METEOROLOGICAL SERVICE

SOLAR RADIATION OBSERVATIONS 1976

PART I : VALENTIA OBSERVATORY
PART II: KILKENNY METEOROLOGICAL STATION
PART III: BIRR METEOROLOGICAL STATION
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1977
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C O N T E N T S

S U M M A R Y

This volume contains a brief description of the site, equipment and observing procedure 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 are available on magnetic tape and copies of the tape may be had on request from: The Director, Meteorological Service, 44 Upper O'Connell Street, Dublin 1.

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

SOLAR RADIATION OBSERVATIONS AT VALENTIA OBSERVATORY

1976

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.

Data derived from the Pyranograph 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 1976.

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 approximately north east - 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 360 m high, the highest peak (Bentee 375 m) 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 instrument is exposed on the roof of the Radiation House and the recording millivoltmeter mounted vertically below it 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 occasionaly 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. Pyranograph Used

The instrument used during 1976 is the same as has been used since recordings began in 1954, namely a G_2 Solarimetric Thermopile by Kipp and Zonen, Serial No. 847. Recording millivoltmeter No. 29 (Kipp and Zonen) has been used since recordings began apart from a few months in 1963 when it was being overhauled.

Lintronic Integrator No. 717A combined with a print-out unit was used on a routine basis throughout the year. This equipment provides a print out of the integrated radiation for each hour L.A.T.

The recording millivoltmeter was maintained in operation to provide a continuous record and as a check against any malfunction of the integrator.

3.3. Calibration of the Pyranograph

The pyranometer, recorder and integrator were calibrated by means of the Actinometer and Millivoltmeter, described in paragraphs 5.1 and 5.2 below. The calibration was done by comparing the intensity of the direct sunlight as measured by the pyranograph 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 north west of the latter. A description of the site is given in 3.1 above.

4.2 Pyranograph Used

The instrument in use is similar to that used for recording the Global Radiation i.e. a G_2 Solarimetric Thermopile, Kipp and Zonen, Serial No. 1387, and the Recording Millivoltmeter

(Kipp and Zonen) Serial No. 168. The width of the shading ring is 48 mm and its diameter is 308 mm.

Lintronic Integrator No. 484B combined with a print-out unit was used on a routine basis throughout the year. As in the case of the Global Radiation, the recorder and integrator were both maintained in operation.

4.3. Calibration of the Pyranograph

The shadow ring was displaced below the horizontal position. The pyranograph was then calibrated in exactly the same way as the Global Pyranograph (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 Solarimeter.

4.4. Shadow-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. Direct Sun Observations

5.1. Instruments Used

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

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.

5.1.1 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

5.2. 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.

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

5.3. 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.

5.4. 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.

5.5. 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:-

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

6. Radiation Balance

Funk Net Radiometer No. 695 combined with Honeywell Recorder No. 68B/2124 was introduced for routine measurements as from 1971.

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)

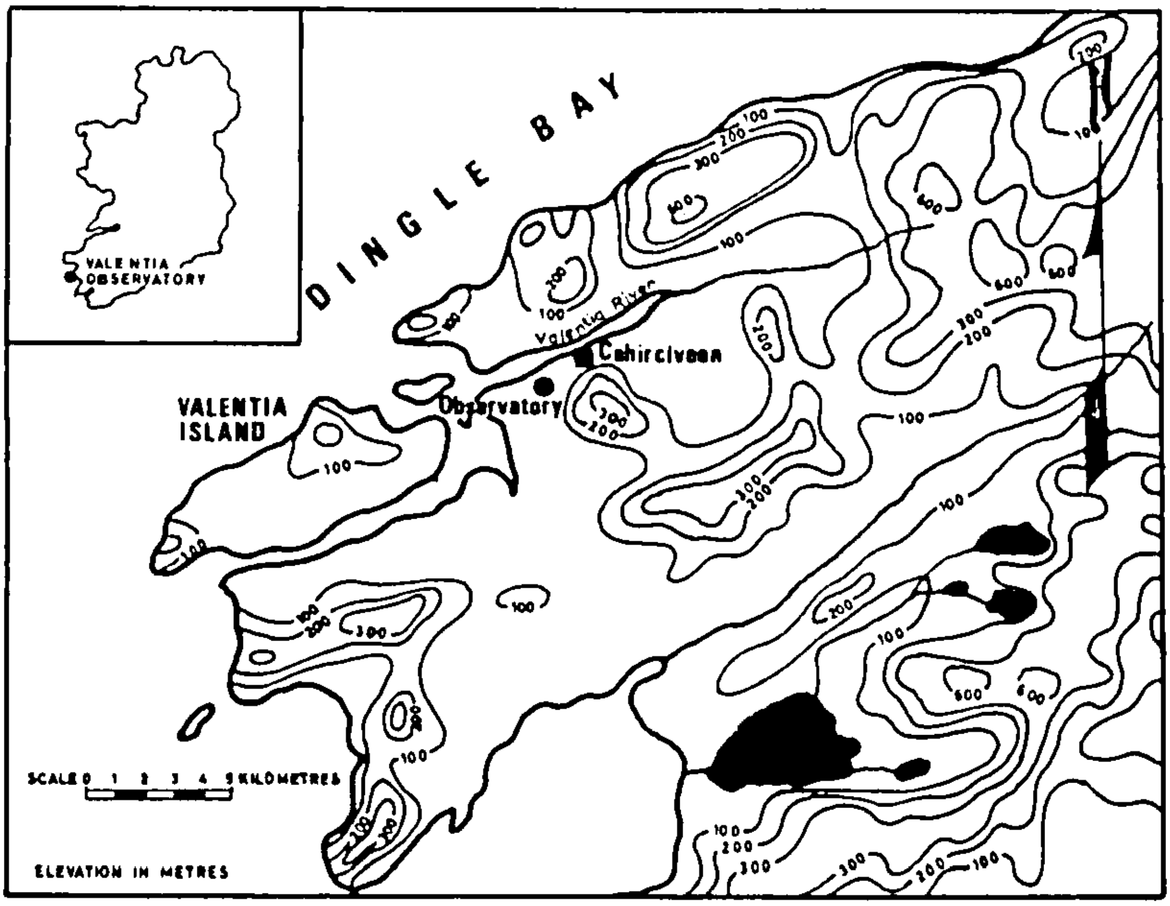


Fig. 1 Map showing the site of Valentia Observatory and its environs.

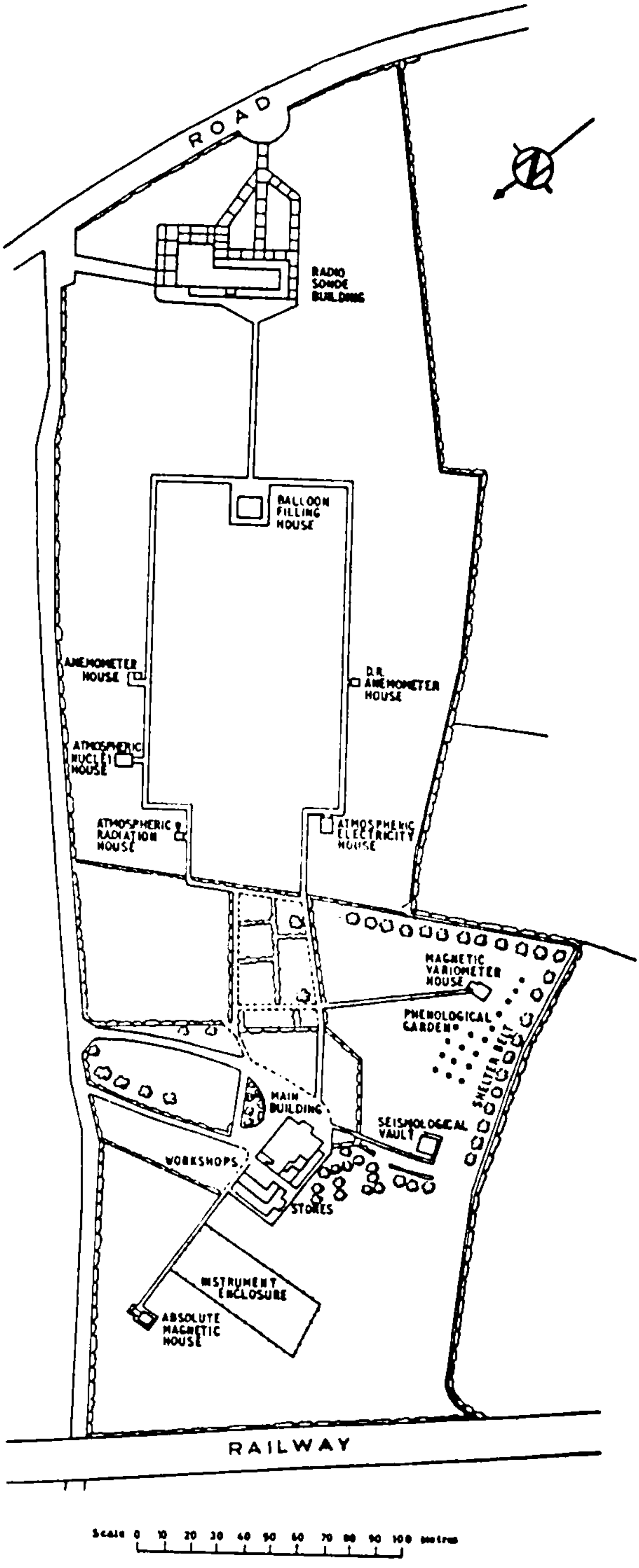


Fig. 2 General layout of Valentia Observatory.

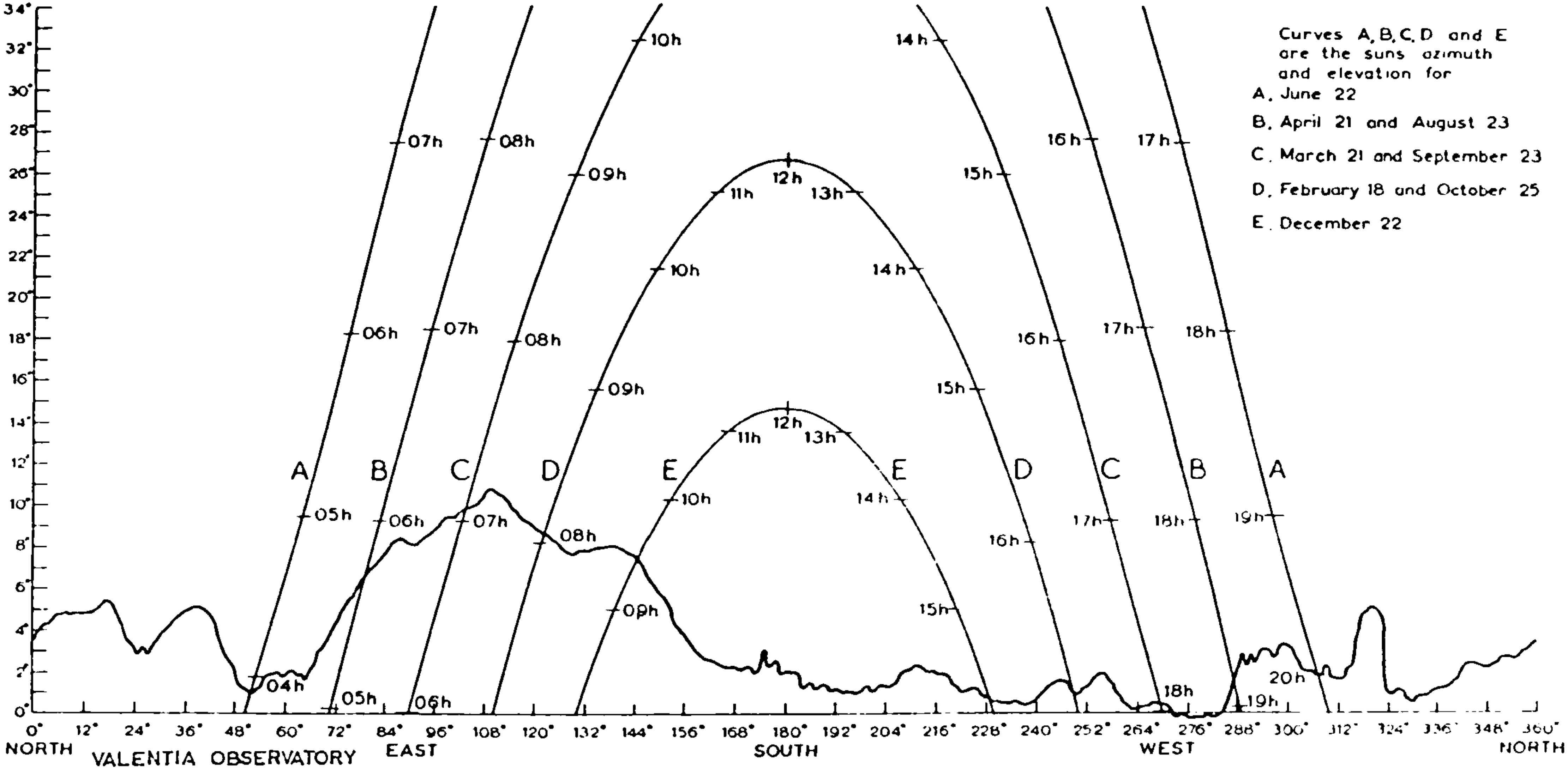


Fig 3 Exposure diagram showing Azimuth and Elevation of all objects which obscure the Solarimeter, together with Elevation and Azimuth of the sun at different times of the year

SOLAR RADIATION OBSERVATIONS AT KILKENNY METEOROLOGICAL STATION

1976

1. Introduction

Measurements of Global Solar Radiation were begun at Kilkenny towards the end of 1968 and the data given in this volume represent the results for the year 1976.

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. To the east of the station the residential area of the town approaches to within half a kilometer. The surrounding country is flat open grassland. The nearest hills are 10 Km to the east (See Fig.4).

The solarimeter 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. Pyranograph Used

The instrument used was a CM_2 Solarimetric Thermopile by Kipp and Zonen, Serial No. 673014 and Lintronic Integrator No. 415A complete with print-out and timing unit. A Recording Millivoltmeter No. XR4/550106 (Kipp and Zonen) was maintained in operation as a check against malfunction of the integrator.

4. 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.

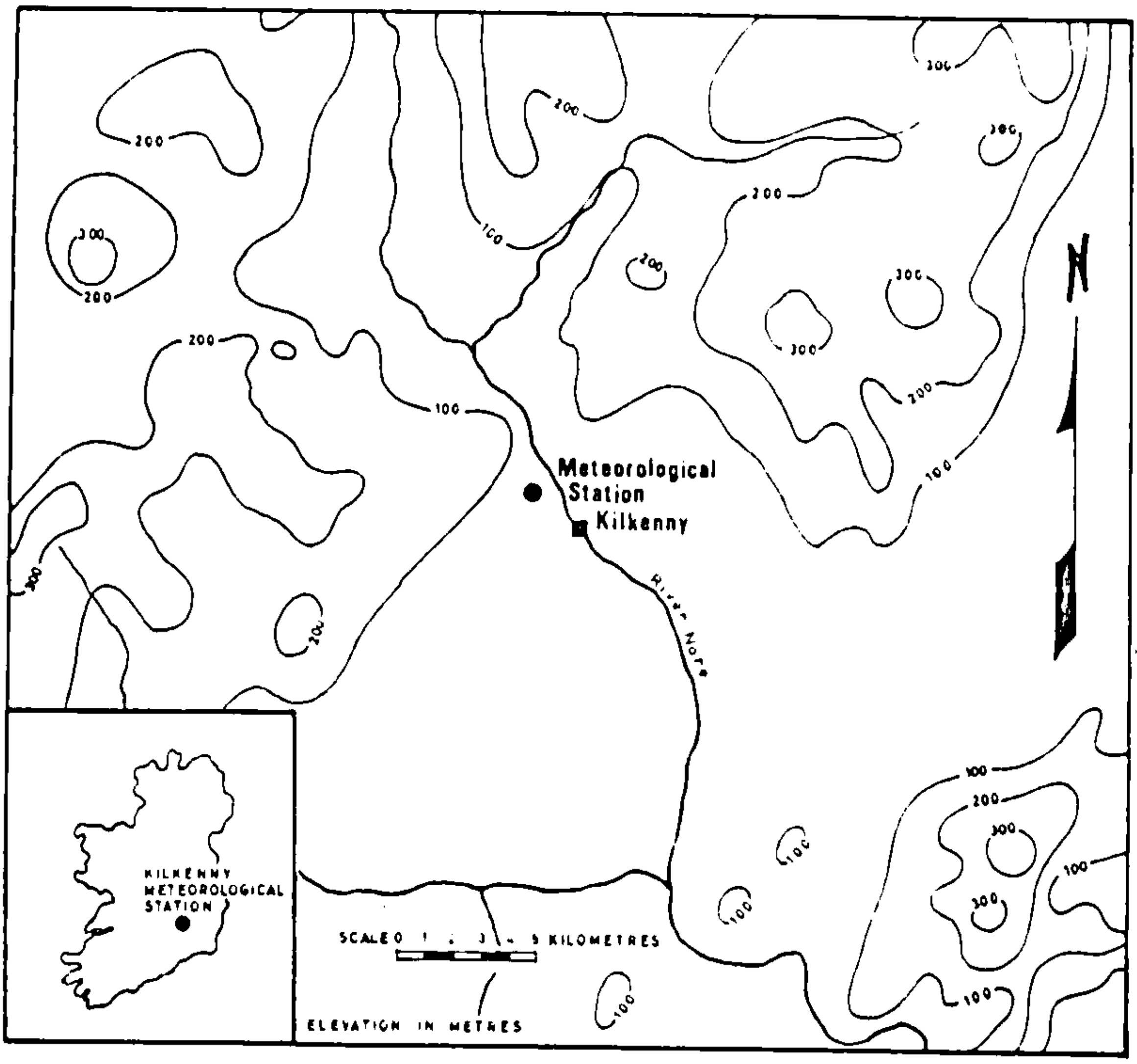
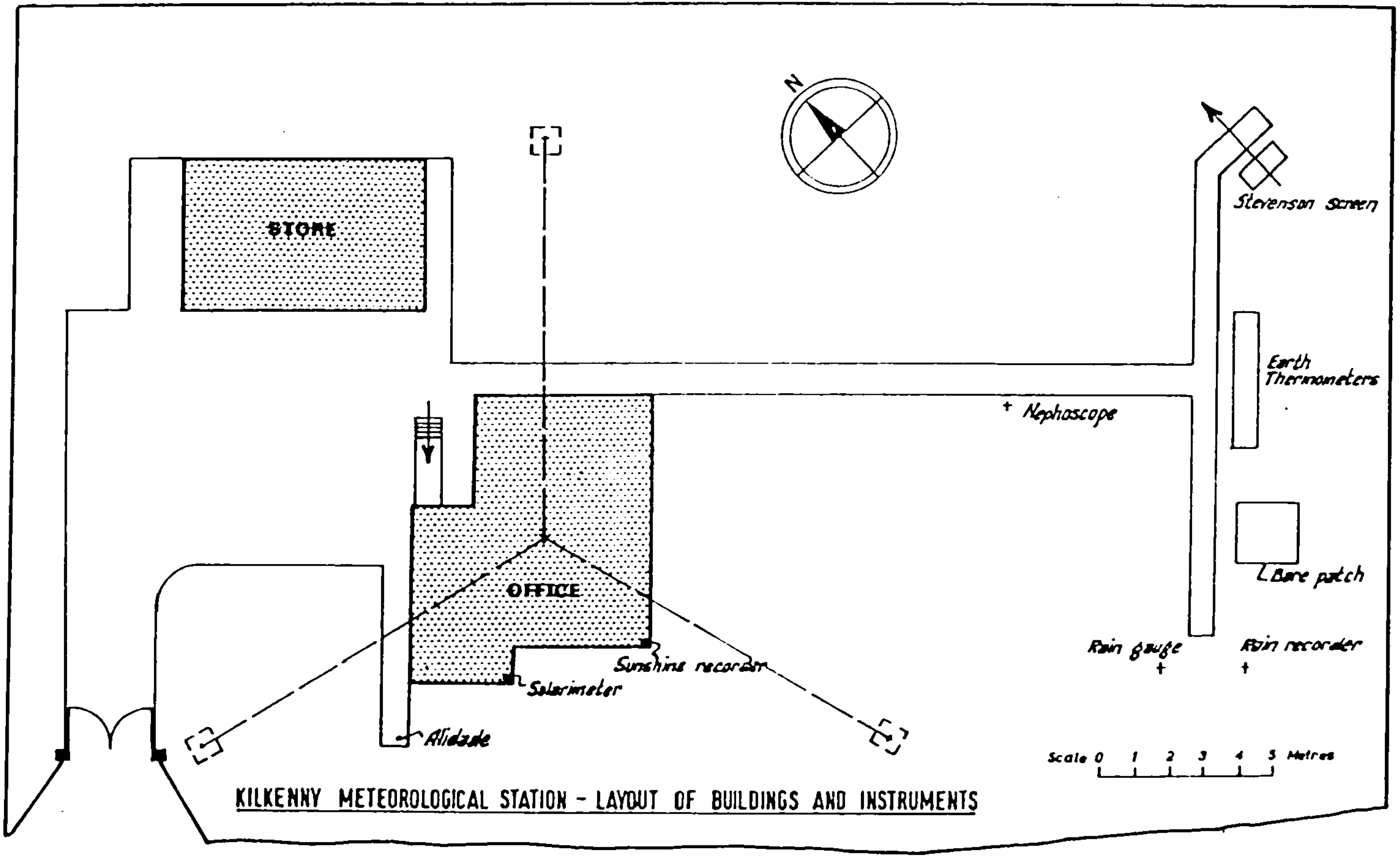


Fig. 4. Map showing site of Kilkenny Meteorological Station.


STORE
N
Stevenson screen
Earth Thermometers
Nephoscope
OFFICE
Bare patch
Rain gauge
Rain recorder
Sunshine recorder
Solarimeter
Alidade
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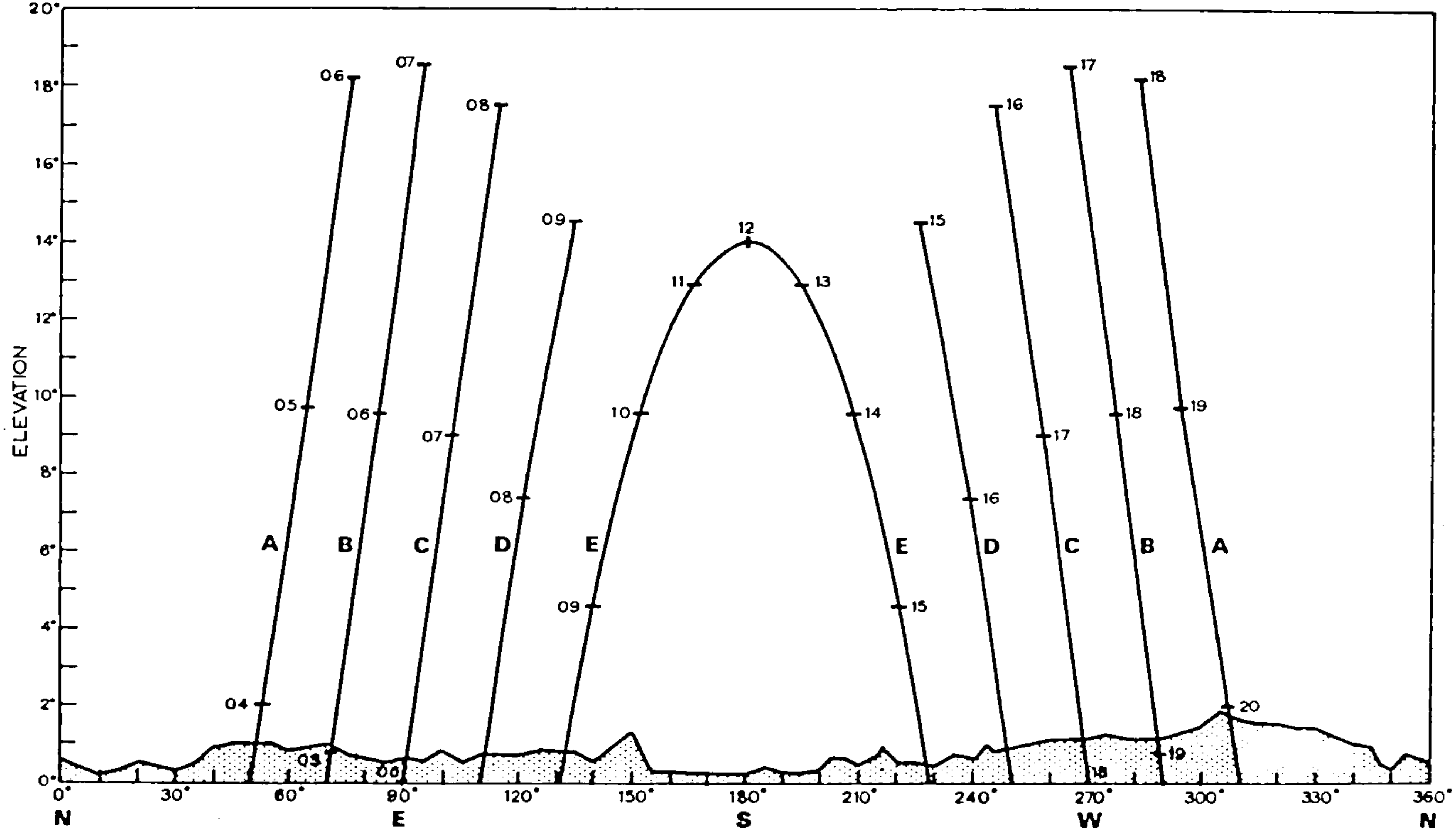
KILKENNY METEOROLOGICAL STATION - LAYOUT OF BUILDINGS AND INSTRUMENTS

Fig. 5.



KILKENNY

Fig. 6. Exposure diagram showing (1) azimuth and elevation of all objects which obscure solarimeter.
(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

1976

1. Introduction

Measurements of Global Solar Radiation were begun at Birr towards the end of 1970 and the data given in this volume represent the results for the year 1976.

2. Site of 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).

The solarimeter 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. Pyranograph Used

The instrument in use was a CM_6 Solarimetric Thermopile by Kipp and Zonen, Serial No. 690246, together with recording millivoltmeter No. XR4/188730-13 (Kipp and Zonen).

Kipp and Zonen Integrator No. 680076 was used on a routine basis throughout the year. The recorder and integrator were maintained in operation.

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

4. 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.

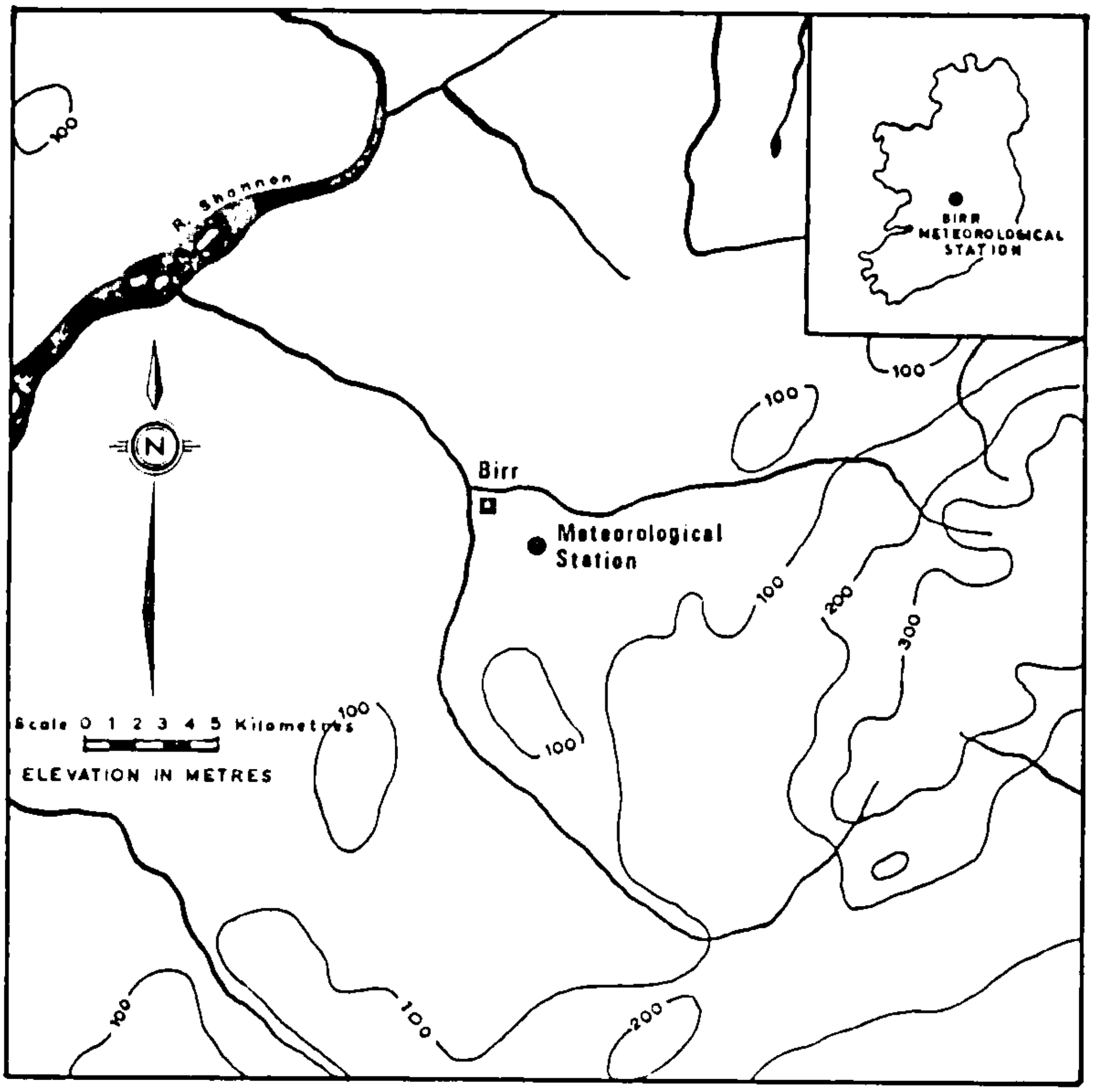
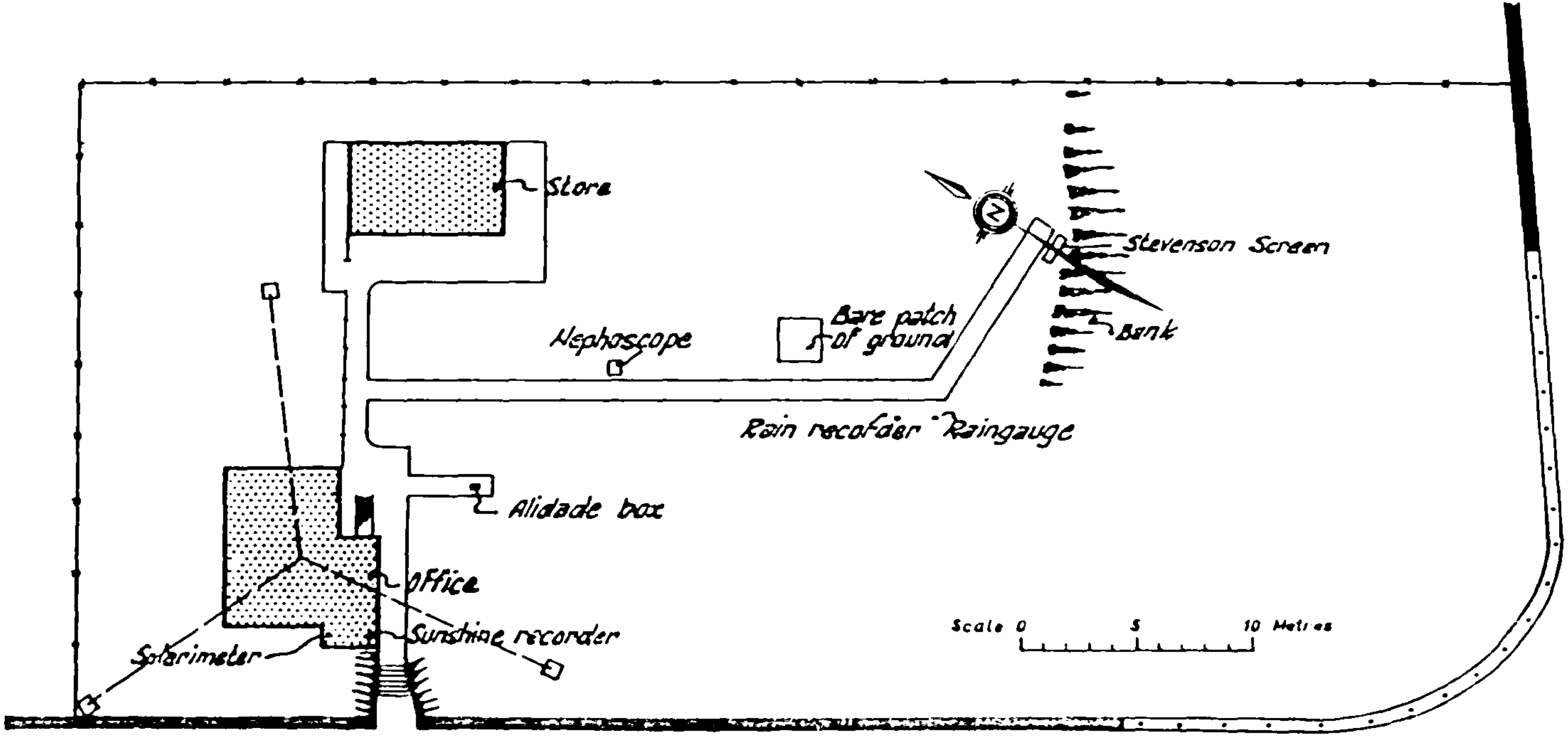


Fig. 7 Map showing site of Birr Meteorological Station.



BIRR METEOROLOGICAL STATION — LAYOUT OF BUILDINGS AND INSTRUMENTS

Fig. 8.

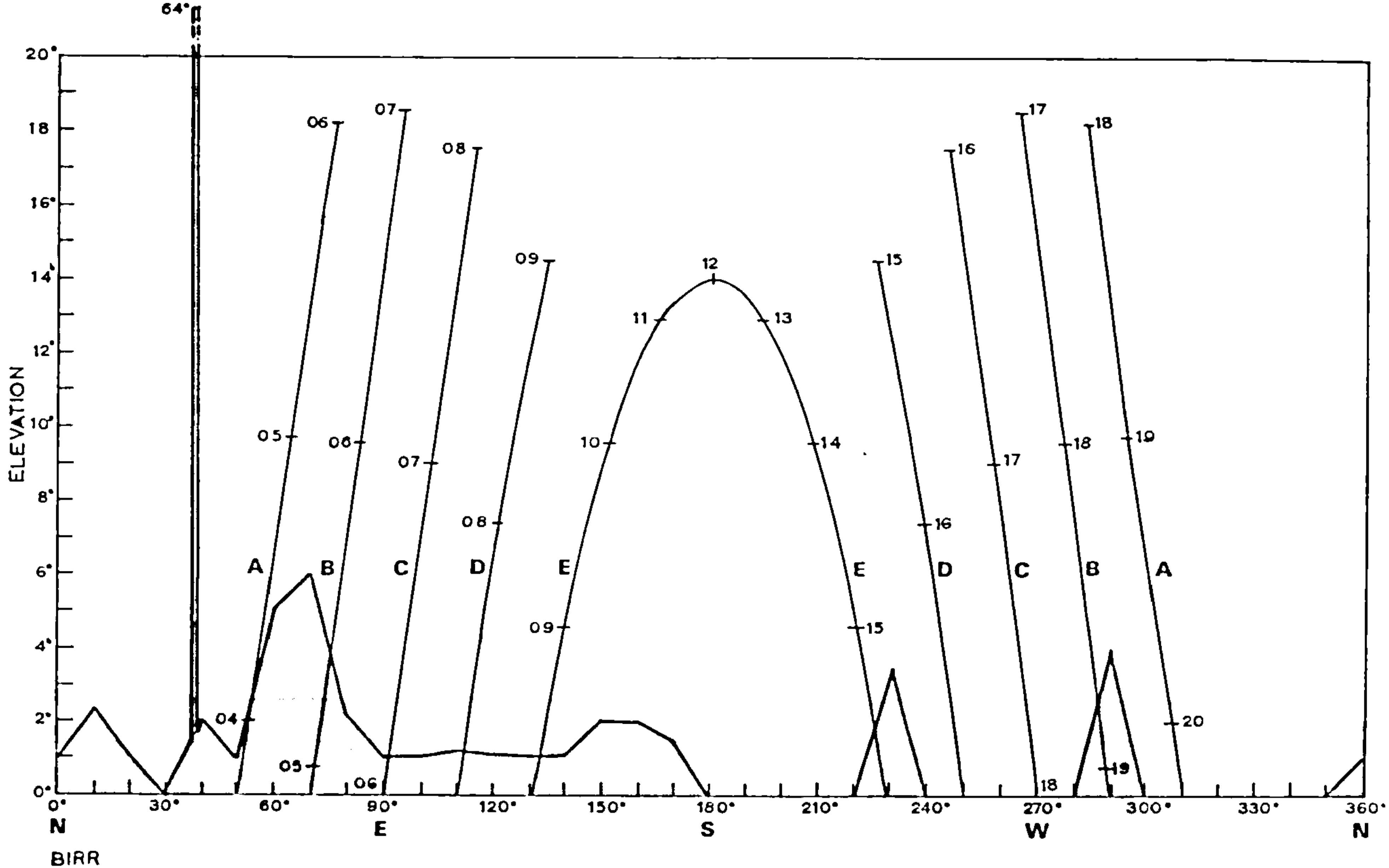


Fig. 9. Exposure diagram showing (1) azimuth and elevation of all objects which obscure solarimeter.
(2) azimuth and elevation of Sun at various times of year as follows (A) June 22 (B) April 21, August 23 (C) March 21, September 23 (D) February 18, October 25 (E) December 22.

SOLAR RADIATION OBSERVATIONS AT DUBLIN AIRPORT

1976

1. Introduction

Measurements of Global 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 1976.

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 solarimeter 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 Pyranograph Used

The instrument used in 1976 was installed when recording commenced in September, 1975, namely a CM3 Solarimetric Thermopile by Kipp and Zonen, Serial No. 2/683279, and Lintronic Integrator No. 606B complete with print-out and timing unit. A recording millivoltmeter No. 258979 (Phillips) was maintained in operation as a check against any malfunction of the integrator.

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.

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 Pyranograph Used

Recording of Diffuse Radiation was commenced on June 1st, using a CM5 Solarimetric Thermopile No. 752732 by Kipp and Zonen, and Integrator No. 750262 complete with print-out and timing unit also by Kipp and Zonen. A recording millivoltmeter No. 8056 (Phillips) was installed on 6th May 1976 as a check against any malfunction of the integrator. The width of the shading ring is 52 mm and its diameter is 315 mm.

4.3 Observing Procedure

Timing and control of print out is by means of a crystal clock, which is maintained within ½ minute of L.A.T. The general procedure for maintaing the instruments and tabulating the records is the same as that already described for Valentia.

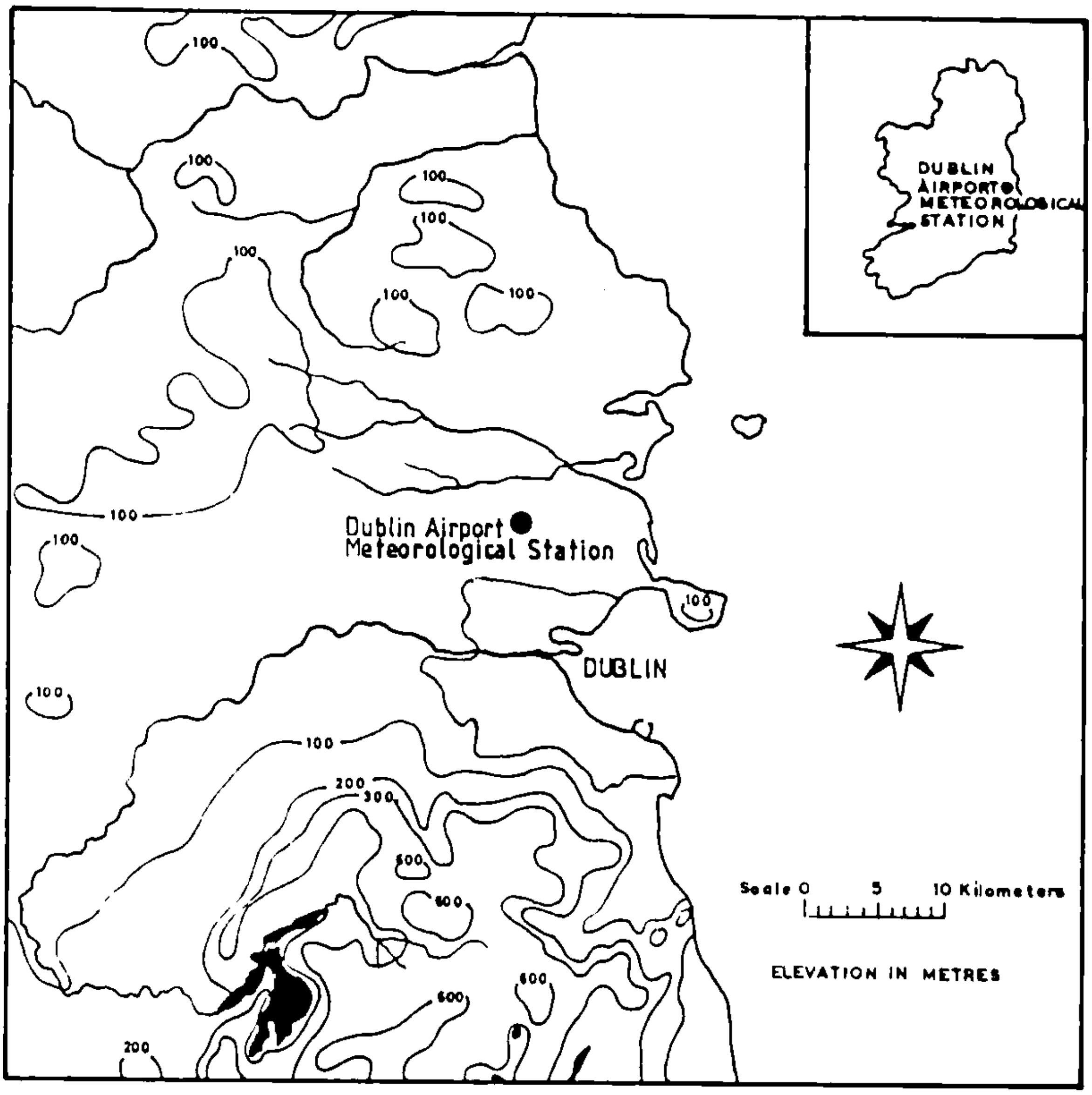
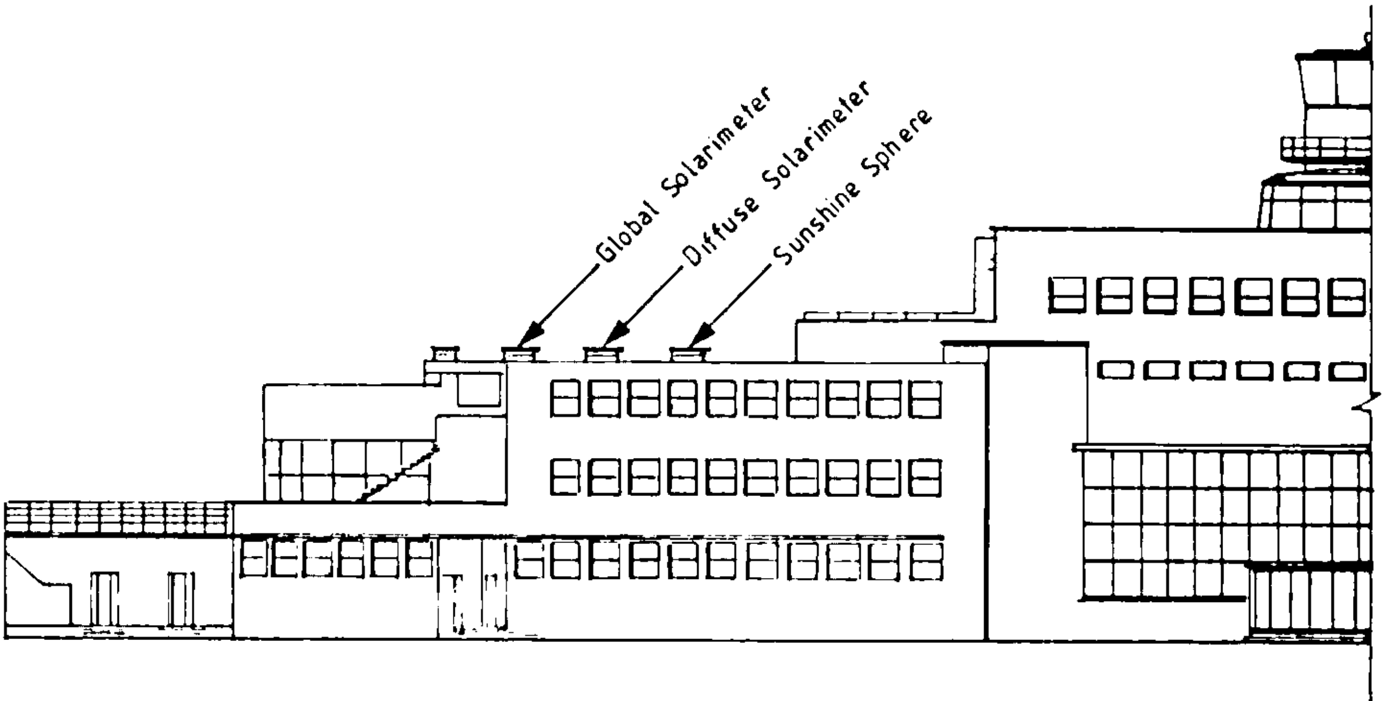
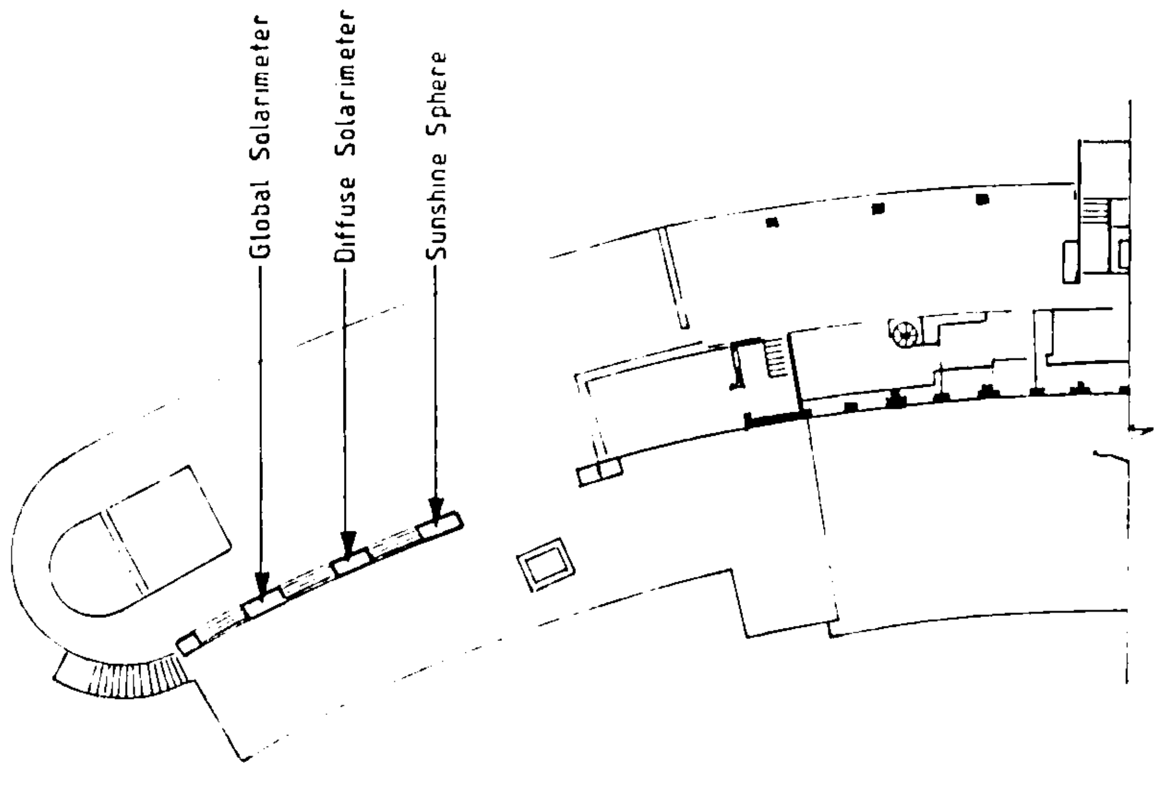


Fig. 10. Map showing site of Dublin Airport Meteorological Station.

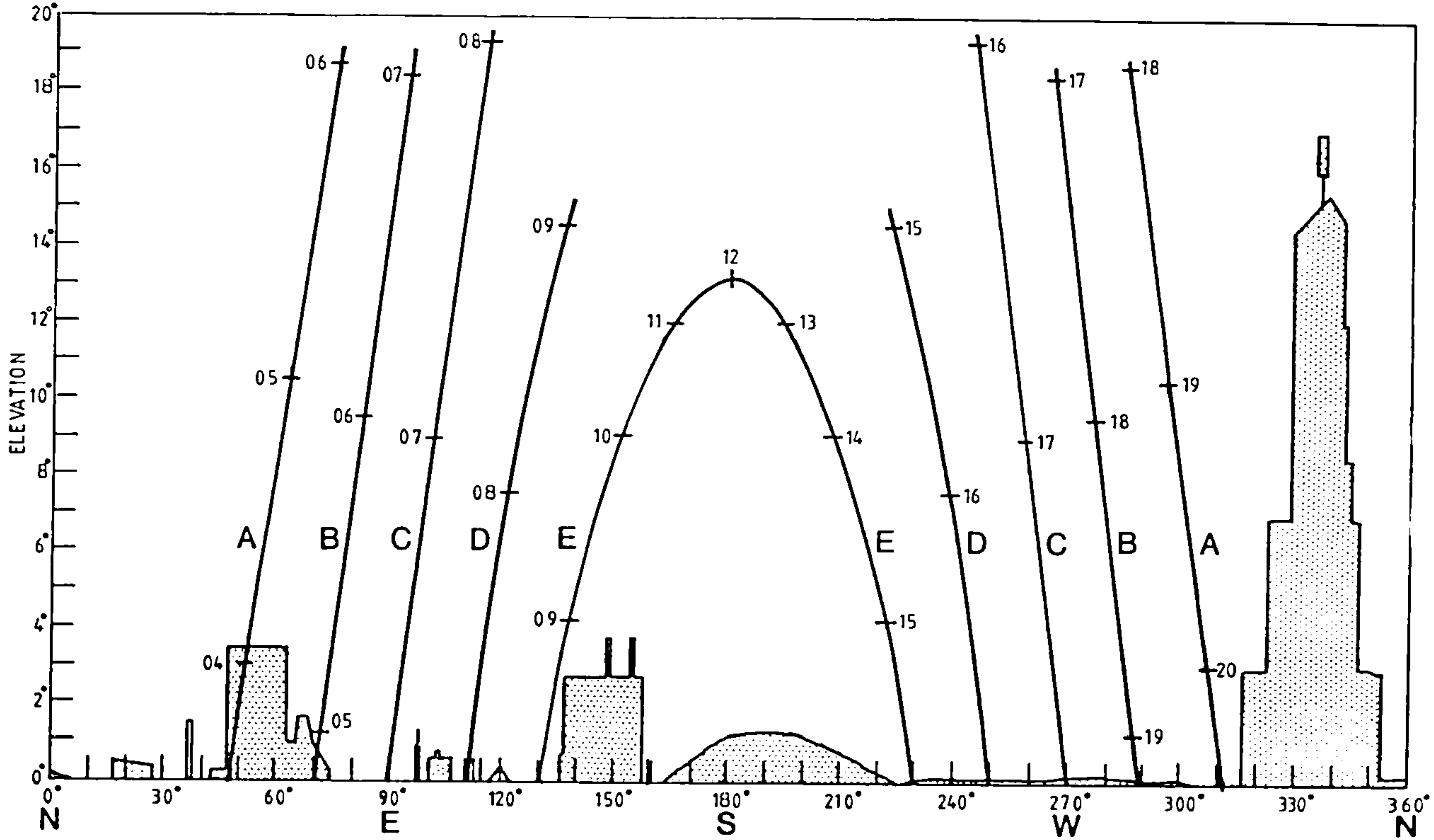


EAST ELEVATION



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 solarimeter.
(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.

TABLE 1 VALENTIA DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1976

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	41	286	348	961	1195	2309	2336	986	1202	630	325	93
2	42	457	680	1699	777	1621	1498	1649	1760	825	348	165
3	202	385	468	1590	2368	2952	1980	1696	1066	927	490	135
4	56	124	265	1569	952	962	1484	1397	1052	1056	218	263
5	65	279	364	808	840	1801	2142	1296	1011	443	587	120
6	264	453	124	919	1301	1881	1635	1612	942	1007	494	222
7	63	234	584	1331	937	2423	1713	2062	1767	946	444	133
8	135	546	771	1636	1420	2074	947	1217	543	562	404	343
9	79	102	239	1457	1288	1801	2009	2397	1636	1006	640	272
10	95	484	82	1121	2133	1443	510	1726	429	835	501	383
11	80	476	1017	1542	965	324	1095	1178	1375	151	538	195
12	68	68	239	1883	1819	1734	1814	2166	1116	1019	408	160
13	92	743	1128	1313	849	795	1160	1796	878	621	240	94
14	383	131	396	1897	689	1857	1252	2299	1460	533	414	69
15	126	888	862	2007	2258	2054	1654	1754	903	881	179	50
16	176	241	523	1158	382	1173	1812	1560	921	337	436	128
17	99	530	1257	1119	1852	2410	1571	2145	1069	471	74	329
18	418	609	495	509	1741	1193	657	1490	883	894	526	138
19	88	213	358	1559	1887	553	1667	2064	875	717	500	78
20	262	287	220	2099	2540	1441	2101	2053	549	594	100	348
21	148	613	1304	2152	502	372	1577	2120	1332	713	95	78
22	158	316	1498	2256	976	679	1436	1960	1415	441	240	158
23	333	190	766	2281	2056	465	1524	755	336	816	274	46
24	389	528	445	1942	1685	790	1501	1409	563	920	232	372
25	218	295	361	1218	2275	1432	1683	1657	600	823	151	294
26	245	528	1307	2150	1093	2698	1030	1812	1073	461	193	372
27	295	405	843	1083	1309	3108	2475	1918	912	444	93	201
28	200	557	547	1297	906	2747	2721	1422	472	827	290	362
29	85	651	553	2261	2295	2634	2663	1652	412	332	372	74
30	195		1335	2098	1757	2631	1451	1252	634	729	179	141
31	604		879		1215		1964	1276		154		104
Total	5704	11619	20258	46915	44262	50357	51062	51776	29186	21115	9985	5920
Mean	184.0	400.7	653.5	1563.8	1427.8	1678.6	1647.2	1670.2	972.9	681.1	332.8	191.0

TABLE 2 VALENTIA DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1976

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	41	258	329	711	705	939	1370	972	895	479	259	92
2	42	252	437	622	717	1116	1044	1361	567	584	238	138
3	172	235	389	600	857	578	1149	1327	888	517	333	128
4	55	121	263	864	751	906	1061	1217	885	400	197	180
5	64	194	314	779	791	748	824	1236	909	414	274	117
6	198	291	124	770	1074	1200	967	1254	877	482	271	170
7	63	226	484	751	912	1012	1368	873	798	460	250	127
8	131	281	572	708	1128	1179	849	898	501	468	273	158
9	78	102	234	796	714	1049	1196	563	577	348	186	177
10	93	269	81	871	843	1196	506	1061	351	408	267	122
11	80	321	395	695	953	324	992	962	549	150	213	159
12	68	67	236	495	1004	1251	964	903	597	462	197	153
13	92	236	466	922	693	742	986	975	696	408	211	93
14	206	130	321	752	676	983	1076	451	717	450	230	69
15	126	224	498	611	825	1009	1079	982	775	366	149	50
16	171	186	487	1027	381	961	1354	976	851	334	192	122
17	99	337	660	891	879	1287	1352	641	711	337	74	143
18	187	271	441	509	1026	1130	655	1009	411	327	159	133
19	85	204	340	820	236	552	1318	728	436	348	153	78
20	201	278	220	724	820	1301	1263	651	517	477	100	117
21	140	456	472	661	501	371	1259	515	362	374	95	76
22	148	261	344	596	883	676	1320	735	510	337	197	151
23	222	189	691	555	783	465	1412	588	322	257	201	46
24	213	474	430	762	1108	763	1275	826	544	419	121	95
25	180	288	354	911	1190	1224	1281	910	469	164	146	123
26	226	445	533	745	1063	885	987	739	625	281	150	87
27	250	373	529	821	1205	356	845	584	716	317	91	155
28	189	488	525	714	877	750	564	798	462	189	180	91
29	85	315	412	782	1296	923	501	779	409	289	225	73
30	163		697	1091	1237	932	1240	717	480	212	128	114
31	197		729		1164		940	932		153		101
Total	4265	7772	13007	22556	27992	26808	32997	27163	18407	11211	5760	3638
Mean	137.6	268.0	419.6	751.9	903.0	893.6	1064.4	876.2	613.6	361.6	192.0	117.4

TABLE 3 VALENTIA DAILY TOTALS OF RADIATION BALANCE (J/cm^2) 1976

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	11	-156	-31	235	556	954	955	487	553	163	-119	-104
2	-31	-153	57	603	367	788	606	828	519	297	-64	-167
3	-58	-19	-27	622	996	1296	988	829	458	268	99	-128
4	40	-16	125	626	306	499	641	622	456	468	-36	-72
5	7	9	148	342	423	926	861	621	487	185	-29	-77
6	-12	-65	45	448	637	811	623	700	406	313	78	-122
7	26	-4	39	575	391	1059	740	997	654	367	-29	-99
8	65	55	62	518	693	1082	480	402	162	80	-26	-180
9	13	-111	92	582	533	822	1024	1006	597	432	-51	-148
10	41	-32	53	501	1065	654	274	630	160	432	61	-84
11	-5	49	380	652	493	214	573	603	548	-20	-5	1
12	-88	42	108	688	807	951	882	978	460	297	62	-95
13	7	128	374	647	359	443	683	646	437	84	67	22
14	-159	56	-51	761	366	1005	576	918	586	127	-10	-3
15	18	111	300	765	1216	1142	819	622	372	212	-14	-48
16	69	-66	117	543	186	510	878	527	433	127	-163	-55
17	-7	-15	323	545	928	1090	870	767	533	185	19	-272
18	14	-43	159	196	726	620	410	503	268	241	25	-124
19	16	10	133	421	923	249	821	732	216	242	-49	-29
20	-24	28	85	663	1181	757	1019	645	165	137	5	-290
21	7	157	396	650	291	200	749	658	326	91	-16	-145
22	12	42	525	703	575	408	705	625	492	-3	4	-135
23	-92	-28	—	692	1006	280	766	267	-95	214	10	-182
24	-125	70	—	644	811	517	816	662	160	135	-32	-303
25	-162	19	179	398	1031	882	809	692	128	86	-62	-369
26	-52	233	490	813	486	1261	476	677	—	3	-83	-435
27	57	177	372	328	660	1264	1231	712	—	-30	-124	-102
28	-36	104	238	368	515	1238	1247	426	238	71	-181	-323
29	-130	-27	207	824	1186	1128	1220	587	194	-85	-26	-93
30	-175		666	843	923	1085	773	501	192	92	-115	-121
31	-311		340		639		893	635		-21		-145
Total	-1064	555	—	17196	21295	24135	24408	20505	—	5190	-804	-4427
Mean	-33.3	19.1	204.3	573.2	686.9	804.5	787.4	661.5	360.9	167.4	-26.8	-142.8

TABLE 4 DIRECT SOLAR RADIATION AT NORMAL INCIDENCES
INSTANTANEOUS VALUES (mW/cm^2) 1976

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													
31	0948	75.2	3.94	473	370	410	233	1012	1.0	4.2	25	Sc	1
31	1140	69.6	2.88	644	471	538	296	1011	2.2	4.6	25	Sc	1
31	1424	76.2	4.21	486	386	427	242	1011	2.5	4.8	25	Sc	1
Feb													
10	1110	67.3	2.63	780	516	614	313	1021	7.1	8.4	30	Cu	4
13	1048	67.4	2.62	837	555	658	336	1012	9.6	9.4	30	CuFc	3
13	1117	66.1	2.49	833	549	647	330	1012	9.6	9.4	30	CuFc	3
13	1144	65.5	2.43	855	558	669	340	1012	10.6	9.3	40	CuFc	3
13	1320	67.7	2.65	822	548	653	332	1012	10.3	9.8	40	CuFcCiCs	4
13	1410	71.2	3.12	745	490	597	303	1012	10.3	9.5	40	CuFcCiCs	5
15	1216	64.9	2.40	828	543	649	330	1024	9.5	8.4	30	Cu	2
15	1348	68.8	2.82	765	513	606	311	1025	9.8	8.1	40	CuSc	Tr
18	0932	71.4	3.14	587	432	495	272	1009	6.0	6.9	18	Ci	1
18	1044	65.8	2.45	608	448	505	274	1007	8.6	7.0	18	FcCi	1
29	1348	64.1	2.34	781	522	620	320	1024	9.8	8.0	35	Fc	Tr
29	1436	68.4	2.77	743	513	612	312	1025	9.6	7.1	35	Fc	Tr
29	1508	71.9	3.27	674	480	562	292	1025	9.0	6.1	40	Fc	Tr
Mar													
11	1340	59.4	1.97	825	531	632	320	1006	9.3	8.3	45	CuCb	5-
21	1418	59.1	1.96	827	529	634	319	1008	9.0	7.8	25	Cu	3
21	1536	68.3	2.71	700	463	548	278	1009	8.6	6.9	25	Cu	5
22	0812	69.8	2.91	709	487	570	293	1013	6.4	6.7	30	Cu	Tr
22	0928	60.2	2.03	799	520	616	310	1013	9.2	7.1	30	Cu	Tr
22	1040	53.8	1.71	857	547	654	331	1013	9.0	7.2	30	Cu	Tr
22	1332	54.7	1.75	865	556	667	331	1013	9.2	6.8	55	CuCi	3
26	0858	62.4	2.20	778	512	606	310	1022	7.4	7.1	30	CuFc	3
26	1040	52.3	1.67	821	521	626	313	1024	6.0	7.6	30	CbFc	4
26	1304	51.3	1.64	793	511	599	309	1025	9.7	7.3	30	Cu	2
30	1004	53.8	1.73	637	437	511	265	1023	11.8	9.5	18	FcSc	2
Apr													
2	1030	50.5	1.60	838	550	653	334	1018	7.7	6.0	30	CuCb	1
2	1056	48.7	1.54	848	548	656	336	1018	8.6	6.3	40	CuCb	3
3	1112	47.5	1.49	807	508	611	303	1008	9.8	8.4	30	CuFcCi	5
3	1248	47.5	1.49	838	572	636	321	1009	9.7	8.3	30	CuSc	3
3	1440	57.0	1.85	768	490	586	293	1009	8.9	8.4	30	Cu	6
3	1528	63.1	2.22	699	470	553	284	1009	9.2	8.1	30	Cu	3
8	1440	55.3	1.80	777	503	606	302	1029	11.6	8.6	50	CuScCi	3
8	1520	60.4	2.08	743	491	586	294	1029	11.4	8.2	50	CuSc	3
11	1316	46.1	1.45	852	530	646	322	1008	9.3	7.1	25	CuCbSc	3
11	1328	47.0	1.48	870	549	658	332	1008	9.3	7.1	25	CuCbSc	3
12	1300	44.8	1.43	914	577	693	354	1018	10.9	6.9	60	CuFcScCi	1
12	1444	54.5	1.75	844	540	650	332	1018	10.3	6.1	60	FcCi	3

TABLE 4 (Contd.)

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES
INSTANTANEOUS VALUES (mW/cm^2) 1976

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	°C	mb	Km		Okta
Apr													
15	1056	44.0	1.43	847	539	642	331	1032	10.7	8.3	25	Sc	2
19	0844	56.6	1.85	511	380	422	238	1020	14.8	11.8	15	Fc	Tr
19	0944	49.0	1.55	568	411	471	251	1020	16.4	12.1	12	CuFcScCi	4
19	1044	43.5	1.41	602	427	492	264	1020	17.1	12.2	12	CuFcCi	5
20	0900	54.2	1.74	591	431	486	266	1020	17.7	10.1	15	NIL	-
20	0944	48.8	1.55	617	445	507	276	1020	17.7	10.1	15	NIL	-
20	1052	42.5	1.38	573	427	505	254	1020	20.0	11.9	12	CuFc	2
20	1304	42.3	1.38	603	440	501	271	1019	20.4	12.0	12	CuFc	3
20	1404	47.4	1.50	624	443	509	278	1019	20.1	10.9	15	CuFc	1
21	0856	54.4	1.74	610	434	492	268	1017	15.7	10.5	12	NIL	-
21	1024	44.4	1.42	655	453	519	275	1017	16.5	10.5	12	NIL	-
21	1424	49.4	1.56	690	470	547	290	1015	18.6	10.5	15	Ac	2
22	0940	48.6	1.53	851	548	652	331	1015	15.0	9.1	25	Ci	1
22	1040	42.8	1.38	866	551	663	333	1015	15.3	8.7	25	NIL	-
22	1250	40.8	1.34	834	538	642	327	1015	16.6	9.0	25	NIL	-
22	1424	49.0	1.55	671	454	531	280	1015	14.9	10.6	25	Sc	3
23	0928	49.8	1.59	867	561	660	347	1025	10.9	6.9	15	NIL	-
23	1040	42.5	1.39	855	555	658	340	1025	12.0	7.1	15	NIL	-
24	0944	47.6	1.52	767	513	604	315	1028	10.6	9.4	20	Fc	1
26	0808	59.8	2.04	638	444	511	273	1026	11.2	9.0	18	Fc	Tr
26	0908	51.5	1.65	755	507	598	309	1026	12.2	8.8	18	Fc	Tr
26	1300	40.1	1.34	757	511	606	313	1025	16.2	8.7	18	Cu	3
26	1400	45.2	1.45	783	523	614	320	1025	17.2	8.3	18	Cu	3
27	0800	60.8	2.10	500	376	416	236	1025	10.5	9.4	10	Fc	Tr
28	1344	43.0	1.40	673	477	543	298	1026	11.4	7.3	18	Sc	3
30	0856	52.0	1.67	643	451	523	278	1028	10.2	9.1	12	CuCi	4
May													
3	0908	49.6	1.55	830	521	625	309	1003	10.5	9.8	25	CuFcSc	4
3	1354	42.7	1.37	843	522	632	319	1005	11.9	10.6	25	CuCbCi	3
3	1612	61.0	2.07	710	458	547	277	1006	11.8	8.9	30	CuFc	3
20	1532	51.7	1.63	824	525	630	314	1009	12.6	9.9	60	CuFc	3
23	0946	40.7	1.34	877	556	666	335	1013	16.3	12.3	30	CuFcCi	3
24	1500	46.5	1.46	859	544	653	320	1008	12.1	10.6	30	CuFc	5
June													
1	1124	30.6	1.19	890	551	665	322	1022	13.7	11.8	30	Cu	3
1	1256	31.7	1.20	895	544	655	316	1022	13.9	11.5	30	CuCi	3
1	1436	42.2	1.38	857	535	647	316	1023	14.4	11.3	30	Cu	2
3	0828	50.1	1.60	814	514	616	307	1027	13.5	12.9	40	CuCiCs	3
3	1356	37.0	1.29	858	540	653	315	1027	15.0	13.0	50	CuCi	4
5	1400	37.3	1.28	869	540	649	330	1020	17.4	13.4	25	FsFcSc	Tr
5	1524	48.6	1.54	825	517	624	307	1020	16.5	14.6	35	Fc	Tr
7	1524	48.5	1.52	732	489	577	296	1008	21.7	13.1	16	CuCi	1

TABLE 4 (Contd.)

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES
INSTANTANEOUS VALUES (mW/cm^2) 1976

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	^{o}C	mb	Km		Okta
June													
15	1316	32.1	1.20	883	530	646	307	1019	19.9	17.1	25	ScCc	3
27	0844	47.0	1.50	890	555	670	326	1027	16.7	13.3	60	CuCi	1
27	0954	37.4	1.29	913	561	678	331	1027	17.3	13.8	60	CuFcCi	1
27	1120	29.7	1.18	930	569	689	337	1027	17.8	14.8	60	FcCi	2
27	1316	32.1	1.21	925	567	686	334	1027	17.7	14.3	60	FcCi	Tr
27	1424	39.7	1.33	908	561	679	333	1027	17.3	15.4	60	Ci	Tr
27	1540	50.5	1.61	870	548	661	327	1026	17.3	15.2	60	Ci	Tr
28	0836	48.1	1.53	686	460	542	272	1025	16.5	15.3	50	NIL	-
28	0932	40.3	1.34	772	497	594	292	1025	18.1	15.9	50	NIL	-
28	1044	32.1	1.21	784	499	597	291	1025	18.7	17.6	50	Nil	-
28	1252	30.3	1.19	776	498	594	288	1024	19.1	18.1	50	NIL	-
29	0828	49.4	1.57	606	427	494	254	1023	19.8	19.8	25	NIL	-
29	0948	38.2	1.30	657	451	526	270	1023	22.3	20.2	25	NIL	-
29	1048	31.9	1.20	650	447	520	264	1023	24.2	20.7	25	NIL	-
29	1356	36.3	1.27	679	456	541	274	1024	24.0	21.5	25	NIL	-
30	0908	43.5	1.41	541	396	448	239	1024	24.4	21.9	8	NIL	-
30	1006	36.1	1.27	594	425	486	256	1024	21.9	19.9	12	NIL	-
30	1054	31.6	1.20	567	410	466	248	1024	21.7	19.4	12	NIL	-
30	1332	33.8	1.23	607	427	493	265	1024	21.4	20.1	12	NIL	-
July													
1	0904	44.2	1.42	442	346	382	213	1018	24.9	19.5	30	Ci	5
1	0940	39.3	1.31	416	325	357	201	1018	24.9	19.5	30	Ci	5
12	1100	32.2	1.19	850	525	634	313	1003	17.9	16.3	30	Cu	5
27	1300	34.9	1.25	852	523	635	299	1026	19.0	17.5	60	CuScCi	5
28	0924	44.9	1.45	874	535	650	311	1027	18.3	15.0	50	CuSc	2
28	1243	34.1	1.24	835	509	618	296	1027	20.0	16.4	50	CuSc	1
28	1400	40.5	1.35	829	507	614	298	1026	20.6	16.5	50	CuSc	1
28	1528	52.2	1.67	788	487	593	282	1026	19.7	16.0	50	CuSc	1
29	0902	48.0	1.53	830	515	624	299	1023	16.7	14.3	35	Fc	Tr
29	1232	33.9	1.23	895	547	663	322	1022	18.0	14.5	35	CuSc	Tr
29	1436	45.2	1.45	862	531	646	314	1021	18.1	14.5	35	FcSc	Tr
Aug													
7	1332	40.0	1.34	852	526	639	305	1027	18.8	16.6	50	CuSc	3
8	0756	59.6	2.02	765	489	589	284	1025	16.8	16.2	40	FcAc	1
8	0840	53.2	1.71	793	499	603	291	1025	16.8	16.2	40	FcAc	1
9	0800	59.3	2.01	731	477	568	277	1027	16.6	16.9	60	FcCi	Tr
9	0856	51.2	1.64	772	492	592	288	1027	18.5	17.2	80	FcCi	2
14	1256	39.4	1.32	881	546	689	442	1022	18.8	16.4	45	CuFc	2
14	1508	53.0	1.69	815	521	652	418	1021	18.7	13.5	45	Fc	Tr
14	1604	61.1	2.11	764	497	619	403	1021	18.6	14.4	45	FcCi	Tr
15	0852	53.2	1.70	402	321	365	269	1021	18.1	16.1	18	Ci	7

TABLE 4 (Contd.) DIRECT SOLAR RADIATION AT NORMAL INCIDENCES

INSTANTANEOUS VALUES (mW/cm^2) 1976

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	°C	mb	Km		Okta
Aug													
17	0932	48.7	1.55	714	488	592	401	1021	22.9	14.1	15	AcCi	4
17	1059	40.6	1.34	712	468	583	399	1021	25.5	14.5	40	CiAc	6
19	0912	51.7	1.65	653	464	558	386	1026	21.0	17.2	15	NIL	-
19	1100	41.2	1.36	782	525	645	427	1026	25.3	15.9	15	Ci	Tr
20	0840	56.3	1.84	611	440	527	368	1024	22.9	12.1	15	NIL	-
20	0920	51.0	1.62	641	454	544	381	1023	22.9	14.1	15	NIL	-
20	1352	45.6	1.46	582	415	501	357	1024	26.1	14.8	15	Ci	Tr
21	1000	46.7	1.48	666	464	557	383	1017	24.8	13.4	18	NIL	-
21	1324	43.4	1.40	759	504	627	416	1016	27.0	15.6	18	NIL	-
22	0916	52.0	1.64	596	428	510	354	1010	23.0	15.6	15	Ac	5
26	1416	50.0	1.59	461	359	408	303	1023	26.2	20.5	7	Ac	Tr
26	1548	61.9	2.17	330	278	308	240	1023	25.2	21.3	7	Cu	Tr
27	1108	43.4	1.41	689	475	574	387	1025	25.5	15.5	15	NIL	-
27	1352	47.8	1.52	582	421	500	354	1024	25.3	17.7	18	NIL	-
Sept													
2	0824	62.3	2.19	813	530	659	431	1021	14.4	8.9	40	ScCi	3
11	1116	48.2	1.51	884	552	684	453	1005	13.9	7.5	30	Cu	5
14	0900	61.3	2.10	821	533	665	436	1013	13.0	9.9	20	CuCb	4
22	0910	62.8	2.21	866	513	635	415	1015	15.9	13.7	50	CuCb	1
Oct													
4	1520	70.6	3.00	721	485	598	391	1003	12.2	9.8	35	CuCb	2
7	1135	57.5	1.88	804	513	645	409	1010	13.0	11.5	30	Cu	3
18	1020	65.3	2.37	754	490	614	398	995	12.3	11.6	40	CuFcCi	2
18	1056	63.3	2.21	782	506	632	407	995	12.3	11.6	40	CuFcCi	2
24	1536	79.0	5.16	639	461	557	374	1000	11.9	9.3	40	Cb	2
25	0932	71.7	3.17	728	507	613	413	1003	5.6	8.6	50	CuCi	Tr
25	1112	65.0	2.37	806	536	661	436	1004	11.5	9.8	60	Cu	Tr
25	1228	64.5	2.32	761	514	628	417	1003	11.7	9.5	60	Cu	1
25	1444	73.4	3.50	663	471	567	381	1003	10.4	9.4	60	Cu	1
30	1034	68.5	2.76	715	494	597	408	1015	9.6	9.1	20	CuScCi	1
30	1156	65.8	2.46	765	518	634	421	1014	10.5	9.5	25	CuCi	1
Nov													
7	1336	71.5	3.10	682	458	564	378	992	10.0	5.2	35	CuCb	3
9	0940	75.3	3.91	514	378	448	313	999	4.5	7.7	40	Cu	1
9	1132	69.2	2.80	678	465	568	382	1000	9.9	9.2	40	Cu	1
9	1200	68.9	2.76	706	479	586	397	1000	9.9	9.2	40	Cu	1
10	0920	77.4	4.56	619	452	540	375	1004	6.9	8.7	60	CuFcCi	4
12	1000	74.5	3.76	686	486	588	399	1010	3.0	7.0	45	CuSc	1

TABLE 4 (Contd.)

DIRECT SOLAR RADIATION AT NORMAL INCIDENCES
INSTANTANEOUS VALUES (mW/cm^2) 1976

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	°C	mb	Km		Okta
Nov													
16	0920	78.8	5.21	526	385	460	316	1027	8.5	8.6	40	FsScCi	Tr
16	1004	75.2	4.00	634	441	538	364	1027	9.8	8.6	40	CuFcCi	Tr
19	1352	75.6	4.15	554	427	496	358	1038	14.4	10.4	25	FcCi	Tr
Dec													
10	1108	75.7	4.11	680	496	595	410	1023	3.4	7.3	40	CuCi	3
20	1012	79.0	5.24	497	385	447	329	1015	1.5	6.6	6	CuSc	1
24	1056	76.7	4.39	669	480	579	394	1018	9.5	7.6	18	CuScCi	2
26	1006	79.4	5.52	591	456	533	379	1031	-0.3	5.1	50	Nil	-
26	1420	81.3	6.63	528	422	485	352	1030	5.2	5.7	50	NIL	-
28	1108	76.1	4.20	697	501	601	414	1017	2.7	5.1	50	CuFcCi	3
28	1324	77.5	4.65	619	446	537	376	1016	5.0	5.4	50	CuFcCi	3

TABLE 5 KILKENNY DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1976

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	43	228	1288	662	679	2314	2623	1235	1021	407	566	120
2	46	143	928	1733	1555	1543	2470	1199	1840	549	669	367
3	261	57	390	1194	2264	1292	2180	1693	1416	1118	720	182
4	90	56	502	1633	1700	1339	2464	1551	708	1338	118	130
5	132	135	317	1377	1012	1601	1779	1013	704	593	653	273
6	101	317	193	794	1713	2855	624	1326	1749	1194	507	188
7	136	442	642	1143	997	2581	1765	1709	1394	1048	430	272
8	208	710	861	1552	2724	2665	2077	1769	719	528	410	303
9	41	302	339	1091	1253	1403	2012	2140	1774	738	599	334
10	73	615	101	873	2483	2087	692	2025	438	439	520	206
11	104	756	510	695	1154	721	575	2160	1012	247	406	312
12	224	304	774	2341	2333	2479	1927	1437	1785	996	273	153
13	97	874	627	926	2007	1920	899	1565	586	1038	352	79
14	355	293	392	1787	850	2643	1724	2543	1085	256	100	97
15	166	783	1179	2173	2166	2091	1971	2191	857	1075	261	130
16	160	142	533	1137	487	1026	1591	1895	760	538	574	40
17	105	202	1317	551	1303	2688	1746	2269	979	284	226	241
18	341	384	1328	1227	2363	1182	1149	1988	738	616	205	39
19	154	357	134	1034	1591	1043	1514	1937	224	338	183	40
20	407	289	112	2367	2150	2039	2034	2145	757	784	59	89
21	195	800	881	2475	820	1317	1717	2171	1256	901	106	110
22	232	595	1465	1989	1863	1980	1039	2143	1435	514	378	140
23	419	315	893	2484	1822	1283	1252	1554	793	344	267	53
24	527	863	435	1047	1631	2130	903	1517	268	687	135	273
25	480	915	270	1486	2461	2695	954	1877	602	761	179	123
26	313	522	1469	2452	1301	2387	797	1785	684	652	93	244
27	550	263	855	1642	1115	3206	1391	2079	546	488	211	224
28	177	479	1192	1914	724	3023	1998	910	716	350	357	375
29	275	860	1270	2254	2028	2951	1786	815	569	324	294	188
30	168		1111	1611	1802	3045	1240	1309	670	504	202	304
31	352		1128		1170		1892	1732		246		191
Total	6932	13001	23436	45644	49521	61529	48785	53682	28085	19895	10053	5820
Mean	223.6	448.3	756.0	1521.5	1597.5	2051.0	1573.7	1731.7	936.2	641.8	335.1	187.7

TABLE 6 BIRR DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1976

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	56	300	1219	743	748	2117	2763	1080	1350	240	529	146
2	52	203	877	1453	1455	1102	2425	1347	1759	455	496	375
3	257	275	581	1366	1935	1936	2088	1463	1052	1067	653	175
4	75	51	600	1549	1634	1084	2408	1141	828	1107	181	164
5	113	178	579	1108	1030	1234	1587	1083	882	749	563	283
6	93	413	307	811	1530	2805	506	1203	1279	1016	557	240
7	166	346	926	1071	1483	2611	1507	1697	1204	998	380	228
8	186	682	781	1784	1631	2428	1787	1806	809	644	550	377
9	79	162	746	1226	1257	1214	2010	2110	1603	1001	723	399
10	110	591	151	1103	2365	1989	777	1435	486	668	540	137
11	129	642	580	537	1080	831	996	1837	1332	266	710	315
12	177	93	810	1969	2019	1738	1720	1715	1522	981	258	240
13	112	879	918	994	1902	1529	1341	1316	670	922	686	77
14	397	375	447	1369	1003	2343	1670	2179	1212	306	138	79
15	139	756	1310	2251	1734	1900	1675	2186	746	1025	226	189
16	185	188	486	842	851	1122	1554	1829	771	449	649	116
17	101	513	1481	830	1307	2642	1786	2118	1488	456	184	336
18	345	505	1533	1214	1727	1243	1079	2140	982	692	164	104
19	105	621	317	1363	1516	1091	1441	1896	551	481	176	72
20	357	363	198	2018	1984	1945	1680	2023	997	737	88	118
21	228	733	1016	2335	851	1391	1549	2122	1325	681	99	158
22	179	540	1693	1826	2097	1371	1052	2093	1550	413	297	77
23	419	158	1051	2529	2104	1237	1331	1318	826	358	275	172
24	565	734	450	1144	1643	1958	805	1765	230	944	137	331
25	515	663	402	1662	2539	2428	910	1728	908	549	191	323
26	274	497	1390	2440	1136	2313	956	1864	850	825	111	215
27	597	289	662	858	877	3149	1728	2004	619	552	151	187
28	142	710	576	2155	778	2941	2124	797	998	220	278	505
29	346	683	1231	2104	2149	2817	1481	894	752	294	298	167
30	203		852	1290	1456	2956	1242	1077	735	620	229	265
31	231		1020		1114		1955	799		260		195
Total	6933	13143	25190	43844	46935	57465	47933	50065	30316	19976	10517	6765
Mean	223.6	453.2	812.6	1461.5	1514.0	1915.5	1546.2	1615.0	1010.5	644.4	350.6	218.2

TABLE 7 DUBLIN AIRPORT DAILY TOTALS OF GLOBAL SOLAR RADIATION (J/cm^2) 1976

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1	58	118	1170	789	663	2408	2485	1462	1023	277	563	166
2	107	52	928	1502	1699	1458	2362	977	1153	267	394	307
3	347	56	981	1054	1992	1801	2111	1469	1081	1079	676	161
4	83	25	470	1508	1436	1483	2406	1425	706	926	136	193
5	145	179	1065	1034	1048	1231	1896	1089	817	404	548	362
6	132	194	676	733	1612	2690	735	1050	1120	1061	501	315
7	233	448	731	1719	1002	2655	1527	1156	1061	919	385	198
8	147	622	872	1722	2151	2509	1987	2072	963	632	312	338
9	56	308	555	1299	1271	1275	1376	1921	1357	937	587	360
10	81	662	202	1270	2353	1998	818	2121	395	663	425	139
11	125	743	326	507	1587	1133	1523	1995	887	204	546	139
12	143	199	209	2113	1985	1890	1478	787	1548	592	355	155
13	168	861	314	923	2045	1718	991	1942	520	944	614	161
14	334	265	229	1789	740	2629	2109	2344	921	123	77	60
15	180	863	705	1870	1805	1498	1380	2200	896	732	218	85
16	329	255	414	1231	826	1693	1613	2076	1426	458	528	24
17	77	155	1413	698	1148	1822	1692	2081	1561	84	168	128
18	258	331	1317	863	1750	1240	1150	2035	787	797	96	149
19	120	519	200	1658	1486	1447	1290	1968	246	388	132	36
20	348	92	239	2233	1710	1999	1649	2045	1212	697	99	66
21	398	462	682	2196	1333	1079	1506	1933	405	708	104	115
22	194	443	325	1237	1774	1494	1325	1949	943	656	384	145
23	333	238	1288	2399	2161	1621	1528	1976	781	115	286	82
24	543	674	586	1684	1347	2013	921	1803	68	674	234	193
25	526	943	476	1881	1979	2572	1096	1769	315	346	256	169
26	246	631	1494	1894	1414	1995	1036	1802	780	296	104	153
27	571	241	1048	1368	876	2913	1586	1928	387	142	234	198
28	133	481	630	2502	877	2779	1976	1400	927	223	394	359
29	88	667	1435	1486	1789	2760	1565	428	704	112	354	165
30	245		774	1221	1736	2691	1207	1422	609	147	257	236
31	111		1144		1227		1665	1614		249		210
Total	6859	11727	22898	44383	46822	58494	47989	52259	25599	15852	9967	5567
Mean	221.3	404.4	738.6	1479.4	1510.3	1949.8	1548.0	1685.8	853.3	511.4	332.2	179.6

TABLE 8 DUBLIN AIRPORT DAILY TOTALS OF DIFFUSE SOLAR RADIATION (J/cm^2) 1976

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Day 1						878	957	1207	699	276	228	160
2						997	1194	918	761	267	216	144
3						1225	1273	989	845	334	164	160
4						1277	1091	971	668	443	134	170
5						1089	1436	1064	723	323	175	161
6						797	713	1006	839	354	216	113
7						953	1285	1071	916	339	242	150
8						873	1205	865	678	535	248	96
9						946	1064	811	618	342	155	146
10						1233	691	646	317	358	253	122
11						1011	1208	794	638	198	128	131
12						1386	1010	703	549	386	286	140
13						1246	848	742	512	284	104	145
14						1154	982	313	557	117	72	60
15						1390	860	541	734	467	204	85
16						1384	1133	668	471	440	103	22
17						1049	1240	672	406	78	166	95
18						1125	1112	742	697	444	95	126
19						1282	1157	672	239	308	132	36
20						1406	1059	552	505	345	96	66
21						1002	1244	645	370	288	104	114
22						1081	1255	722	555	226	136	140
23						1287	1262	582	589	112	211	82
24						1274	909	705	67	248	206	136
25						898	1087	638	312	260	186	102
26						1322	946	658	471	268	104	133
27						354	1028	476	288	139	185	162
28						579	840	975	541	212	113	100
29						652	1200	412	609	110	110	160
30						814	1018	767	536	145	160	117
31							900	510		235		178
Total						31964	33207	23037	16710	8681	4932	3752
Mean						1065.5	1071.2	743.1	557.0	286.5	164.4	121.0