METEOROLOGICAL SERVICE

SOLAR RADIATION OBSERVATIONS 1979

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CONTENTS

S U M M A R Y

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 Pyreheliometric Scale, 1956.

SOLAR RADIATION OBSERVATIONS AT VALENTIA OBSERVATORY

1979

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 1979.

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 in 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^{o} so that their effect on the Diffuse Radiation is negligible.

In the sector 080^{o} to 150^{o}E. from north, the elevation of the obscuring objects lies between 8^{o} and 10.5^{o} 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^{o} to 150^{o}). 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 $\frac{1}{2}$ 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, provided with red and yellow filters was used for all instantaneous direct sun observations

See Appendix ,

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^{o} to 54^{o}", 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:-

$$m = m_h \frac{P}{1000}$$ where P = 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)

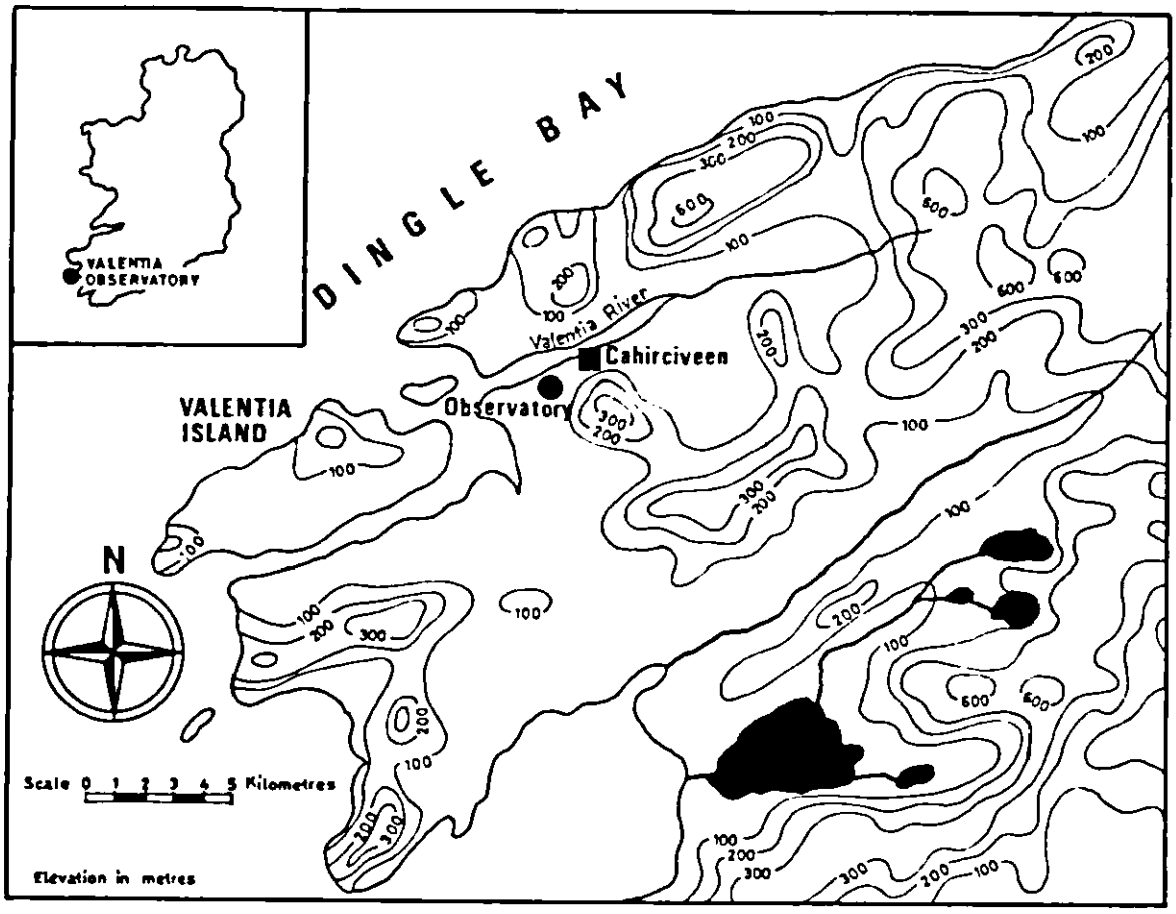


Fig. 1. Map showing the site of Valentia Observatory and its environs.

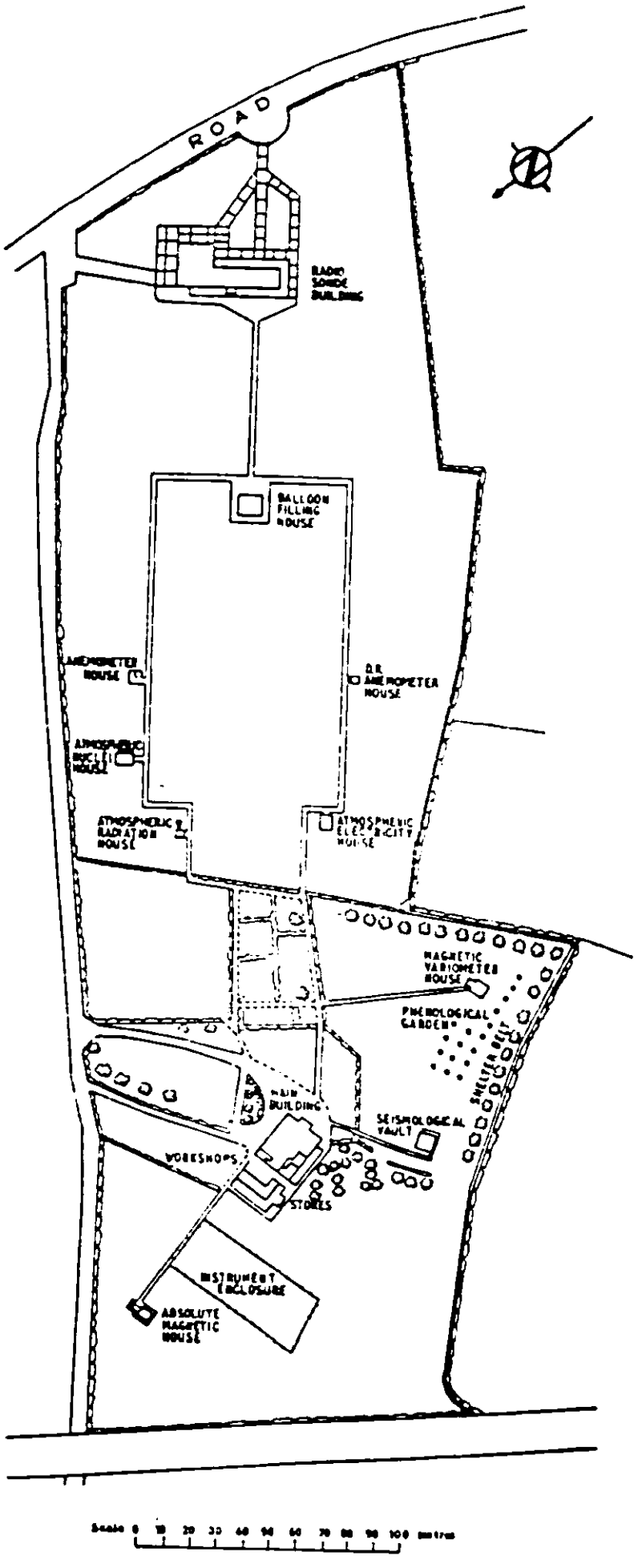


Fig. 2 General layout of Valentia Observatory.

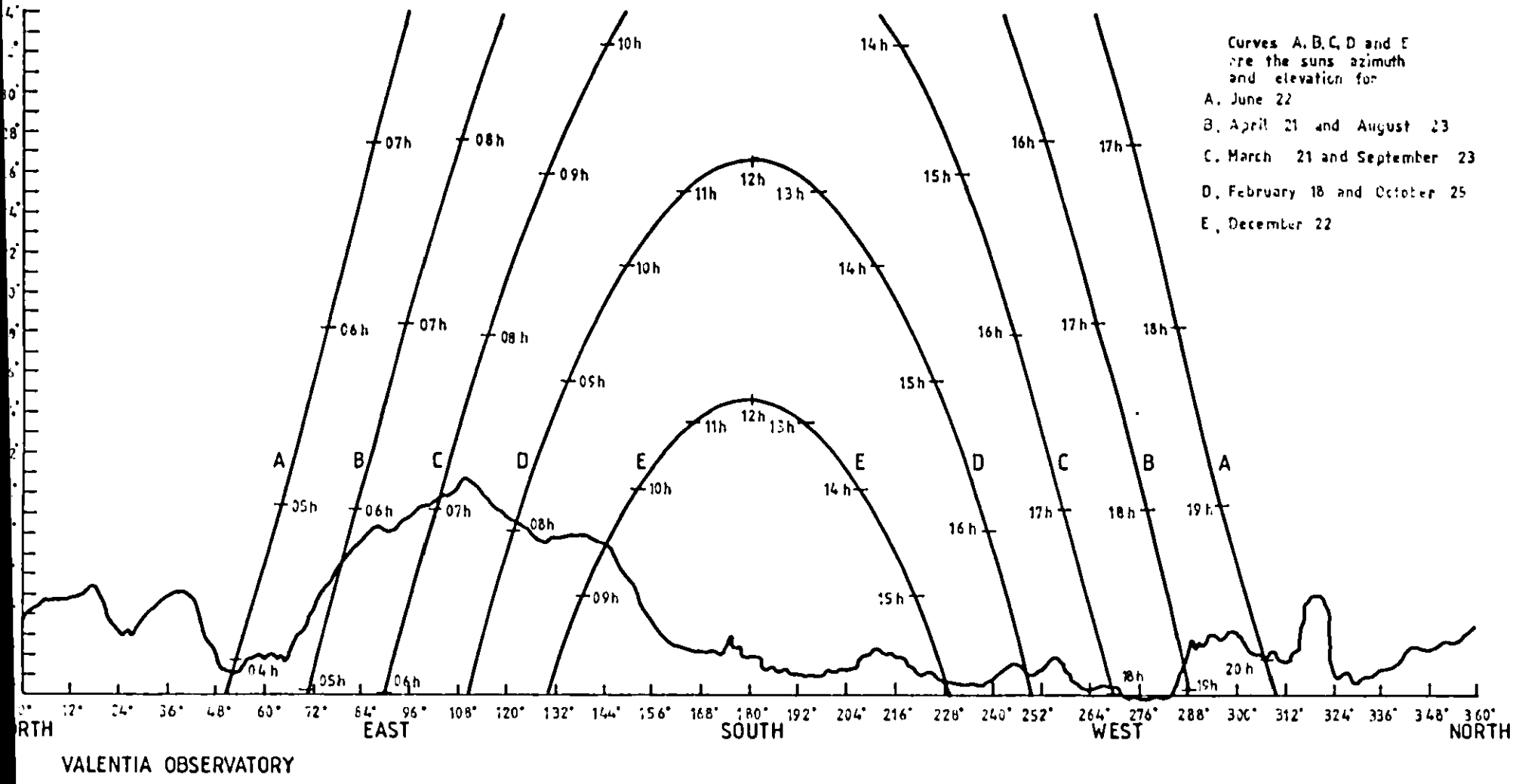


Fig. 3. Exposure diagram showing Azimuth and Elevation of all objects which obscure the pyranometer, together with Elevation and Azimuth of the sun at different times of the year.

SOLAR RADIATION OBSERVATIONS AT KILKENNY METEOROLOGICAL STATION

1979

1. Introduction

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

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].

5. Missing Data

Global Radiation Data are not available for 11th, 18th and 22nd January due to a fault in the Pyranometer.

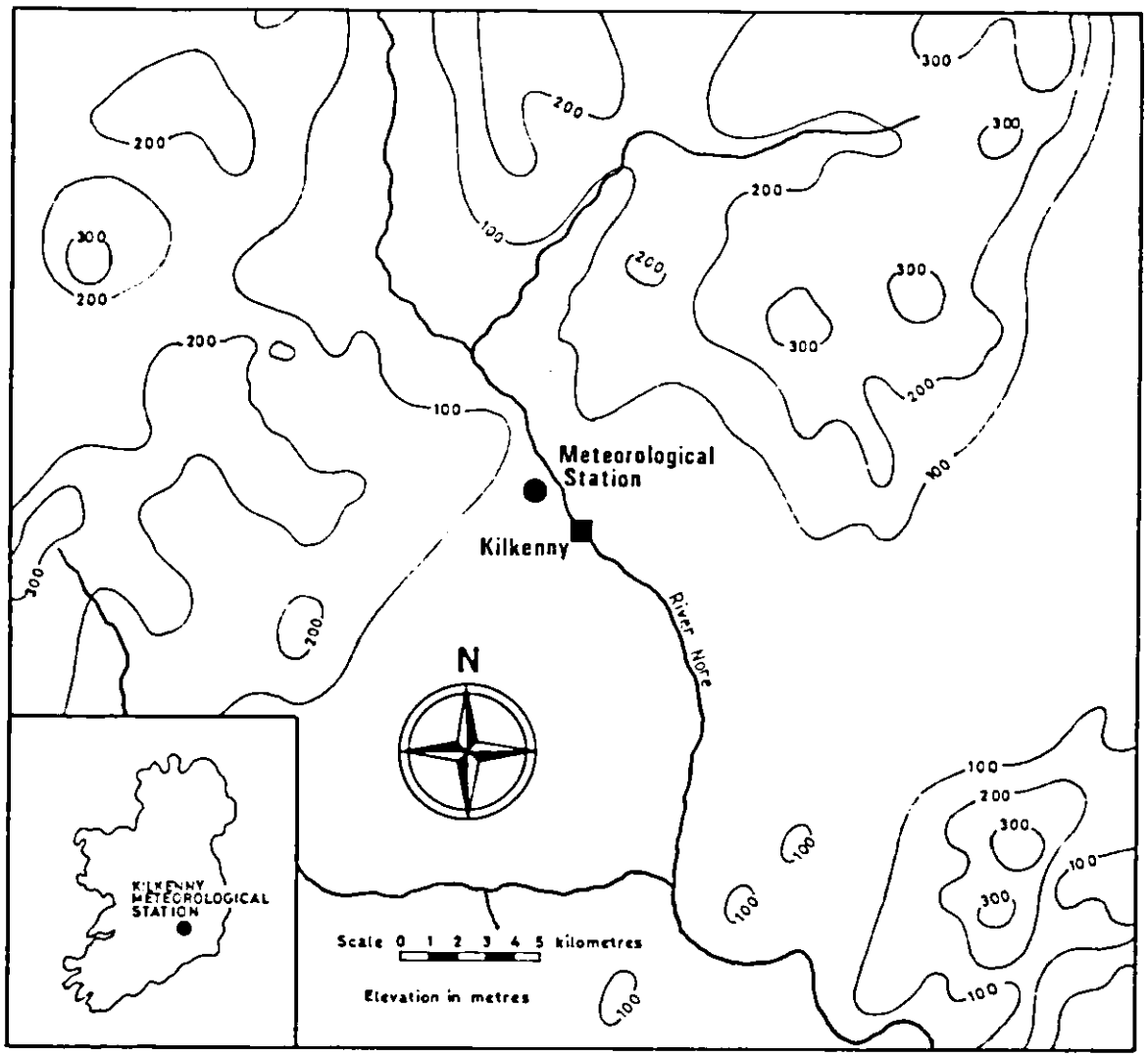


Fig. 4. Map showing site of Kilkenny Meteorological Station.

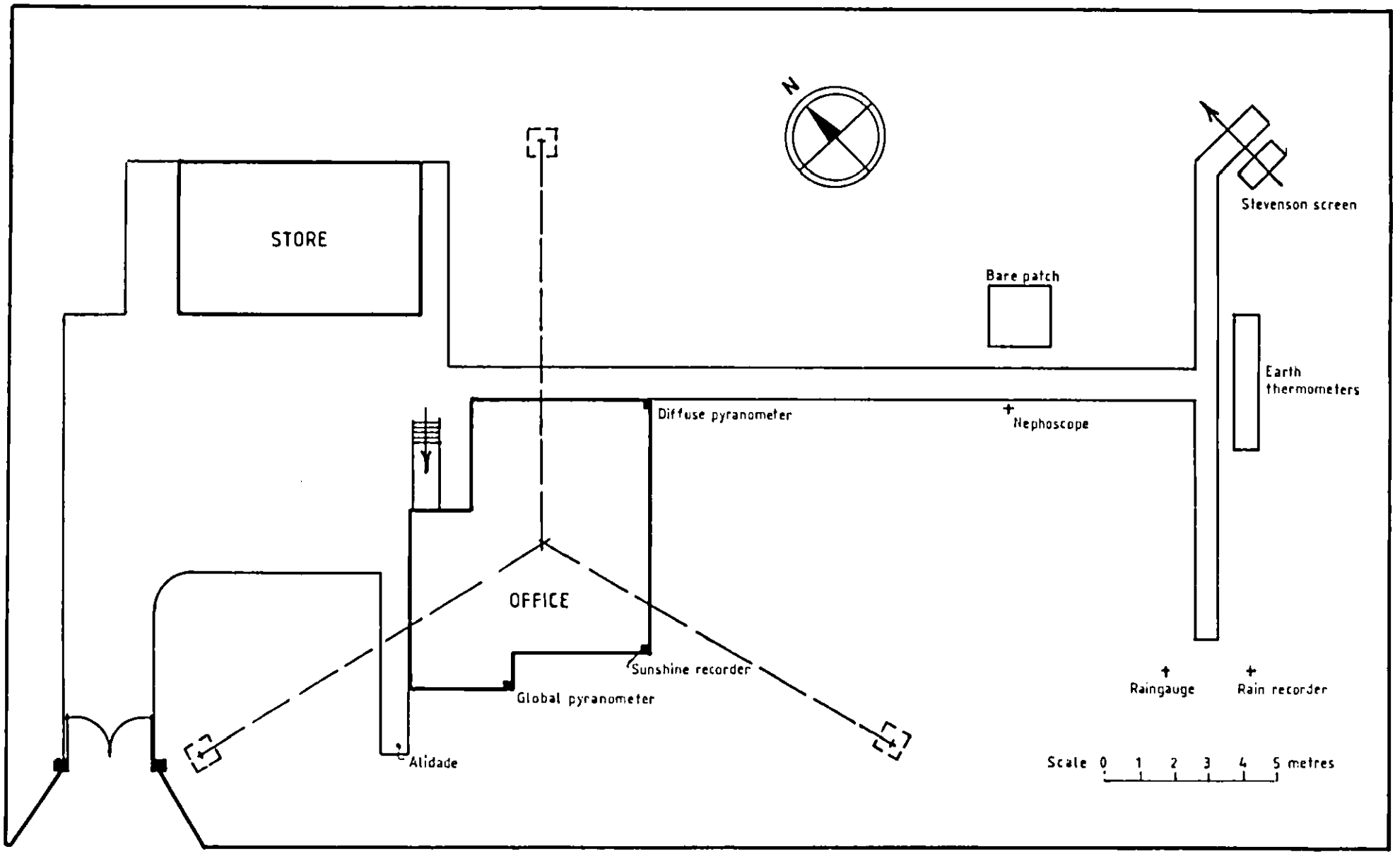


Fig. 5. Kilkenny Meteorological Station - layout of buildings and instruments

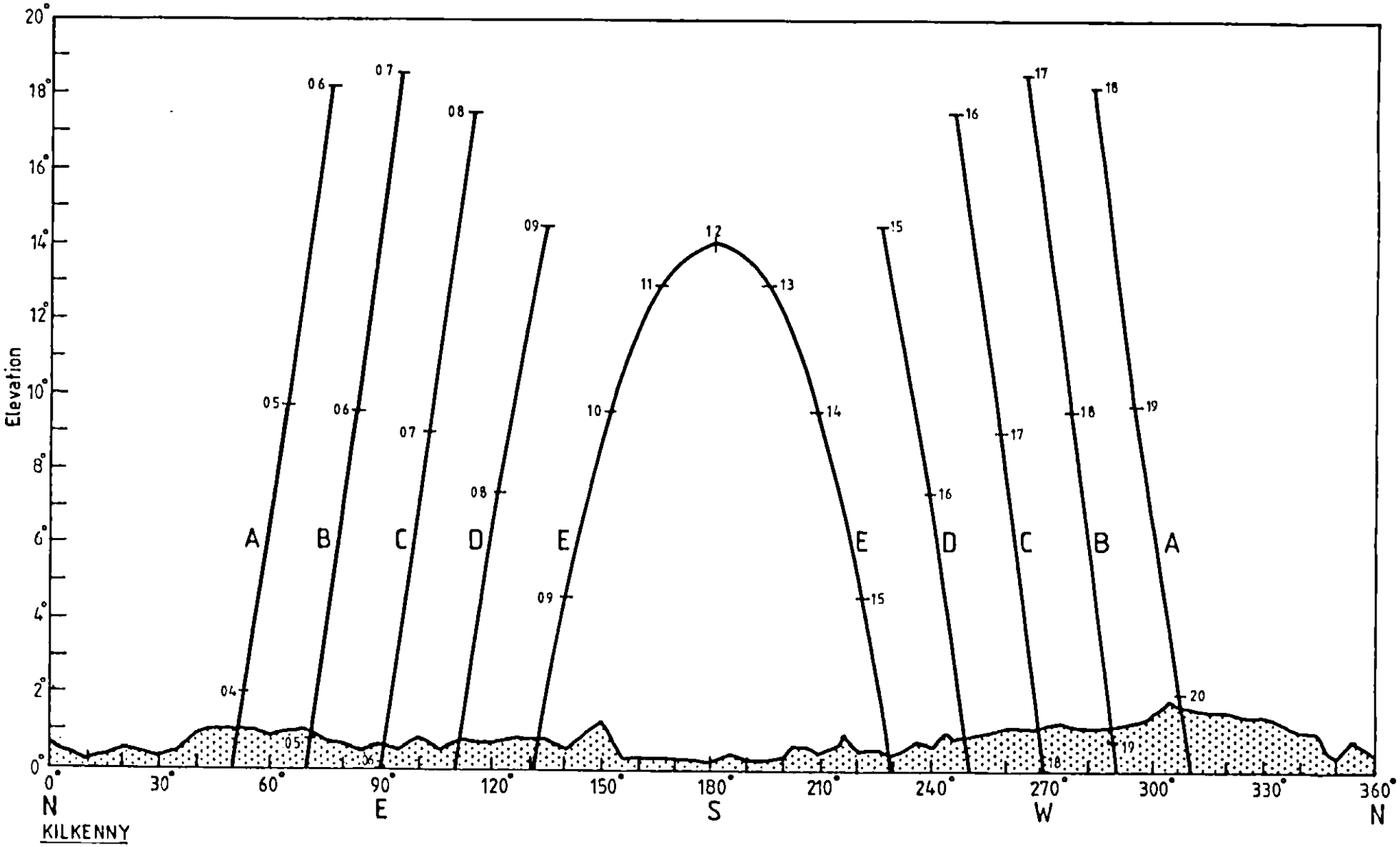


Fig. 6. Exposure diagram showing (1) azimuth and elevation of all objects which obscure pyranometer.
(2) azimuth and elevation of sun at various times of year as follows: (A) June 22, (B) April 21, August 23
(C) March 21, September 23, (D) February 18, October 25, (E) December 22.

SOLAR RADIATION OBSERVATIONS AT BIRR METEOROLOGICAL STATION

1979

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 1979.

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 6½° 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].

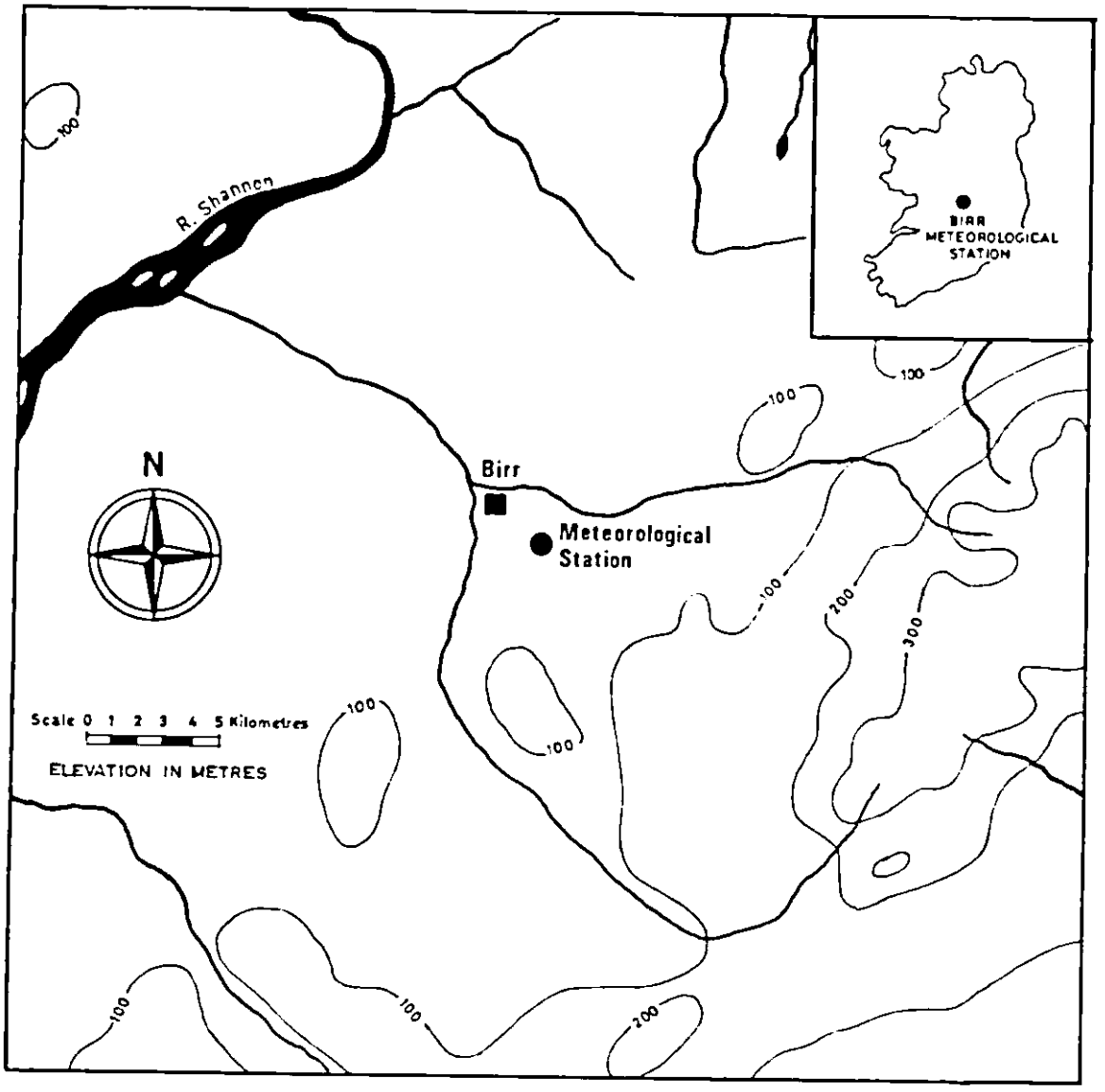


Fig. 7 Map showing site of Birr Meteorological Station.

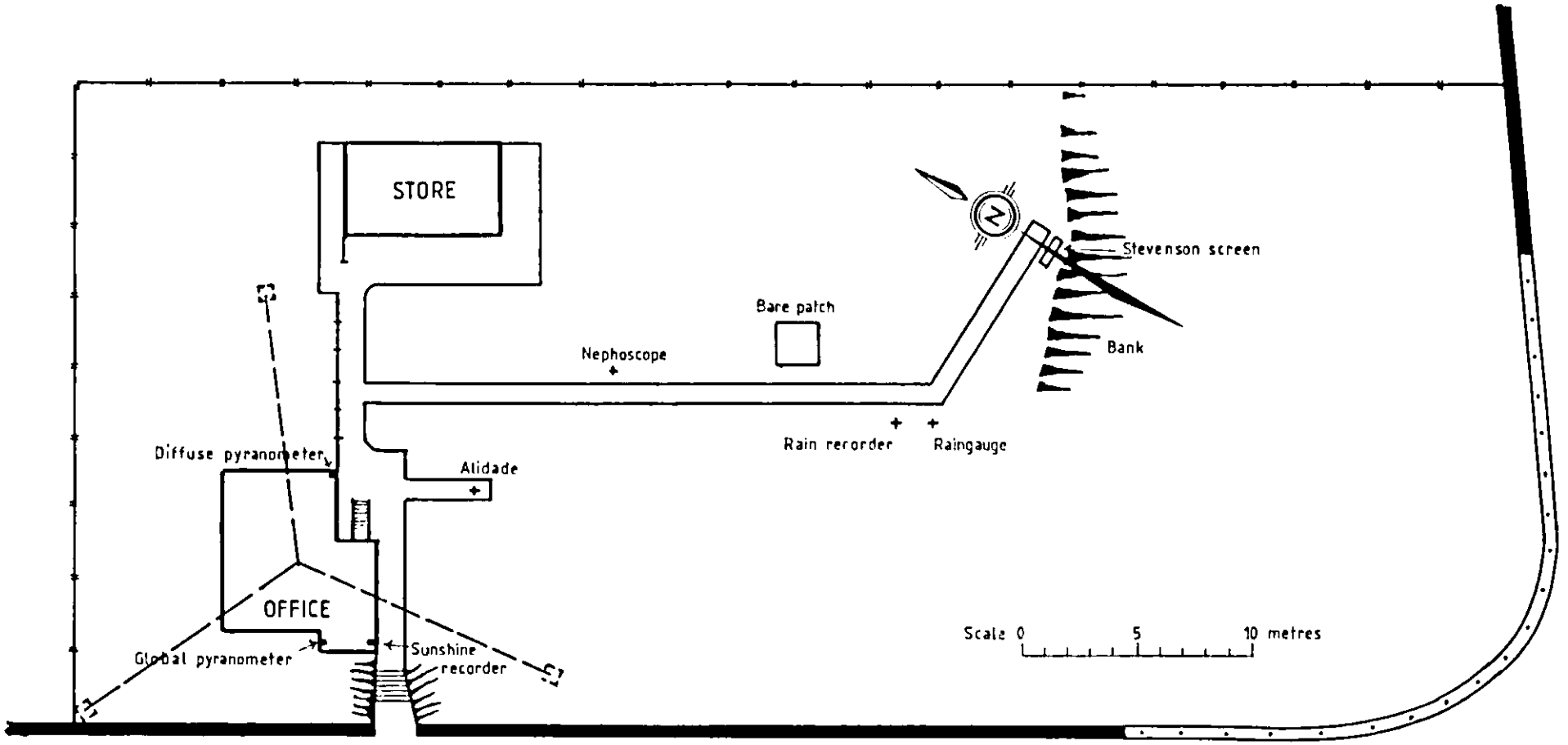
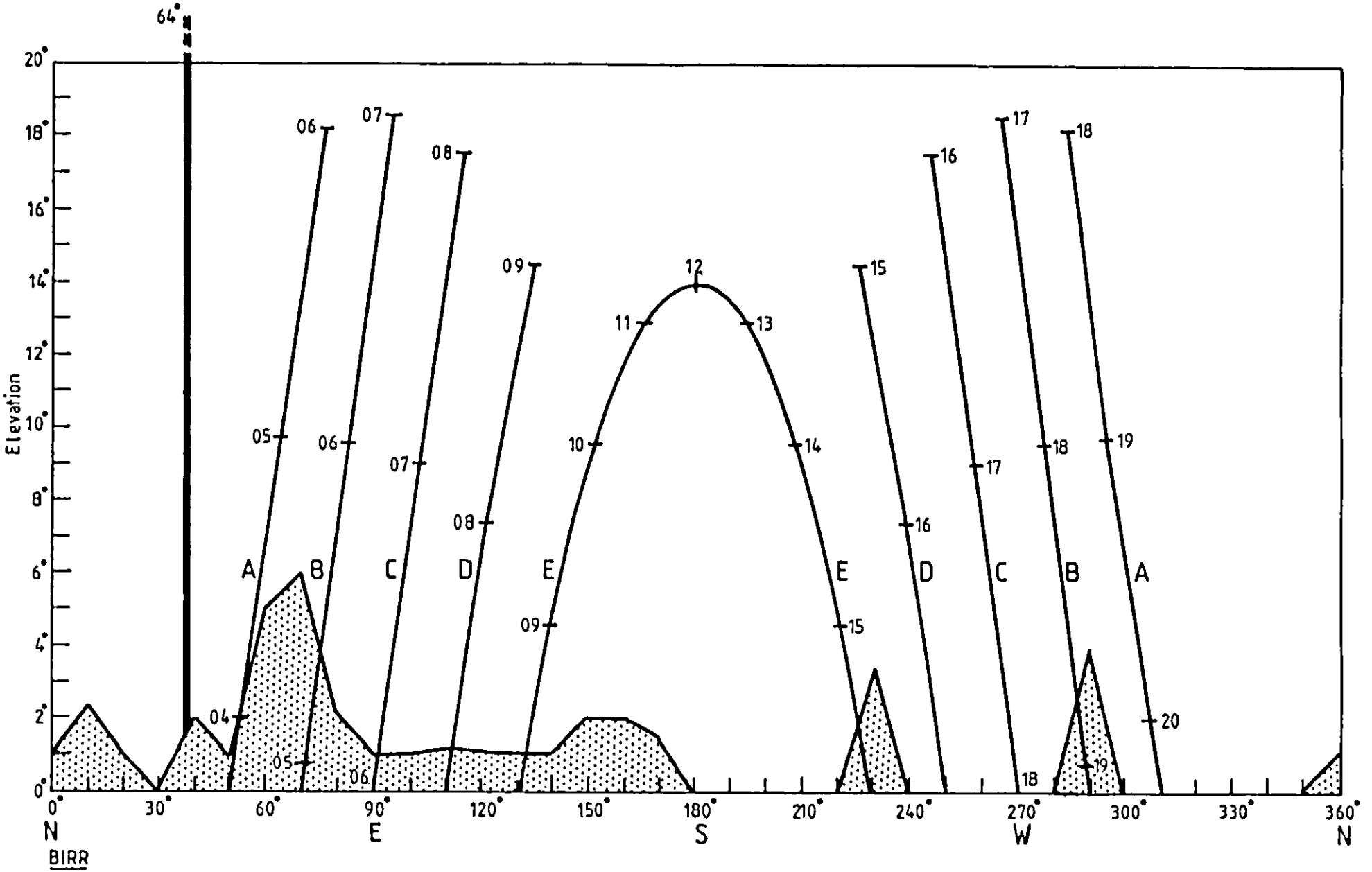


Fig. 8. Birr Meteorological Station – layout of buildings and instruments



ig. 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

1979

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 1979.

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].

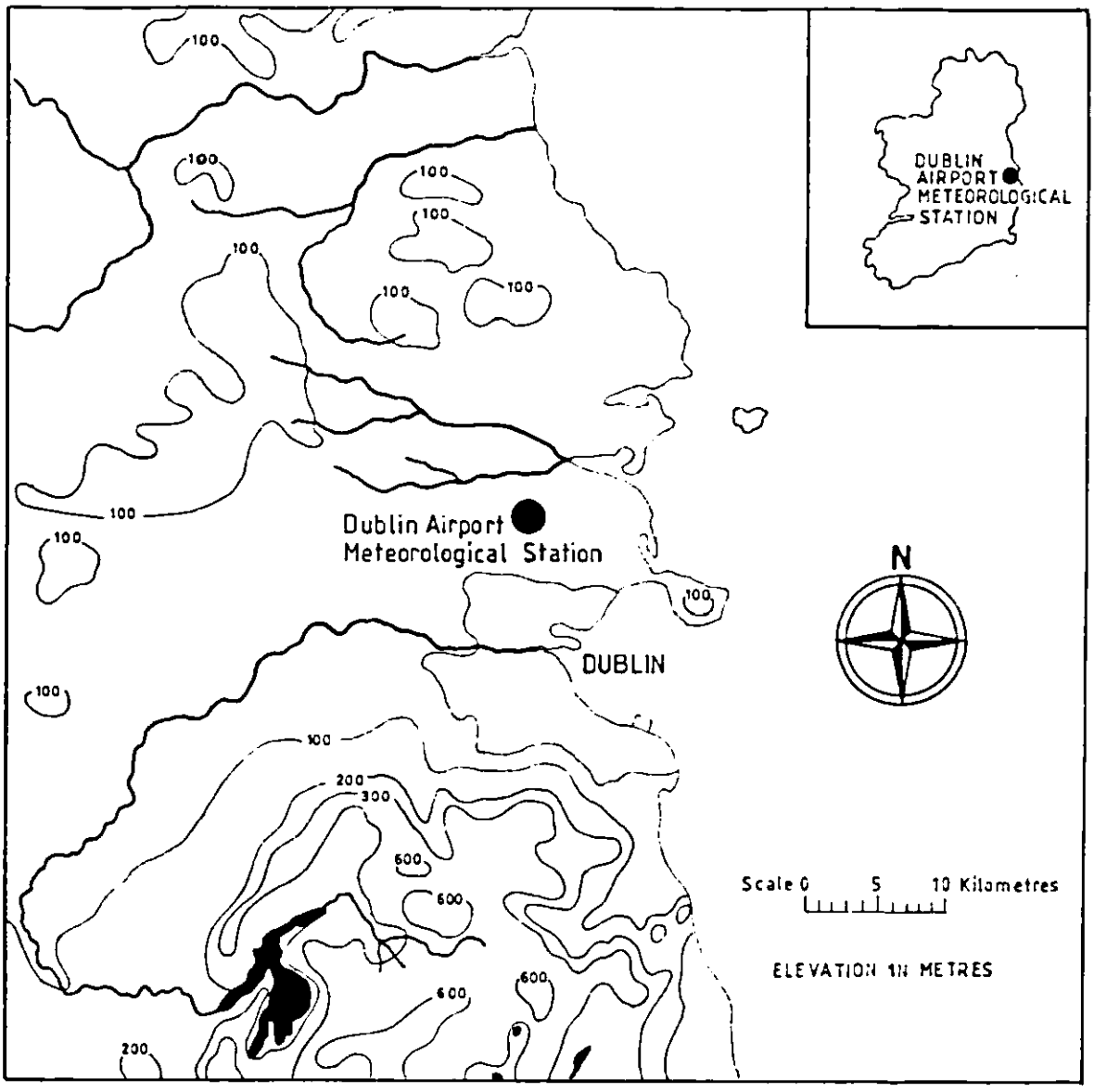
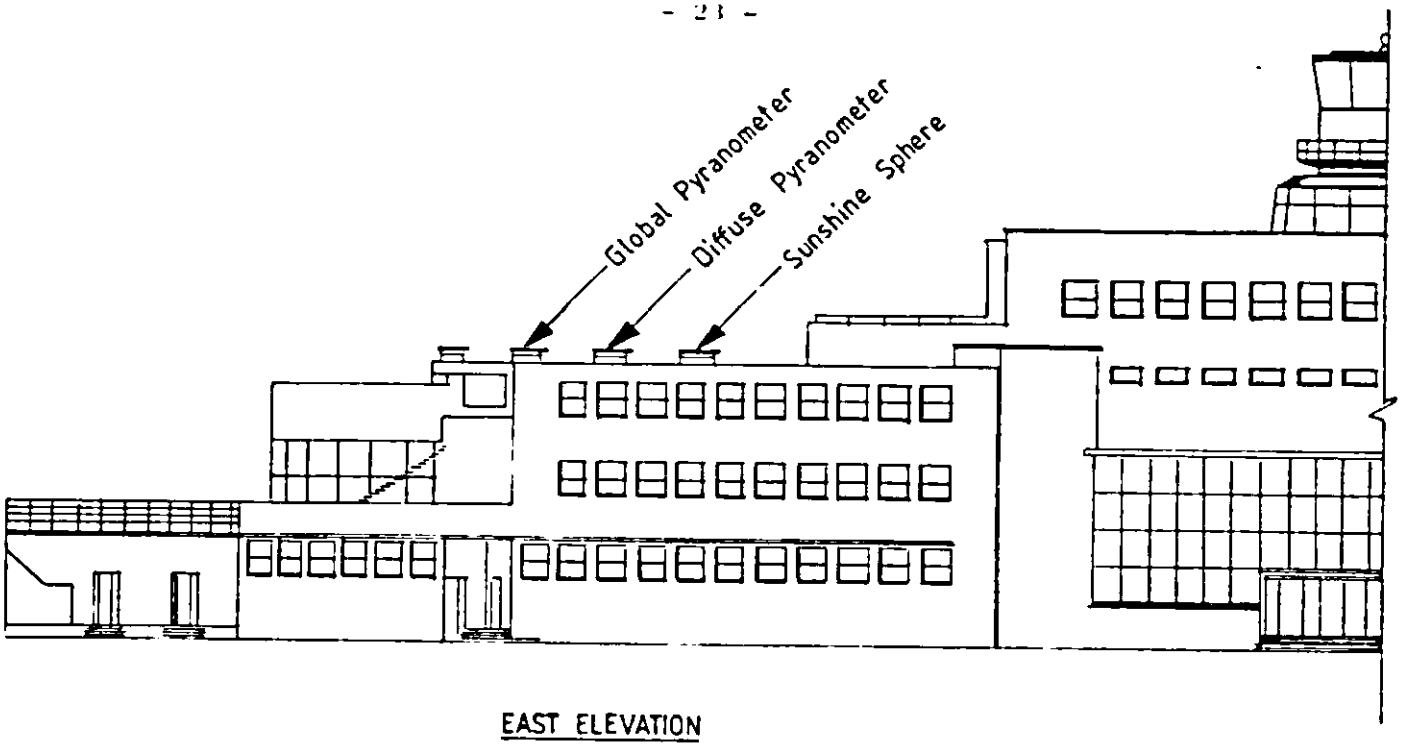
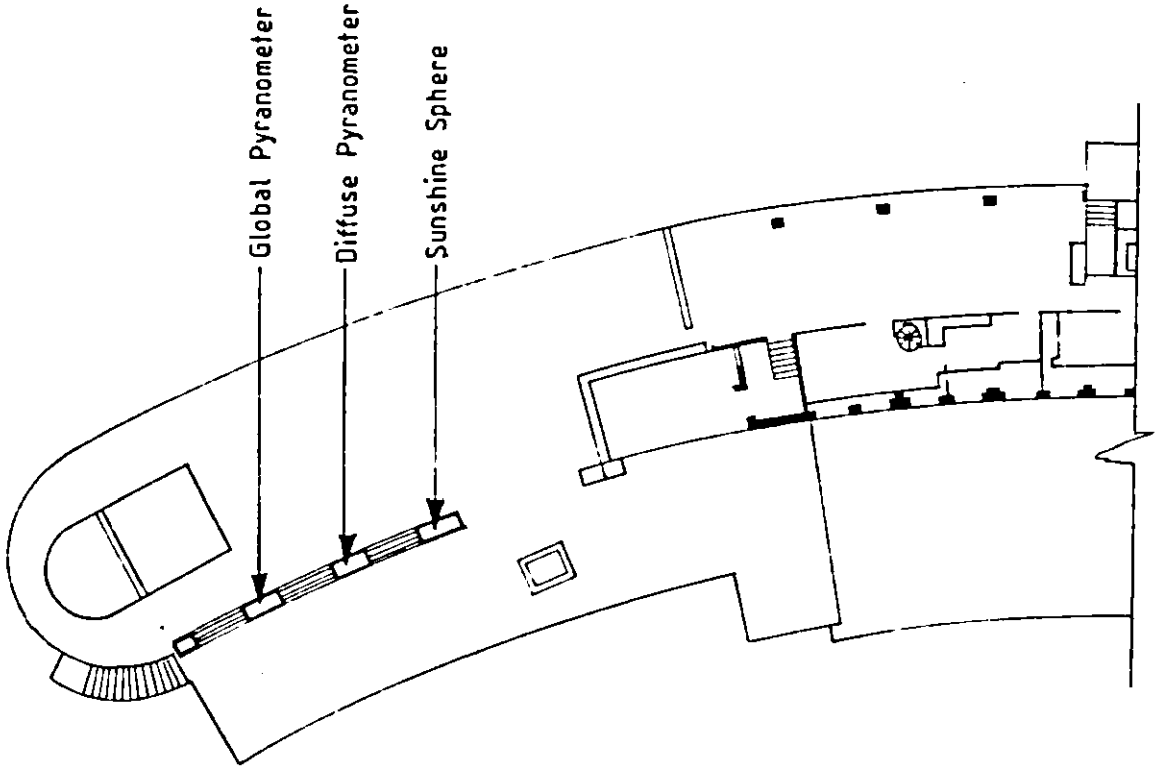


Fig. 10. Map showing site of Dublin Airport Meteorological Station

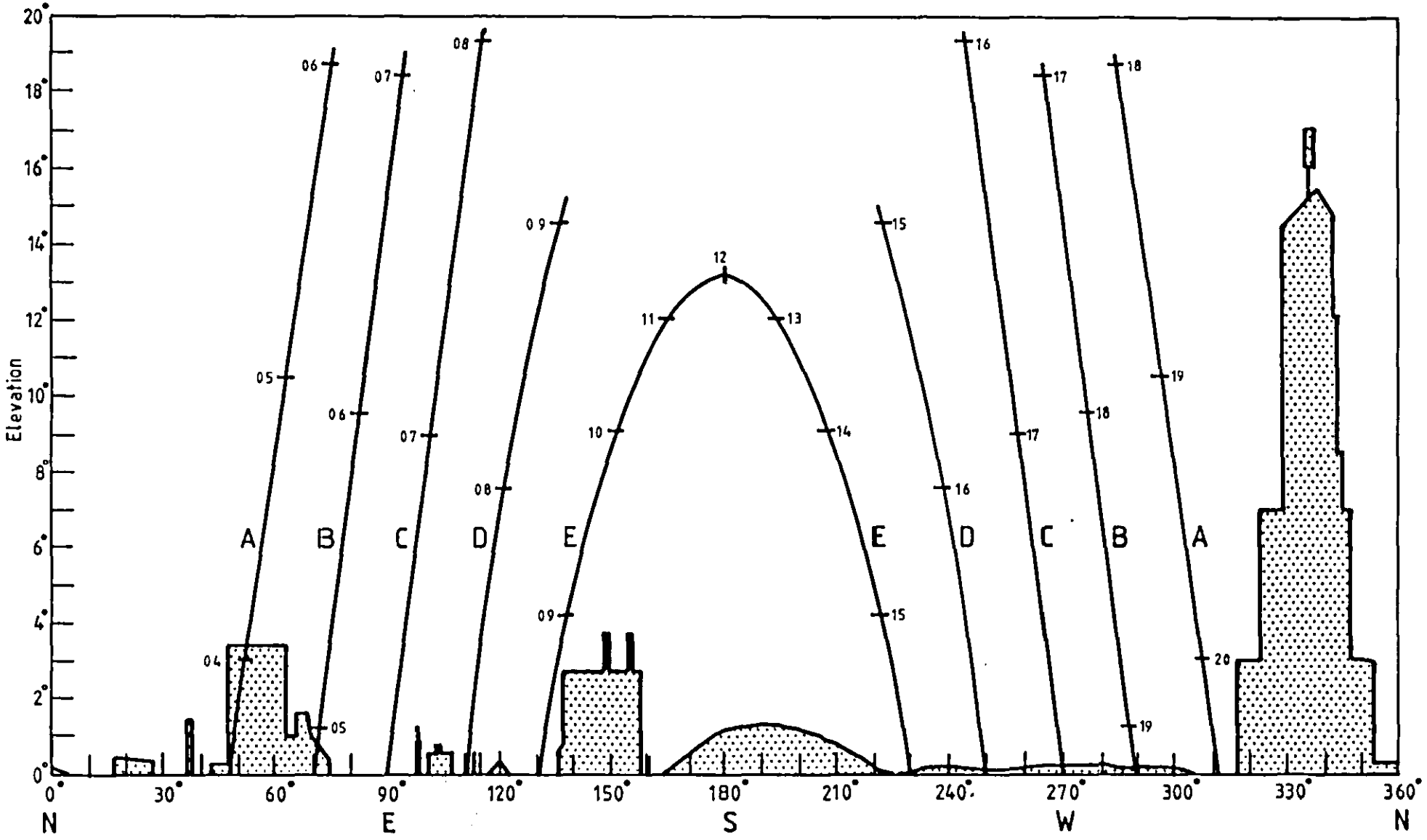


EAST ELEVATION



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 - 1979

	Sensor	Recorder	Integrator	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	Philips 8053	CC2 750338	-	-
Diffuse	CM5-752732	Philips 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) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	387	184	359	1445	1951	2385	1544	1506	801	277	616	133
2	226	699	403	1315	1653	2651	1398	1237	1135	449	198	88
3	105	225	462	1657	2132	1591	2216	2171	1011	1083	139	185
4	298	181	536	1777	2569	2146	1028	1557	991	1158	439	32
5	343	186	748	1551	2242	1860	2528	1404	496	788	77	157
6	98	431	921	1109	1328	1663	2289	565	1491	1039	143	155
7	109	589	900	719	948	1595	976	1592	391	801	418	108
8	175	118	184	933	574	892	599	349	678	459	428	161
9	241	158	880	1747	1097	1011	1813	1287	1279	699	410	146
10	264	318	223	319	293	496	1423	702	850	771	473	84
11	233	312	798	1370	344	2105	1488	537	325	920	304	214
12	213	382	790	554	1562	524	1828	567	818	829	626	191
13	234	199	1190	1507	780	1483	1911	544	1179	525	231	75
14	127	178	1236	826	2189	1583	1479	1106	1391	1034	463	67
15	165	880	965	2125	1376	2192	2639	2089	1477	586	193	257
16	290	181	532	2273	1957	2592	991	777	1067	775	342	109
17	428	321	441	666	1457	2896	580	1688	364	186	157	223
18	126	880	702	1092	2133	2746	1458	1197	289	252	387	126
19	264	316	1128	1018	1249	2814	1723	1496	1220	585	138	260
20	154	66	726	1580	2215	1468	1591	629	1450	702	216	247
21	282	660	1165	1429	2249	1876	1683	1966	1100	680	141	216
22	110	869	1617	507	1764	797	1516	1477	396	447	138	144
23	458	859	1241	1326	2137	2696	700	556	1590	858	380	188
24	458	559	264	2010	1968	2329	1547	635	307	128	286	356
25	492	576	143	2076	2423	2614	1383	1740	348	571	70	140
26	293	516	771	1425	2106	1416	1110	1829	845	783	92	58
27	614	170	721	545	2005	413	1423	2124	1431	591	68	207
28	309	608	1080	698	2065	1593	966	1939	1377	660	45	228
29	151		1350	1066	1714	1212	1577	2054	249	288	70	244
30	435		905	1364	2958	1682	1112	1261	183	208	155	356
31	179		1091		2317		1767	401		139		99
Total	8261	11621	24472	38029	53755	53321	46286	38982	26529	19271	7843	5254
Mean	266.5	415.0	789.4	1267.7	1734.0	1777.4	1493.1	1257.5	884.3	621.6	261.4	169.5

Table 2 VALENTIA DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	86	180	349	641	854	849	1157	1116	582	273	322	131
2	140	108	384	612	796	873	1333	1099	849	442	196	87
3	102	217	402	544	782	1254	1237	962	787	483	138	143
4	226	178	510	519	619	819	1024	1256	825	337	278	32
5	207	183	551	794	757	923	1029	956	460	540	75	152
6	96	419	450	867	1169	1335	1461	562	806	442	140	152
7	104	338	518	560	944	1343	969	1096	389	577	227	106
8	161	118	182	766	573	892	580	347	560	410	269	136
9	186	156	476	530	913	968	1658	1058	824	516	273	140
10	153	278	221	319	293	496	1120	682	668	515	241	82
11	156	307	468	763	344	837	1203	532	325	523	290	150
12	190	332	676	520	936	524	1247	551	646	472	178	169
13	222	199	447	707	777	975	1565	521	945	348	186	75
14	125	178	454	700	978	1443	1190	764	598	395	220	67
15	164	237	528	510	1240	1496	770	658	478	422	162	171
16	230	181	511	347	1053	903	932	755	769	370	280	109
17	120	318	426	660	1151	614	577	1064	363	182	154	169
18	124	271	563	997	1123	939	1258	817	287	234	230	117
19	206	305	534	533	1095	894	1110	1015	555	323	135	144
20	149	66	574	1045	919	1231	1450	619	512	335	205	174
21	216	467	523	1176	824	1357	1007	856	607	371	136	154
22	110	350	364	495	907	794	1060	996	395	226	134	141
23	273	439	493	903	1125	985	699	528	395	221	173	168
24	234	498	263	874	1113	1230	1324	626	307	128	236	158
25	213	410	142	876	1125	1399	1235	1039	344	348	68	133
26	224	460	571	920	1136	1367	1050	829	575	274	90	54
27	253	170	609	539	927	411	1190	515	316	263	68	173
28	218	342	693	681	1331	1425	940	764	269	352	44	149
29	147		650	922	1303	1185	1409	471	246	283	70	143
30	271		560	1045	757	1318	974	1026	182	190	148	140
31	175		810		1215		1135	400		136		97
Total	5481	7705	14902	21365	29079	31079	34893	24480	15864	10931	5366	4016
Mean	176.8	275.2	480.7	712.2	938.0	1036.0	1125.6	789.7	528.8	352.6	178.9	129.6

Table 3 VALENTIA DAILY TOTALS OF RADIATION BALANCE (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	-520	-95	95	594	922	1006	711	819	295	129	-51	78
2	-377	-292	242	510	682	1229	741	625	531	184	34	-79
3	-38	-107	128	567	991	874	1040	1243	563	327	74	-216
4	-251	71	58	549	1234	1096	460	884	576	170	-6	-5
5	-227	79	248	481	1007	904	1124	744	261	304	-10	19
6	27	195	369	402	656	885	1152	337	757	386	41	14
7	-42	-7	192	302	532	750	565	796	168	305	-5	20
8	-162	-94	52	251	369	519	335	134	326	157	3	-85
9	-134	-33	288	565	610	575	967	648	563	205	-152	-113
10	-159	71	170	40	189	259	766	408	416	323	-11	-116
11	-247	64	342	655	186	1033	858	336	173	365	74	-202
12	-184	29	321	193	722	249	1052	261	331	373	-157	-54
13	-15	69	507	634	489	819	1043	248	480	75	-99	-124
14	10	-104	337	334	1224	832	742	520	461	393	-48	-173
15	25	-169	179	722	744	1064	1229	1115	589	127	-131	-52
16	-217	-11	58	852	1001	1192	534	435	489	114	-11	-62
17	-346	187	169	336	641	1458	384	920	166	-26	8	-175
18	-62	147	315	540	949	1272	788	656	111	61	-30	-167
19	-121	30	475	483	580	1349	946	794	485	86	94	-161
20	-77	52	178	687	1001	760	900	345	575	77	97	-72
21	-104	93	360	738	932	1029	965	950	353	77	63	23
22	-53	82	448	264	607	439	789	702	196	48	62	-6
23	10	45	397	625	969	1455	442	192	559	194	-103	-146
24	-9	30	185	957	882	1267	924	340	128	-34	-19	-200
25	82	101	51	1028	1076	1193	689	954	220	17	33	-102
26	-26	207	275	485	909	797	566	865	227	0	62	-9
27	38	-15	297	265	958	243	817	781	352	107	38	-137
28	-110	68	397	451	1094	791	584	759	396	104	-27	-204
29	-110		559	606	910	665	870	662	-9	102	-47	-238
30	21		293	630	1275	801	570	579	43	16	15	-192
31	-6		471		1071		1003	247		36		-55
Total	-3384	693	8456	15746	25482	26809	24559	19299	10781	4712	-209	-2991
Mean	-109.2	24.8	272.8	524.9	822.0	893.6	792.2	622.5	359.4	152.0	-7.0	-96.5

Table 1

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES

INSTANTANEOUS VALUES (mW/cm^2) 1979

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
Jan													
1	1008	78.9	5.23	677	523	612	428	1022	-0.7	3.6	50	Cu	Tr
1	1148	75.0	3.92	765	559	666	456	1022	2.3	4.0	50	CuFc	Tr
17	1008	76.8	4.46	702	503	601	405	1028	4.4	5.9	40	Cu	1
17	1132	73.0	3.50	760	529	644	422	1027	6.0	8.2	40	Cu	2
25	1100	72.2	3.24	776	535	643	433	998	5.0	6.6	40	Cu	3
27	1148	70.5	2.97	739	499	605	406	998	4.3	6.7	60	CuScCi	4
Feb													
2	1004	73.3	3.48	803	560	673	453	1005	3.4	4.7	30	Sc	Tr
2	1136	69.0	2.79	852	582	708	471	1005	4.4	1.9	30	Sc	Tr
2	1448	77.9	4.74	711	525	620	423	1006	5.3	5.1	70	Ci	Tr
15	1012	68.8	2.81	755	548	648	455	1024	-1.7	4.2	35	Cu	1
15	1124	65.2	2.43	816	580	695	475	1024	-0.9	1.1	35	Cu	2
18	1208	63.7	2.28	698	449	560	358	1011	10.5	10.3	25	CuFc	2
22	1052	64.0	2.34	740	487	589	386	1031	9.3	9.5	40	CuSc	3
Mar													
22	0948	58.4	1.91	884	577	714	465	1005	5.0	7.5	40	CuCbSc	1
23	0836	66.4	2.52	819	564	679	453	1013	5.0	5.1	50	CuScAc	Tr
23	0936	59.3	1.98	882	588	716	465	1013	7.2	7.1	50	CuSc	Tr
Apr													
3	1528	63.2	2.22	806	542	661	438	1002	8.0	6.3	20	CuFc	2
4	1100	48.0	1.50	803	550	665	444	1004	8.2	6.6	30	CuCb	3
4	1334	50.3	1.57	820	557	678	455	1004	8.4	5.8	35	CuFc	1
9	0852	58.8	1.93	800	548	660	442	1004	7.6	7.2	35	CuFc	1
9	0956	51.3	1.60	859	572	696	459	1004	8.5	6.9	35	CuFc	2
15	1000	48.9	1.56	882	561	698	446	1026	12.0	9.6	50	Ci	6
15	1320	45.3	1.46	844	543	670	448	1028	12.2	10.6	60	FcCi	6
16	0952	49.3	1.58	866	566	690	466	1030	11.3	7.9	50	FcCi	3
16	1120	42.7	1.40	867	535	689	460	1029	13.3	8.5	40	FcCi	5
16	1228	42.3	1.39	892	574	708	469	1029	13.9	8.5	40	FcCi	5
16	1408	49.3	1.58	855	557	686	456	1029	14.4	7.9	40	Ci	2
16	1552	62.6	2.23	713	501	604	404	1029	11.5	10.3	20	ScCi	2
May													
3	0928	47.2	1.49	887	569	699	467	1015	6.5	7.0	50	CuCb	2
3	1108	37.8	1.28	917	580	720	473	1015	7.5	7.3	50	CuCb	3
3	1544	57.1	1.86	788	515	626	421	1015	8.6	7.0	50	CuCb	3
4	0904	50.3	1.59	803	529	642	431	1018	6.0	7.6	40	CuCb	4
4	1100	38.0	1.29	914	585	724	473	1020	7.4	7.5	50	CuSc	3
4	1248	37.3	1.28	928	590	731	481	1020	8.6	7.3	50	CuFc	3
4	1536	55.7	1.81	841	546	671	443	1021	9.3	7.9	70	CuFc	2
5	1044	38.8	1.31	877	560	691	455	1024	8.7	7.5	25	CuScAc	5
5	1252	37.2	1.28	892	563	700	458	1024	8.9	7.6	50	CuScAc	3
21	0812	54.1	1.70	829	535	663	431	998	9.3	8.6	45	CuCbCi	3

Table 4
(Contd.)

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES

INSTANTANEOUS VALUES (mW/cm^2) 1979

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	^oC	mb	Km		Okta
May													
21	1012	38.1	1.27	905	566	705	460	999	10.7	8.9	50	CuCbSc	2+
21	1348	38.1	1.27	895	566	700	459	999	10.9	9.3	50	CuCb	5
30	1120	31.2	1.18	861	540	671	431	1014	14.9	11.7	25	CuCbCi	4+
30	1448	44.2	1.41	876	554	689	447	1013	15.0	10.6	35	CuCb	2
30	1616	57.1	1.86	822	528	655	429	1014	14.0	11.6	35	CuCb	2
June													
5	1416	39.4	1.31	877	550	684	443	1016	13.4	10.9	45	Cu	2
16	1340	34.4	1.24	883	544	680	434	1025	18.0	16.0	40	FcCi	Tr
16	1456	44.1	1.43	872	540	676	437	1026	18.0	16.0	40	CuSc	3-
16	1520	47.6	1.52	855	531	667	431	1026	18.0	16.0	4	CuSc	3-
17	0944	38.6	1.31	843	525	660	419	1028	16.4	14.0	60	CuCi	2+
17	1528	48.6	1.55	782	496	619	402	1028	18.0	15.8	30	CuFcSc	1
19	0836	48.0	1.53	714	468	587	384	1022	18.8	16.4	20	FcCi	5
21	1528	48.6	1.53	781	482	596	402	1016	13.1	10.3	20	CuFcSc	6
23	1508	45.7	1.44	835	520	647	417	1007	13.7	11.0	40	Cu	4
24	0824	49.8	1.56	855	538	673	434	1009	12.6	11.0	30	CuSc	2+
24	1020	34.3	1.22	896	554	693	441	1010	13.4	11.2	40	CuSc	2
July													
15	0848	47.7	1.53	692	461	563	376	1029	16.0	13.6	45	FcCi	5
15	1120	31.3	1.20	746	478	591	389	1029	17.0	15.1	50	CuFcCi	3
21	1434	43.3	1.40	856	540	673	436	1019	14.8	11.9	40	CuFcScCi	5
Aug													
3	1200	34.3	1.23	901	558	697	452	1017	16.0	14.0	25	Cu	3
3	1252	35.9	1.25	892	548	689	438	1017	16.1	14.1	25	Cu	3
3	1432	45.5	1.45	859	533	669	429	1018	15.5	13.1	25	CuSc	4
15	0816	58.1	1.90	805	511	632	405	1008	14.0	12.4	30	CuScCi	5+
15	0956	45.1	1.43	860	533	679	422	1008	14.8	13.3	30	CuCi	6
15	1100	39.6	1.31	883	539	680	433	1008	15.8	13.8	30	CuCi	5
15	1340	42.8	1.37	882	541	683	435	1009	16.0	12.6	40	Cu	3
15	1404	45.2	1.43	842	517	649	411	1009	15.5	14.2	40	CuFc	5
21	1000	46.5	1.48	874	541	681	439	1017	14.0	12.6	30	Cu	3
26	1448	53.6	1.72	596	427	341	361	1020	17.6	14.1	12	CuCi	4
27	1020	46.4	1.48	865	537	644	443	1022	15.6	13.6	50	CuScCi	7
27	1408	49.2	1.56	810	498	544	417	1022	16.7	14.4	45	CuFcCiCs	7+
28	1528	59.5	2.01	686	477	579	392	1022	17.2	14.1	12	CuAcCi	2
29	0852	57.0	1.87	674	465	561	374	1021	17.0	12.1	16	Ci	4
29	1352	48.3	1.53	783	522	640	423	1020	21.0	13.2	14	Fc	Tr
29	1504	56.6	1.85	669	469	564	385	1019	20.9	15.3	15	Fc	Tr
Sept													
1	1528	60.7	2.05	808	513	643	411	1007	15.5	15.4	25	CuScCi	5
9	1504	60.0	2.05	809	509	640	410	1026	14.0	10.9	55	CuSc	3

Table 4 (Contd.)

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES

INSTANTANEOUS VALUES (mW/cm^2) 1979

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 (αG_1)	RED (RG_8)					TYPE	AMOUNT
				$x10^{-1}$	$x10^{-1}$	$x10^{-1}$	$x10^{-1}$	mb	^oC	mb	Km		Okta
Sept													
9	1628	71.7	3.24	693	454	527	364	1026	14.0	11.1	55	Cu	1
14	1316	51.0	1.63	827	509	640	405	1025	15.1	12.6	45	CuScCi	3
20	0928	59.7	2.01	793	504	632	407	1015	12.7	9.4	25	Cb	3
20	1312	52.9	1.68	853	533	664	436	1017	14.0	9.1	25	CuFc	2
20	1328	54.0	1.73	844	530	659	428	1017	14.0	9.1	25	CuFc	2
21	1444	61.6	2.14	819	525	656	419	1023	12.0	10.0	25	CuFc	5
23	1112	52.8	1.69	882	560	648	445	1023	14.4	9.9	40	CuFc	2
23	1304	53.7	1.73	847	538	639	431	1023	14.9	10.5	40	CuSc	4
23	1536	68.8	2.81	712	475	573	382	1023	13.8	9.9	40	CuCi	2
27	1320	56.1	1.84	814	516	646	413	1029	15.1	11.2	60	CuFcCi	4
27	1352	58.5	1.97	787	499	624	401	1029	15.1	11.2	60	CuFcCi	4
28	0900	65.8	2.50	794	525	648	423	1029	13.0	11.4	60	Ci	Tr
28	1024	57.5	1.91	861	554	686	446	1029	15.3	11.4	60	FcCi	Tr
28	1120	54.5	1.77	878	565	699	453	1028	16.2	11.5	60	Fc	1
28	1444	64.0	2.34	821	541	668	440	1027	17.2	11.3	60	FcCi	2
28	1516	67.9	2.71	766	511	630	418	1027	15.9	10.5	70	FcCi	1
Oct													
3	1544	73.1	3.46	713	481	593	399	1009	14.0	12.1	50	CuCi	3
4	0904	67.4	2.61	790	522	647	426	1007	13.3	11.3	40	CuFc	3
4	1048	58.2	1.91	871	556	694	454	1007	13.0	11.2	40	CuFc	3
19	1312	63.8	2.31	766	498	623	404	1021	14.0	12.7	25	CuFc	3
19	1436	70.3	3.01	646	432	525	350	1021	13.1	11.6	25	Cu	1
20	0928	70.2	3.01	645	435	544	351	1027	9.5	11.4	18	Cu	1
20	1430	70.1	3.00	669	446	552	361	1027	13.3	13.0	18	Cu	5
20	1548	79.1	5.35	448	324	392	267	1026	13.4	12.8	18	Cu	4+
21	1456	73.1	3.49	606	441	526	363	1018	14.1	10.7	35	CuSc	3
21	1520	75.8	4.12	584	431	514	358	1017	13.4	10.6	35	Cu	3
22	1548	79.7	5.56	577	411	493	339	1011	12.8	10.7	60	CuFc	3
23	0856	74.6	3.80	627	451	538	370	1015	5.1	8.5	50	FcCi	1
23	0951	69.1	2.83	700	474	579	381	1015	7.9	10.0	50	FcCi	3
23	1056	64.8	2.37	778	514	633	417	1014	12.6	10.5	50	FcCi	1
23	1124	63.7	2.28	778	512	626	415	1013	13.5	10.5	50	CuCi	1
23	1300	64.6	2.35	778	514	635	419	1013	13.5	10.5	50	FcCi	2
23	1336	66.6	2.54	762	511	626	415	1012	14.0	10.2	50	CuCi	1
25	1316	66.0	2.45	841	550	684	449	999	11.5	10.0	40	CuScCi	4
26	0924	72.5	3.35	744	515	627	419	1012	7.1	10.0	50	CuFcSc	1+
27	1012	68.7	2.76	781	524	636	419	1008	13.3	11.8	60	FcScCi	1+
Nov													
7	1216	68.2	2.68	716	469	574	382	1001	12.0	12.2	40	FcCuSc	5
7	1440	76.5	4.26	558	393	478	327	1003	11.8	9.5	30	CuFc	3
8	1248	69.2	2.82	736	495	604	327	1006	8.3	7.8	35	CuCb	4
8	1412	74.3	3.70	641	444	544	365	1006	9.3	7.4	35	Cu	3+

Table 4
(Contd.)

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES

INSTANTANEOUS VALUES (mW/cm^2) 1979

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	^oC	mb	Km		Okta
Nov													
10	1124	69.4	2.89	705	488	591	399	1024	9.7	9.4	30	CuCb	5
12	1016	73.1	3.47	709	499	602	407	1014	7.5	7.0	50	ScCi	1-
12	1120	70.1	2.96	754	523	635	426	1014	8.3	6.8	50	ScCi	1+
12	1212	69.6	2.89	764	526	640	432	1014	8.3	6.8	50	Sc	1
23	1114	73.0	3.47	698	478	588	382	1019	9.4	8.1	30	Cb	3
Dec													
19	1036	77.6	4.75	611	434	522	358	1032	7.7	7.0	20	Cu	3
24	1000	79.8	5.62	669	481	572	387	1012	5.6	8.1	30	Cu	3
24	1344	78.7	5.09	620	461	547	375	1012	8.4	8.2	40	CuFc	2
30	0956	79.9	5.66	632	473	555	386	1010	5.0	7.3	45	CuFc	3

Table 5 VALENTIA DAILY TOTALS OF DIRECT SOLAR RADIATION AT NORMAL INCIDENCES (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	1446	9	4	1363	1808	2504	386	464	467	1	759	0
2	329	2137	17	1153	1277	2799	72	184	385	10	1	0
3	0	8	115	2310	2112	465	1705	1679	233	1412	0	155
4	194	0	39	2185	3178	1768	5	272	192	1998	357	0
5	479	0	297	1165	2186	1516	2150	615	85	396	0	13
6	13	0	945	488	136	401	1005	0	1030	1137	1	1
7	30	721	651	249	8	392	15	627	0	304	559	0
8	33	0	0	261	3	3	82	0	159	68	414	102
9	155	0	708	2366	204	44	125	456	895	316	411	0
10	371	102	2	5	2	3	405	8	273	436	657	5
11	255	0	598	935	0	1781	406	0	0	748	21	260
12	77	103	97	72	1246	0	650	19	388	696	1472	43
13	9	0	1420	1122	3	700	586	33	293	340	148	0
14	0	0	1661	302	1572	244	532	526	1414	1479	777	0
15	0	1814	775	2744	131	1005	2829	2235	1785	350	101	279
16	106	0	15	3456	1162	2628	77	14	377	906	119	0
17	1245	0	6	3	486	3175	0	775	0	4	0	201
18	3	1509	169	49	1539	2467	197	459	0	40	424	17
19	151	0	1017	743	170	2722	741	616	1320	686	0	478
20	4	0	347	676	1941	279	132	6	1597	1178	12	249
21	206	427	1155	258	2170	719	1003	1721	859	945	0	232
22	0	1214	2570	21	1671	0	526	644	1	634	0	0
23	535	969	1646	450	1474	2294	0	39	2466	1746	752	58
24	630	91	2	1633	1241	1473	222	9	4	0	150	923
25	863	346	0	1819	2011	1622	316	929	4	520	0	4
26	242	61	289	977	1419	34	51	1502	414	1367	0	0
27	1169	0	171	11	1536	0	211	2735	2283	901	0	96
28	237	616	598	7	910	296	20	1940	2573	826	0	294
29	6		1140	153	526	41	133	2837	5	3	0	428
30	410		631	349	3332	598	199	372	4	50	14	963
31	1		390		1755		860	0		631		0
Total	9199	10129	17474	27325	37209	31973	15641	21716	19506	20128	7149	4801
Mean	296.7	361.8	563.7	910.8	1200.3	1065.8	504.5	700.5	650.2	649.3	238.3	154.9

Table 6 VALENTIA DAILY TOTALS OF LONG-WAVE (INFRA RED) RADIATION (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	1714	2709	2822	2555	2596	2578	3088	3169	3126	3220	2523	3064
2	2181	1774	3090	2436	2406	2771	3252	3155	3044	3149	3037	2855
3	2742	2455	2784	2270	2394	3230	2923	3089	3247	2575	3223	2645
4	2237	2895	2552	2213	2402	2982	3135	3158	3293	2462	2769	3075
5	2192	2975	2715	2389	2403	2874	2807	3190	3163	2942	3042	2879
6	2952	2910	2579	2603	2754	2947	3024	3385	3007	2935	3110	3057
7	2818	2395	2421	2660	3017	2953	3298	3016	3194	3079	2835	3092
8	2535	2649	2947	2530	2986	3241	3248	3160	3130	3226	2597	2801
9	2509	2807	2548	2254	3003	3210	3136	3052	2786	3012	2404	2847
10	2456	2557	3089	2677	3192	3256	3130	3359	2993	3022	2557	2782
11	2300	2640	2844	2757	3210	3003	3255	3440	3284	3020	2918	2469
12	2319	2576	2733	2813	2899	3159	3201	3285	3049	2975	2155	2750
13	2713	2752	2560	2591	3101	3126	3065	3193	2892	2897	2606	2513
14	2923	2431	2288	2699	2944	2991	3159	3028	2764	2682	2413	2573
15	3277	1722	2255	2330	3011	2931	2818	2872	2672	2897	2598	2506
16	2416	2507	2381	2376	2888	2914	3319	3206	3103	2653	2631	2733
17	2012	2865	2564	2948	2757	2863	3405	3093	3264	2934	2925	2456
18	2563	2523	2548	2938	2566	2825	3146	3165	3209	2980	2678	2530
19	2347	2790	2538	2955	2733	2838	3122	3135	2773	2786	3050	2352
20	2647	3051	2469	2802	2688	3181	3153	3218	2733	2528	3012	2454
21	2601	2500	2321	2997	2520	3056	2942	2818	2696	2672	3094	2615
22	2649	2256	2143	3019	2558	3124	3055	2928	3102	2834	3067	2577
23	2483	2232	2316	2809	2661	2858	3363	3042	2651	2606	2509	2434
24	2434	2539	3063	2591	2700	2903	3340	3166	3097	2930	2699	2263
25	2547	2670	2830	2660	2695	2788	3189	3177	3369	2496	3118	2680
26	2530	2883	2610	2580	2700	3078	3234	2935	2897	2288	3199	2840
27	2362	2759	2589	2941	2768	3270	3352	2623	2469	2665	3157	2452
28	2520	2389	2475	3060	2865	3169	3420	2771	2517	2716	3119	2406
29	2671		2478	3033	2964	3077	3284	2597	3049	3028	3077	2325
30	2626		2591	2760	2615	2934	3202	3056	3120	3069	3011	2217
31	2839		2783		2755		3047	3404		2664		2511
Total	78105	72211	80926	80246	85751	90130	98112	95885	89693	87942	85133	81753
Mean	2519.5	2579.0	2610.5	2674.9	2766.2	3004.3	3164.9	3093.1	2989.8	2836.8	2837.8	2637.2

Table 7 KILKENNY DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	437	62	553	1258	1116	2282	2278	1769	703	972	648	171
2	414	724	458	1212	1865	2365	1883	1205	1064	753	319	65
3	208	449	415	1201	1738	1105	1876	1136	883	231	286	262
4	208	85	835	1051	1959	955	1476	1753	942	1020	471	73
5	356	247	881	1243	1952	1049	2065	571	726	881	255	223
6	122	233	385	1280	1055	1228	2199	880	1259	100	327	80
7	105	207	1131	366	980	1383	1135	1142	482	896	347	93
8	150	302	260	770	713	1521	869	1045	556	449	332	267
9	358	60	904	1233	1707	1204	1496	1520	1649	857	501	189
10	340	100	255	236	481	1354	1348	783	689	930	588	145
11	-	208	977	833	1167	1115	2494	1072	682	674	187	288
12	331	82	720	463	1766	981	1870	1048	717	283	637	107
13	176	394	852	1162	2016	781	1364	797	1282	217	226	255
14	255	513	1086	437	2072	1634	1198	819	1105	171	590	97
15	197	908	929	1828	588	2303	2083	1907	1429	693	564	162
16	137	247	571	1976	1294	1377	1467	639	1267	633	311	76
17	472	65	418	1806	1285	2168	1577	1696	769	206	139	287
18	-	244	614	1162	1436	2668	944	2187	383	721	518	265
19	74	795	790	595	2304	2725	1616	1296	1346	343	145	350
20	68	145	842	1103	938	1301	1305	641	1339	919	135	269
21	400	205	1304	1384	1197	1444	1732	1601	1242	944	240	193
22	-	809	1127	614	1672	1822	1202	1638	569	60	184	254
23	246	999	1489	1490	1731	1340	1681	1685	1055	181	325	69
24	520	544	158	1815	1840	1861	1253	1126	456	318	309	337
25	624	763	422	1700	1630	2192	1515	669	513	702	46	219
26	467	612	887	1668	1184	1527	1040	1189	419	355	138	53
27	461	138	913	1052	1867	1258	1569	1861	1180	216	126	76
28	511	999	1225	937	1093	1550	1809	1585	1240	677	265	329
29	513		1144	786	1989	1210	1755	1807	242	403	204	299
30	576		1425	1341	1576	1344	641	1614	68	141	155	374
31	365		1034		2315		1721	422		703		160
Total	-	11139	25004	34002	46526	47047	48461	39103	26256	16649	9518	6087
Mean	-	397.8	806.6	1133.4	1500.8	1568.2	1563.3	1261.4	875.2	537.1	317.3	196.4

Table 8 KILKENNY DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1					780	887	1078	973	641	449	213	161
2					706	705	1207	1067	793	584	281	65
3					731	979	1252	1023	769	226	218	147
4					813	861	1315	1128	664	400	257	71
5					788	782	1181	557	614	404	218	156
6					997	1083	1117	760	598	98	280	80
7					952	1202	1090	940	467	583	220	93
8					693	1451	816	853	529	358	235	112
9					1040	1038	1363	1022	555	442	168	164
10					480	1285	1159	721	637	380	144	113
11					1028	1004	906	775	636	405	181	132
12					923	979	1187	906	578	274	105	99
13					946	705	1173	565	670	215	155	143
14					939	1229	1023	775	733	171	118	77
15					588	1104	1134	849	527	476	118	148
16					743	1202	1032	518	589	380	206	74
17					1044	1141	999	767	640	195	134	133
18					1122	585	890	596	374	370	149	176
19					1155	697	1146	1011	440	250	145	80
20					772	1133	1179	597	483	215	131	154
21					957	1084	1213	759	482	161	210	165
22					1143	1192	1086	789	537	60	174	201
23					904	869	1012	774	594	147	182	68
24					1090	1239	1103	823	439	271	169	85
25					1212	1196	1181	662	461	232	45	151
26					1000	1102	965	766	370	319	121	53
27					984	1208	1152	583	335	201	110	76
28					883	1012	927	823	345	272	226	124
29					1099	1146	861	625	235	338	195	103
30					1355	1273	625	662	52	138	127	128
31					849		1009	416		218		151
Total					28716	31373	33381	24085	15787	9232	5255	3683
Mean					926.3	1045.8	1076.8	776.9	526.2	297.8	175.2	118.8

Table 9 BIRR DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	426	138	569	1348	1098	2565	1971	1285	813	808	598	214
2	386	659	285	1318	1814	2621	1929	873	683	698	289	72
3	237	523	555	1146	1697	1041	2098	1040	856	716	245	262
4	241	237	747	1193	1719	815	1351	1385	1079	968	423	64
5	404	267	790	1186	1874	931	1904	913	1069	987	212	261
6	105	421	625	1128	882	852	2150	1072	1434	198	121	129
7	158	478	1147	690	941	1102	949	1156	613	995	294	100
8	230	395	291	548	602	1203	648	958	361	551	336	226
9	271	147	857	1021	2019	1579	1620	1414	1300	783	542	137
10	250	146	500	377	608	1703	1151	909	741	870	533	129
11	347	370	770	771	1077	978	2441	804	368	613	208	237
12	370	148	637	476	1548	942	2125	924	749	493	587	158
13	306	169	862	1506	2241	1122	1423	1011	1175	549	174	189
14	199	521	1168	169	1956	1689	1792	686	1127	163	515	105
15	361	747	906	1695	663	2058	2210	1644	1323	575	507	151
16	346	307	493	1931	1340	1668	1310	872	834	496	348	112
17	515	152	575	1353	1112	2431	887	1527	501	181	136	233
18	73	486	357	889	1383	2615	858	1865	501	667	328	220
19	239	613	683	522	2138	2689	1439	821	1234	425	158	307
20	128	432	773	1084	1118	1082	1046	677	1172	824	225	175
21	472	309	1337	1241	1199	1401	1375	1642	1073	877	340	232
22	77	736	997	481	1440	1492	1255	1578	546	85	142	208
23	280	926	1429	1511	1561	1897	1983	1282	1064	814	301	97
24	448	685	452	1752	1844	1613	1050	1054	392	408	365	311
25	492	794	368	1611	1707	1930	1312	691	370	781	60	220
26	501	376	818	1552	1370	1805	1000	1300	498	477	247	52
27	512	259	822	882	1616	795	1388	1704	1128	262	136	120
28	454	1032	1256	500	1597	1687	1431	1601	1313	600	127	220
29	343		1269	800	1772	1212	1606	1832	835	336	141	202
30	406		1135	1226	1823	1295	807	1501	154	201	117	274
31	340		1046		1673		1547	844		576		142
Total	9917	12473	24519	31907	45432	46813	46056	36865	25306	17977	8755	5559
Mean	319.9	445.5	790.9	1063.6	1465.5	1560.4	1485.7	1189.2	843.5	579.9	291.8	179.3

Table 10 BIRR DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1					798	728	1062	962	754	563	261	214
2					779	637	1273	840	585	577	287	72
3					831	975	1114	934	825	576	239	182
4					812	787	1296	1153	840	406	277	62
5					862	781	1190	900	768	399	208	158
6					838	801	1223	969	640	194	121	126
7					916	975	913	1068	611	448	193	97
8					602	1005	583	857	356	502	225	137
9					899	1312	1342	1046	686	523	216	130
10					601	1281	1133	853	702	378	178	112
11					998	929	913	741	367	405	196	109
12					1013	913	1140	770	658	445	114	129
13					925	901	1310	702	795	451	152	151
14					894	1300	1373	655	603	162	121	102
15					660	1164	1041	744	510	421	130	145
16					872	1266	943	828	606	347	222	112
17					881	1126	773	818	493	178	135	125
18					1073	665	850	746	500	322	210	164
19					1237	679	1191	809	486	299	155	90
20					802	1063	1023	661	503	167	214	112
21					1001	1250	1140	808	559	163	239	140
22					1032	1155	1156	835	545	83	139	180
23					945	1139	1063	768	561	304	159	97
24					1122	1247	1029	838	379	346	161	82
25					1243	1268	1052	681	364	168	57	173
26					1130	1299	964	781	414	431	157	48
27					912	758	1104	673	418	255	131	115
28					1097	827	1071	780	286	276	122	146
29					1124	1132	874	492	614	333	140	128
30					1268	1145	771	762	154	200	117	127
31					974		908	824		292		120
Total					29141	30508	32818	25298	16582	10614	5276	3885
Mean					940.0	1016.9	1058.6	816.1	552.7	342.4	175.9	125.3

Table 11 DUBLIN AIRPORT DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	417	64	701	1268	1161	2549	1900	1626	748	742	573	261
2	414	695	276	1063	1510	2367	1972	959	825	798	304	76
3	234	680	611	985	1392	1539	1975	1226	1002	308	326	260
4	155	317	885	1236	1437	775	1716	1277	1168	353	445	75
5	320	372	881	699	1740	1709	1854	545	625	1011	243	277
6	124	496	267	1116	1055	1057	2131	2146	1261	322	164	111
7	115	200	1178	1351	909	1239	956	890	568	674	157	139
8	189	513	412	394	670	1155	860	1725	389	243	428	239
9	319	122	873	632	2191	2426	1583	1840	1360	548	494	174
10	237	62	434	226	657	2252	996	683	1043	656	490	182
11	367	386	818	804	1384	1345	2474	1148	598	434	243	249
12	285	82	1126	475	1379	399	2286	1186	898	356	508	65
13	367	53	607	1546	2365	735	1448	1039	1238	270	244	177
14	124	231	1146	973	2099	2197	1555	803	1124	165	392	168
15	292	506	588	1745	336	2364	2084	1978	1075	262	472	176
16	213	126	444	1571	1187	1184	1810	667	931	447	437	119
17	458	201	432	1504	1215	2404	1456	1490	622	230	124	260
18	30	129	200	665	991	2485	1252	1800	620	765	343	192
19	32	525	417	647	2236	2536	1078	768	1088	333	263	259
20	70	384	803	1572	905	1525	1299	786	1257	792	264	185
21	401	187	1318	1133	1267	1603	1481	1640	1148	795	280	128
22	37	838	1221	537	1300	1861	1079	1317	745	196	167	158
23	141	954	1120	1410	1405	1471	1058	1296	937	57	280	46
24	296	699	178	1717	1615	1911	1146	1233	545	410	307	286
25	429	829	482	1195	2499	1787	1638	1353	452	695	100	198
26	407	372	900	1558	1846	1616	1333	1316	366	189	304	62
27	503	210	652	1124	1579	1471	1651	1767	1122	329	121	75
28	440	811	1327	678	962	1916	1722	1706	1120	561	143	189
29	207		463	732	1888	1298	1483	1492	966	408	129	148
30	547		1280	1382	1404	1184	685	1590	196	240	246	263
31	394		918		2059		1692	880		561		179
Total	8564	11044	22958	31938	44643	50360	47653	40172	26037	14153	8991	5376
Mean	276.3	394.4	740.6	1064.6	1440.1	1678.7	1537.2	1295.9	867.9	456.6	299.7	173.4

Table 12 DUBLIN AIRPORT DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1979

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	86	47	514	602	860	507	1053	965	663	382	177	233
2	86	108	255	620	844	595	1305	883	569	508	304	76
3	179	113	462	567	692	1083	1404	1100	706	308	295	98
4	155	275	396	712	754	673	1092	981	538	306	253	73
5	160	238	515	633	807	1208	1362	542	384	217	234	161
6	124	337	246	773	1008	915	1080	796	526	322	163	111
7	115	180	359	939	862	1069	881	823	559	489	153	123
8	133	355	384	391	639	1045	838	821	387	241	259	155
9	162	91	396	567	678	1066	1370	784	482	393	172	119
10	156	53	434	225	651	1252	941	661	730	368	108	103
11	122	262	493	776	1221	1265	515	875	575	381	217	153
12	125	53	439	469	959	357	1061	835	521	318	83	53
13	103	46	554	814	530	704	1232	540	496	257	147	119
14	124	231	424	852	896	1078	1438	752	590	164	196	95
15	204	439	453	772	311	906	1189	751	553	260	100	125
16	147	126	438	887	794	1009	1143	596	664	303	103	116
17	120	201	432	773	1012	869	1252	801	584	228	122	113
18	30	126	194	660	859	481	1190	630	616	207	213	144
19	26	441	404	644	953	585	1045	708	437	284	207	75
20	62	374	602	779	892	1296	1181	648	375	157	155	150
21	177	178	432	938	1042	1013	1227	583	399	157	209	126
22	37	238	495	537	1024	1374	1034	721	702	194	162	134
23	141	181	372	835	857	1030	894	708	618	47	153	41
24	263	467	157	703	1053	874	1060	633	521	284	119	80
25	172	377	477	818	627	1123	1255	831	447	143	88	102
26	138	369	633	743	1353	1182	1245	733	345	187	132	60
27	218	207	574	1082	891	1259	1310	557	333	297	117	73
28	180	280	704	676	679	991	869	598	242	333	135	87
29	205		366	548	908	1170	974	598	395	391	128	145
30	212		642	986	1320	1112	652	618	192	230	142	95
31	321		661		1018		715	674		236		154
Totnl	4483	6393	13907	21321	26994	29091	33807	22746	15149	8592	5046	3492
Mean	144.6	228.3	448.6	710.7	870.8	969.7	1090.5	733.7	505.0	277.2	168.2	112.6