration was checked by comparing the values recorded during the hours when the sky was overcast with the corresponding values as recorded on the Global Pyranometer.

4.4. Shading-Ring Correction

Corrections have been made to increase the values extracted from the charts to compensate for the diffuse energy intercepted by the ring simultaneously with the eclipse of the sun's disc. Theoretical corrections were computed following the method described by Blackwell [2].

5. Measurement of Direct Sun Radiation

5.1 Exposure of the Pyrheliometer

The Direct Sun Pyrheliometer is mounted on the same site as the Global Pyranometer at a distance of 2.4 metres north-west of the latter. A description of the site is given in 3.1 above.

5.2 Pyrheliometer Used

See Appendix

The Pyrheliometer is mounted on an Eppley Solar Tracker - a power driven equatorial mount with provision for varying the elevation and azimuth settings. The tracker settings are adjusted as necessary to keep the pyrheliometer directed at the sun at all times.

5.3 Calibration of the Pyrheliometer

The pyrheliometer and integrator were calibrated by means of the Actinometer and Millivoltmeter, as described in paragraphs 7.1 and 7.2 below. The calibration was done by comparing the intensity of the radiation as measured by the pyrheliometer with the intensity measured by the actinometer.

6. Measurement of Infra-red Radiation

6.1 Exposure of the Radiometer (Pyrgeometer)

The Infra-red Radiometer is mounted on the same site as the Global Pyranometer at a distance of 1 metre south-west of the latter. A description of the site is given in 3.1 above

6.2 Radiometer Used

See Appendix

6.3 Calibration of the Radiometer

The radiometer was calibrated in a water-heated hemispherical cavity which provided a source of isotropic black-body radiation. The radiation as measured by the radiometer was compared with the radiation in the cavity as calculated from the Stefan-Boltzmann law.

7. Direct Sun Observations

7.1 A Linke-Feussner thermoelectric iron-clad actinometer (Serial No. 93) by Kipp and Zonen, provided with red and yellow filters, was used for all instantaneous direct sun observations. Sangamo Weston Millivoltmeter No. 56501 was used.

The actinometer body consists of six massive copper rings, which are made to serve as diaphragms. The openings of these diaphragms decrease progressively towards the thermopile, and the chambers formed between them are specially shaped so as to eliminate turbulent air currents within the instrument. Felt lagging around the body shields the instrument thermally.

The detachable filter head consists of a heavy copper core, which is screwed on to the exterior ring and carries a filter disc. Only a small segment of this disc protrudes from the head, so that the filters are kept at actinometer temperature. The Moll thermopile is divided into two equal sections, connected in opposition and each consisting of twenty constantin-manganin couples. One of the sections is screened from radiation and thus acts as a compensating device for the elimination of thermal effects associated with quasi-adiabatic pressure changes, occurring near the thermopile surface.

A thermometer for reading the temperature of the instrument is set inside the copper parts.

7.1.1. Filters Used

Three filters of Schott glass OG_1, RG_2 and RG_8 received from the Radiation Commission of the International Association of Meteorology, were used for all the observations. These filters were tested at Davos Observatory and a certificate with the reduction factor (DR) supplied.

For Filter OG_1, DR = 1.108

For Filter RG_2, DR = 1.132

For Filter RG_8, DR = 1.050

7.2 Calibration of the Actinometer

In 1961, an Angstrom Compensating Pyrheliometer (No. 548) was received, with calibration data,from Stockholm. This instrument is reserved as National Reference Standard. Its calibration has been maintained in agreement with IPS 1956 by participation in the W.M.O. Region VI Comparisons of National Standard Pyrheliometers held at Davos in 1964, in Carpentras, France, in 1969 and at Davos in October, 1975, and also by participation in a comparison organised by the E.E.C. in Carpentras in 1978.

The Actinometer and associated meter were calibrated by reference to the Pyrheliometer.

7.3 Observational Routine

All observations were made at a site about 6 metres south east of the Radiation House (Fig. 2) and at a height of 15.5 metres above M.S.L. Observations were made three times daily, when sky conditions permitted, at approximately 1030, 1230 i.e. at approximately the average time of local noon and at 1430 G.M.T. Each of the observations consisted of a double series of measurements in the order:- Zero - RG_8 - Total - RG_2 - OG_1 - OG_1 - RG_2 - Total - RG_8 - Zero. Observations were made of the time G.M.T. of each of the individual settings, the temperature at the beginning and end of each set of observations, as indicated by the thermometer attached to the Actinometer, the cloud type and amount, visibility and weather.

7.4 Computation of the Sun's Zenith Distance (Z)

The Sun's Zenith Distance for each time of observation was obtained from a special table prepared for Valentia, based on Tables 5, 6 and 11 as given in Linke's "Meteorologisches Taschenbuch" Vol. IV (Leipzig, 1939 edition) and the "Alt Azimuth Tables for Latitude limits 30° to 64°", prepared by P.L.H. Davis and published by H.M. Stationery Office, London (1918 edition). The values are correct to the nearest tenth of a degree.

7.5 Computation of the Optical Air Mass (m)

The Relative Air Mass (m_h) was obtained from the Sun's Zenith Distance (Z) by using Table 137, page 422 of "Smithsonian Meteorological Tables" (1951 edition). This table is based on Bemporad's formula:-

$$m_h = \frac{\text{Atmospheric Refraction in Seconds}}{58.36 \sin Z}$$

The Optical Air Mass (m) was computed from the formula:-

$$m = m_h \frac{P}{1000} \qquad \text{where } P = \text{the atmospheric pressure in millibars}$$

8. Radiation Balance

Measurement of the radiation balance commenced on a routine basis in 1971. Details of the instruments used will be found in the Appendix.

The exposure is over a lawn surface adjacent to the Radiation House on the roof of which the other radiation instruments are exposed.

The calibration is checked regularly by reference to the Angstrom Pyrheliometer.

References

[1] Solar Radiation Observations at Valentia Observatory, 1954 - 1959 (Meteorological Service, Department of Transport and Power, Dublin, 1961)

[2] Five years Continuous Recording of Total and Diffuse Solar Radiation at Kew Observatory - By M.J. Blackwell.
(Meteorological Research committee, Air Ministry, London.
M.R.P. No. 895, 1954)

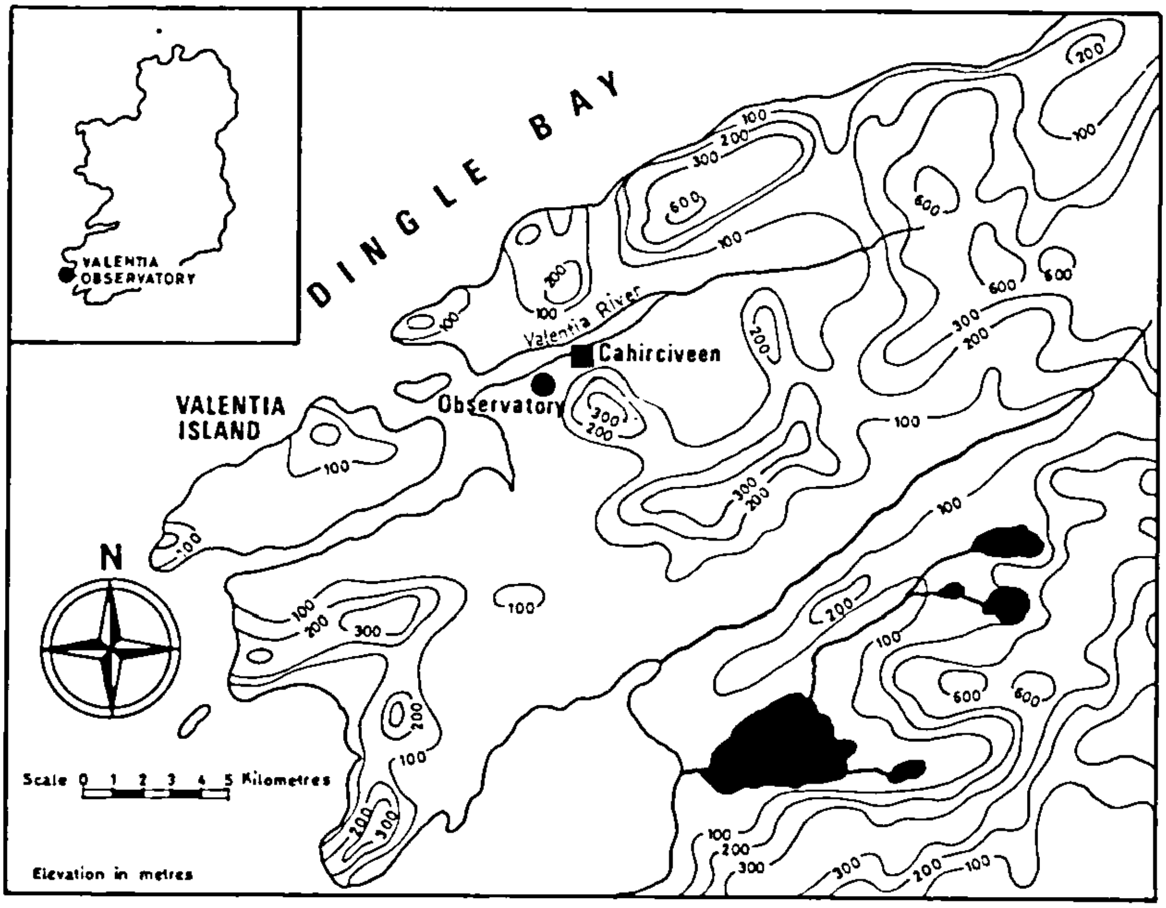


Fig. 1. Map showing the site of Valentia Observatory and its environs.

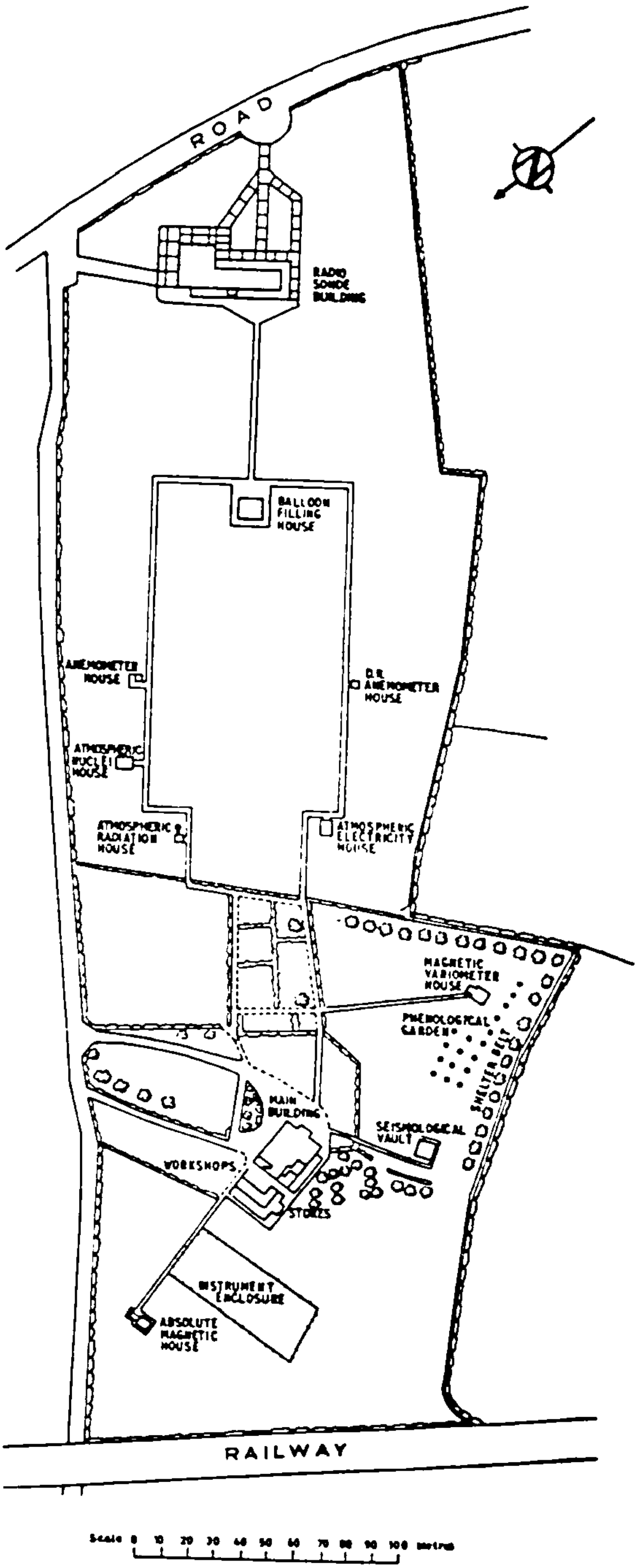
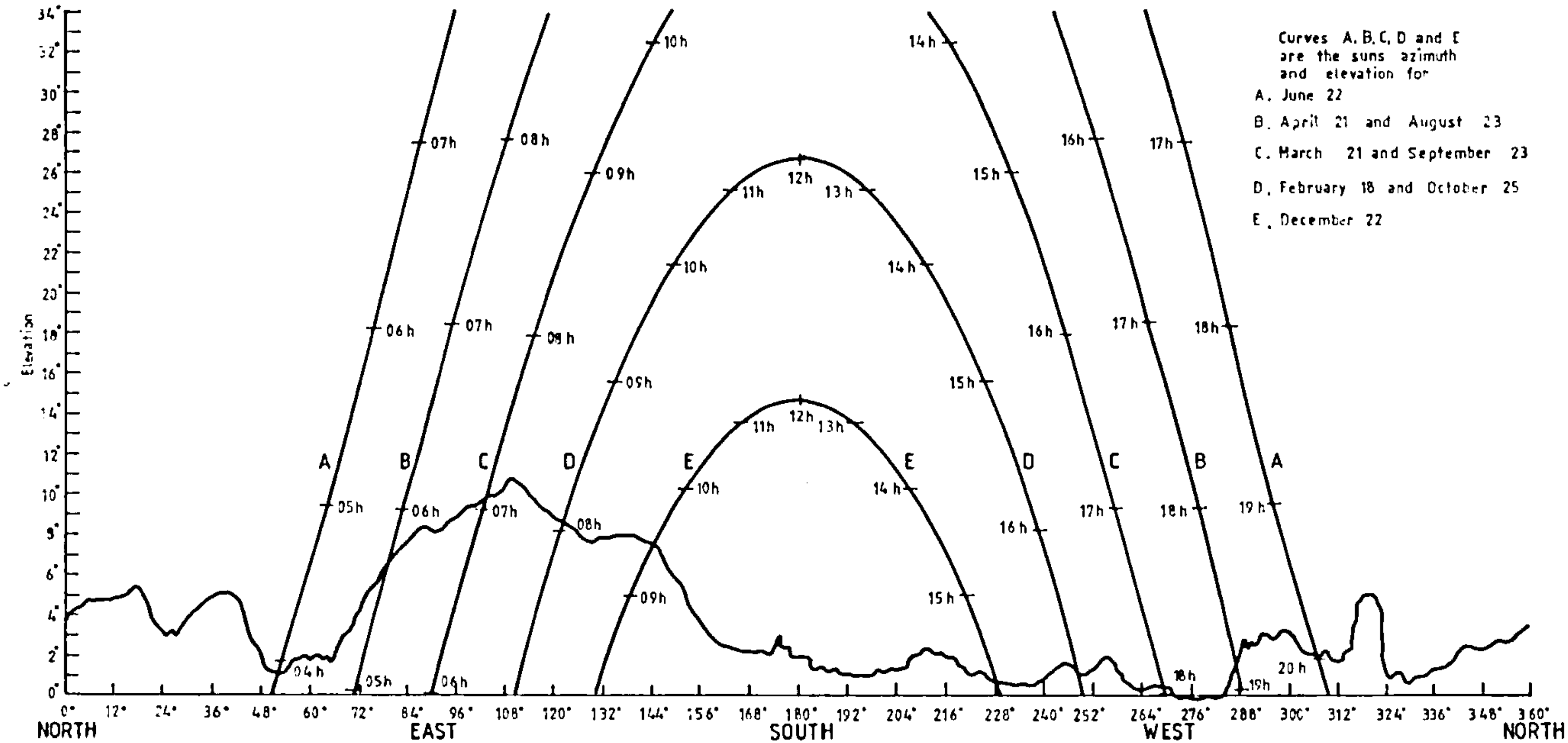


Fig. 2 General layout of Valentia Observatory.



VALENTIA OBSERVATORY

Fig. 3. Exposure diagram showing Azimuth and Elevation of all objects which obscure the pyranometer, together with Elevation and Azimuth of the sun at different times of the year.

SOLAR RADIATION OBSERVATIONS AT KILKENNY METEOROLOGICAL STATION

1980

1. Introduction

Measurements of Global Solar Radiation were begun at Kilkenny towards the end of 1968 while measurement of Diffuse Solar Radiation commenced in May 1979. Data given in this volume represent the results for 1980.

2. Site of the Observations

The Meteorological Station is situated 2 Km north-west of the centre of Kilkenny at Latitude 52° 40' N; Longitude 07° 16' W. Kilkenny is mainly a marketing town of population 10,000, in which there are no major industries or sources of atmospheric pollution. The countryside immediately surrounding the station is flat open grassland. Low hills beyond this area are sufficiently distant to avoid causing obstruction.

3. Measurement of Global Solar Radiation

3.1 Exposure of the Pyranometer

The global pyranometer is installed on a stand at the southern edge of the flat roof of the station building 5 metres above ground level (Fig. 5) and 67 metres above sea level.

The exposure is good, all effective obstruction being below 2° elevation except between 57° and 59° azimuth where an anemometer mast obstructs to 65° elevation (See Fig. 6)

3.2 Pyranometer Used

See Appendix

3.3 Observing Procedure

Time marking of the records and control of print-out is by means of an electric clock, reset each night to maintain timing within ½ minute of time L.A.T. The method of tabulation of the records is the same as that already described for Valentia Observatory.

3.4 Calibration of the Pyranometer

The instrument in use is similar to that in use at Valentia Observatory and was calibrated, before installation, against the Valentia Standard.

4. Measurement of Diffuse Solar Radiation

4.1 Exposure of the Pyranometer

The diffuse pyranometer is mounted on the same site as the global pyranometer, at a distance of 9 metres north-east of the latter. A description of the site is given in Section 2 above.

4.2 Pyranometer Used

See Appendix

4.3 Calibration of the Pyranometer

The shading-ring was displaced below the horizontal position and the calibration was done in exactly the same way as for the Global pyranometer. The calibration was checked by comparing the values recorded during the hours when the sky was overcast with the corresponding values as recorded by the global pyranometer.

4.4 Shading-Ring Correction

Corrections have been made to increase the values extracted from the charts to compensate for the diffuse energy intercepted by the ring simultaneously with the eclipse of the sun's disc. Theoretical corrections were computed following the method described by Blackwell [2].

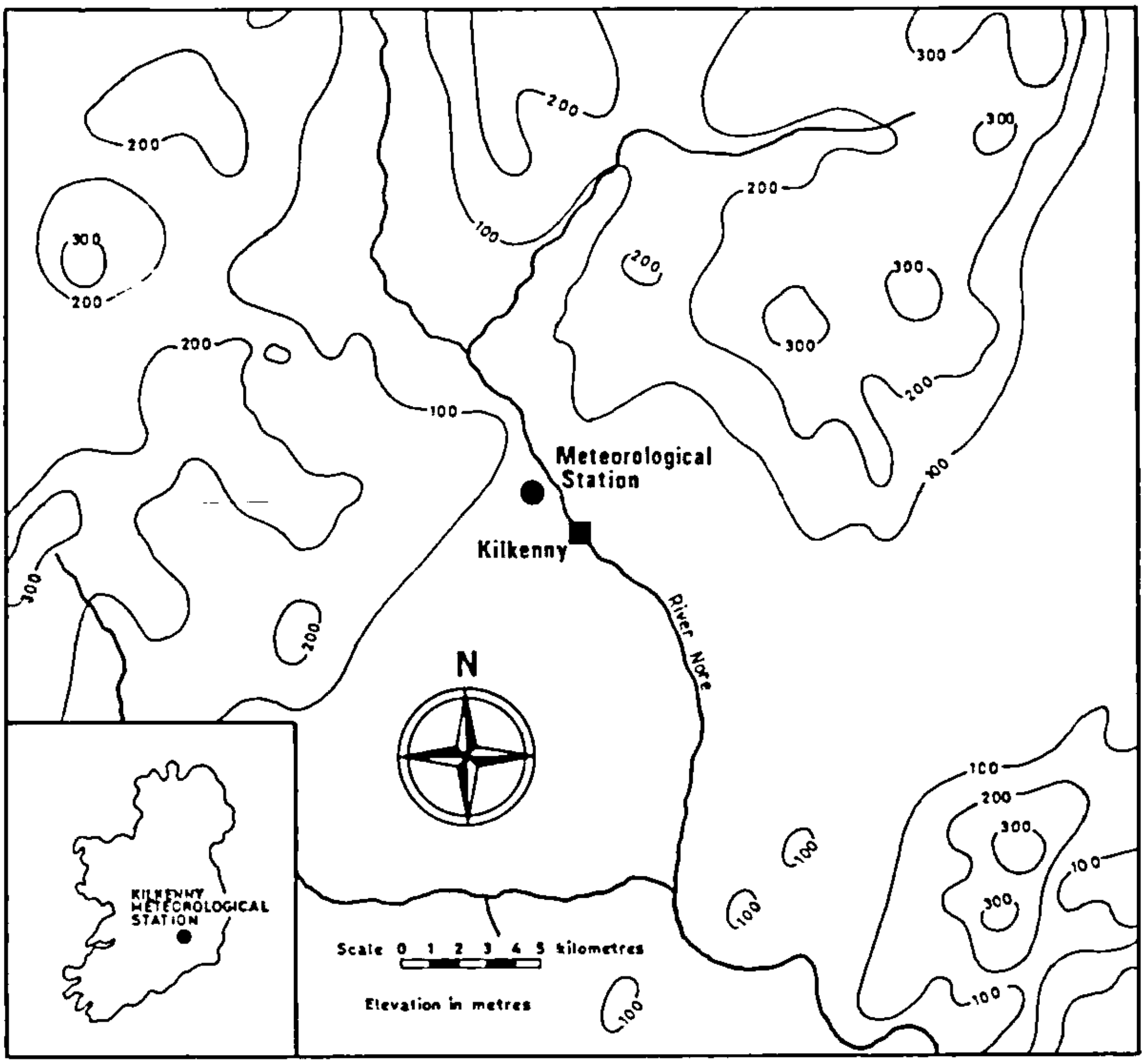
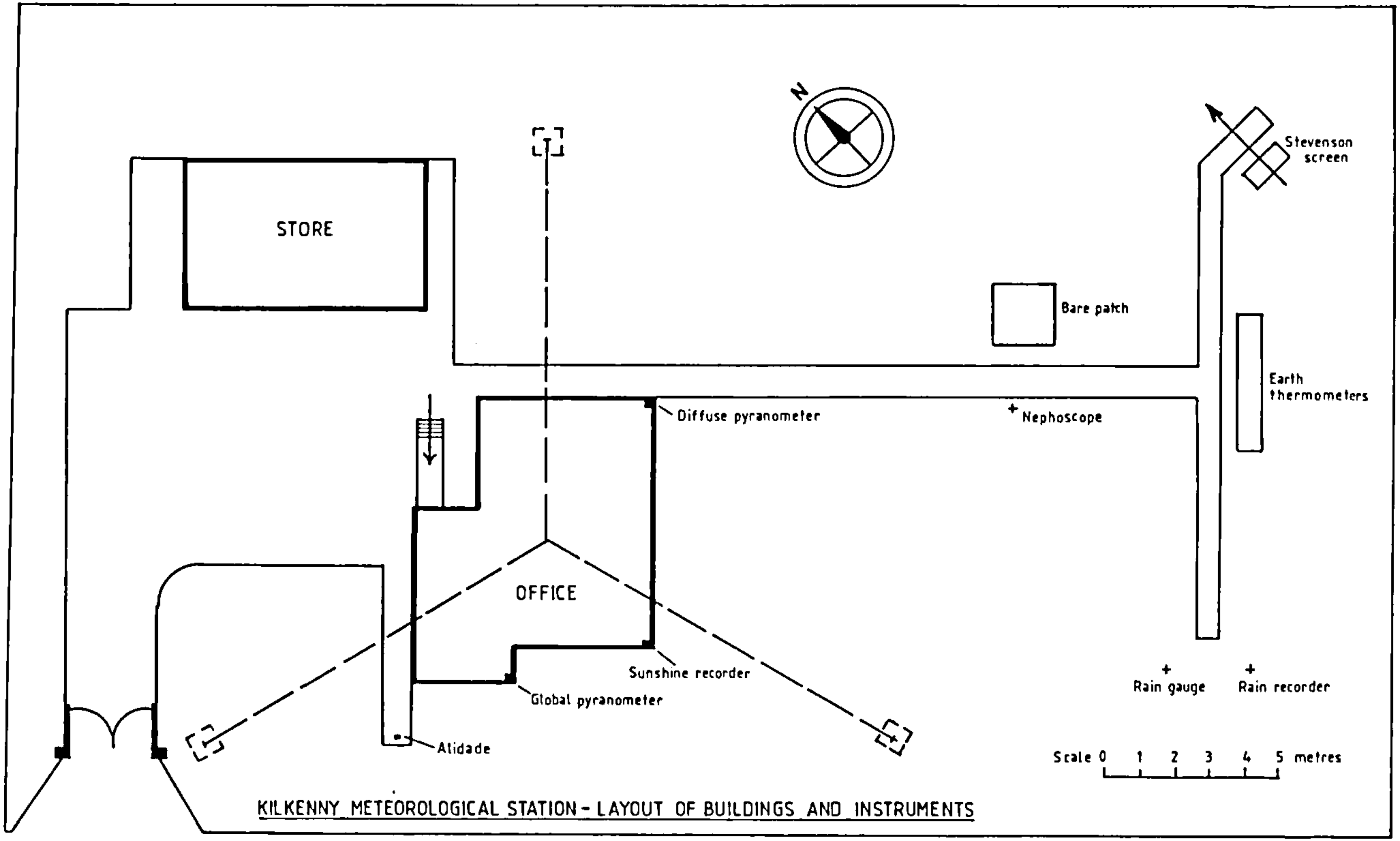
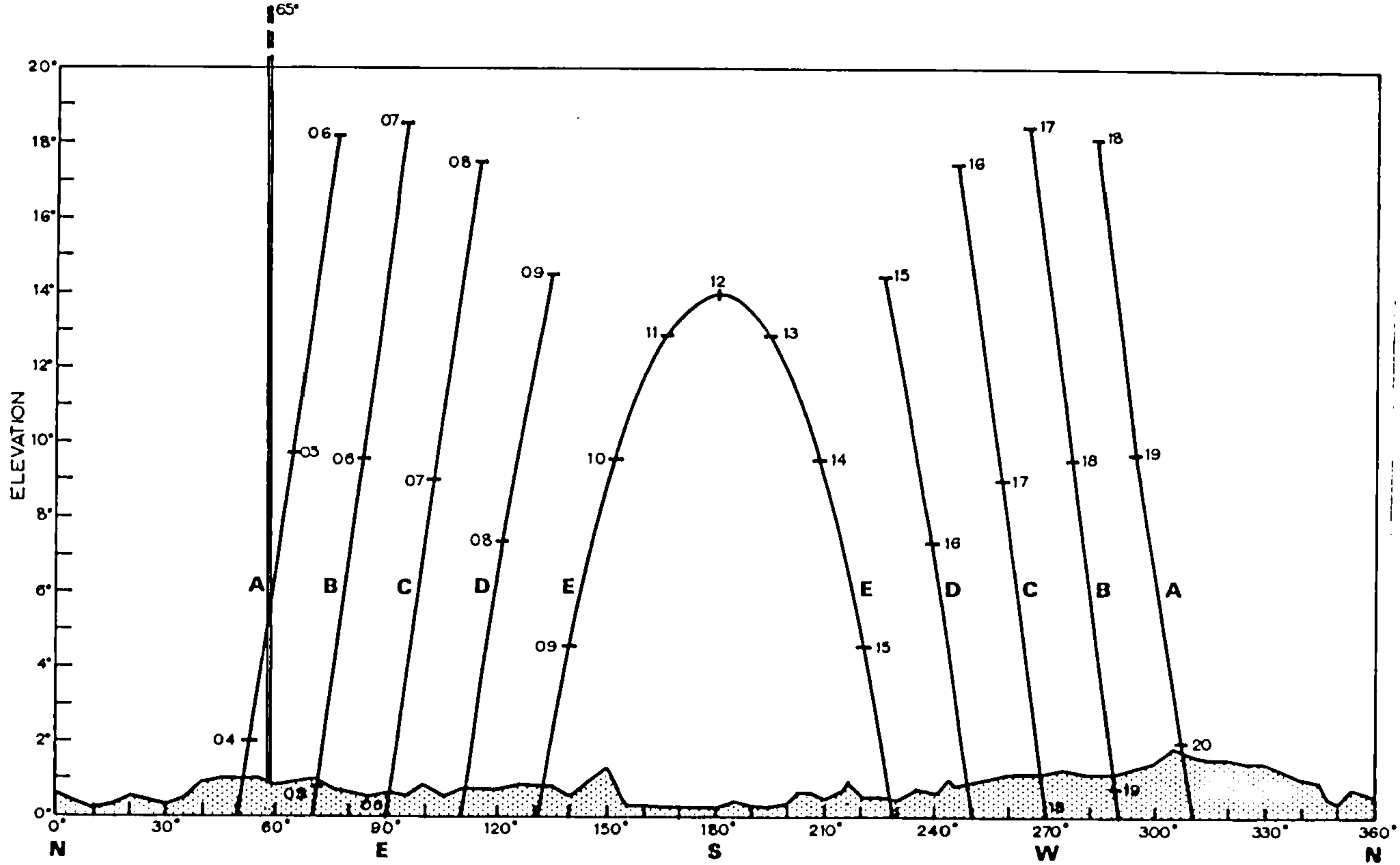


Fig. 4. Map showing site of Kilkenny Meteorological Station.



KILKENNY METEOROLOGICAL STATION - LAYOUT OF BUILDINGS AND INSTRUMENTS

Fig. 5.



KILKENNY

Fig. 6. Exposure diagram showing (1) azimuth and elevation of all objects which obscure ~~solarimeter~~ PYRANOMETER
(2) azimuth and elevation of Sun at various times of year as follows; (A) June 22, (B) April 21, August 23, (C) March 21, September 23, (D) February 18, October 25, (E) December 22.

SOLAR RADIATION OBSERVATIONS AT BIRR METEOROLOGICAL STATION

1980

1. Introduction

Measurements of Global Solar Radiation were begun at Birr towards the end of 1970, while measurements of Diffuse Solar Radiation commenced in May 1979. Data given in this volume represent the results for the year 1980.

2. Site of the Observations

The Meteorological Station is situated in flat pasture land, fairly well wooded, about 1½ Km east of the town of Birr at Latitude 53° 05' N; Longitude 07° 54' W. The surrounding country is gently undulating. About 16 Km to the east lie the Slieve Bloom mountains, the main axis of which runs north east - south west. The highest peak of this range is 518 metres. About 10 Km to the north of the station, there is an extensive area of bog (see Fig. 7).

3. Measurement of Global Solar Radiation

3.1 Exposure of the Pyranometer

The global pyranometer is installed on a stand at the southern edge of the flat roof of the station building 5 metres above ground level (Fig. 8) and 75 metres above sea level.

The exposure is generally good, all effective obstruction being below 2° elevation, except for a few isolated buildings which obstruct the horizon above 2° and between 37° and 39° azimuth where an anemometer mast obstructs to 64° elevation (See Fig. 9).

3.2 Pyranometer Used

See Appendix

3.3 Observing Procedure

Time marking of the records and control of print-out is by means of an electrical clock reset each night to maintain timing within ½ minute of true L.A.T. The method of tabulation of the records is the same as that already described for Valentia Observatory.

3.4 Calibration of the Pyranometer

The instrument in use is similar to that in use at Valentia Observatory and was calibrated, before installation, against the Valentia Standard.

4. Measurement of Diffuse Solar Radiation

4.1 Exposure of the Pyranometer

The diffuse pyranometer is mounted on the same site as the global pyranometer, at a distance of 7 metres north-east of the latter. A description of the site is given in Section 2 above.

4.2 Pyranometer Used

See Appendix

4.3 Calibration of the Pyranometer

The shading-ring was displaced below the horizontal position and the calibration was done in exactly the same way as for the global pyranometer. The calibration was checked by comparing the values recorded during the hours when the sky was overcast with the corresponding values as recorded by the global pyranometer.

4.4 Shading-Ring Correction

Corrections have been made to increase the values extracted from the charts to compensate for the diffuse energy intercepted by the ring simultaneously with the eclipse of the sun's disc. Theoretical corrections were computed following the method described by Blackwell [2].

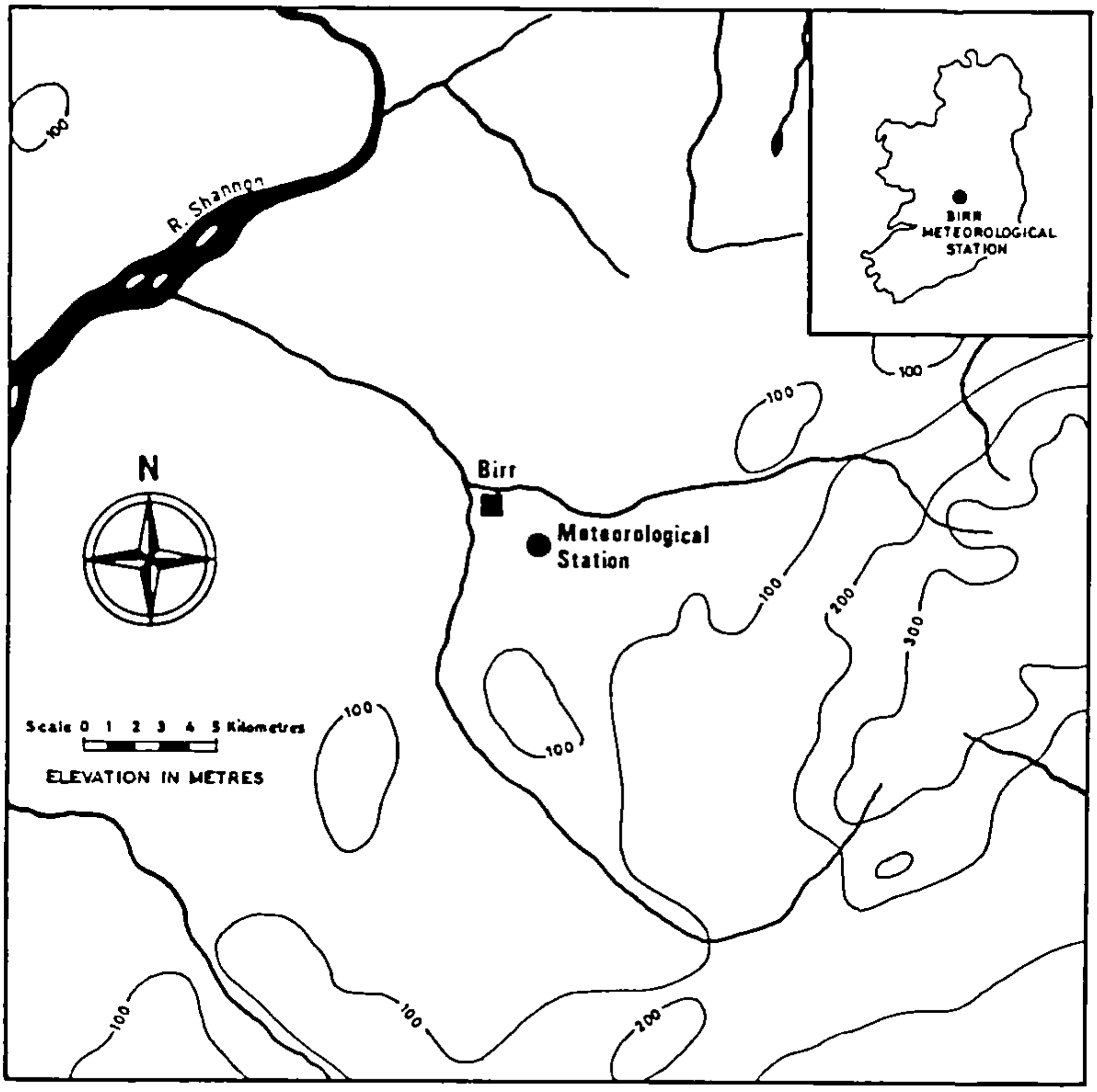
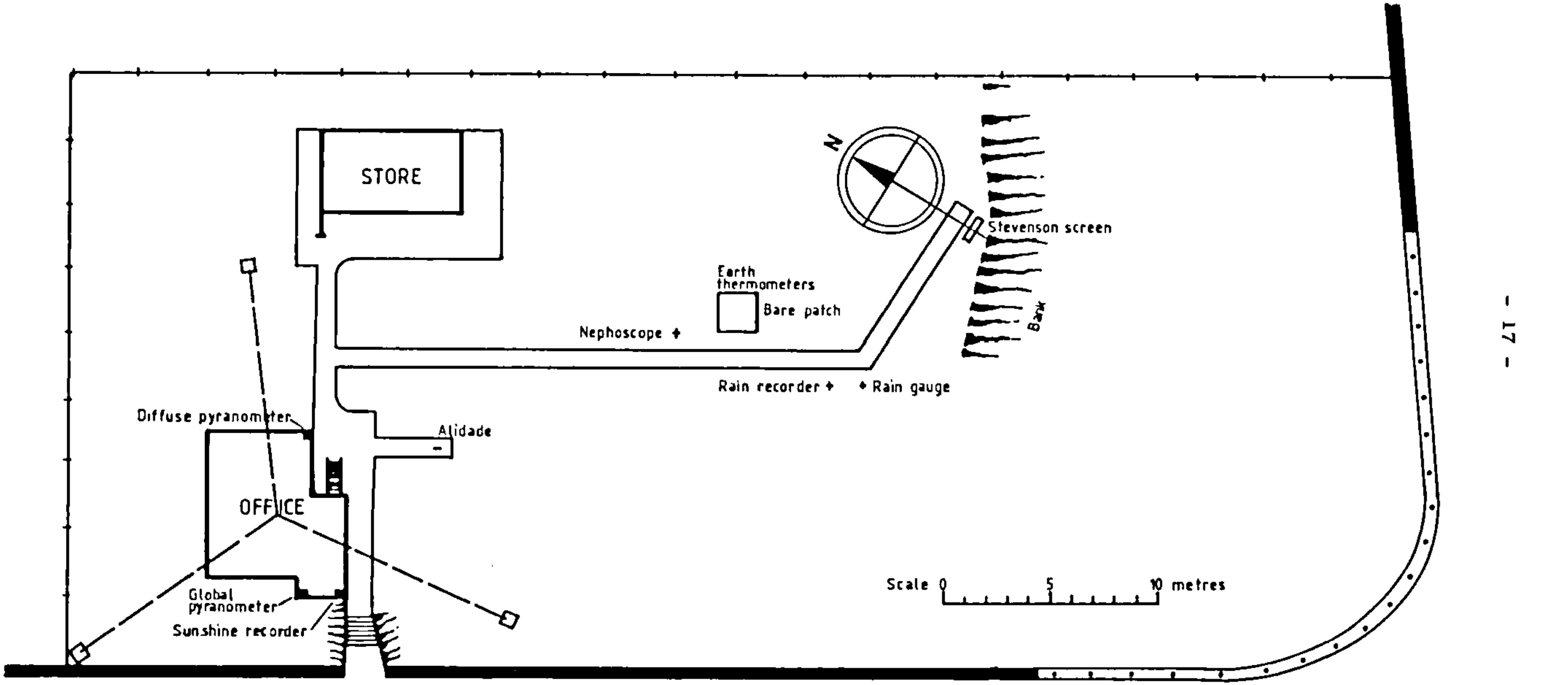


Fig. 7 Map showing site of Birr Meteorological Station.



BIRR METEOROLOGICAL STATION – LAYOUT OF BUILDINGS AND INSTRUMENTS

Fig. 8.

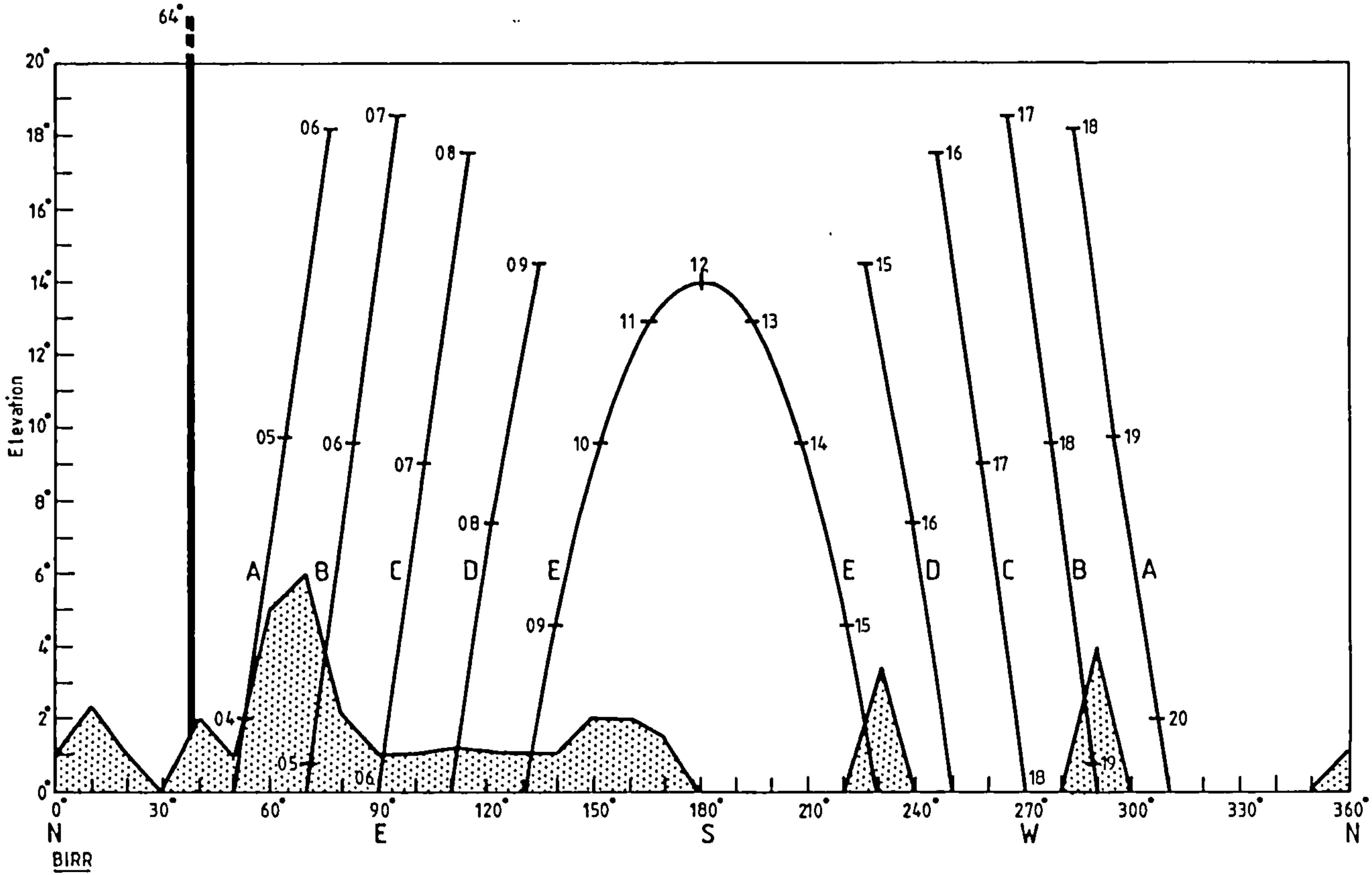


Fig. 9. Exposure diagram showing (1) azimuth and elevation of all objects which obscure pyranometer.
(2) azimuth and elevation of sun at various times of year as follows (A) June 22 (B) April 21, August 23
(C) March 21, September 23 (D) February 18, October 25 (E) December 22

SOLAR RADIATION OBSERVATIONS AT DUBLIN AIRPORT

1980

1. Introduction

Measurements of Global Solar Radiation were begun at Dublin Airport in September, 1975 and of Diffuse Solar Radiation in May 1976. Data given in this volume represent the results for 1980.

2. Site of the Observations

Dublin Airport, Latitude 53° 26'N ; Longitude 06° 14' W, is situated on a low hill 8 Km north of Dublin City and 9 Km from the sea to the east (Fig. 10). The surrounding country is flat, the nearest mountains lying about 20 Km to the south.

3. Measurement of Global Solar Radiation

3.1 Exposure of the Pyranometer

The Pyranometer is installed on the third storey balcony of the Terminal Building 82 metres above sea level and 13 metres above ground level (Fig. 11).

As the prevailing winds are westerly and the sources of pollution from the city lie to the south the site is relatively pollution free.

There is some obstruction from surrounding buildings (see Fig. 12) but as the vertical component of radiation lost is less than 0.5% no attempt has been made to allow for it.

3.2 Pyranometer Used

See Appendix

3.3 Observing Procedure

Time marking of records and control of print-out is by means of an electric clock, which is maintained within ½ minute of L.A.T. The general procedure for maintaining the instruments and tabulating the records is the same as that already described for Valentia.

3.4 Calibration of the Pyranometer

The instrument in use is similar to that in use at Valentia Observatory and was calibrated, before installation, against the Valentia Standard.

4. Measurement of Diffuse Radiation

4.1 Exposure of the Pyranometer

The Diffuse Pyranometer is mounted on the same site as the Global Pyranometer, at a distance of approximately 14 metres to the north of the latter. A description of the site is given in 2 above.

4.2 Pyranometer Used

See Appendix

4.3 Calibration of the Pyranometer

The shading-ring was displaced below the horizontal position and the calibration was done in exactly the same way as for the global pyranometer. The calibration was checked by comparing the values recorded during the hours when the sky was overcast with the corresponding values as recorded by the global pyranometer.

4.4 Shading-Ring Correction

Corrections have been made to increase the values extracted from the charts to compensate for the diffuse energy intercepted by the ring simultaneously with the eclipse of the sun's disc. Theoretical corrections were computed following the method described by Blackwell [2].

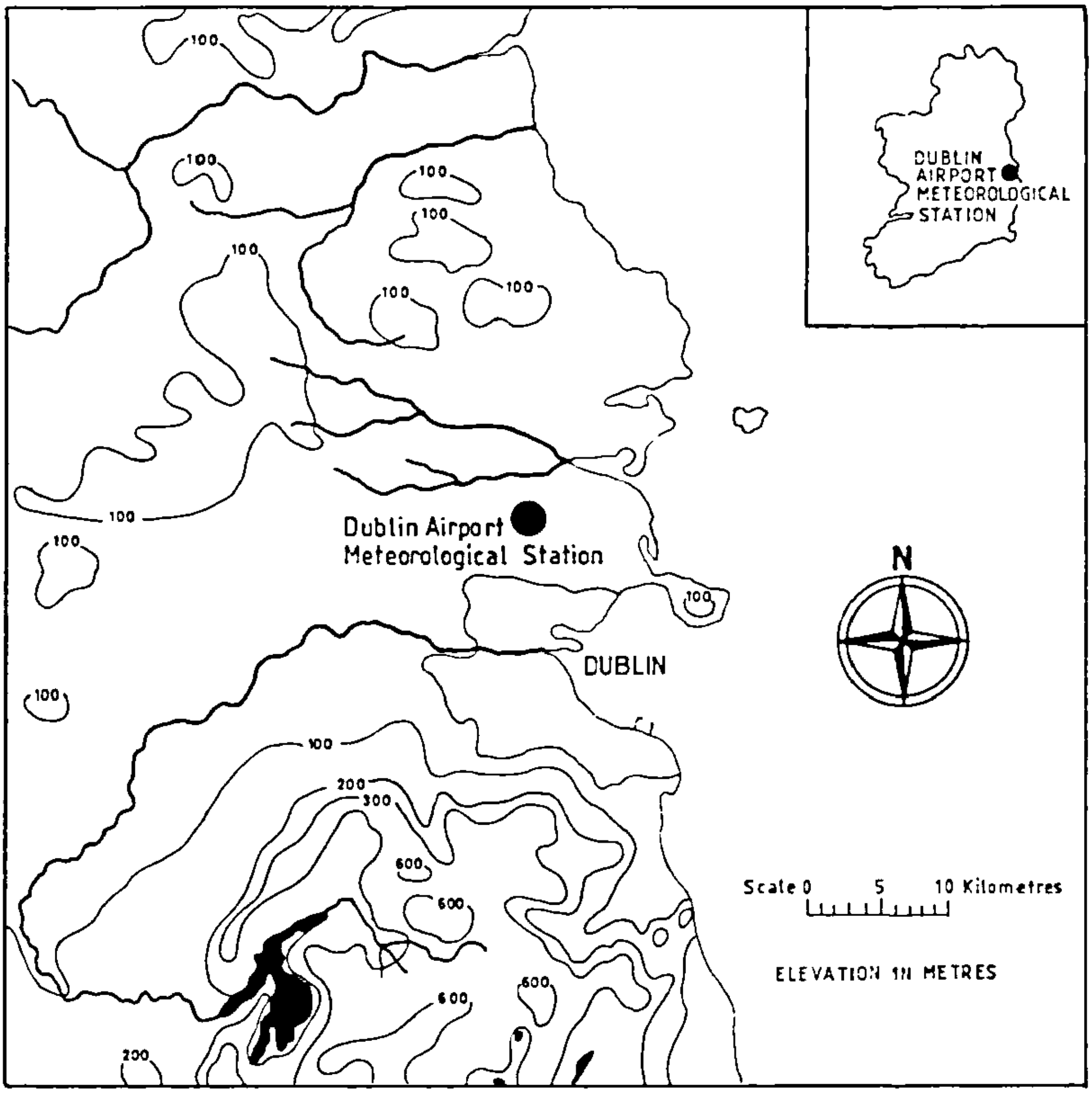
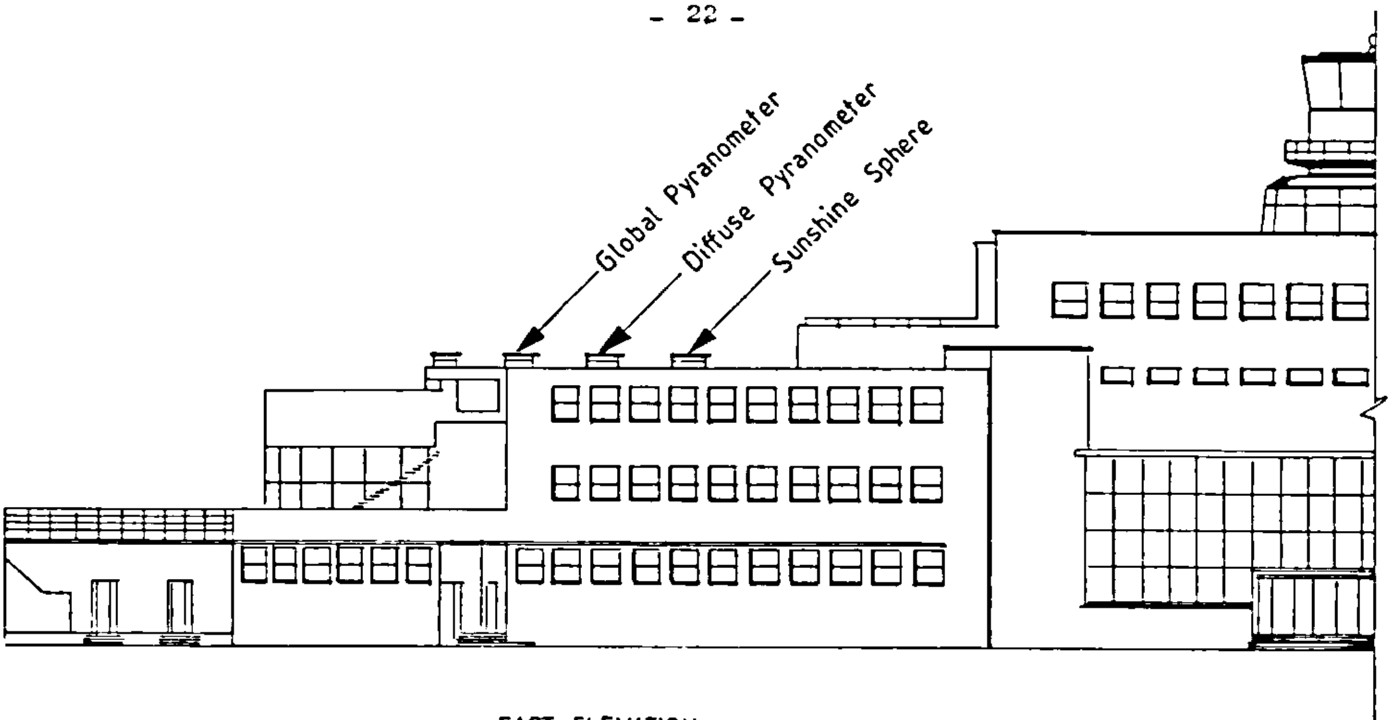
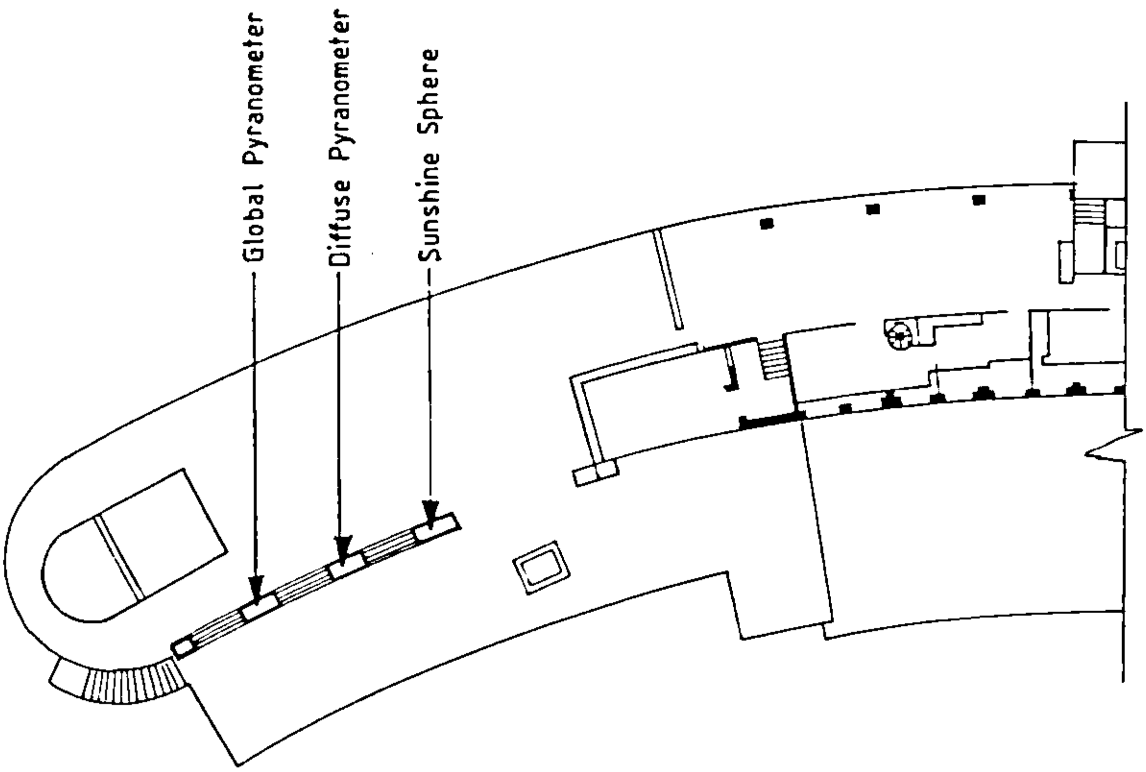


Fig. 10. Map showing site of Dublin Airport Meteorological Station

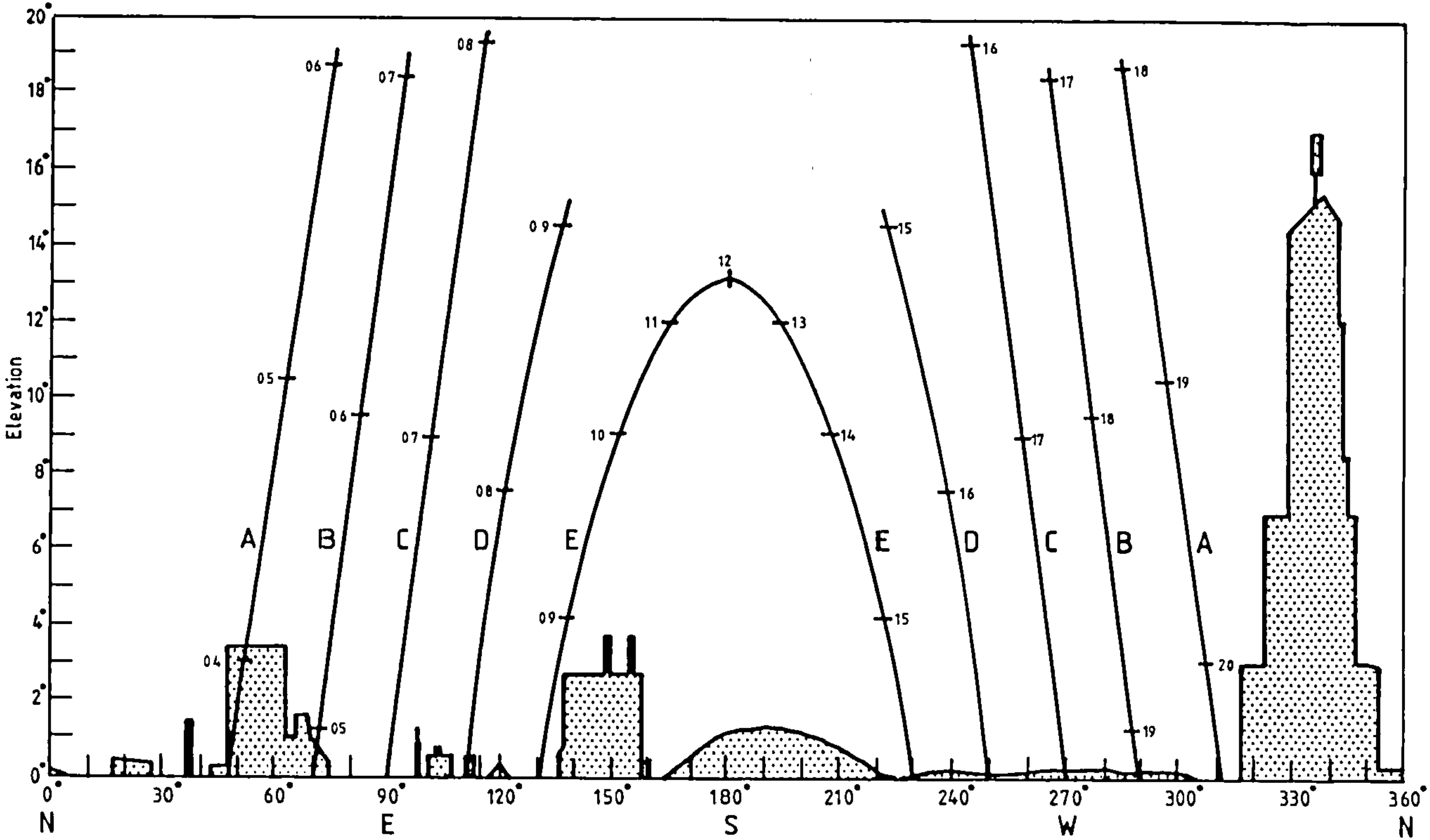


EAST ELEVATION



THIRD FLOOR PLAN

Fig. 11. Dublin Airport - layout of specified instruments on terminal building.



DUBLIN AIRPORT

Fig. 12. Exposure diagram showing (1) azimuth and elevation of all objects which obscure pyranometer.
(2) azimuth and elevation of sun at various times of year as follows (A) June 22, (B) April 21, August 23
(C) March 21, September 23 (D) February 18, October 25 (E) December 22

APPENDIX

TABLE OF INSTRUMENTS IN USE - 1980

	Sensor	Recorder	Integrator	Shading Ring	
				Width	Diameter
Valentia					
Global	G2-847	No. 29	Lintronic 717A	-	-
Diffuse	G18-1387	No.168	Lintronic 484B	48mm	308mm
Balance	Funk 695	Honeywell 68B/2124	-	-	-
Infra-Red	Eppley 17154F3	-	Eppley 411-5879	-	-
Direct Sun	Eppley 17247E6	-	Eppley 411-5880	-	-
Kilkenny					
Global	CM2-673014 (1st Jan - 21st Jan) CM5-690224 (22nd Jan - 31st Dec)	XR4-550106	Lintronic 415A	-	-
Diffuse	CM5-785154	BD8-774733	-	51mm	305mm
Birr					
Global	CM5-690246	XR4-188730-13	CC1 680076	-	-
Diffuse	CM5-785160	BD8-785761	-	51mm	305mm
Dublin Airport					
Global	CM5-773731	Phillips 8053	CC2 750338	-	-
Diffuse	CM5-752732	Phillips 8056	CC2 750262	52mm	315mm

NOTE : All instruments are Kipp & Zonen unless otherwise stated

Table 1 VALENTIA DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	142	174	418	1336	1601	791	2952	2178	646	913	68	155
2	76	564	796	1766	1910	476	1467	903	665	1301	47	101
3	52	303	298	1904	1983	2561	614	831	1644	107	463	372
4	255	345	221	2066	1554	1319	1736	878	258	973	429	172
5	187	554	509	1754	2288	2047	1332	1284	1246	283	459	298
6	289	293	615	1758	1929	1386	2497	859	725	195	304	298
7	116	149	504	1734	1194	2238	2073	1683	1282	615	308	388
8	94	293	489	1343	1756	815	1859	1612	1478	686	143	275
9	258	508	640	1102	1556	1609	1624	978	404	1101	213	46
10	292	576	1050	1253	1521	1381	1383	697	986	270	359	32
11	246	204	224	1112	948	1363	1734	1947	350	1079	300	195
12	250	137	1016	1308	435	870	632	455	1502	693	238	108
13	223	439	1065	1638	2662	385	1471	329	812	835	135	186
14	199	371	1251	1185	2201	1917	1892	1470	788	940	205	221
15	470	263	1142	2290	1856	1224	2777	1979	539	864	176	243
16	440	359	301	1398	2821	2019	1839	715	1261	803	288	54
17	458	241	1149	1868	2349	1580	1206	1273	620	917	281	135
18	120	750	711	1623	1126	672	491	1518	712	847	281	232
19	434	1030	716	1850	919	2120	1782	1313	792	418	90	105
20	474	706	1329	1000	2223	2108	2578	573	1366	416	310	263
21	239	386	1602	1533	1929	2037	1925	2149	227	176	103	154
22	285	695	1438	1777	2483	2550	177	1427	348	292	314	89
23	461	494	866	951	2736	1427	2557	1827	640	809	322	286
24	557	619	967	1650	1693	2547	395	1122	1445	858	400	108
25	535	831	877	2315	1246	2006	1170	1363	863	318	214	168
26	365	670	830	1213	1813	2254	1150	1721	127	156	245	64
27	175	758	1629	2072	2640	552	719	614	854	323	286	132
28	160	449	681	1697	2215	1097	1038	606	1321	687	411	152
29	317	1032	1403	2425	2407	2211	865	1174	246	668	434	132
30	312		404	1922	838	753	939	1518	1244	401	318	140
31	541		678		2609		1584	1183		131		194
Total	9022	14193	25819	48843	57442	46315	46458	38179	25391	19065	8144	5498
Mean	291.0	489.4	832.9	1628.1	1853.0	1543.8	1498.7	1231.6	846.4	615.0	271.5	177.4

Table 2 VALENTIA DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	142	173	396	690	910	773	820	1059	646	701	67	155
2	76	270	461	612	1218	473	1365	834	662	367	46	97
3	49	281	296	451	1162	996	607	799	749	106	398	180
4	186	266	214	285	975	1037	1465	793	257	645	252	168
5	182	266	487	647	1102	1446	1220	1010	826	283	281	230
6	184	248	430	599	1059	1325	1070	833	672	189	273	174
7	115	149	440	745	988	1535	1192	1094	794	433	259	115
8	93	251	443	874	1036	805	1161	1097	706	387	142	216
9	197	243	581	939	1130	1308	987	943	401	401	208	42
10	227	342	533	1069	1106	1254	1200	669	809	270	329	29
11	182	201	224	889	885	1046	1362	773	349	443	248	159
12	216	135	519	921	433	830	624	449	622	383	230	107
13	221	419	493	969	565	378	1097	325	777	450	133	156
14	143	342	464	948	1287	1242	1357	1117	752	476	185	187
15	157	263	716	311	1226	1096	897	896	523	358	174	173
16	105	266	300	810	545	1255	1555	703	610	477	260	53
17	142	241	546	896	918	1218	1131	1121	615	378	217	120
18	118	347	496	703	873	661	491	1090	601	366	241	185
19	161	287	599	817	838	1354	841	926	598	403	88	103
20	229	505	734	846	1126	1610	1031	541	496	403	257	196
21	217	362	403	1173	1184	1556	1397	837	225	174	99	145
22	199	315	589	1141	1188	1346	173	1116	347	276	246	88
23	193	428	530	920	1104	1119	911	1074	617	331	242	188
24	152	517	503	984	1315	1014	390	924	395	278	213	106
25	122	384	671	700	1161	1209	1068	862	616	286	191	146
26	302	498	723	1056	1455	1220	1070	847	124	150	200	63
27	175	513	500	1161	992	543	716	611	721	318	228	130
28	157	444	491	1072	1088	946	837	595	328	367	173	150
29	190	600	800	696	1106	1248	746	666	246	318	138	131
30	263		403	900	831	723	723	993	432	345	243	130
31	214		664		935		1141	1015		128		182
Total	5309	9556	15649	24824	31741	32566	30645	26612	16516	10890	6261	4304
Mean	171.3	329.5	504.8	827.5	1023.9	1085.5	988.5	858.5	550.5	351.3	208.7	138.8

Table 3 VALENTIA DAILY TOTALS OF RADIATION BALANCE (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	-112	-102	167	506	613	387	1374	1158	358	318	49	-62
2	-51	61	241	663	670	308	704	434	396	495	33	-15
3	-18	77	76	696	733	1428	317	475	804	-16	-224	-171
4	-162	150	13	581	500	630	812	456	72	206	-112	-70
5	-20	12	231	537	832	1072	598	762	538	21	-26	67
6	-175	-35	261	549	643	710	1236	468	396	-24	-78	-191
7	-8	48	151	547	368	1104	882	877	615	143	34	-332
8	-34	-98	93	471	645	411	647	864	626	131	-30	-95
9	-148	-30	192	424	705	823	718	549	199	329	-161	-29
10	-103	13	368	513	869	524	700	411	519	82	-81	22
11	29	40	135	368	525	579	890	946	130	315	-130	-43
12	73	74	444	626	226	315	323	215	637	137	-110	19
13	40	177	357	599	1070	201	804	198	388	203	1	-231
14	-138	42	275	342	971	1011	918	672	416	278	121	-61
15	-355	-13	278	814	832	630	1226	882	331	141	80	-172
16	-343	-135	-6	614	1004	1014	790	385	439	150	42	-7
17	-201	108	482	742	943	822	660	659	245	222	-3	-121
18	-79	158	249	755	567	371	260	736	287	260	-61	-172
19	-34	130	184	752	468	1243	943	640	319	150	59	-30
20	67	157	398	399	1198	1146	1184	346	492	140	71	-48
21	-3	132	601	787	835	1157	977	1020	45	88	52	-53
22	-127	83	441	814	1019	1345	112	755	186	52	-31	50
23	-87	185	299	296	1116	698	1444	887	141	196	13	18
24	-44	228	325	672	711	1271	214	443	514	33	-67	-77
25	-212	222	279	950	654	966	727	616	430	17	-206	-218
26	-154	269	237	550	845	1141	624	667	-42	55	-113	-132
27	84	296	620	939	1143	280	370	304	158	143	-60	-16
28	95	258	287	682	1070	617	566	374	279	117	-196	72
29	3	465	471	971	977	1185	422	613	18	42	-296	63
30	-62		181	740	426	396	445	714	588	28	-250	60
31	17		355		1237		844	643		-21		-66
Total	-2262	2972	8685	18899	24415	23785	22731	19169	10524	4431	-1680	-2041
Mean	-73.0	102.5	280.2	630.0	787.6	792.8	733.3	618.4	350.8	142.9	-56.0	-65.8

Table 4 DIRECT SOLAR RADIATION AT NORMAL INCIDENCES

INSTATANEOUS VALUES (mW/cm^2) 1980

MONTH AND DAY	TIME L.A.T.	ZENITH DISTANCE (Z)	AIR MASS (m)	RADIATION				PRESSURE	TEMPERATURE	VAPOUR PRESSURE	VISABILITY	CLOUD	
				CLEAR	RED (RG_2)	YELLOW (OG_1)	RED (RG_8)					TYPE	AMOUNT
				$x10^{-1}$	$x10^{-1}$	$x10^{-1}$	$x10^{-1}$	mb	^oC	mb	Km		Okta
Jan													
16	1020	76.2	4.26	675	498	589	410	1023	1.8	6.3	50	Fc	Tr
16	1204	72.9	3.47	734	524	625	433	1023	5.6	6.5	50	NIL	-
16	1336	75.9	4.17	677	498	588	410	1022	6.4	6.3	50	Fc	Tr
16	1452	82.0	7.11	459	372	419	320	1022	5.6	6.4	50	Cu	Tr
17	0952	78.0	4.85	615	472	548	390	1020	-0.5	5.0	60	Sc	Tr
17	1044	74.7	3.84	653	491	572	403	1020	1.0	5.0	60	Sc	Tr
17	1332	75.5	4.04	566	436	507	366	1018	4.0	5.2	60	FcCi	1
19	1128	72.7	3.33	779	526	630	442	994	5.2	7.4	50	CbCuCi	3
19	1212	72.4	3.26	798	554	670	450	994	6.1	6.6	50	CbCi	3
23	1024	74.6	3.71	583	426	507	353	991	7.6	8.9	40	CbCu	1
23	1212	71.6	3.12	621	451	540	371	992	8.5	8.6	40	Cu	1
24	0948	76.9	4.39	608	443	527	360	1005	4.0	8.0	25	Cu	1
24	1104	72.3	3.28	710	492	596	401	1005	7.6	8.4	25	CuCi	2
24	1156	71.2	3.10	726	500	606	406	1006	8.5	8.4	45	Cu	1
24	1332	74.0	3.63	701	497	597	405	1006	8.4	8.1	45	CuCi	2
25	1020	74.3	3.75	712	514	617	419	1019	2.4	6.9	45	FcScCi	1+
25	1144	71.1	3.12	745	521	619	428	1019	4.5	7.5	60	FcScCi	1+
31	1208	69.5	2.81	724	496	599	400	989	8.8	9.4	40	CuCi	3
Feb													
18	1348	67.9	2.67	779	521	636	419	1011	9.5	9.4	50	CuScCi	3
19	0848	75.7	4.08	654	470	560	382	1015	3.8	7.6	35	CbCu	1
22	1328	65.2	2.42	724	468	576	387	1018	8.5	7.5	40	CuFcAc	3
25	1408	67.2	2.64	722	501	607	401	1027	10.5	9.7	20	CuScAcCi	3+
Mar													
12	1016	59.4	1.98	826	540	671	433	1011	6.7	7.3	30	CuSc	2
12	1120	55.7	1.79	832	538	659	441	1011	8.0	6.2	30	CbCu	1
13	1544	72.1	3.29	600	413	501	339	1019	5.5	7.1	40	CuFc	4
14	0848	67.7	2.67	780	524	643	431	1020	5.6	7.7	80	CuScCi	Tr
14	0946	61.1	2.10	836	551	690	443	1020	7.8	7.7	80	CuFcCi	1+
21	1036	54.5	1.72	919	599	731	486	1001	4.4	5.5	50	Cu	1
22	0812	69.7	2.86	778	542	653	441	997	1.0	5.4	50	CuFc	2
29	1000	54.5	1.74	832	540	663	431	1014	9.5	8.1	30	CuFc	4
Apr													
1	1504	60.5	2.05	794	522	639	424	1012	9.6	7.9	30	CuSc	1
2	0904	59.2	2.00	804	521	644	420	1024	10.0	9.6	50	CuSc	2
2	1316	49.4	1.58	863	511	683	439	1026	11.0	9.3	50	CuScAcCi	3
3	1308	48.5	1.56	893	568	705	454	1033	13.3	10.5	50	CuScCi	2
4	0756	67.9	2.72	799	538	656	436	1030	9.9	8.0	50	Fc	Tr
4	0842	61.5	2.15	858	567	695	457	1030	9.9	8.0	50	Fc	Tr
4	0936	54.9	1.79	901	585	722	473	1030	11.5	8.0	50	Fc	Tr
4	1036	49.3	1.58	910	586	727	475	1030	12.5	7.8	50	Fc	Tr
4	1244	46.9	1.51	918	588	731	474	1030	12.6	8.1	50	FcCi	Tr
4	1348	51.2	1.64	885	573	706	464	1029	13.0	8.4	50	FcCi	Tr
4	1508	60.1	2.06	796	529	646	434	1029	12.5	8.4	50	Fc	Tr

Table 4
(Contd.)

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES

INSTATANEOUS VALUES (mW/cm^2) 1980

MONTH AND DAY	TIME L.A.T.	ZENITH DISTANCE (Z)	AIR MASS (m)	RADIATION CLEAR	RADIATION RED (RG_2)	RADIATION YELLOW (OG_1)	RADIATION RED (RG_8)	PRESSURE	TEMPERATURE	VAPOUR PRESSURE	VISIBILITY	CLOUD TYPE	CLOUD AMOUNT
				x10^{-1}	x10^{-1}	x10^{-1}	x10^{-1}	mb	^{o}C	mb	Km		Okta
Apr													
6	0756	67.2	2.66	667	478	574	392	1035	8.7	9.7	12	Ci	5
6	0900	58.5	1.98	759	518	630	421	1036	10.8	9.4	12	Ci	5
6	1000	51.7	1.67	822	540	665	440	1036	12.0	10.0	12	FcCi	5+
6	1104	46.8	1.51	858	559	689	452	1035	13.0	8.9	20	CuCi	5
7	0844	60.2	2.08	804	528	632	432	1037	10.6	8.6	40	CuFc	1
15	0904	55.1	1.77	881	580	706	469	1017	9.5	8.8	50	CuCs	1+
15	1016	47.1	1.49	919	591	731	479	1017	10.2	8.2	50	FcCi	1+
15	1108	43.4	1.40	936	597	741	484	1017	10.8	9.1	70	FcCi	1+
15	1304	44.0	1.41	929	594	735	482	1018	10.5	8.9	70	FcCi	1+
15	1344	47.0	1.49	916	590	729	476	1018	10.5	8.9	70	FcCi	1+
25	1308	40.9	1.34	884	559	702	447	1017	12.0	11.3	60	CuSc	3
27	1432	48.6	1.54	860	546	679	440	1022	12.3	9.6	50	CuSc	6
29	0808	59.0	1.99	811	537	668	429	1026	10.3	7.5	50	CuCi	Tr
29	0928	48.1	1.53	886	566	705	455	1026	11.6	8.6	60	CuFcCi	1+
29	1048	40.0	1.34	875	568	701	457	1025	12.8	9.1	60	CuFc	3
29	1424	47.1	1.50	827	535	652	434	1024	13.0	9.6	55	CuAc	3
30	0844	53.6	1.72	799	526	647	425	1022	12.1	9.8	30	FcScAc	2
30	1052	39.5	1.32	808	530	643	438	1021	13.0	9.9	30	Cu	5
May													
13	1256	35.2	1.24	919	588	725	465	1014	14.2	10.4	45	CuCi	5
13	1412	42.3	1.37	923	593	737	477	1014	14.6	10.6	45	CuFcCi	2
16	0816	54.2	1.75	737	506	611	413	1025	16.7	8.7	20	Ci	3
16	0928	44.1	1.43	841	556	683	447	1025	17.9	10.0	20	Ci	2
16	1040	36.3	1.27	867	565	697	455	1025	19.3	10.7	20	Ci	2
16	1424	43.1	1.40	806	535	654	433	1025	20.0	9.2	25	Ci	3
23	1112	32.6	1.22	669	468	561	382	1027	15.0	12.5	7	CuCi	2
27	1252	32.2	1.19	881	554	688	443	1009	14.5	11.7	50	CuScCi	3
27	1420	40.8	1.33	793	509	627	408	1009	14.6	7.4	50	CuSc	1-
28	1336	35.6	1.24	879	560	693	453	1010	11.8	7.4	50	Cu	5
29	1504	46.4	1.46	835	542	668	431	1010	12.2	9.4	45	CuAc	1
31	1436	42.3	1.37	847	533	665	428	1010	13.1	11.3	30	CuCb	3
June													
22	1604	54.1	1.71	726	474	585	378	1002	14.0	12.6	40	CuScAc	2
26	1604	54.2	1.74	716	483	588	386	1019	14.6	12.3	35	CuSc	3+
July													
1	1356	36.4	1.27	859	540	670	433	1020	14.6	11.1	50	Sc	1
1	1420	39.3	1.32	870	547	681	439	1020	14.6	11.1	50	Sc	1
9	1540	51.3	1.63	762	498	615	395	1020	14.5	12.9	30	CuSc	3
15	0816	52.5	1.67	785	509	632	406	1015	15.2	12.7	60	Cu	2
15	0932	41.7	1.36	846	541	675	429	1016	15.5	12.4	60	CuSc	3
15	1552	53.8	1.72	791	514	639	411	1019	15.0	10.8	50	CuSc	1+
23	0900	47.2	1.48	819	520	645	412	1009	15.3	14.0	20	CuSc	3+
Aug													
11	1248	38.1	1.28	860	529	666	418	1006	16.0	14.4	30	CuSc	4
15	1244	39.1	1.30	835	512	647	401	1007	17.5	18.0	30	CuSc	5
15	1452	51.2	1.61	806	503	634	391	1008	17.6	17.9	85	CuSc	3

Table 4
(Contd.)

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES

INSTANTANEOUS VALUES (mW/cm^2) 1980

MONTH AND DAY	TIME L.A.T.	ZENITH DISTANCE (Z)	AIR MASS (m)	RADIATION				PRESSURE	TEMPERATURE	VAPOUR PRESSURE	VISIBILITY	CLOUD	
				CLEAR	RED (RG_2)	YELLOW (OG_1)	RED (RG_8)					TYPE	AMOUNT
				$x10^{-1}$	$x10^{-1}$	$x10^{-1}$	$x10^{-1}$	mb	°C	mb	Km		Okta
Aug													
15	1532	56.7	1.83	784	494	618	389	1008	17.5	17.4	84	CuCi	1
18	1100	40.8	1.35	858	535	669	421	1025	15.7	13.0	73	CuSc	4
21	1100	41.8	1.37	869	543	681	433	1026	15.8	11.7	40	CuSc	4
21	1308	42.3	1.39	862	540	676	427	1026	16.0	11.7	50	CuSc	3
21	1412	48.1	1.53	847	534	666	422	1026	15.8	11.7	50	CuSc	1
21	1516	56.1	1.84	802	512	637	405	1026	15.5	11.6	50	Sc	1
26	0932	51.3	1.62	814	520	647	410	1012	20.0	13.6	45	ScAc	2+
Sept													
3	0920	55.3	1.78	813	523	650	412	1017	15.4	13.6	45	CuCi	2
20	1048	53.2	1.67	793	507	632	398	1005	18.1	14.0	30	CuCi	5
24	0940	60.2	2.05	808	525	653	416	1022	13.9	11.5	30	Cu	3
24	1056	54.2	1.74	833	532	664	418	1022	14.4	10.9	30	CuCi	3
28	1412	60.9	2.10	773	498	623	393	1026	14.6	11.6	50	CuCi	1
28	1508	67.1	2.62	721	474	589	377	1026	14.1	11.3	50	FcCi	1
Oct													
2	0820	72.4	3.37	490	342	418	269	1029	8.0	10.0	25	Cu	Tr
2	1420	63.1	2.26	733	474	585	375	1025	15.5	11.8	25	FcScAc	1
9	1056	59.9	2.01	805	515	640	415	1011	10.4	8.1	30	CuFc	4
13	0952	65.8	2.43	708	471	579	371	1003	11.1	11.3	30	CuFc	4
13	1100	61.2	2.07	715	462	577	360	1002	11.9	10.6	35	Cu	4
13	1344	64.0	2.27	716	465	578	368	1000	11.2	9.8	35	Cu	4
14	0912	70.2	2.93	730	504	611	399	999	7.4	9.4	50	CbScAcCi	3
15	1312	62.6	2.19	741	512	623	408	1010	11.3	8.7	25	CuCi	1
15	1408	66.6	2.53	773	523	640	416	1010	11.0	8.3	25	CuCi	1
24	1432	71.8	3.19	586	406	493	322	1004	11.7	10.5	35	CuFcAc	1+
Nov													
4	0944	73.7	3.66	597	454	531	366	1032	5.7	6.8	25	FcCi	1
5	1416	73.9	3.67	541	418	490	347	1023	8.3	7.5	25	CuScAc	1
Dec													
7	0956	79.3	5.45	629	470	556	381	1027	0.2	5.5	50		0
7	1040	76.7	4.43	695	507	603	406	1027	1.4	5.6	50	Ci	Tr
7	1216	74.7	3.87	737	525	629	421	1027	5.0	6.4	50	Ci	Tr
15	1200	75.2	3.93	561	388	483	326	1011	7.3	8.5	25	CbCuFc	5

Table 5 VALENTIA DAILY TOTALS OF DIRECT SOLAR RADIATION AT NORMAL INCIDENCES (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	0	0	7	1132	984	27	3208	1348	0	317	0	0
2	0	720	745	1887	867	0	201	77	4	-	0	1
3	0	31	0	1822	1180	1913	0	6	1409	-	73	779
4	233	144	10	3385	898	357	541	97	10	-	570	7
5	7	703	14	1863	1815	680	92	248	557	-	577	238
6	339	95	337	2004	1316	49	1907	12	59	-	50	440
7	0	0	131	1759	328	791	1329	766	759	-	107	1211
8	0	74	73	628	1044	2	1399	578	1181	577	0	184
9	253	663	72	196	481	370	958	24	0	1382	12	0
10	179	535	936	88	428	161	187	33	191	0	45	0
11	200	0	0	492	60	512	401	1633	1	1309	160	124
12	78	0	873	510	1	55	3	0	1458	635	4	0
13	1	39	1135	1150	3186	6	395	0	39	708	0	86
14	201	54	1687	247	1410	863	623	-	27	1242	27	96
15	1183	0	602	3306	640	197	3037	-	13	1169	6	198
16	1434	289	4	1009	3564	917	339	3	1155	723	38	0
17	1191	56	1069	1419	2124	388	37	137	8	1183	155	53
18	0	1078	313	1288	272	0	0	420	152	1067	109	130
19	1033	1974	146	928	63	776	1104	498	226	15	0	4
20	842	-	1084	219	1320	586	2059	63	1590	11	148	206
21	56	50	2437	413	978	611	554	1876	0	0	0	13
22	253	917	1556	954	1815	1422	0	342	0	35	167	0
23	913	107	460	86	2391	379	2206	1051	30	-	202	382
24	1486	140	727	997	726	1915	0	217	2001	1522	603	0
25	1517	976	288	2517	75	898	84	613	363	58	66	91
26	127	311	127	131	484	1617	66	1672	0	0	141	0
27	0	532	2001	1131	2497	0	0	0	195	4	163	0
28	0	1	279	992	1756	227	177	4	2079	831	966	0
29	401	812	952	2970	2028	1035	102	784	0	855	1164	1
30	122		0	1530	4	22	356	862	1502	157	202	27
31	988		6		2384		465	162		0		34
Total	13037	-	18071	37053	37119	16776	21830	-	15009	-	5755	4305
Mean	420.5	-	582.9	1235.1	1197.4	559.2	704.2	-	500.3	-	191.8	138.9

NOTE: Data not available 20th February, 14th/15th August, 2nd - 7th and 23rd October due to power cuts, Damage to solar tracker cable and tracker not directed at sun.

Table 6 VALENTIA DAILY TOTALS OF LONG-WAVE (INFRA-RED) RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	2455	2562	2792	2465	2485	2880	2432	2889	3145	2780	3039	2613
2	2757	2562	2510	2395	2471	3119	2846	3036	3163	2539	2939	2798
3	2964	2787	2741	2331	2456	2952	3066	3190	2933	2958	2176	2138
4	2505	2861	2680	2109	2451	2879	2838	3081	3042	2433	2254	2565
5	2726	2501	2753	2253	2370	2870	2842	3110	2879	2819	2408	2761
6	2391	2512	2753	2268	2493	2846	2820	3216	3143	2835	2453	2266
7	2808	2902	2648	2289	2518	2746	2750	3073	2892	2569	2571	1796
8	2833	2615	2622	2501	2506	2716	2562	2846	2725	2451	2636	2445
9	2461	2471	2593	2625	2687	2525	2847	3125	3048	2379	2391	2847
10	2398	2498	2507	2672	2903	-	2983	3204	3034	2703	2305	3025
11	2705	2848	2937	2469	2965	-	2966	2875	3054	2400	2238	2784
12	2803	2925	2481	2721	3058	-	3059	3100	2711	2367	2454	2967
13	2732	2758	2312	2457	2472	-	3126	3241	2994	2479	2795	2542
14	2482	2653	2128	2320	2649	-	2845	2968	3069	2497	3041	2650
15	1892	2650	2271	2270	2831	-	2569	2866	3218	2312	3047	2452
16	1834	2500	2547	2761	2431	-	2768	3145	2709	2342	2873	2898
17	1945	2901	2430	2457	2599	2970	3123	3040	2899	2290	2755	2633
18	2540	2428	2506	2636	2994	3097	3162	2861	2927	2433	2604	2381
19	2244	2122	2323	2492	2942	2787	2966	3022	2877	2840	3115	2805
20	2427	2310	2110	2638	2718	2777	2616	3258	2650	2897	2894	2598
21	2566	2685	2074	2835	2658	2778	2812	2773	2907	2998	3068	2704
22	2413	2326	2140	2686	2545	2769	3124	2928	3043	2790	2786	2990
23	2314	2643	2368	2597	2440	2857	2781	2807	2690	2531	2758	2786
24	2173	2643	2389	2529	2654	2680	3128	2780	2520	2272	2529	2753
25	1939	2451	2426	2555	2882	2776	3240	2911	2957	2617	2370	2378
26	2286	2677	2454	2749	2798	2737	3117	2799	2976	2918	2506	2619
27	2839	2745	2386	2619	2593	3012	3167	3127	2594	2877	2605	2638
28	2974	2944	2641	2568	2543	3026	3184	3227	2272	2400	2089	2897
29	2730	2713	2460	2326	2435	2925	3160	3050	2804	-	1823	2905
30	2557		2729	2444	2794	3030	3053	2927	2719	-	2140	2897
31	2438		2891		2531		2920	3104		-		2641
Total	77131	76193	77602	75037	81872	-	90872	93579	86594	-	77662	82172
Mean	2488.1	2627.3	2503.3	2420.5	2641.0	-	2931.4	3018.7	2886.5	-	2588.7	2650.7

NOTE: No data for periods 10th - 16th June and 29th-31st October due to instrument malfunction.

Table 7 KILKENNY DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	120	379	548	879	1238	1597	1590	1995	644	869	52	84
2	267	294	518	1597	1907	1019	1665	729	1127	1194	215	198
3	57	226	1175	1495	2000	1437	850	989	1022	111	708	241
4	352	294	242	1883	2261	1454	1672	945	502	945	217	168
5	275	259	677	1798	1764	1979	1151	1567	1608	347	353	166
6	181	104	584	1774	1491	1507	1319	779	1377	209	199	352
7	225	82	626	1342	1228	1690	1425	498	823	667	175	390
8	93	338	444	1236	1690	1523	704	903	1454	1047	137	267
9	84	123	845	744	1872	1278	938	1203	485	1009	209	45
10	344	517	1159	463	1139	1207	1344	1002	700	253	238	42
11	130	384	301	881	1670	794	1525	1473	290	811	347	317
12	127	123	1041	915	787	1344	884	865	1411	961	409	34
13	163	415	1130	943	959	463	565	644	679	628	313	205
14	183	101	1111	222	1997	800	2023	927	533	144	114	218
15	268	270	412	468	2403	1203	1657	1607	690	674	182	200
16	460	568	326	1327	2571	1493	1300	1074	1356	409	410	87
17	110	624	885	1845	2504	1711	914	1369	645	935	285	99
18	118	131	477	1624	2499	565	821	967	590	858	489	280
19	57	252	496	1839	1647	1945	1228	1730	837	308	86	117
20	522	327	823	1020	1071	1852	1285	1789	790	169	139	281
21	203	159	1382	1120	1801	1869	2230	1687	270	70	67	196
22	372	720	1163	1273	2481	1928	1120	1211	272	159	235	252
23	328	1052	560	1031	1870	1394	1972	1015	626	627	331	307
24	431	796	901	1030	1819	1753	635	1251	1380	342	323	46
25	509	506	984	1258	1080	1657	492	1390	1140	457	244	302
26	387	636	977	1273	1147	2077	1044	1803	205	191	327	95
27	125	459	970	905	1644	965	697	606	769	291	322	220
28	110	416	622	1534	2161	2067	1502	849	1379	421	439	128
29	113	284	1387	1774	2030	1920	325	582	387	675	426	125
30	400		481	1069	1283	689	1229	966	905	356	400	80
31	167		546		1917		1696	1321		246		152
Total	7281	10839	23793	36562	53931	42998	37802	35736	24896	16383	8391	5694
Mean	234.9	373.8	767.5	1218.7	1739.7	1433.3	1219.4	1152.8	829.9	528.5	279.7	183.7

Table 8 KILKENNY DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	112	286	471	563	1017	1088	1260	919	637	622	52	84
2	153	223	462	499	1199	968	1149	721	703	415	213	162
3	56	182	154	548	975	1271	784	880	747	111	199	206
4	103	201	241	277	642	1215	1173	854	502	435	208	163
5	161	211	478	379	1038	1102	999	1122	621	330	252	141
6	154	104	482	451	1076	1199	1257	778	748	204	171	96
7	190	80	504	732	1098	1151	1119	496	606	334	169	94
8	93	245	434	704	1270	1260	662	801	647	364	133	135
9	81	118	493	681	1075	1178	913	942	477	353	197	44
10	153	286	406	457	1055	907	1146	842	608	253	229	41
11	130	337	301	815	1128	763	1124	933	283	432	278	107
12	125	121	447	841	767	1213	850	757	646	471	258	34
13	160	358	569	695	870	449	560	622	593	376	220	156
14	140	99	445	220	1273	781	1092	858	492	144	108	135
15	180	261	411	450	653	1033	1244	782	479	353	160	156
16	102	244	324	908	464	1175	1112	815	475	386	224	85
17	110	366	492	841	592	1310	728	1005	611	301	211	99
18	118	122	329	624	550	553	781	844	502	237	160	120
19	52	248	442	736	1139	1087	988	853	620	308	86	99
20	108	324	573	761	976	1153	1053	550	550	168	128	184
21	178	159	368	965	1214	1207	1159	923	264	70	67	152
22	217	285	517	855	896	1111	920	948	268	159	211	158
23	201	130	495	928	1350	1107	819	861	534	296	240	141
24	193	360	555	961	1168	1068	574	892	374	294	168	45
25	152	358	668	794	1030	1268	492	1049	500	380	201	201
26	213	406	665	1012	1030	1047	841	644	205	190	159	95
27	123	395	614	887	1136	901	690	693	626	287	152	187
28	110	410	532	889	997	1300	880	760	337	246	99	127
29	92	284	544	871	997	1256	324	529	379	217	90	122
30	215		477	852	1071	533	956	732	470	290	138	80
31	164		482		1011		1034	938		246		142
Total	4339	7203	14375	21196	30757	31654	28683	25343	15504	9272	5181	3791
Mean	140.0	248.4	463.7	706.5	992.2	1055.1	925.3	817.5	516.8	299.1	172.7	122.3

Table 9 BIRR DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	202	300	629	855	1197	1583	1651	1875	879	1013	91	75
2	238	423	592	1515	1867	749	2380	864	824	1124	169	225
3	83	317	1185	1304	2146	1876	722	1069	1362	271	561	268
4	275	312	485	1948	2606	1697	1676	1251	640	1170	181	102
5	241	256	786	1902	2330	2032	1312	1435	1619	235	161	143
6	201	144	549	1882	1686	1360	889	1065	1493	254	195	290
7	203	248	548	1570	1470	2294	1481	949	1521	678	160	396
8	154	623	458	1318	1686	1689	1716	1192	1467	1052	191	182
9	79	200	864	632	2023	1295	1407	1269	564	1258	461	81
10	350	808	1216	595	760	958	1410	1166	765	342	289	53
11	113	537	293	969	1119	771	1787	1401	396	855	306	292
12	133	171	1103	853	764	1119	1020	969	1175	664	331	148
13	195	614	1203	1148	702	807	797	929	692	904	229	193
14	283	235	1389	646	2315	1243	1619	1285	559	306	125	198
15	399	706	958	839	2660	1482	1667	2197	830	1068	95	187
16	465	724	485	1521	2720	1842	1248	1492	1557	504	220	71
17	146	611	816	1703	2724	1888	828	1113	789	775	211	134
18	356	280	390	1707	2576	650	829	1022	1169	846	283	312
19	129	450	1111	2335	1604	2218	936	1461	1134	456	137	155
20	468	445	970	1031	1510	2141	2042	1681	792	240	163	195
21	108	336	1521	766	1778	2305	2395	1489	290	232	89	166
22	371	650	1549	1276	2554	2562	546	1490	375	135	285	162
23	452	1091	740	948	2058	1554	2136	1363	1139	585	200	301
24	515	1017	1369	991	1466	2077	779	1388	1494	381	216	96
25	457	765	1231	1484	1403	2024	1347	1604	1160	595	174	137
26	437	457	1148	1319	1036	1853	1050	1890	291	196	238	97
27	133	402	1401	1109	1025	957	756	1050	902	275	284	242
28	211	491	631	1729	2753	1619	1846	991	1327	466	385	138
29	142	342	1649	1961	1967	1854	439	792	274	698	284	156
30	440		629	1761	1500	828	2204	1175	1004	495	283	104
31	242		703		1635		1524	1345		302		248
Total	8221	13955	28601	39616	55640	47327	42439	40262	28483	18375	6997	5547
Mean	265.2	498.4	922.6	1320.5	1794.8	1577.6	1369.0	1298.8	949.4	592.7	233.2	178.9

Table 10 BIRR DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	124	294	589	693	1094	1135	1524	1154	852	675	90	75
2	201	219	541	671	1387	742	1390	859	771	517	169	213
3	79	210	183	755	1131	1520	706	1042	819	270	293	190
4	150	176	475	282	502	1538	1388	1108	595	511	176	97
5	182	184	514	358	1154	1411	1281	1291	750	235	161	131
6	176	117	475	574	1116	816	857	1059	831	224	195	121
7	197	206	490	887	1235	1391	1239	858	834	504	160	103
8	152	262	449	897	1335	1578	1492	1133	704	440	175	150
9	79	161	635	630	1225	1233	1224	1145	519	425	253	69
10	194	313	506	595	723	869	1338	1045	635	342	278	45
11	113	412	288	886	1078	723	1208	1136	375	525	259	150
12	133	145	578	852	719	1082	951	878	841	560	305	140
13	192	430	513	913	698	700	780	801	591	447	226	174
14	193	184	648	646	1369	1230	1313	1217	536	271	124	169
15	137	289	792	685	862	1318	1243	889	750	339	95	135
16	132	266	454	1047	571	1336	1239	1156	609	482	204	71
17	146	346	605	966	588	1468	788	1049	695	381	184	110
18	174	211	388	727	622	642	816	970	626	300	186	162
19	129	368	744	752	1365	1316	927	1135	789	450	133	123
20	120	394	763	949	1206	1448	1310	991	598	240	154	161
21	107	317	517	738	1259	1408	1313	1142	273	231	87	132
22	219	290	429	1025	1248	1319	479	1171	358	119	230	130
23	202	184	659	839	1497	1342	1168	940	665	365	182	112
24	136	265	802	929	1325	1331	699	1000	486	334	190	73
25	160	493	547	1020	1290	1341	955	1188	608	429	169	99
26	256	451	833	1148	1007	1257	1048	716	248	188	225	96
27	133	401	679	1096	990	932	747	1013	761	265	196	192
28	210	490	499	918	1158	1211	1115	913	393	330	137	119
29	132	336	794	853	1089	1336	411	724	268	286	104	114
30	270		622	1259	1291	659	1036	421	619	444	163	91
31	236		657		1173		1012	553		302		195
Total	5064	8414	17668	24590	33307	35632	32997	30697	18399	11431	5503	3942
Mean	163.4	290.1	569.9	819.7	1074.4	1187.7	1064.4	990.2	613.3	368.7	183.4	127.2

Table 11 DUBLIN AIRPORT DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	182	467	565	663	922	2026	1839	1719	1060	846	243	48
2	229	194	517	1660	1534	1133	1689	867	1279	1014	341	228
3	68	84	671	1347	1658	2047	1057	909	962	388	603	221
4	263	118	324	1773	1983	1013	1824	1157	615	942	93	157
5	256	240	535	1704	1684	1973	1474	1565	1534	449	167	179
6	291	123	463	1790	2092	1716	987	677	1429	264	62	248
7	186	90	766	1247	1445	1600	756	591	730	860	160	318
8	72	370	616	774	1471	1402	1367	1477	1418	933	69	270
9	37	134	876	629	1360	1472	1123	1196	741	906	240	58
10	252	611	977	908	1417	1662	1692	826	782	218	161	52
11	101	496	323	594	1277	676	1529	1359	400	853	410	258
12	187	59	870	1189	1048	545	1014	1284	1347	798	464	61
13	141	316	1210	1213	2007	1140	1493	787	767	350	295	221
14	200	109	1182	511	2173	383	2142	627	649	500	109	166
15	89	694	269	508	2439	1513	1290	1691	724	600	121	169
16	144	623	302	1417	2579	1024	1455	1300	1245	384	268	101
17	82	584	566	1574	2586	1651	1002	1385	621	741	322	89
18	108	106	85	2046	2453	766	869	1024	387	828	432	263
19	26	198	415	1922	1466	2032	1123	1119	617	529	209	88
20	384	67	906	1034	1011	1803	1179	1748	1269	254	164	142
21	64	271	1311	1242	1797	2329	1772	1699	451	137	120	166
22	224	498	1440	1124	2484	1714	1810	1507	257	128	310	175
23	315	916	403	801	1587	1331	1758	1509	559	598	225	228
24	436	651	1166	1154	1844	1608	998	1931	1219	593	192	125
25	409	411	630	791	1268	1647	474	1558	1079	467	119	195
26	396	529	1018	1497	954	1898	2116	1700	217	139	358	115
27	228	221	694	845	1217	1321	1361	1132	804	248	342	193
28	225	424	356	1196	1784	1089	2053	854	1069	513	369	89
29	105	295	1317	1933	2195	1774	732	508	496	593	342	103
30	452		766	1251	1495	845	1580	1293	1227	350	294	146
31	81		888		1295		1700	1330		155		192
Total	6233	9899	22427	36337	52525	43133	43258	38329	25954	16578	7604	5064
Mean	201.1	341.3	723.5	1211.2	1694.3	1437.8	1395.4	1236.4	865.1	534.8	253.5	163.4

Table 12 DUBLIN AIRPORT DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1980

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	105	201	410	618	777	996	1269	955	890	544	238	32
2	118	176	402	469	944	1038	1270	832	689	453	316	138
3	66	84	492	605	643	1358	1003	857	726	378	193	142
4	99	86	269	280	783	906	1324	990	531	466	89	121
5	137	229	374	365	1034	881	1088	1020	-	415	163	122
6	98	123	421	314	852	1044	942	674	-	250	56	116
7	153	90	414	755	909	1111	749	487	-	381	144	54
8	72	235	440	606	1078	1231	962	1025	-	343	63	127
9	30	134	363	629	844	1322	1004	907	-	338	238	40
10	127	232	372	775	1184	1383	1325	733	660	215	154	35
11	101	331	324	564	1092	676	1139	879	390	279	180	95
12	176	46	447	900	923	542	996	-	566	336	171	54
13	139	257	424	829	1033	624	1248	745	596	273	214	137
14	129	107	382	509	834	374	875	606	510	296	94	120
15	83	247	262	508	535	1174	1061	844	552	409	101	107
16	141	220	290	884	425	982	1154	843	408	326	182	99
17	82	305	421	766	439	1269	792	1100	511	317	172	85
18	108	106	85	432	682	757	829	827	266	198	85	117
19	26	192	415	735	1039	1003	1017	1052	463	372	185	82
20	94	61	628	732	1005	1055	868	500	581	241	122	124
21	62	263	493	957	1251	993	1398	744	323	118	103	118
22	182	445	400	976	919	991	1255	734	254	110	183	118
23	190	151	377	765	1135	995	733	919	550	300	181	101
24	109	388	447	862	1169	1169	882	431	357	352	142	111
25	112	367	511	784	1034	1223	467	972	487	296	105	97
26	186	404	648	922	853	1020	964	596	215	139	120	113
27	214	218	543	778	940	1099	1079	916	636	248	126	161
28	217	408	317	898	903	953	862	702	367	234	74	87
29	101	288	507	735	911	1193	654	494	488	202	76	100
30	173		626	1016	1203	726	859	887	314	331	105	140
31	79		657		980		926	874		152		153
Total	3709	6394	13161	20968	28353	30089	30994	-	-	9312	4375	3246
Mean	119.7	220.5	424.6	698.9	914.6	1003.0	999.8	-	-	300.4	145.8	104.7

NOTE: No data for 12th August - Shade ring removed for calibration purposes. No data for period 5th-9th September due to instrument malfunction.